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## 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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**Abstract**

As the role of central banks expanded, demand for public scrutiny of their actions increased. This paper investigates whether parliamentary hearings, the main tool to hold central banks accountable, are fit for this purpose. Using text analysis, it detects the topics and sentiments in parliamentary hearings of the Bank of England, the European Central Bank and the Federal Reserve from 1999 to 2019. It shows that, while central bank objectives play the most relevant role in determining the topic, unemployment is negatively associated with the focus of hearings on price stability. Sentiments are more negative when uncertainty is higher and when inflation is more distant from the central bank's inflation aim. These findings suggest that parliamentarians use hearings to scrutinise the performance of central banks in line with their objectives and economic developments, but also that uncertainty is associated with a higher perceived risk of under-performance of central banks.

**Keywords**: Central Bank Accountability; Monetary Policy; Uncertainty; Text Analysis.

**JEL codes**: E02; E52; E58.

## Non-Technical Summary

Most central banks, including the European Central Bank, take monetary policy decisions independently from elected officials. Since central bank officials are unelected, this independence from political influence might give rise to a perceived democratic deficit. However, central banks are not free to set monetary policy according to their preference. On the contrary, their policy decisions need to be taken in accordance with the specific mandate that was assigned to them by elected officials. To make sure that central banks explain and justify their decisions, most advanced democracies have established regular parliamentary hearings where central bank governors respond to parliamentarians' questions.

This paper aims to assess whether parliamentary hearings, the main tool to hold central banks accountable, are fit for this purpose. In particular, we investigate (1) whether the debate between central banks and parliamentarians is focused on their mandate and (2) what drives the tone of the discussion.

In doing so, this paper introduces a new dataset and empirical methodology to assess central bank accountability practices based on text analysis. We look at the transcripts of the parliamentary hearings of the Bank of England, the European Central Bank and the Federal Reserve from 1999 to 2019. We use a technique that tracks the main topics and sentiments contained in a text, based on the matches of key terms in the transcripts. We obtain a quantitative score for each topic (e.g. price stability, employment...) and for sentiment (positive or negative), allowing us to track them over time and across central banks.

The analysis shows that, while central bank objectives play the most relevant role in determining the topic of discussion, higher rates of unemployment are associated with a decrease in the focus of hearings on price stability. Second, the paper finds that sentiments in the hearings are more negative when there is higher uncertainty and when actual inflation is more distant from the central bank's inflation aim.

Overall, our results suggest that parliamentary hearings are fit for purpose. Parliamentarians use them to scrutinise the performance of central banks in line with their objectives and economic developments. The analysis also finds, though, that greater perceived uncertainty plays an important role in setting the tone of the debates, and is associated with a higher perceived risk of under-performance of central banks. This is consistent with the relation between economic uncertainty and the economic outlook, whereby an increase in uncertainty is likely to be seen

as increasing the risks that central banks' objectives are not fulfilled. It also suggests that the tone of the debate is likely to be more positive when central banks are able to reduce uncertainty through their communication and action.

More broadly, our findings are helpful to better understand how central banks and elected representatives interact both in normal and crisis times. Moreover, the approach of the paper opens new avenues for the research on central bank accountability, which so far has been largely dominated by theoretical or qualitative considerations.

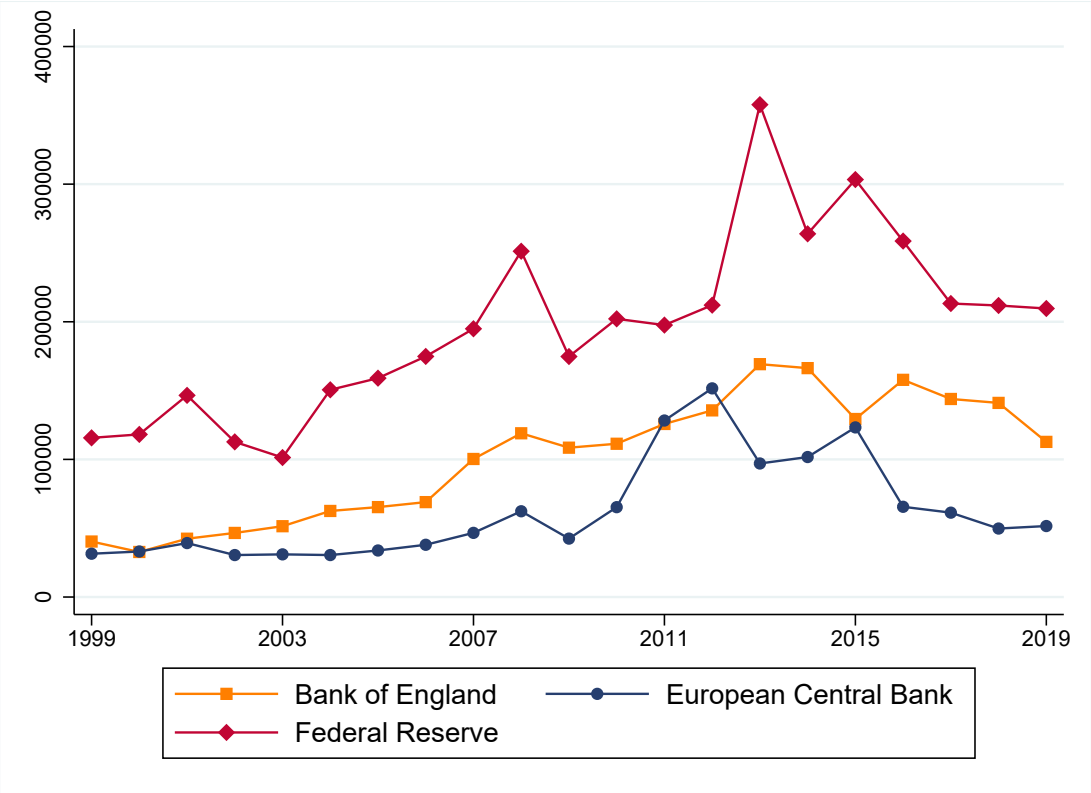
# 1 Introduction

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 et al. (1991). As they do so, they put in place a series of arrangements that allow elected representatives to monitor the central bank's attainment 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 to the pre-crisis period (see Figure 1). On the other hand, the adoption of non-standard measures made the scrutiny of monetary policy more complex (Coeuré, 2018).

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 newspaper in all the languages available on Factiva.

This revived the debate around the legitimacy of granting independence to unelected powers in constitutional democracies (Tucker, 2018). Moreover, with the emergence of populist platforms during the crisis, the institutional tenets of central banks have been increasingly challenged. The literature emphasise 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 (Issing, 2018, Masciandaro and Romelli, 2015).

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

for central banks in 2019 (Figure 6 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 Eurozone 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. However, since the crisis, the discussion has mainly focused on whether central banks have become too independent (Balls et al., 2018). Relatively less attention has instead been given to the aspect on which the legitimacy of central bank independence rests, namely central bank accountability. 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: (1) what topics are discussed? and (2) 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 (Clayes et al., 2014a; Schonhardt-Bailey, 2013). 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 what drives respectively 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 an essential aspect of central bank accountability as well as new findings on the three cases we examine. This is relevant compared to 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 *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 (Bholat et al., 2019; Hansen et al., 2019; Born et al., 2014), speeches (Neuhierl and Weber, 2019), minutes of their meetings (Hansen et al., 2017; Apel and Blix-Grimaldi, 2012), our work is the first to explore the communication between central banks and parliaments in a comparative setting (Schonhardt-Bailey, 2013 and Sanders et al., 2018 examine the parliamentary hearings of the Fed and the BoE respectively to address different questions).

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 analyse the text of central bank policy announcements and speeches (Lucca and Trebbi, 2009; Born et al., 2014; Tobback et al., 2017; Hansen et al., 2019), the minutes of their meetings (Apel and Blix-Grimaldi, 2012; Hansen et al., 2017; Shapiro and Wilson, 2019), or of news and tweets related to central banks (Binder, 2018 and Bianchi et al., 2019 respectively), 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 are Schonhardt-Bailey (2013) and Sanders et al. (2018), who analyse these text sources focusing on specific case studies, namely the Fed and the BoE respectively.

Three important caveats apply to our findings. First, our analysis focuses on 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 et al., 2018). Third, an important role is generally played by the executive in jurisdictions where, together with the parliament, it holds the central bank accountable. As we focus on parliamentary hearings, our study does not encompass the relationship between the

central bank and the government.

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 et al., 1997; Gailmard, 2014). In this set-up, 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 set of arrangements that allow them to scrutinise 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 attain 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 (Clayes et al., 2014a; 2014b; Schonhardt-Bailey, 2013) 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 and parliamentarians could intensify, as they did in Europe during the euro crisis (Fraccaroli et al., 2018), since both bodies, under different roles, cooperated to tackle the euro area's problems (Collignon and Diessner, 2016; Torres, 2013).

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.

[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.

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 re-elected.

A third element is uncertainty. Baker et al. (2016) find that greater economic policy uncertainty is associated with both political (e.g. tight presidential elections) and economic events (e.g. failure of Lehman Brothers) 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, Klodiana and Anamaria (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 at 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 indexes to rank and compare the degree of *de jure* accountability of different central banks across the world (Briault et al., 1998; De Haan et al., 1999; Bini-Smaghi and Gros, 2000; see De Grauwe and Gros, 2008 for a review). These indexes, which are summarised in Table 6 in the Appendix, are similar to the widely used indexes of central bank independence (e.g. the ones constructed by Grilli et al., 1991 and Cukierman et al., 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 scrutinise 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

[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).

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 et al., 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% of them central banks are accountable to parliament, in 30% to the minister of finance, in 21% to the government or its head, in 9% to the head of state and in 17% 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 characteristics can be appreciated in comparison to other methodologies adopted to study the relationship between central banks and politicians. For example, Binder (2018) studies the pressures of the executive on the central bank using the text of news reports, whereas Bianchi et al. (2019) analyse the tweets of US 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

[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.

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 Q&A session where the staff of the central bank and parliamentarians interact in real time. Moreover, and more importantly, as previously described, the hearings rest on an explicit legal requirement to scrutinise 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 to approaches that look exclusively at the relationship between the central bank and the executive, as Binder (2018) and Bianchi et al. (2019).

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), that 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 to

[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 US, 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 US President has the authority to fire the Chair of the Fed's Board of Governors (Conti-Brown, 2015, 2019).

the ones on monetary policy, and leave therefore little room for comparison due to their short time series. Moreover, the three cases we analyse 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 UK 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 scrutinise whether and how the central bank is attaining to 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%.[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 quantitative definition of this objective: inflation rates of below, but close to, 2% over the

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

medium term.[7] The price stability objective of the Fed is enshrined in Section 2A of the Federal Reserve Act, that 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% is consistent with the Fed's statutory mandate.[9]

However, there are also relevant differences. 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 to the BoE and the ECB where employment is a secondary objective, i.e. an objective that is subject to the attainment of price stability.[10]

In our empirical analysis we exploit these commonalities and differences to investigate how the mandates democratically assigned to 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 UK 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 scrutinise whether and how the BoE reaches its inflation target, which is set at 2% 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

[7]The Governing Council of the ECB is composed by 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.

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

to the hearings together with other members of the MPC. While the Treasury Committee has sole statutory authority to scrutinise the BoE, also the Economic Affairs Committee of the House of Lords holds hearings with the BoE (Schonhardt-Bailey, 2015; Sanders et al., 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 note 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 those of Edward George (1993-2003), Mervyn King (2003-2013) and Mark Carney (2013-).

**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 (2003-2011) and Mario Draghi (2011-2019).

**Federal Reserve.** The Fed is accountable to the public and the US Congress. Although the

[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.

formalisation 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 Fed appears each 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 (2006-2014), Janet Yellen (2014-2018) 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 semi-annual hearings to ensure consistency.

# 4 Model

We apply topic and sentiment techniques 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.

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

### 4.1 Text Data and Preprocessing

For each central bank we collect the transcripts of their parliamentary hearings from 1999 to 2018, which are available in all three cases on the websites of the respective parliaments. In all three cases, transcripts are available in English. However, ten of the transcripts of the 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 et al. (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 tokenising the text, i.e. splitting raw character strings into individual elements, removing English stopwords (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 et al., 2019). Descriptive statistics of the three databases following the pre-processing are summarised in Table 1.

*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 trancript | 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 stopwords, numbers and white spaces.

### 4.2 Topic Analysis

First, we use topic analysis to investigate whether central banks and parliamentarians focus the debates on the central bank objectives. 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 transcripts are then divided by the total number of words of each transcript to avoid that longer texts are over-represented. In this

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

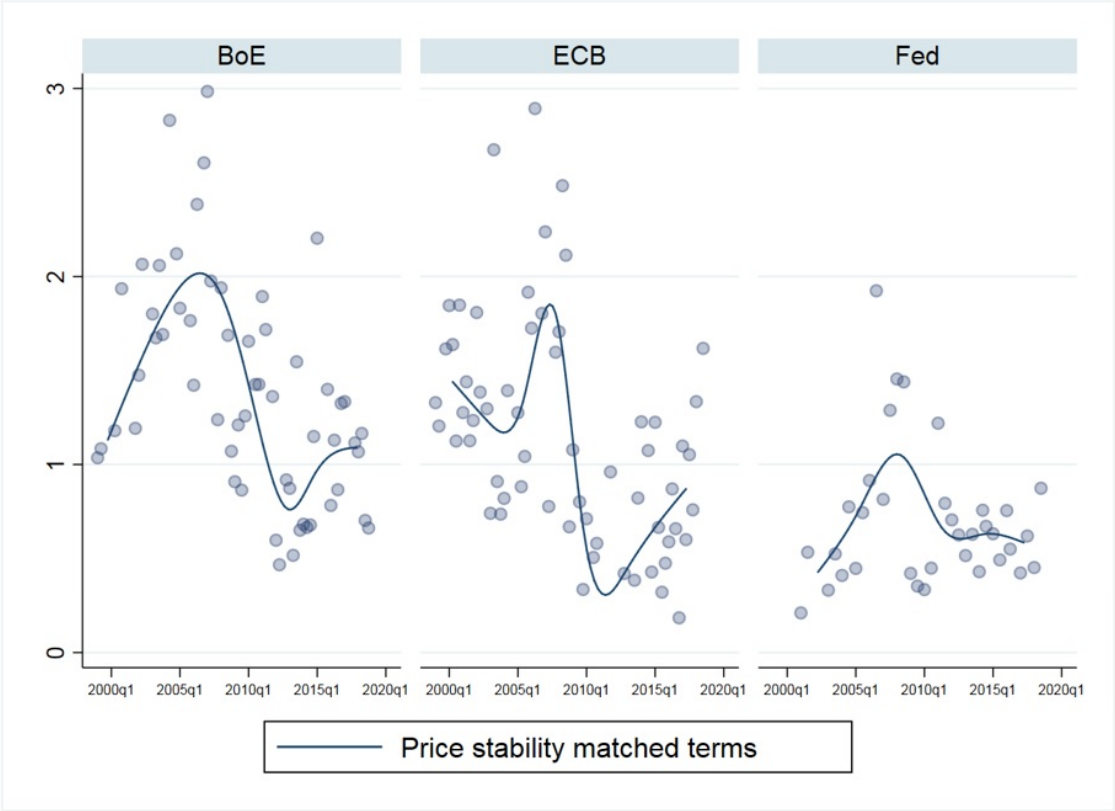
way, we obtain a measure of the intensity of the focus on a specific topic at transcript level, based on the frequency of key words for each document.

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, that 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 prioritisation 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 7.3 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 programmes 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 across central banks over time around price stability, a parsimonious and general dictionary better suits the purposes of our research question.

From a preliminary inspection of the scores on the price stability topic, the text bag seems to perform well (the same holds for the text bag on the crisis, whose frequency increases in the years of the Great Recession: see Figure 8 in the Appendix). Figure 2 shows that inflationary matters have been discussed more in the hearings of the BoE and of the ECB, the two central banks that have price stability as their primary mandate, than in the hearings of the Fed, for which price stability represents one among its multiple objectives. Despite these differences, the focus on price stability follows a similar path in all three central banks. For all three cases values are higher in the pre-crisis period and then fall when the crisis hit their respective economy. As we might expect, this fall has been accompanied by an increase of the focus on financial stability in all three cases financial stability (see Figure 9 in the Appendix).

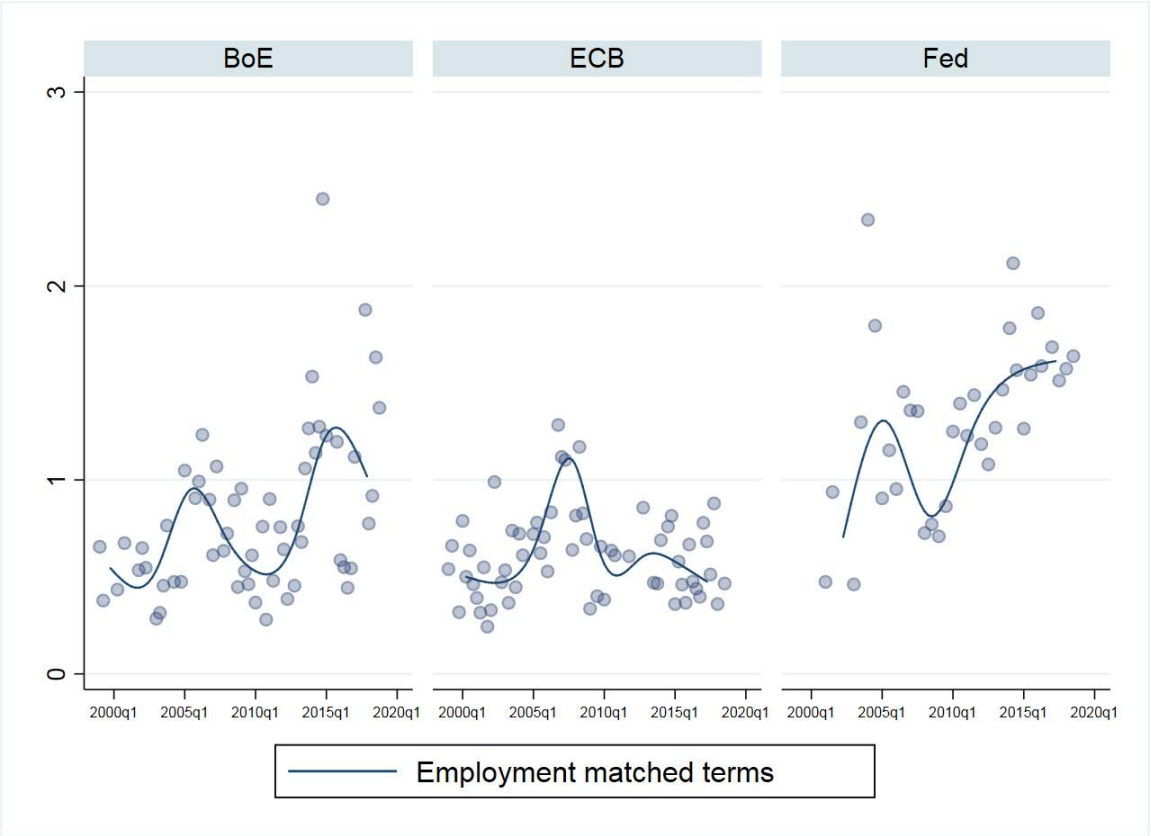
Figure 2: Occurrence of terms related to price stability in parliamentary hearings, by central bank (1999-2019)




Sources: authors' elaboration. Note: the line is a cubic spline based on cross-median values of the sentiment ratio scores, which are depicted by the scatter plot. Both the source and the note apply to the following charts.

The relevance of the central bank mandate in driving the focus of discussion is further supported by the comparison of discussions around the topic of employment. The Fed, which has maximum employment as one of its objectives, is the central bank that debates the issue with parliamentarians the most. As shown in Figure 3, the Fed tends to have higher scores than the BoE and the ECB on the employment text bag.

Figure 3: Occurrence of terms related to employment in parliamentary hearings, by central bank (1999-2019)




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:

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

where $Y_{it}$ is the score of a topic text bag for each central bank $i$ during each hearing $t$. Since we aim to see whether the objective of the central bank is the main 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 relevant driver of the focus on a topic, we expect the coefficient $\delta$ 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 actual rate of inflation, $\pi$, from the targeted rate of inflation, $\pi^*$, which we set equal to 2%, as it

approximates the aim of all three central banks.[15] Importantly, we look at the absolute distance between the two values to account for both inflationary and deflationary deviations from the aim.

$E_{it}$ 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,[16] for the Fed at presidential elections.

$X_{it}$ is a vector of macroeconomic controls including unemployment, GDP growth and credit-to-GDP, that is a good proxy for financial stability (Schularick and Taylor, 2012).[17] 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. Interestingly, this variable displays a strong correlation with the scores of our financial stability text bag, as shown in Fig. 10 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 et al. (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 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

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

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

[17] 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...). Data on credit growth has the advantage of being at quarterly level, differently from data on crises which are on a yearly basis, and of being harmonised 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.

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, it has a predictive accuracy on economic texts that is comparable to LM and higher than GI, as found by Shapiro et al. (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 contain a larger number of terms and of terms that are unique compared to the other two (Shapiro et al., 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 US firms submit to the Securities Exchange Commission to summarise 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', that 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 amount to 1,968 terms, whereas the list of negative ones 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 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 Shapiro et al. (2019) and Nyman et al. (2018), 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 to 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 et al. (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 (Apel and Blix-Grimaldi, 2012; Birz and Lott, 2011). For robustness, we compute an alternative estimate of sentiment ratio based on this methodology. In particular, we estimate the following equation:

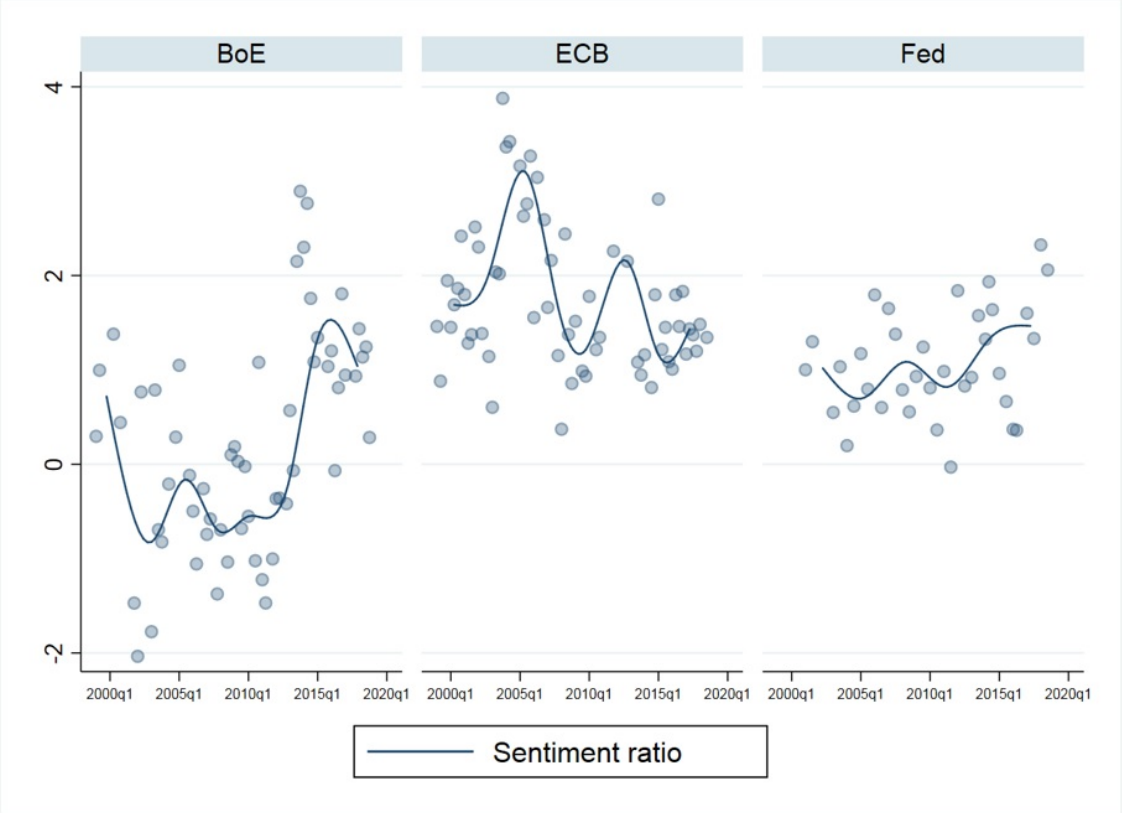
$$SentimentRatio_{it} = [\frac{Positive_{it}}{Positive_{it}+Negative_{it}} - \frac{Negative_{it}}{Positive_{it}+Negative_{it}}] + 1$$

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.

Figure 4 plots the sentiment ratios for each central bank. Sentiments are heterogeneous across parliamentary hearings: they tend to be less volatile in the case of the Fed and overall the ECB displays the most positive score. Despite these differences, in all three cases sentiment ratios fall in the crisis period (2007-2010), even if with different intensity. Sentiment ratios then undertake

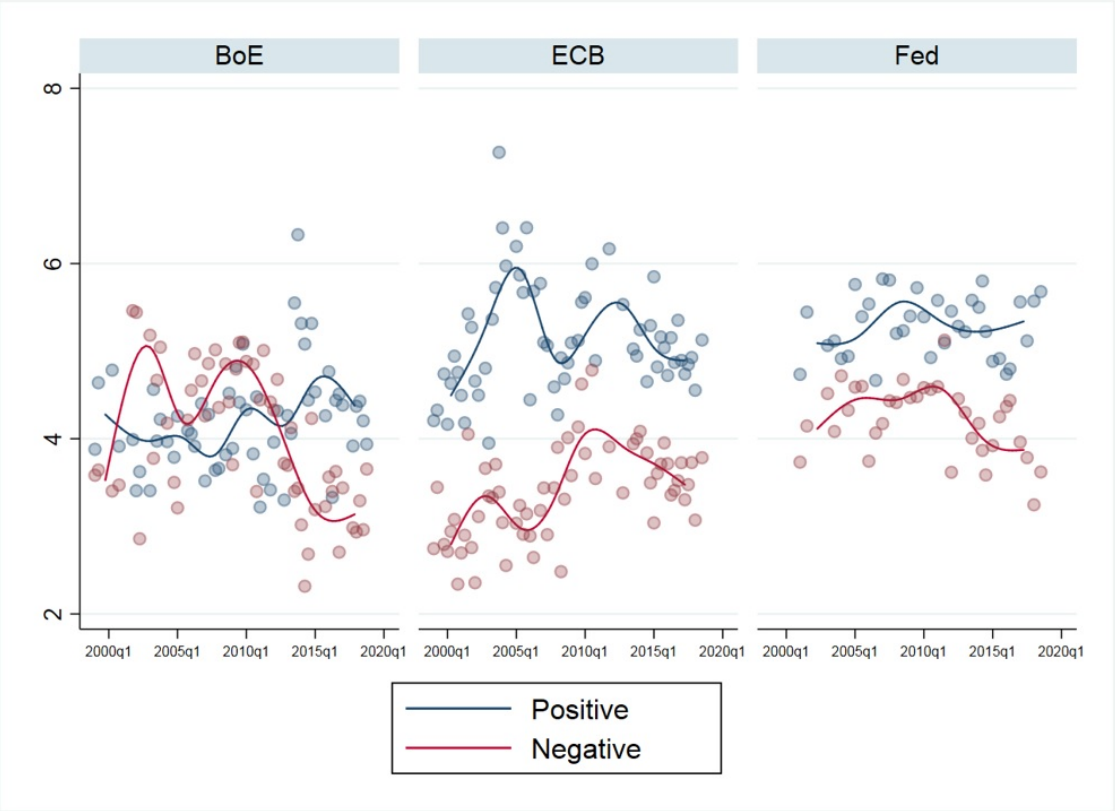
again different patterns in more recent years. This leads to the questions whether these different paths in the recent period are the result of different drivers of tone (e.g. reflecting the different objectives of central banks) and/or diverging economic developments. This is further discussed below.

Figure 4: Net sentiment ratios, by central bank (1999-2019)




While Figure 4 displays the evolution of sentiments, it does not show whether changes are mainly determined by shifts in positive or negative sentiments. Due to the structure of the sentiment ratio, lower (higher) sentiments might be driven both by an increase (decrease) in negative sentiments or a decrease (increase) in positive sentiments. Figure 5 thus shows the evolution of two measures of positive and negative tones separately. It emerges that while (positive and negative) tones in the Fed parliamentary hearings tend to be relatively stable over time, in the ECB case positive tones tend to vary more and thus have a larger impact on net sentiment. Finally, sentiments in the BoE hearings seem to be largely driven by evolution of negative tones.

Figure 5: Positive and Negative Tone Indexes, by central bank (1999-2019)




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

$$SentimentRatio_{it} = \alpha + \lambda(|\pi_{it} - \pi^*_{it}|) + \eta E_{it} + \zeta \mathbf{X}_{it} + \eta \mathbf{W}_{it} + \mu_i + e_{it}$$

This model differs from the one used for topics just in two aspects. First, here we do not include the objective dummy as an explanatory variable for sentiments. Second, here we include central bank fixed effects, which are captured by $\mu_i$, and that we did not include in the topic model to avoid collinearity with the objectives' dummies.

# 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 sole primary objective. As mentioned in

the previous section, the inflation objective dummy equals 1 for the case of the BoE and of the ECB.

The results of the regression are displayed in Table 2.[18] 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. Interestingly, this result is significant also once we control for the divergence of inflation rates from the 2% aim, which is not significant, except in Column 7. The same holds for variables such as the presence of elections and uncertainty. Moreover, the coefficient of the objective dummy remains positive and significant also once we control for macroeconomic factors, namely unemployment, GDP and credit to GDP.

The second interesting result is that unemployment is negatively and significantly correlated with the focus on price stability. This result seems intuitive: as unemployment increases, the attention shifts toward this issue, leaving less room to considerations on price stability. This may also reflect that the hearings react swiftly to changes in inflation or unemployment in a 'Phillips curve' fashion, increasing the attention on unemployment when it grows and inflation decreases, and viceversa.

Table 2: OLS estimates on Topic Price Stability as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Inflation Objective | 0.631*** | 0.622*** | 0.766*** | 0.756*** | 0.763*** | 0.758*** | 0.699*** |
| | (0.096) | (0.117) | (0.048) | (0.098) | (0.095) | (0.185) | (0.120) |
| $\|\pi - 2\%\|$ | | -0.028 | 0.002 | 0.002 | -0.002 | -0.002 | 0.034** |
| | | (0.094) | (0.083) | (0.085) | (0.083) | (0.078) | (0.017) |
| Unemployment rate (log) | | | -0.652*** | -0.633** | -0.631** | -0.626* | -0.555* |
| | | | (0.181) | (0.265) | (0.272) | (0.365) | (0.295) |
| Uncertainty | | | | 0.193 | 0.207 | 0.197 | 0.190 |
| | | | | (0.969) | (0.992) | (0.841) | (0.864) |
| Elections | | | | | 0.164 | 0.164 | 0.156 |
| | | | | | (0.120) | (0.120) | (0.150) |
| GDP (log) | | | | | | -0.003 | -0.064*** |
| | | | | | | (0.056) | (0.014) |
| Credit-to-GDP (%) | | | | | | | -0.005 |
| | | | | | | | (0.006) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.181 | 0.182 | 0.273 | 0.273 | 0.278 | 0.278 | 0.293 |
| Central Bank FE | NO | NO | NO | NO | NO | NO | NO |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

[18] 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 2.09 and 1.34 respectively. These results indicate that our estimates are robust to multicollinearity.

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 puzzling, 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 turns to 0 for the BoE after 2011, when the BoE is entrusted the objective of financial stability.[19] The results, displayed in Table 9 in the Appendix, are robust to this specification: the objective dummy remains positively and significantly correlated with the focus on price stability under all specifications.

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 and the objective dummy with a dummy that equals 1 if the central bank is the Federal Reserve, as it is the only one of the three that has employment as primary objective.

Results are displayed in Table 3. The Federal Reserve dummy is positively and significantly correlated with the focus on employment, providing further evidence of a significant and positive association between the objective and the focus of the discussion on the topic of the objective.

The coefficient of unemployment is however puzzling, as its negative sign suggests that, as unemployment grows, the discussion on employment is less frequent. This can be explained by the fact that the increase in unemployment is concomitant to the crisis, which might have diverted the attention to other topics. This hypothesis is supported by the results of Table 3, Column 7, which shows that credit as a share of GDP, a proxy of financial instability, is positively and significantly correlated with employment. Figure 11 and the regression results reported in Table 8 in the Appendix provide further evidence in this direction. Figure 11 plots the evolution of unemployment and the topics of employment and financial stability in the hearings. It shows that unemployment growth tend to rise contemporaneously to the focus on financial stability, while the focus on employment is more prominent in the post-crisis period. In Table 8 we keep

[19]This date refers to the Financial Services Act 2012, which amended the Bank of England Act 1998 (Tucker et al., 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.[20] 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 from the ones in Tables 2 and 9.

the same regression model of Table 3, but replace the topic of employment with the one of financial stability. We note that unemployment is positively and significantly correlated with the focus on the topic of financial stability.

An interesting result concerns the coefficient of elections, which is positive and significant under all specifications. This is in line with the political business cycle theory, according to which politicians increase their pressures to on the central bank to boost employment (or become less inflation-averse) as elections approach. The size of the coefficient is however relatively small, suggesting that elections play a less relevant role than other factors.

Table 3: OLS estimates on Topic Employment as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Fed dummy | 0.585*** | 0.613*** | 0.539*** | 0.535*** | 0.511*** | 0.509*** | 0.454*** |
| | (0.084) | (0.088) | (0.044) | (0.044) | (0.075) | (0.140) | (0.147) |
| $\lvert\pi - 2\%\rvert$ | | -0.114* | -0.099 | -0.100 | -0.101 | -0.101 | -0.134* |
| | | (0.066) | (0.073) | (0.074) | (0.076) | (0.079) | (0.078) |
| Unemployment rate (log) | | | -0.338*** | -0.338*** | -0.385** | -0.387* | -0.453* |
| | | | (0.102) | (0.102) | (0.170) | (0.230) | (0.245) |
| Elections | | | | 0.069** | 0.065** | 0.065** | 0.073*** |
| | | | | (0.033) | (0.028) | (0.028) | (0.012) |
| Uncertainty | | | | | -0.499 | -0.495* | -0.488 |
| | | | | | (0.400) | (0.292) | (0.308) |
| GDP (log) | | | | | | 0.001 | 0.057 |
| | | | | | | (0.040) | (0.044) |
| Credit-to-GDP (%) | | | | | | | 0.005*** |
| | | | | | | | (0.001) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.306 | 0.342 | 0.389 | 0.391 | 0.398 | 0.398 | 0.422 |
| Central Bank FE | NO | NO | NO | NO | NO | NO | NO |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

Overall, these results suggest that accountability works, as the statutory objective seems to be the main driver 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.

## 5.2 Results on Sentiments

We now investigate which variables are associated with the shifts 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 three variables (Tab. 4, Columns 1-3). Distance from the inflation aim is significantly associated with a decrease in the sentiment ratio, meaning that it is associated with a decrease in positive words and an increase in negative words (Tab. 4, Col. 1). This suggests that the more central banks deviate from their inflation aim, the worse net sentiments will get, due to either higher negative sentiments or lower positive sentiments. This suggests that sentiments are driven by accountability concerns: as the agent deviates from its mandate, the principal tends to have a more negative tone towards it. The same applies to the result for unemployment: as unemployment grows, net sentiments worsen.

The coefficient for uncertainty is the largest and most robust. Its negative sign is not surprising: Baker et al. (2016) find that uncertainty is associated with a negative economic outlook and with major (geo)political events, such as the 9/11 terrorist attack (for the United States), the Scottish independence referendum and the Brexit referendum (for the United Kingdom).[21] Moreover, based on data on the BoE, the ECB and the Bank of Japan, Klodiana and Anamaria (2020) show that shocks in uncertainty deteriorate public trust toward central banks. Their results provide a reasonable explanation for the worsening of the sentiments in the hearings as uncertainty increases in our estimates. As monetary policy is generally effective in reducing uncertainty in the markets (Bekaert et al., 2013), it is possible that high uncertainty is seen by some parliamentarians as the sign that central banks are not doing enough. A complementary explanation is that both central bankers and parliamentarians acknowledge that uncertainty poses an obstacle to monetary policy transmission.[22] In this context, sentiments worsen as uncertainty hinders the central bank's ability to fulfill its mandate.

Once we control for other factors, the significance of the coefficient for deviations from inflation and uncertainty holds, whereas the one for unemployment vanishes. The coefficient of uncertainty is larger and more significant than the one of deviations from inflation. These results suggest that sentiments are mostly associated with uncertainty. This is further confirmed by the results of Column 7, where distance from the inflation aim is no longer significant once we control for credit. The results under the alternative approach to compute sentiment ratio do not differ substantially from the ones presented in Table 4, as shown in Table 10 in the Appendix.

[21] 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.

[22] There is extensive evidence on how uncertainty has a negative impact on monetary policy (see, for example, Husted et al., 2019; Tillmann, 2019; Bauer et al., 2019 De Pooter et al., 2020)

Table 4: OLS estimates on Sentiment Ratio as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| $\|\pi - 2\%\|$ | -0.293** | | | -0.295** | -0.295** | -0.330* | -0.213 |
| | (0.057) | | | (0.050) | (0.054) | (0.095) | (0.097) |
| Unemployment rate (log) | | -0.648** | | -0.391 | -0.391 | -0.414 | 0.375 |
| | | (0.077) | | (0.234) | (0.235) | (0.196) | (0.553) |
| Uncertainty | | | -2.799*** | -3.051** | -3.050** | -2.867*** | -3.184*** |
| | | | (0.100) | (0.405) | (0.382) | (0.235) | (0.253) |
| Elections | | | | | 0.004 | 0.004 | -0.051 |
| | | | | | (0.227) | (0.227) | (0.208) |
| GDP (log) | | | | | | 0.879 | 2.308 |
| | | | | | | (1.015) | (1.547) |
| Credit-to-GDP (%) | | | | | | | -0.031 |
| | | | | | | | (0.015) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.056 | 0.021 | 0.047 | 0.121 | 0.121 | 0.150 | 0.280 |
| Central Bank FE | YES | YES | YES | YES | YES | YES | YES |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

A relevant issue that remains unresolved regards the actual 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.

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. Applying these measures to the minutes of the monetary policy meetings of the Swedish central bank, they find that it is useful to predict future policy rate decisions. Their dictionaries are therefore useful for our purpose of disentangling sentiments from negative economic considerations. Applying the same dictionaries to the transcripts, we obtain two scores that capture 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.[23]

Table 5 display the results including the hawkish-dovish ratio. The hawkish-dovish ratio is significantly and positively correlated with sentiments, suggesting that more hawkish stances are correlated with a more positive tone during the hearing. This positive relationship can be explained by the fact that hawkish policy stances are generally associated with periods of

[23]This measure could also be defined as 'net hawkishness', as suggested by Apel and Blix-Grimaldi (2012), since the score for hawkish terms is at the numerator.

economic growth, and therefore of positive economic conditions.

Table 5: OLS estimates on Sentiment Ratio as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Hawkish-Dovish Ratio | 0.433** | 0.376*** | 0.335** | 0.314 | 0.322 | 0.410** | 0.475** |
| | (0.080) | (0.025) | (0.046) | (0.109) | (0.141) | (0.082) | (0.080) |
| $\|\pi - 2\%\|$ | | -0.279** | -0.260** | -0.289** | -0.288** | -0.325* | -0.205 |
| | | (0.036) | (0.040) | (0.034) | (0.039) | (0.079) | (0.081) |
| Unemployment rate (log) | | | -0.334 | -0.298 | -0.295 | -0.296 | 0.531 |
| | | | (0.131) | (0.256) | (0.270) | (0.202) | (0.572) |
| Uncertainty | | | | -3.009** | -3.013** | -2.798*** | -3.112** |
| | | | | (0.344) | (0.339) | (0.227) | (0.386) |
| Elections | | | | | -0.056 | -0.072 | -0.140 |
| | | | | | (0.273) | (0.269) | (0.254) |
| GDP (log) | | | | | | 0.984 | 2.465 |
| | | | | | | (0.950) | (1.520) |
| Credit-to-GDP (%) | | | | | | | -0.032 |
| | | | | | | | (0.015) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.022 | 0.073 | 0.078 | 0.132 | 0.132 | 0.168 | 0.304 |
| Central Bank FE | YES | YES | YES | YES | YES | YES | YES |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

Although the hawkish-dovish ratio is positively and significantly associated with sentiments, it does not affect the size nor the significance of the coefficients of the indexes of policy drift and of uncertainty. Uncertainty remains the variable with the larger coefficient and the one that is most significantly (negatively) correlated with sentiments. While the coefficient of hawkish sentiments is higher than the one for the policy drift, its significance is less stable, especially once we control for uncertainty and the occurrence of elections (Table 5, Columns 4-5). The coefficient of policy drift however loses significance once we control for credit.

# 6 Conclusions

Our results suggest that parliamentary hearings are fit for purpose, as the hearings tend to focus on the statutory objective of the central bank and the tone of the debates worsens partially when the divergence from the inflation aim widens.

The first result is particularly relevant in light of the criticism for which parliamentary tend to diverge to topics other than the central bank's performance in attaining its mandate, which should be the object of scrutiny. The second result is however less stable as uncertainty is playing a larger and more significant role in determining the tone of the debate. This suggests that higher levels of uncertainty are associated with greater perceived risk of under-performance

of central banks. This is consistent with the relation between economic uncertainty and the economic outlook, whereby an increase in uncertainty is likely to be seen as increasing the risks that central banks' objectives are not fulfilled. This also means that expectations for central bank action are likely to grow with uncertainty. In turn, some parliamentarians may also see higher uncertainty as the sign that central banks are not doing enough. Overall this suggests that the tone of the debate is likely to be more positive (or less negative) when central banks are able to reduce uncertainty (as perceived by parliamentarians) through their communication and action.

In exploring these questions, this paper introduces a new empirical methodology to assess central bank accountability practices based on text analysis. The dictionary-based techniques that we apply to track the topics and the tones of the parliamentary hearings of the BoE, the ECB and the Fed, can be extended to other central banks. 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 explore in more detail the speakers involved in hearings. One limitation of our work is that it analyses accountability based on the hearing as unit of analysis. 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. Moreover, it is worth exploring whether parliamentarians' individual characteristics play a role in explaining the tone and focus of their participation in hearings. For example, by analysing news on the pressures from the governments on the central banks in a number of countries, Binder (2018) find 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 with the central bank simultaneously. Therefore, while our contribution already provides new insights on central bank's in parliaments, it also opens promising avenues for further research.

In conclusion, our work sheds new light on the use of accountability practices as an unexplored but rich source of data. In Fraccaroli et al. (2018) we 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.

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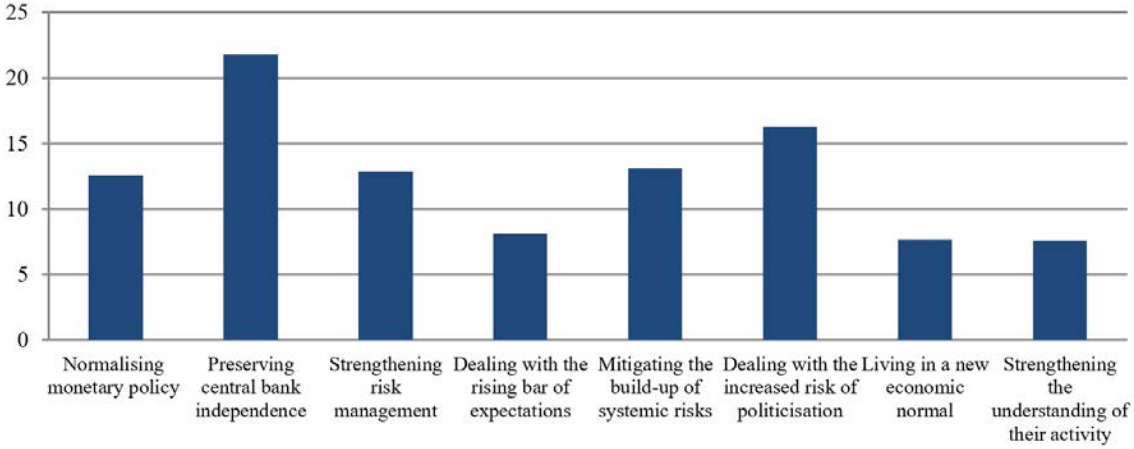
# 7 Appendix

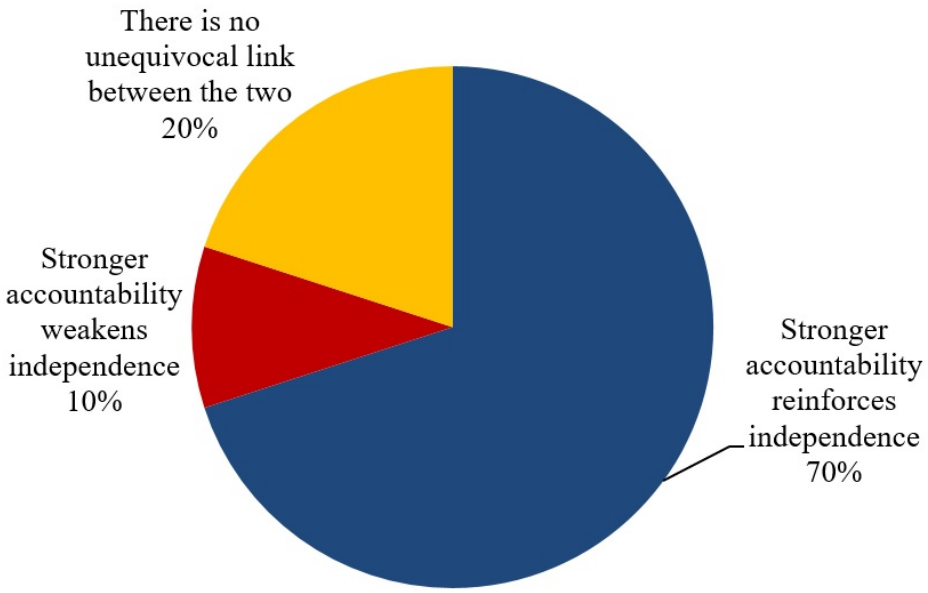
## 7.1 Survey Results

Figure 6: 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 to 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 Riskbank, 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.

Figure 7: 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 to 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 Riskbank, 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.

### 7.2 Indexes 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 characterised by different governance traits and legal foundations (constitutions, central bank statutes, additional regulations, etc.) that make cross-country comparisons more difficult (see Frisell et al., 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 independence indexes (such as those developed by Bade and Parkin, 1988; Alesina, 1989; Grilli et al., 1991; Cukierman et al., 1992), researchers constructed accountability indexes based on central banks' legal frameworks (Briault et al., 1998; De Haan et al., 1999; Bini-Smaghi and Gros, 2000). These indexes, summarised in Table 6, are constructed by selecting a number of

common criteria that are applicable to the statutes of most, if not all, central banks.

*Table 6:* 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;<br>- minutes of the meetings are published;<br>- inflation or monetary policy report are published;<br>- government can override a decision of the central bank. |
| De Haan et al. (1999) | Binary | - clarity of the monetary policy objective (e.g. quantification of the objective);<br>-transparency of monetary policy (e.g. publication of inflation or monetary reports);<br>- 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);<br>- ex post accountability (e.g. public hearings and meetings);<br>- procedures (transparency of the central bank vis-à-vis the parliament and the public). |

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 twenty years of history, the ECB has experienced no change in its accountability indexes, 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 indexes 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 indexes 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 indexes as the least accountable central bank when compared to the FED, the BoE and ECB (De Grauwe and Gros, 2008), it is one of the central bank which 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).

### 7.3 Text bags for topic analysis

**Price stability:**

price(s), inflate, inflation, inflationary, HICP, CPI, 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:**

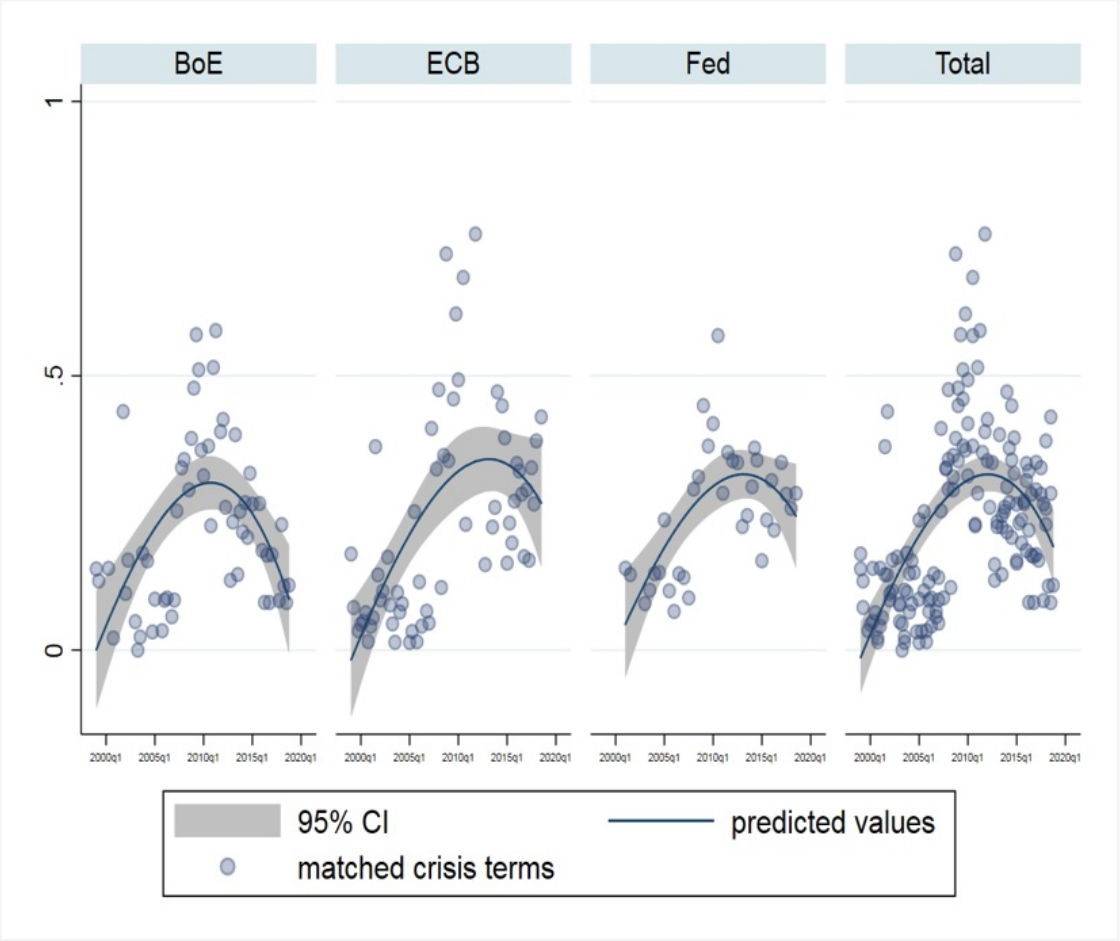
financial (in)stability, bank (in)stability, (financial) crisis, financial stress, financial risk, systemic risk, contagion, financial shocks, bubble, financial imbalance, misalignment, credit growth, banks, insurers, hedge funds, investment funds, financial markets, securities markets, leverage, capital, 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.

**Crisis:**

crisis, crises, recession(s), recessionary, bust(s), stagnate, stagnation(s), stagnating, bubble(s), crash(es), slump(s), downturn(s), default(s), defaulting, turmoil(s).

## 7.4 Crisis Text Bag

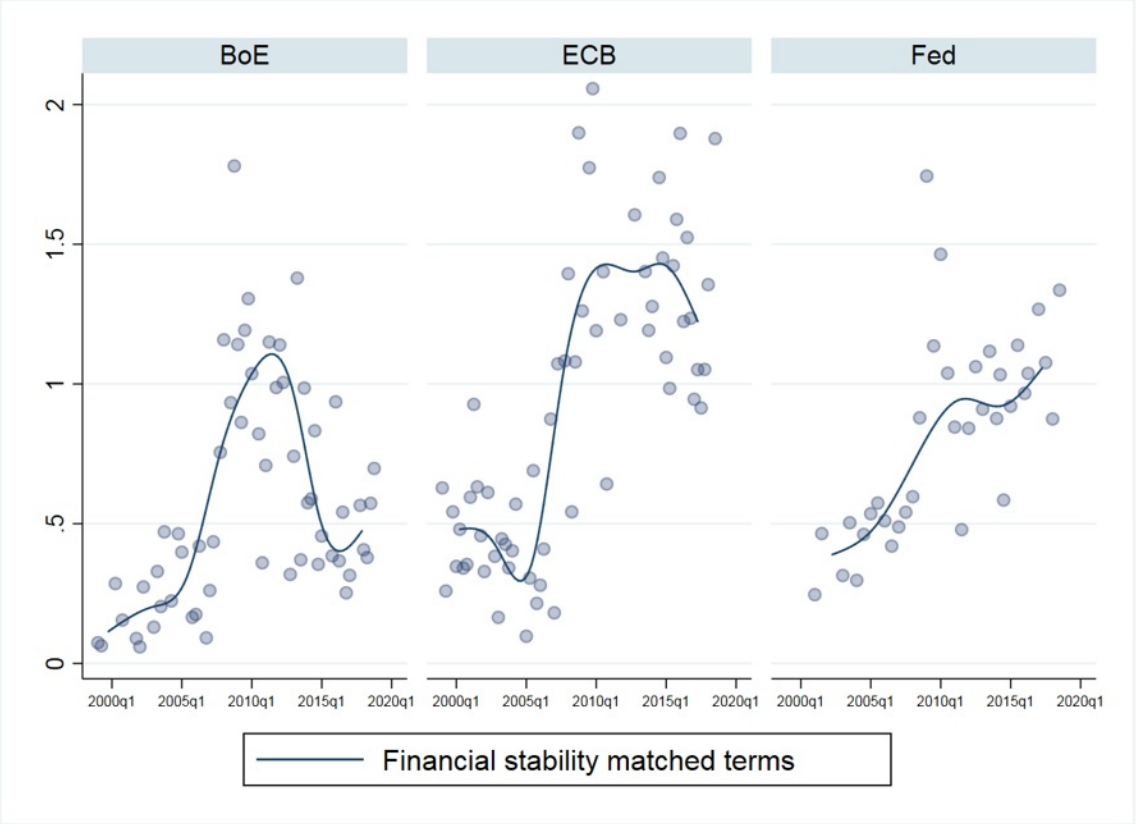
Figure 8: Occurrence of terms related to the crisis in parliamentary hearings, by central bank (1999-2019)




Sources: authors' elaboration.

## 7.5 Financial Stability Topic in Parliamentary Hearings

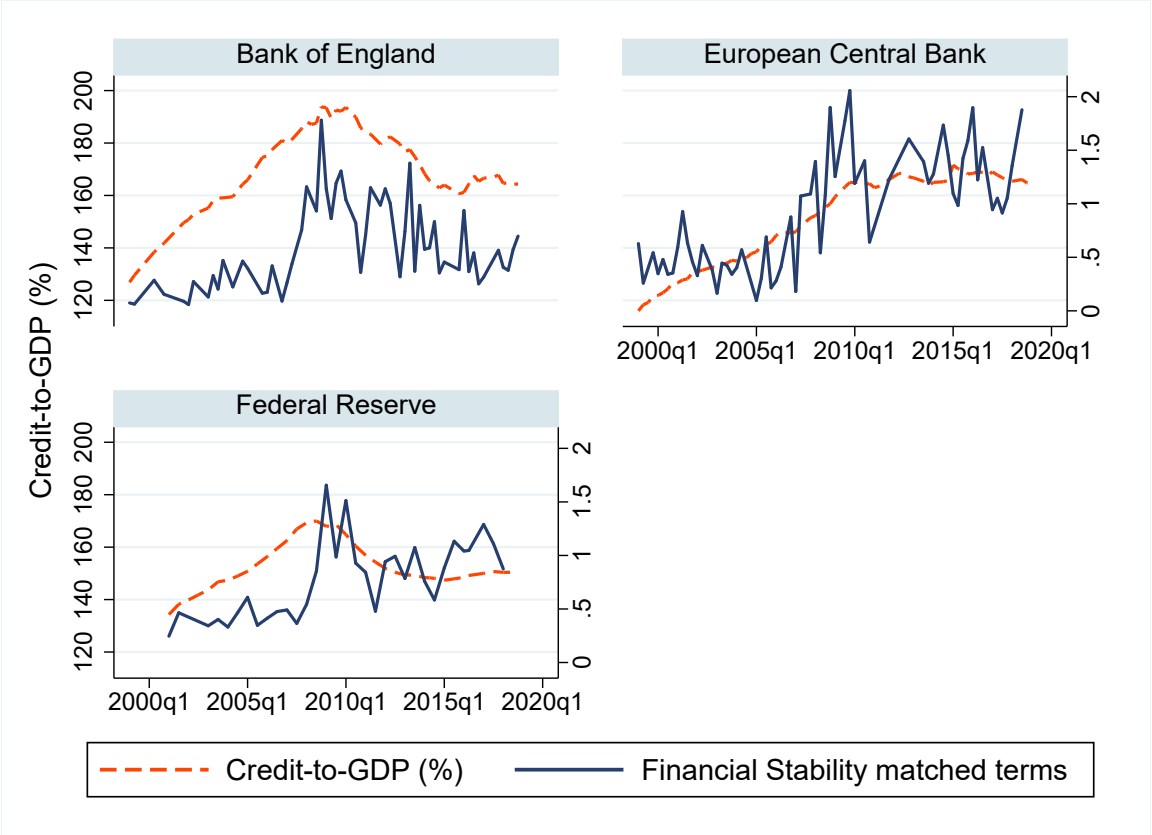
Figure 9: Occurrence of terms related to financial stability in parliamentary hearings, by central bank (1999-2019)




Sources: authors' elaboration. Note: the line is a cubic spline based on cross-median values of the matches with the text bag on financial stability, which are depicted by the scatter plot.

## 7.6 Financial Stability and Credit Growth

Figure 10: 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 BIS data. Data for the ECB refer to the euro area.

Table 7: OLS estimates on Topic Financial Stability as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Credit-to-GDP (%) | 0.020** | 0.020** | 0.018** | 0.013* |
| | (0.003) | (0.003) | (0.004) | (0.004) |
| Uncertainty | | -0.613 | -0.681 | -0.652* |
| | | (0.411) | (0.259) | (0.182) |
| Unemployment rate (log) | | | 0.350* | 0.471** |
| | | | (0.103) | (0.099) |
| Elections | | | -0.024 | -0.032 |
| | | | (0.052) | (0.050) |
| GDP (log) | | | | 0.638 |
| | | | | (0.372) |
| Observations | 151 | 151 | 151 | 151 |
| R-squared | 0.465 | 0.474 | 0.495 | 0.534 |
| Number of id | 3 | 3 | 3 | 3 |
| Central Bank FE | YES | YES | YES | YES |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

## 7.7 Unemployment and Financial Stability

Figure 11: Unemployment growth and focus on employment and financial stability, by central bank

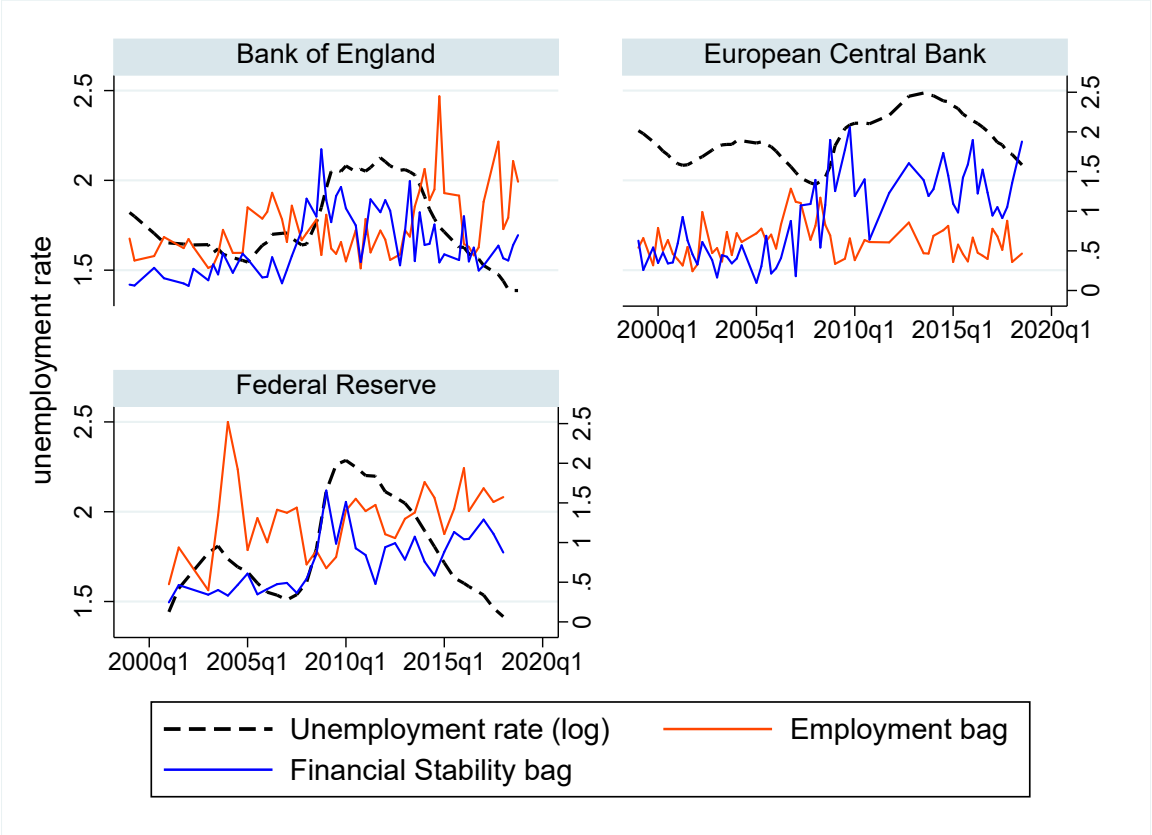


Table 8: OLS estimates on Topic Financial Stability as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Fed dummy | 0.018 | -0.034 | 0.135*** | 0.137*** | 0.097*** | -0.052 | -0.232*** |
| | (0.145) | (0.175) | (0.023) | (0.019) | (0.012) | (0.077) | (0.065) |
| $\|\pi - 2\%\|$ | | 0.208* | 0.174 | 0.175 | 0.174 | 0.184 | 0.074 |
| | | (0.126) | (0.119) | (0.121) | (0.127) | (0.130) | (0.068) |
| Unemployment rate (log) | | | 0.762*** | 0.762*** | 0.683*** | 0.530*** | 0.314*** |
| | | | (0.063) | (0.063) | (0.016) | (0.122) | (0.075) |
| Elections | | | | -0.057 | -0.062 | -0.060 | -0.036 |
| | | | | (0.093) | (0.094) | (0.085) | (0.054) |
| Uncertainty | | | | | -0.827*** | -0.561*** | -0.539* |
| | | | | | (0.053) | (0.215) | (0.277) |
| GDP (log) | | | | | | 0.090 | 0.276*** |
| | | | | | | (0.064) | (0.052) |
| Credit-to-GDP (%) | | | | | | | 0.015*** |
| | | | | | | | (0.002) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.000 | 0.104 | 0.316 | 0.317 | 0.334 | 0.344 | 0.579 |
| Central Bank FE | NO | NO | NO | NO | NO | NO | NO |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

## 7.8 Robustness Check for the Price Stability topic

Table 9: 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 | 0.683*** | 0.559*** | 0.869*** | 0.856*** | 0.863*** | 0.772*** | 0.745*** |
| | (0.023) | (0.192) | (0.076) | (0.095) | (0.094) | (0.106) | (0.058) |
| $\|\pi - 2\%\|$ | | -0.034 | 0.016 | 0.018 | 0.014 | 0.008 | 0.031* |
| | | (0.087) | (0.069) | (0.075) | (0.073) | (0.072) | (0.017) |
| Unemployment rate (log) | | | -1.020*** | -0.970*** | -0.970*** | -0.796** | -0.754** |
| | | | (0.303) | (0.366) | (0.370) | (0.362) | (0.294) |
| Uncertainty | | | | 0.534 | 0.554 | 0.047 | 0.054 |
| | | | | (0.951) | (0.952) | (0.823) | (0.823) |
| Elections | | | | | 0.182 | 0.187 | 0.182 |
| | | | | | (0.129) | (0.136) | (0.159) |
| GDP (log) | | | | | | -0.114*** | -0.145** |
| | | | | | | (0.030) | (0.059) |
| Credit-to-GDP (%) | | | | | | | -0.003 |
| | | | | | | | (0.006) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| R-squared | 0.200 | 0.201 | 0.388 | 0.392 | 0.399 | 0.417 | 0.423 |
| Central Bank FE | NO | NO | NO | NO | NO | NO | NO |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

## 7.9 Sentiment Analysis under the alternative weighting methodology

Table 10: OLS estimates on Sentiment Ratio (alternative weighting method) as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| $\|\pi - 2\%\|$ | -0.035** | | | -0.034** | -0.034** | -0.037* | -0.022 |
| | (0.007) | | | (0.005) | (0.006) | (0.011) | (0.013) |
| Unemployment rate (log) | | -0.097* | | -0.068 | -0.068 | -0.070 | 0.033 |
| | | (0.023) | | (0.034) | (0.034) | (0.031) | (0.055) |
| Uncertainty | | | -0.312*** | -0.339** | -0.339** | -0.319** | -0.361*** |
| | | | (0.027) | (0.075) | (0.072) | (0.050) | (0.018) |
| Elections | | | | | 0.000 | 0.000 | -0.007 |
| | | | | | (0.027) | (0.026) | (0.026) |
| GDP (log) | | | | | | 0.094 | 0.281 |
| | | | | | | (0.134) | (0.182) |
| Credit-to-GDP (%) | | | | | | | -0.004 |
| | | | | | | | (0.002) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| R-squared | 0.057 | 0.034 | 0.042 | 0.125 | 0.125 | 0.149 | 0.310 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Central Bank FE | YES | YES | YES | YES | YES | YES | YES |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

Table 11: OLS estimates on Sentiment Ratio (alternative weighting method) as dependent variable

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Hawkish-Dovish Ratio | 0.062* | 0.055** | 0.048* | 0.045 | 0.047 | 0.056* | 0.065** |
| | (0.017) | (0.012) | (0.015) | (0.022) | (0.026) | (0.018) | (0.009) |
| $\|\pi - 2\%\|$ | | -0.033** | -0.029*** | -0.033*** | -0.032** | -0.037** | -0.021 |
| | | (0.004) | (0.003) | (0.003) | (0.004) | (0.008) | (0.011) |
| Unemployment rate (log) | | | -0.058** | -0.054 | -0.054 | -0.054 | 0.054 |
| | | | (0.013) | (0.036) | (0.038) | (0.031) | (0.058) |
| Uncertainty | | | | -0.333** | -0.334** | -0.310** | -0.351*** |
| | | | | (0.064) | (0.064) | (0.041) | (0.029) |
| Elections | | | | | -0.009 | -0.010 | -0.019 |
| | | | | | (0.035) | (0.033) | (0.032) |
| GDP (log) | | | | | | 0.109 | 0.303 |
| | | | | | | (0.123) | (0.177) |
| Credit-to-GDP (%) | | | | | | | -0.004 |
| | | | | | | | (0.002) |
| Observations | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| R-squared | 0.032 | 0.083 | 0.094 | 0.142 | 0.142 | 0.174 | 0.342 |
| Number of id | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Central Bank FE | YES | YES | YES | YES | YES | YES | YES |

Notes: Standard errors robust to clustering by central bank.
*p<.05; **p<.01; ***p<.001

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