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The Different Paths of Central Bank Scientization: The Case of the Bank of England

Aurélien Goutsmedt* Francesco Sergi† François Claveau‡
Clément Fontan§

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Abstract

This article investigates the scientization process in central banks, using the Bank of England (BoE) as a case study. It proposes an ideal type of the scientized central bank, which is tied to the core idea that the scientization of an organization grows with its willingness to contribute to the relevant science. We derive from this ideal type empirically observable characteristics regarding leadership and staff profiles, use of internal resources, composition of external networks, and publication and discursive outputs. The BoE is then contrasted to this ideal type of a thoroughly scientized central bank. The empirical material includes archives and interviews as well as three databases providing quantitative information from 1980 to 2019. We find that the path towards scientization is strategically motivated and varied, influenced by factors such as balancing the imperatives of expert credibility and informing policymaking. Based on this empirical analysis, we underline the multifaceted dynamics of the scientization process and call for more nuanced representations in the academic literature.

1 Introduction

On February 25, 2015, the Bank of England (BoE or “the Bank” hereafter) organized an event for Bank representatives and “external experts.” This gathering launched the Bank’s “One Bank Research Agenda.”¹ For the first time in its long history, the

*UCLouvain, ISPOLE; F.R.S.-FNRS.

†Université Paris-Est Créteil, LIPHA.

‡Université de Sherbrooke; CIRST.

§UCLouvain, ISPOLE; USL-B, IEE.

¹<https://www.bankofengland.co.uk/news/2015/february/one-bank-research-agenda-launched-today>. Retrieved 17/08/2022.

Bank publicly outlined a research strategy. This strategy entailed two main components: a list of research topics presented as priority areas for staff investigation, and the creation of the Research Hub, an internal structure dedicated to producing scientific contributions. As emphasized by its new governor, Mark Carney (2015, p. 2), this strategy was designed to “transform the way research is done at the Bank” and intended to “cultivate an extensive research community that spans the Bank and beyond.”

This evolution toward a “scientized” central bank, one that has the resources, internal organization, and network to output scientific contributions, is abundantly discussed in the academic literature (Claveau & Dion, 2018; Golub et al., 2015; Marcussen, 2006, 2009; Mudge & Vauchez, 2016, 2018b; Rosenhek, 2013; Schmidt-Wellenburg, 2017a; Thiemann et al., 2020; Van’t Klooster & Fontan, 2020). However, this literature fails to emphasize that central banks have embraced this transition to different degrees, with differing timeframes and strategies. This article aims to examine the concept of “scientization” in central banks, focusing on the recent evolution of the Bank of England as a case study.²

To do so, we provide a well-delimited concept of “scientization,” outlining an ideal type of a “scientized” central bank, and then contrast this ideal type with our empirical analysis of the BoE. Our case study relies on the quantitative analysis of three databases³ that we combine with material from archives and interviews.

The comparison between the ideal type of a scientized central bank and the BoE’s actual trajectory is an antidote against various shortcuts made by the extant literature. Yes, there is a transnational epistemic community of central bankers, but its members have professional profiles unlike what we typically associate with a standard scientific community. Yes, the proportion of hired PhDs have increased dramatically in central banks, but these highly skilled workers are not necessarily incentivized to make scientific contributions. Yes, policymakers now have more scientific references and concepts in their discourse, but they cater most frequently to

²See the introduction of the special issue for a broader literature review and discussion of the concept of scientization.

³See Appendix B for details on the databases.

non-scientific audiences and adjust their language accordingly. Most importantly, the process of scientization is not always going forward and is not a foolproof strategy against criticism.

Martin Marcussen (2009) used “large brush strokes” to paint a preliminary picture of the scientization of central banks. Although stimulating, this work resulted in an oversimplified picture. Our article is a plea for more careful representations of the evolving place of science in central banks.

2 Scientization: Delineating the Concept

When introducing the idea that central banks are getting scientized, authors typically refer to a few papers by Martin Marcussen in the 2000s. However, these authors do not explain whether their use of the term conforms to Marcussen’s concept (J. Acosta & Cherrier, 2021, p. 324). In fact, making this assessment would be difficult because Marcussen does not maintain a stable definition of scientization across his different papers.

Marcussen (2006) emphasizes the transition from *applying* scientific methods to *producing* scientific methods and theories. A central bank is scientized to the extent that it attempts to contribute to science instead of simply being a user of it. This understanding of scientization is consistent with part of the literature that followed. For instance, Mudge & Vauchez (2018b, p. 249) calls attention to “a broad shift in central bank organizations toward acting more like scientific or academic research centers.” Similarly, Dietsch et al. (2018) and Schmidt-Wellenburg (2017b) claim that the influence of central banks inside the academic community has steadily grown, while, Thiemann et al. (2020) and Thiemann & Priester (2022) show that when central banks gained macroprudential competences, they also became major producers of scientific knowledge on the topic.

However, the emphasis is elsewhere in a later piece by Marcussen (2009). He explicitly dismisses that what is happening in central banks is a “genuine science,” presenting it instead as “essentially an ideology or dogma presented in the guise

of science” (Marcussen, 2009, p. 377; citing Gregory, 2007). In the 2009 chapter, the process of scientization is thus a matter of the increasing mastery of “scientific ‘techno-speak’.” Scientization is also presented as a linear process, which is tightly associated with Max Weber’s concept of “rationalization,” that is, the overarching historical progression towards a growing dependence on standardized and quantifiable rules. Marcussen characterizes this process as a “fifth age” of central banking, marked by features such as scientization and inflation targeting.

There is one characteristic that Marcussen systematically associates to scientization: a scientized central bank is not only operationally independent from government (i.e., the de-politicization of the 1990s), it is “immune to political argumentation” altogether—i.e., “a-politicized” (Marcussen, 2009, p. 389). He goes as far as claiming that “we should imagine political issues that have obtained a status akin to a law in physics” (Marcussen, 2011, p. 329). More precisely, scientization would lead to a-politization because the acquisition of scientific authority by central bankers is supposed to shelter their policymaking from outside criticism (Abolafia, 2012, p. 3; Coombs & Thiemann, 2022, pp. 14–15; Trondal & Jeppesen, 2008, p. 422). For example, Mudge & Vauchez (2018a, p. 248) claim that the scientization of the ECB follows a strategy “to operate at a distance from both domestic politics and Brussels-based inter-state bargaining”.

However, the connection between scientization and a-politization is dubious. Although claiming the authority of science can help fend off criticisms and is frequently used for this purpose exactly, it is not a foolproof strategy. A central bank using or contributing to science remains possibly subject to distrust and counter expertise by specialists and non-specialists alike (Coombs, 2020).

For the purpose of this article, we retain the core of Marcussen’s original use of the term: scientization as the growing willingness of a central bank to *contribute* to the relevant science. Although the line can be blurry, contributing to science should not be conflated to using science—which is something central banks have done for a long time.⁴

⁴Central banks’ reliance on research is tightly associated with the development of their administrative capacities in the 1950s (Monnet, 2018).

What does it entail for a central bank to be scientized from the 1990s onwards? We submit that four characteristics encapsulate the ideal type of a scientized central bank.⁵ These characteristics intersect some, but not all of what Marcussen subsumed under his concept of scientization in his different papers.

First, **leadership and staff profiles** must fit certain standards if “central bankers consider themselves, and are considered to be scientists” (Marcussen, 2006, table 3.1). The typical contemporary scientist has a PhD. So scientized central banks should have a historically high level of employees with PhDs (Georgakakis & Lebaron, 2018; Lebaron & Dogan, 2016). Yet, only observing the sheer number of PhDs is not sufficient. With the normalization of graduate studies and the growing level of required specialized skills needed to operate scientific tools (such as macroeconomic models or econometric techniques), having a PhD does not entail being an active contributor to science. A more reliable indicator of being a scientific contributor is a career trajectory involving academic positions before and after one’s time in the organization, or simultaneous affiliation to academia.

Second, scientized central banks channel **internal resources** to promote research that aims at advancing the scientific conversation (Mudge & Vauchez, 2016). Accordingly, scientific contributions should be encouraged with means such as dedicated time for undirected research, publication of working paper series, regular workshops and programs for visiting researchers.

Third, researchers from a scientized central bank have an **external network** composed principally of other contributors to the relevant scientific fields (Baker, 2015, p. 356; Maman & Rosenhek, 2012, pp. 320, 326; Mudge, 2015, p. 77; Wansleben, 2022, pp. 7, 41). Those typically have academic positions or a job in another scientized organization. Furthermore, the network of researchers in a scientized central bank should be distinctively international (Fourcade, 2006; Heilbron & Gingras, 2018).

⁵In qualitative social science, ideal types are heuristic devices. Researchers built an intentionally exaggerated ideal type to systematically characterize the actual course of events by its distance from the ideal type [gerhard1994]. Furthermore, an ideal type is not a normative ideal. In our specific case, we do not suggest that actual central banks ought to strive to be thoroughly scientized.

Fourth, the **publication and discursive outputs** of a scientized central bank should have distinctive characteristics. Central bankers should strive to produce *en masse* the paradigmatic support of a scientific contribution: the peer-review journal article (Claveau & Dion, 2018). A thoroughly scientized organization also talks the language of science: speeches from its representatives should include references to scientific contributions and terminology. This characteristic of speeches is akin to the “scientific ‘techno-speak’” identified by Marcussen (2009), but without the presumption that it is a mere symbolic use of science, as “talking the talk without walking the walk” (Marcussen, 2011, p. 322).

We are thus left with a circumscribed concept of scientization, which does not correspond to everything that Marcussen wanted to pass off as its features.⁶ By contrasting this ideal type of scientization to the trajectory of the Bank of England, the rest of this article shows that scientization is not an unstoppable force and does not serve as a recipe to avoid criticism.

3 Method and General Results

In this article, we put forward and discuss several quantitative indicators of scientization running from the 1980s to 2019 that we organize along three dimensions: (i) the characteristics of policymakers and of the economic staff within the BoE; (ii) the features of research publications; (iii) the place for “science” in central bankers’ speeches. These indicators rely on the use of three databases: (1) *Web of Science*, for access to peer-reviewed journals of central banks’ economists; (2) a database, constructed by us, containing all documents published on the Bank’s website; (3) a prosopographic database of the Bank staff and leadership, also of our own making.⁷ We complement these indicators with qualitative insights from semi-directed interviews and archives.

This section focuses on the quantitative methodology and describes the main quan-

⁶More specifically, we do not define scientization as a linear process, shielding central banks from criticism, although we engage with these claims.

⁷See Appendix B for details on the methodology of our quantitative analysis.

titative results. The following section interprets these results, combining the quantitative and the qualitative dimensions of the analysis.

3.1 Prosopographic Analysis of BoE Profiles

Our prosopographic analysis looks at the professional characteristics and experiences of BoE leadership and staff. We rely on two career indicators: last diploma when joining the Bank and professional experience prior to and after working for the Bank (i.e., *ex ante* and *ex post* employment). These indicators are based on two samples. The first sample is constituted by 369 current and former BoE employees who authored research papers.⁸ The second, smaller sample is exclusively constituted by the Bank’s highest hierarchical levels—that is, the Governor, his Deputies, the Executive Directors, and, from 1997 onward, members of the Monetary Policy Committee (MPC).⁹

A first result stemming from our prosopographical analysis is the increasing proportion of employees hired at the Bank who hold a PhD (Figure 1). This rise began in the early 1990s; the proportion stabilized in the early 2000s, and then it accelerated again from 2010 onwards. Based on the location of the last degree, internationalization has increased since the late 1980s, with an increasing share of BoE researchers educated in continental Europe or North America. Yet those having UK diplomas remained the majority until very recently (Figure 2). The profiles of the Bank leadership display similar temporal patterns in terms of level of education (see Table 1), albeit with a higher share of UK diplomas.

Staff’s *ex ante* and *ex post* employment enriches the picture. Before the mid-1990s,

⁸One cannot approach the measurement of the degree of qualification by simply looking at all BoE employees, since numerous employees in administrative or clerical positions are not within the scope of our analysis. Besides, in the particular case of the BoE, there are no stable job titles allowing us to identify over time people who devote their time to research. Moreover, there is no specific/unique administrative unit (or group of units) tasked with research duties (there is no “Research Department” or equivalent).

⁹Over the period under investigation, the BoE organizational chart has evolved numerous times. However, as a rough approximation, it consists of three layers: the Governor and the Deputy Governor(s); Directorates, chaired by Executive Directors, reporting to the Governor and Deputy Governor(s); Divisions, chaired by Heads of Division, reporting to an Executive Director. The MPC, created in 1997, comprises the Governor, two Deputy Governors, two Executive Directors (these five members constituting the “internal” members of the MPC), and four external members.

individuals with an academic position before joining the Bank constituted the largest group among various professions (Figure 3). However, after this date, the share of this group declined. Academic hires were substituted by staff coming from other central banks and international organizations: in recent years, these groups represent around a third of the researchers entering the BoE.¹⁰ The trend is less pronounced among those departing the Bank. Over the period of our analysis, approximately one quarter of departing BoE employees secured positions in academia, although there was a slight decrease in the number of BoE employees joining an academic institution around the financial crisis (Figure 4). The proportion is similar for departures to other central banks or international organizations. Finally, the private sector, especially financial firms, provides job opportunities for around one fourth of employees leaving the Bank.

The BoE leadership displays a different pattern than the staff. A long career within the Bank (or in other UK public institutions) remains the norm for finding one's way up the ladder. For those who had built a career outside the Bank, their employment had been mostly UK-based, either for British large corporations or for the UK headquarters of multinational banks (see also Table 3). Academic careers prior to joining the Bank (which constitutes a large proportion of external MPC members; see Table 3) are more international than non academic profiles.¹¹ Finally, *ex ante* employment or careers in other central banks or international organizations are overall much less common among BoE leadership than among BoE staff (Table 2).

3.2 Publishing Practices

We analyze three types of research publications: the articles from the BoE's different working papers series; the research articles appearing in the Bank *Quarterly Bulletin*; and the articles published in peer-review journals by at least one BoE-affiliated author.

¹⁰Excluding hires of new graduates with no *ex ante* employment, which is also trending downward.

¹¹Yet, most of those with an academic profile hold a position in a British university when joining the Bank.

In the late 1980s and early 1990s, we observe that the BoE staff, outside of publishing relatively many working papers (Figure 5), published more in peer-reviewed journals than other central banks, FED excluded (Figure 6). A significant part of these articles was published in the most prestigious US-based international journals in economics (the “Top 5”). From the mid-1990s to the early-2000s, the number of BoE publications in peer-review journals remained relatively low compared to the previous period (Figure 5).

In the early 2000s, publication indicators were on the rise again (Figure 5): the number of working papers and articles published in peer-review journals increased, and a larger share of articles was published in the Top 5, in comparison to other central banks (Figure 7). Moreover, the BoE became (again) one of the most prolific central banks in terms of publications in all economic journals—although the recently-established ECB was out-of-reach (Figure 6). We also observe a new trend: the proportion of peer-review articles written with authors affiliated to non-UK institutions increased after the mid-2000s, overtaking collaborations with UK institutions (Figure 8). While almost no peer-reviewed articles were co-authored with other central banks’ authors before 2000, the proportion of such articles constantly increased steadily thereafter.

However, with the Great Financial Crisis (GFC) of 2007-2009, the rhythm of publications decreased and then started to grow again with a large increase of the number of working papers after 2014.

3.3 Discursive Practices

To investigate quantitatively the scientific dimension of central banks communication, we examine the speeches pronounced by BoE leadership and we develop two sets of indicators. First, we consider the references made in speeches to articles published in research journals and to the publications of the Bank (i.e., staff working papers and articles published in the Bank’s *Quarterly Bulletin*).

Second, we analyze the content of the speeches by measuring the proximity between

each paragraph and several lexical fields. As a first step to our procedure, we use a pre-trained neural word embedding model. A word embedding model represents each word as a dense vector of a certain number of dimensions (300 in our case). The proximity between two word-vectors provides a quantitative indicator of the semantic proximity between the two corresponding words (Rodriguez & Spirling, 2022). Neural word embedding models need to be trained on a very large corpus while being trained also on an appropriate corpus. We thus used a model that has been pre-trained on a corpus of 23,000 documents from 130 central banks by Zahner & Baumgartner (2022). We then applied the method developed by Arora et al. (2017) and Ash et al. (2022) to compute the proximity between specific lexical fields and each paragraph of the BoE speeches.¹² We build 3 different indexes of lexical fields, by selecting sets of words identifying different dimensions of speeches’ rhetoric (see Table 4 for details on the different lexical fields). For instance, our “econometrics index” is composed of all the words and bigrams in the word embedding model that are composed of “econometric”, “estimation”, “output gap”, “lagged”, “regression”, and “time series”.¹³ By constructing these indexes for each lexical field, we are able to observe the changing prevalence of specific lexical fields over time.¹⁴

We rely on these two sets of indicators to identify two ways for BoE speakers to appeal to science. The referencing indicator allows us to detect a formal use of academic codes, that is, a reference in a bibliography or in a footnote. The lexical indicator helps us to spot more informal ways of using science, consisting in mentioning concepts, theories, and the like in the main body of the text. Both sets of indicators are further disaggregated and sorted by the speaker’s position within the Bank (Governor; Deputy Governor; Executive Directors; MPC internal members; MPC external members), and by the speech’s audience (politicians; finance and banking professionals; business sectors; other central bankers and international

¹²We use the cosine similarity to measure this proximity. More details are provided in the Appendix (Section B.2).

¹³One of the advantages of using the word embedding method rather than a “dictionary method” is that we are not only measuring the occurrences of the words of our lexical fields in a paragraph, but also the distance between all the other words and our lexical fields. To put it otherwise, the presence of words very “distant” from our lexical fields in a paragraph will make this paragraph more distant from our lexical fields (Grimmer et al., 2022, pp. 79–81).

¹⁴See Table 5 for examples of the speeches’ paragraphs that are the closest to the lexical fields.

organizations; academics).¹⁵

Overall, from the 1990s, we observe an increase in the share of BoE speeches citing research (Figure 9). In the 1980s, there was a plain and simple absence of reference to any research work in speeches made by BoE leadership (for any role, and to any audience); conversely, in recent years, more than half of the speeches contain explicit mention to research publications. This trend is similar both for quotes to BoE research and for quotes to other articles in peer-review journals.¹⁶ Moreover, since the early 1990s, there is an increased lexical proximity between BoE speeches and language of “research”, “macroeconomic theory”, and “econometrics” (Figure 13).

Figure 11 shows the steady, but slow rise of scientific references in the speeches made by the Governor of the BoE.¹⁷ By contrast, speeches by members of the MPC (both internal and external) display a constantly higher share of references to research. The results of our word-embedding analysis confirm this pattern: when considering the proximity of speeches with lexical fields, we observe that Governors are less likely to use the language of econometrics or macroeconomic theory (Figure 14). In short, we observe, over the whole period, that the higher the position of the speaker, the less references to or mention of science. However, we can observe clearly the impact on our indicators of the arrival of Governors with a more significant background in economics: the first years of King’s governorship and then those of Carney’s are characterized by more references to scientific research and a discourse closer to scientific rhetoric.

The audience also matters. Over the studied period, the main audience of the Bank was the private business sector (Figure 10). However, it appears that speeches addressed to this audience are much less likely to contain references to published research or to use a scientific language than in speeches addressed to academics and

¹⁵See the Appendix (section B.1.1.1) for details on the classifications of speeches.

¹⁶See Appendix (Section B.1.1.2) for details on the identification of references.

¹⁷Of course, a more contextualized analysis of these speeches should investigate more carefully the production process of such speeches, notably the “ghostwriting” practices for Governors’ speeches—that is, when most Governors’ speeches are actually mainly written by advisors or private secretaries to the Governor. However, sources uncovering these practices are obviously mostly out of reach.

other central banks (Figures 12 and 15).

Finally, with the GFC period, the ascending trends observed for the previous two decades stopped. The share of speeches citing scientific publications decreased, on average, during the crisis and its immediate aftermath; this is particularly visible in speeches made by MPC members (internal and external), and for speeches addressed to other central banks and international organizations. Similarly, the proximity with the lexical field of “research” and “macroeconomic theory” has significantly decreased—above all, again, in speeches addressed to central banks.¹⁸

4 Discussion

Our contribution can be summarized in five points. First, the professional trajectories of BoE members suggest that the specialized community of central bankers has been significantly different than an ideal-typical transnational scientific community. Second, scientization is constrained by trade-offs between two types of research in central banks: analysis directly informing policy-making and work meant primarily as scientific contributions. Third, in their communication, central banks cater to different publics, and the appeal of playing the “we are scientists” line depends on the audience. Fourth, scientization is a non linear process and can go in reverse for a time. Fifth and finally, the tight connection to science can sometimes ignite challenges, instead of being a foolproof strategy against controversy.

4.1 Workforce: Hybrid Professional Profiles

A necessary input for scientization is a specialized workforce actually able to contribute to the relevant science. Our data unambiguously indicate that this condition has been increasingly met by the BoE, with rising proportions of researchers and policymakers holding a PhD (see Figure 1 for researchers), most frequently in

¹⁸However, the reliance on the “research” lexical field remained constant in speeches addressed to any academic audience.

economics.¹⁹ The BoE follows in this respect a global trend among central banks (Lebaron & Dogan, 2016; Marcussen, 2009, p. 379). This transformation is mirrored by the rising level of qualifications required according to BoE job advertisements. For instance, before the mid-1990s, BoE job ads published in *The Economist* and other periodicals did not mention graduate studies as a job requirement. From the mid-1990s, these advertisements started indicating post-graduate studies in economics as a job requirement (see e.g. *The Economist*, May 20, 1995). Furthermore, in the 2010s, the Bank actively pursued the hiring of PhDs by developing two specific recruitment programs (see Bank of England, 2016, pp. 18, 21).²⁰

Another symptom of scientization is the internationalization of the workforce. This should mirror the dynamics observed in economics, the main field of training for the BoE workforce. Indeed, since the 1970s, economics had undergone an “internationalization” process (Coats, 1996), with the emergence of common scientific and professional standards, making economics a “global profession” (Fourcade, 2006; Harrington & Seabrooke, 2020). The research staff at the BoE was increasingly internationalized based on an explicit hiring strategy decided in the mid-1990s. This strategy was notably supported by Mervyn King, then chief economist of the Bank: “[King] said we will not constrain ourselves to hire Britons and [that we will] open to the international market and to PhDs” (Interview, Charles Bean).²¹ However, this internationalization was relatively slow: more than half of new BoE researchers were still UK-educated at the end of our period (Figure 2). The preference toward UK nationals is even stronger for BoE leadership, most policymakers being firmly rooted in the UK. Looking at the professional trajectories of BoE staff, they remain diverse, with proportions of transitions from and to non-academic organizations that either increase or fluctuate without a clear trend (see 3 and 4).

¹⁹Economics had become the most common degree of staff employed by the BoE “Economics Division” around the mid-1970s, followed by mathematics (Bank of England, 1976, p. 442). Before the 1970s, it was not uncommon for the “Economics Division” staff to hold degrees in English literature or History (J. C. Acosta et al., 2023, fn. 25).

²⁰The first program, the PhD Research Programme, started in 2015, offers a favorable entry-level career path for recent PhD graduates. The second, the PhD Internship Programme, is aimed at hosting and supporting current PhD students/candidates; the current form of this programme (dating from 2015) is the latest example of a longer tradition of programmes for PhD candidates, dating back at least to 2007 (Bank of England, 2008, p. 24).

²¹On the role of King in the transformation of the BoE, see J. C. Acosta et al. (2023, sect. 3).

In short, there is some truth to saying that “academia and central banking are forging ever closer links” (Marcussen, 2006, p. 93), especially because advanced specialized training has become an almost prerequisite for researchers and policy-makers. However, the case of the BoE shows that, through time, professional links with academia can weaken in some respects (e.g., *ex ante* employment) or fluctuate with no clear direction in other respects (e.g., *ex post* employment). Indeed, the BoE maintains substantial links to other types of organizations—such as central banks, international organizations, and financial firms. No steamroller of scientization is changing this fact. The central banking community—with ties to academia, finance, international organizations and the public sector—is a hybrid epistemic community quite distant from the ideal type of a scientific community.

The profiles of MPC external members can further illustrate this hybridity. The Bank of England Act 1998 act (Sec. 13-4) states that any person who “has knowledge or experience which is likely to be relevant to the Committee’s functions” is qualified to sit in the MPC. “Knowledge” is thus at par with “experience”. Indeed, professional experience as an economist in the private sector is the most frequent qualification for external MPC members, while fewer external members hold an academic position (Table 2). When looking at the career of external MPC members, we observe that most of them have built a career as economists in large banks (Goldman Sachs, Deutsche Bank, Morgan Stanley, NatWest, Citigroup, . . .), asset management funds, large UK corporations (British Petroleum, British Airways, . . .), or the Confederation of British Industries (a fifth of the external MPC members served as an economist there).²² These observations are overall consistent with Lebaron & Dogan (2016), who distinguishes four central bankers’ profiles: “academics”, “insiders”, “bureaucratic and political profiles”, and “private financiers”. The two last categories clearly do not belong to the “epistemic community” of academia, and they are not endangered species within the BoE (see also Dogan and Lebaron, this issue).

²²There are as well a few examples of individuals circulating between the two fields—academia and private business, particularly finance. Only two external MPC members have built a career in public administration (HM Treasury) or in international organizations. When leaving the MPC, external and internal members are most likely to join private business, particularly in finance.

4.2 Two Types of Research Output

We saw that the BoE has a growing army of PhDs, but we should not be too hasty in concluding that this trend necessarily translates into more contributions to science. Indeed, for much of the period, recruiting highly skilled economists was primarily justified by the need for policy analysis.

This need for technical skills was felt when the Bank was entrusted with the task of publishing quarterly the *Inflation Report* in 1992 (James, 2020). The report had to present inflation forecasts and assess how monetary policy would contribute to achieving the recently established inflation target (Elgie & Thompson, 1998, Chapter 4). To fulfill these new objectives, the Bank underwent a significant restructuring process (J. C. Acosta et al., 2023). During the internal debates regarding this reorganization, Mervyn King, the newly appointed Chief Economist, argued, in a memorandum titled ‘The Analytical Functions [of the Bank]’ addressed to the Deputy Governor:

We require a high-powered team of economists who are familiar with the academic literature as well as the latest work in other central banks. Most of these people should have a PhD or equivalent qualification in economics.²³

Moreover, King considered that, to perform its functions, the Bank had to adopt models that aligned with the prevailing standards of academic macroeconomics in the US (Goutsmedt et al., 2022). This change required economic PhDs, who could master advanced knowledge to build and use these models, but the primary aim was not to contribute to science. Rather, the principal objective lay in the practical application of these models for policy.

Another important step in the development of research at the Bank was the transition to operational independence in 1997, and the consecutive creation of the MPC, whose mission was to take operational decisions (notably setting the Bank rate).

²³King to the Deputy Governor, “The Analytical Functions,” 5 January 1993, 9A226/1, Bank Archives.

Staff economists were swiftly integrated into MPC pre-meetings, where they provided statistical and econometric analysis (including model forecasts), and analysis on specific topics commissioned by MPC members (J. C. Acosta et al., 2023).²⁴ Highly skilled economists were needed, but primarily for policy analysis, not to contribute to economic science. In interview, one of the former Executive Director of the Bank reflected on this tension between academic credentials and the pressing need for producing forecasts and analysis in the early days of the MPC:

Now we have all of these smart economists publishing journal-quality papers that look like Harvard-MIT-Chicago economics; but, actually, we got no one that can do a forecast. (Interview, Executive 3).

A staff economist also recalls this prevailing tension experienced during the 2000s:

[A]lthough there was always the tradition of hiring PhDs, they were not receiving any particular incentive to publish their own work. So, they will all do their policy work like everybody else. Probably they will deal more than others with the technical side of policy analysis. (Interview, staff economist 10)

In sum, the level of qualification of researchers is not a particularly good indicator of scientization, understood as the willingness to contribute to science. For most of our period, the Bank’s leadership expected qualified economists to utilize their specialized skills predominantly in supporting internal policy work, and not for engaging with academic activities such as publications in peer-reviewed journals.

This state of affairs changed in 2014. Following a significant change in leadership, notably with the appointment of the new Governor Mark Carney, the Bank developed

²⁴Expectations on staff were set very high from the beginning of the MPC, especially because external MPC members with an academic background would challenge the forecasts. About these early years, a former Executive Director recalls: “I think that [the staff] underinvested in the forecasting model, [which] had its problem, essentially exposed by the external MPC members. Particularly, in my recollection, Willem [Buiter], aided by Charles [Goodhart] [...] there were some occasions when the forecast meeting was a bit of a disaster. [...] These were forecast meetings where you have not made any progress because the staff hadn’t adequately prepared.” (Interview, Executive 3)

a “Strategic Plan” which was intended to transform several aspects of the institution. This included the reorganization of research, with two explicit objectives: “increase the Bank’s external profile and influence” and “inform policy development” (Bank of England Independent Evaluation Office, 2019).²⁵ With regards to these objectives, the Research Hub was created. BoE staff can apply internally for short (six months) research leaves to this new unit. During their time there, they can focus on their research, as they are relieved from their duties related to internal policy work. According to the staff, this reorganization contributed to clarify the distinction between policy analysis and (scientific) research:

Now there is a fairly clear definition. We think of research as analytical output, which is primarily aimed at publication (externally). While ‘policy analysis’ is aimed at internal publication, and without being attributed to a particular researcher. So, we have a fairly clear definition, although in terms of content, policy analysis and research can be very close. (Interview, staff economist 10)

4.3 Audience and Language

Marcussen posits that central bankers’ communication is couched in a “techno-speak,” that is, the “discourse of science.” In the new “age” of central banking, “scientific breakthrough” has purportedly emerged as the “major nodal points in central bank rhetoric,” with central bankers primarily communicating through “a common language: econometrics” (Marcussen, 2006, pp. 85–86). It is undeniable that BoE officials have exhibited an increasing proclivity towards adopting the language of science (Figure 12). Moreover, recent speeches include a higher proportion of words associated with econometrics, macroeconomic theory and research (Figure 13).

Upon closer analysis of the BoE’s communication practices, it becomes apparent that its leadership modulates the technical and scientific aspects of its language to

²⁵These two objectives echo the two general functions of science in politics, respectively the legitimating function and the instrumental function (Weingart, 1999, p. 155).

cater to diverse audiences. Over the period under consideration, the Bank primarily oriented its communications towards the private business sectors, without any notable increase in the proportion of speeches addressed to an academic public (Figure 10). Although scientists typically communicate primarily with their ‘scientific peer groups’ (Marcussen 2006, Table 3.1), the BoE leadership did not exhibit this tendency. The reason should be obvious: according to the received view, “the advantages of a sound monetary policy are largely dependent upon the policy’s being *understood* and relied upon by the private sector in arranging its affairs.” (Woodford, 2003, p. 4) Consequently, BoE officials keep themselves busy by speaking before multiple audiences outside their epistemic community.

Furthermore, speeches have a distinctive flavor depending on the audience. In general, the use of scientific terminology and references is less predominant when addressing a non academic audience (Figures 12 and 15). This points to a reinterpretation of discursive strategies. When attempting to project credibility toward non-peers, central bankers do not double down on ‘science speak.’ They go in exactly the opposite direction. In other words, although the language of science has permeated their epistemic community, BoE officials recognize that achieving their policy goals is not best served by cluttering their speeches with jargon and explicit reference to the scientific literature. This was eventually put forth by the Bank itself in an effort to simplify its communication with the public (Haldane & McMahon, 2018).

In sum, the case of the BoE illustrates that, as organizations with a policy mandate, there are limits to the scientization process both in terms of who to speak to and how to speak to them.

4.4 The Hesitant Path of Scientization

Following Marcussen’s work, the literature depicts the scientization of central banks as being on a steady upward path. We have noted that central banks face tradeoffs in their quest to become genuine contributors to the relevant science. Consequently, we should anticipate that the process of scientization may not always be a forward

progression. Depending on the central banks' response to the fluctuating challenges and advantages inherent in this endeavor, scientization will sometimes experience regression. It is exactly what we find in the recent history of the BoE.

The evolution of scientific publications is arguably the most direct indicator of a central bank's scientific contributions. Scholars have compiled various characteristics such as the creation of working paper series, the number of working papers, the positions in RePEc rankings²⁶ and the foundation of self-funded scientific journals (Marcussen, 2009, p. 379; Mudge & Vauchez, 2016, pp. 157–158). Yet, increasing publications and citations in peer-reviewed journals are probably the surest sign of scientization (Claveau & Dion, 2018).

In 1978, the BoE initiated its first working paper series, the *Bank of England Discussion Papers*, which was renamed *Staff Working Papers* in 1991.²⁷ The initial goal for this series was to facilitate “wider circulation to research” deemed too “exploratory” or “technical” for publication in the *Quarterly Bulletin* (Threadgold, 1978, ii; Bank of England, 1979, p. 26). Until that point, the Bulletin had been the main BoE outlet for economic analysis produced within the Bank. A few years after the *Discussion Papers*, the *Technical Series* was introduced to “give wider circulation to econometric research work predominantly in connection with revising and updating the various Bank models and to invite comment upon it” (Davis, 1982, i).

This early bout of scientization corresponds to a specific momentum for economic research at the Bank. Under the leadership of Chief Economist John Flemming (1984-1991), the Bank developed substantially its research activities. During this period, the Bank considered it important that the economic staff displayed “very serious technical expertise in econometrics” (Interview, staff economist 7). This technical proficiency played a twofold role. Firstly, this ‘technical expertise’ contributed to the development of the Bank’s macroeconomic forecasting model, providing scientific justifications for the Bank to resist political pressures from the Treasury

²⁶Recently, the BOE itself relies on RePEc rankings to assess the success of its research strategy (Bank of England Independent Evaluation Office, 2019, p. 8).

²⁷Publication in the *Staff Working Papers* has been, since the beginning, conditional to passing a peer-review process, with at least one referee external to the Bank, thus mimicking standards for academic journals.

(Goutsmedt et al., 2022, pp. 4–9). Second, for this technical expertise to be deemed “serious,” the Bank decided to showcase it, for instance by supporting the publication costs of a working paper series. During this period, economic research remained relatively separated from policy routines (J. C. Acosta et al., 2023), which seems to have favorably positioned BoE researchers to make scientific contributions (see Figures 5 and 6).²⁸ More specifically, the BoE staff was internationally renowned in the field of econometrics, notably for their contribution to time series analysis and innovative techniques in estimating and simulating forward-looking macroeconomic models (J. C. Acosta et al., 2023).

This first phase of scientization came to an end in the early 1990s, with an especially marked drop for publications in peer-reviewed journals, despite the rise of hired PhDs. This reversal of the trend for scientific output reflects a reorientation of research efforts toward policy analysis. The view that research had to cater to the needs of the policy process was heralded by a few key Bank executives (notably Mervyn King, then Charles Bean). They considered as paramount that the Bank did not attempt to mimic academic publishing practices, which they considered as inappropriate with respect to the Bank’s missions:

[Research] should be embedded. That’s good for the researchers, it pushes them to work on good topics and not on the problems of the self-referential literature. You want researchers to be exposed to the big questions of the policy makers, and you want the materials to do more conceptual stuff to be presented to the MPC. And it’s good for those providing conjunctural analysis as it exposes them to up-to-date academic thinking. (Interview, Charles Bean)²⁹

As a result, publishing in peer-reviewed journals was generally seen as “an optional extra” to policy works, as a then-newly recruited PhD economist recalls:

²⁸Many of these contributions were published in peer-review journals in collaborations with economists from UK universities or other UK institutions (Figure 8).

²⁹Bean also adds: “the Bank did a lot of research, but a different kind of research. We did not produce academic research for the sake of it. If you use public money, you cannot use it for your personal career (like in academia). We value research but there were topics we thought were not appropriate.”

[Research in the 2000s] was more of a combination of ‘we have done some policy analysis, let’s turn that into a paper’. This was the way research was produced mostly. But you could also do research as an optional extra.³⁰ (Interview, staff economist 10)

Although indicators suggest that scientization at the BoE was on the rise again in the early 2000s, the Great Financial Crisis (GFC) of 2007-2009 interrupted the process. In the aftermath of the crisis, reconfiguring policy analysis took precedence over publishing articles in scientific journals. As a former Executive recalls: “Before the crisis, of course there was more time to do research., Then, obviously the urgency of the situation required to stop that.” (Interview, Executive 1)

This trend is in contrast with other central banks, such as the ECB, where scientific publications increased during this period (Figure 6; see also Mudge & Vauchez, 2016). This divergence is probably the result of different organizational structures for research. The ECB devotes an entire administrative unit, with its own full-time staff, to scientific research. At the BoE, no such “research department” existed. As a staff economist during the crisis explains:

The contrast with us [compared to other central banks] was that we should not have a research department, we should be embedded in the policy process. We were not here to have an appropriately funded research department. (Interview, staff economist 11)

At the BoE, the financial crisis did not only reverse the trend for scientific publications (Figure 5), it also impacted speeches. Indeed, we detect that, in the aftermath of the crisis, the BoE leadership had a smaller propensity to cite scientific research and to use scientific jargon in their speeches (see Figures 9 and 13). Since much was in flux in the world of central bankers at the time, many factors might explain this reduction in ‘science speak,’ including the fact that economic science temporarily

³⁰Some significant variations existed across the different Divisions of the Bank, with some having a stronger “tradition” of conducting and publishing scientific research.

became a less reliable ally in the quest for credibility and policy effectiveness (see below for more on that).

To sum up this section, the recent history of the BoE teaches us that the process of scientization sometimes goes in reverse. In particular, depending on external circumstances, the internal organizational structure and the views of the leadership, a central bank can reallocate its resources between policy analysis and scientific research.

4.5 Scientization as a Locus of Controversy

In the literature on the scientization of central banks, Marcussen and other scholars argue that this process insulates organizations from external criticisms: who would dare challenge a scientized organization? Indeed, this “symbolic” (Amara et al., 2004) or “legitimizing” (Weingart, 1999) use of science is a well-worn credibility-enhancing strategy. However, two trends in the recent history of the BoE demonstrates that science can also generate controversies both inside and outside the Bank.

First, when the Bank became independent in 1997, the Monetary Policy Committee became the central body for monetary policymaking. The composition of the MPC includes nine members, four of whom are not BoE employees. A former external MPC member (MPC member 3) emphasized that this structure “makes it possible to have very gifted people in the MPC, who will not otherwise be there.” In particular, he pointed out that external MPC members with a strong academic background did “come in and question how things are done” (see also J. C. Acosta et al., 2023). In other words, the advanced qualifications in economics of some external MPC members (as well as, for some of them, their professional experience in academia), often led them to challenge the knowledge produced by the Bank.

Facing the refusal of Mervyn King to disclose details about BoE modeling and forecasting, external MPC members voiced their concerns publicly in the *Financial Times* (Interview, Executive 3). The BoE did not shy away from the controversy by discarding outside criticism. On the contrary, it fostered internal debates by

equipping its external MPC members with personal staff.³¹ These resources allowed them “to write their speeches and scrutinize internal forecasts” (staff economist 11). While, in the past, there was a strong degree of *bricolage* involved to make the BoE forecasting models work, the MPC scrutiny forced BoE economists to address academic criticisms and provide more explanations about their modeling choices (Goutsmedt et al., 2022).

This insider controversy stoked public controversy as well. After its first year of existence, the MPC was notably criticized in the *Financial Times* for its “paralysis by analysis,” resulting from each member having a different opinion (James, 2020, p. 435). The business community also worried that “the MPC could have been damagingly dominated by central bankers and academic economists” and highlighted the importance of other profiles more connected to financial markets and the private sector, such as DeAnne Julius (James, 2020, p. 437).³²

Second, the 2007-2009 Great Financial Crisis and the main BoE policy to answer it (Quantitative Easing; QE) intensified insider controversy and public scrutiny over the role of science at the Bank. In fact, interviewees recalled that the strong institutional separation between the production of expertise on financial markets and monetary policy precluded the Bank from acting on early signs of financial instability (Interview, staff economist 11 and executive 3). An internal reorganization followed whereby both expertises would be combined to feed the policymaking process.

The implementation of QE also fuelled controversies about the use of specific macroeconomic models within the Bank. For example, standard new Keynesian DSGE models were deemed ineffective for formulating policies addressing financial dynamics. The implementation of QE necessitated a return to the utilization of “simpler and older economic literature, back at least to Tobin and Brainard in the 1960s and 1970s” (Interview, staff economist 11; see also J. C. Acosta et al. (2023)). A “QE

³¹See “Bank to meet demand of the MPC outsiders”, *The Financial Times*, 24 November 1999; “MPs berate Bank over handling of research row”, *The Financial Times*, 10 December 1999. See also James (2020), 438.

³²When arriving at the MPC, Julius had held positions at British Airways or the Royal Dutch Shell Group. Worries were also raised about more academic profiles like Willem Buiter, targeted as “a Dutchman with extensive experience in academia but little exposure to the world of commerce and industry” (437).

team” of inhouse researchers was set up to propose policy options, but the papers they wrote never made it to the MPC’s deliberation. Instead, the QE plan was decided in about three days by a small group of top executives (Interview, Executive 3). In this episode, up-to-date science was judged to be either irrelevant (DSGE models) or too immature to be an input to policy making around QE (the research of the QE team).

More recently, the unstable science of QE came back to hunt the BoE. In early 2021, the Economic Affairs Committee of the UK parliament—which notably included Mervyn King, who was governor of the BoE when QE was first implemented—held hearings with experts to gather evidence about the theoretical mechanisms underlying QE (Committee, 2021). The experts interviewed come from the different audiences to which the BoE answers: academic researchers (e.g., Daniela Gabor, Charles Goodhart, Kenneth Rogoff), former and current central bankers (e.g., Otmar Issing, Peter Praet), consultants from financial market participants (e.g. Blackrock, City UK), financial journalists and NGOs, as well as former MPC and Treasury members (e.g., Edward Balls, Paul Tucker, Adam Posen). The interviews and the final report of the committee zoomed in on the theoretical justifications for implementing QE and academic debates on its effectiveness.

By doing so, the Parliament critically examined the economic knowledge produced by the BoE. It explicitly challenged potential bias in BoE research, emphasizing that “central banks take a more positive view of quantitative easing than independent analysts” (19). The report, likewise, noted considerable “knowledge gaps” concerning QE. It pointed out that the Bank’s “understanding of quantitative easing’s effects and its transmission mechanisms are far from complete more than a decade on from the policy’s introduction” (20). It recommended prioritizing research on the effectiveness of its transmission mechanisms and its macroeconomic effects. Moreover, the committee stated that “the Bank has not adequately engaged with debate about the tradeoffs created by sustained quantitative easing.” To ensure the existence of a counter expertise, it invited the Treasury “to reply to any research that the Bank produces on the distributional effects of quantitative easing” (24).

In sum, although the BoE is more scientized today than in the early 1980s, this process has not neutralized debates on the production of economic knowledge and on monetary policymaking, both inside and outside the Bank. In fact, now that the BoE is not only using science, but also contributing to it, its scientific credentials and conclusions are fertile grounds for controversy.

5 Conclusion

This article makes two contributions to the literature on the place of science in central banks. First, our conceptual contribution is to trim back the concept of “scientization” and to construct an ideal type of the “scientized central bank” to which the evolution of concrete central banks can be compared. The core of our concept of ‘scientization’ Marcussen (2011) is that scientization is about becoming a contributor to science, which is different from being a user of science. The scientized central bank has the resources, internal organization and network to be a contributor to science, and it indeed outputs scientific contributions and communications imbued with science.

Our second contribution is empirical. It consists in a comparison of the ideal type of a scientized central bank with the evolution of the Bank of England. This comparison demonstrates that scientization is not descending on central banks as an ineluctable change of nature. It is rather a strategy, seized knowingly by central bank actors. The strategy is always adapted in light of other imperatives such as maintaining the credibility of the organization and delivering on its mandate in tumultuous circumstances. Becoming a stronger contributor to science is definitely not a foolproof strategy: more scientization can get in the way of maintaining the credibility of a central bank and can be perceived as diverting resources away from more pressing policy work.

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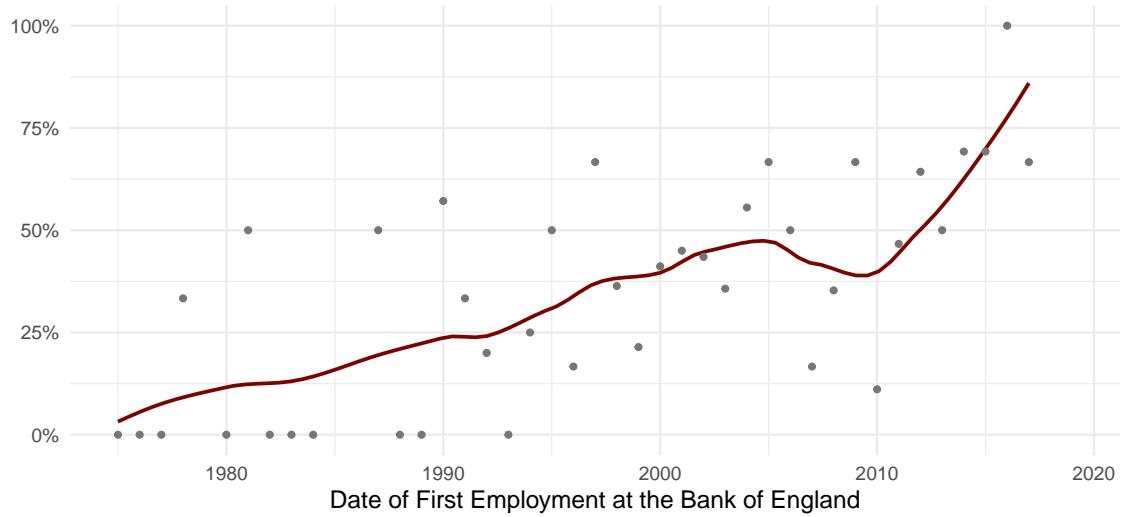
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A Appendix - Figures and Tables

A.1 Figures

Figure 1: Share of PhD hired



Points are the share of individuals with a PhD hired each year. The curve is fitted using a polynomial regression with $\alpha=0.4$

Figure 2: Location of Last Degree before Arriving at the Bank of England



Figure 3: Last Employment when Arriving at the Bank of England

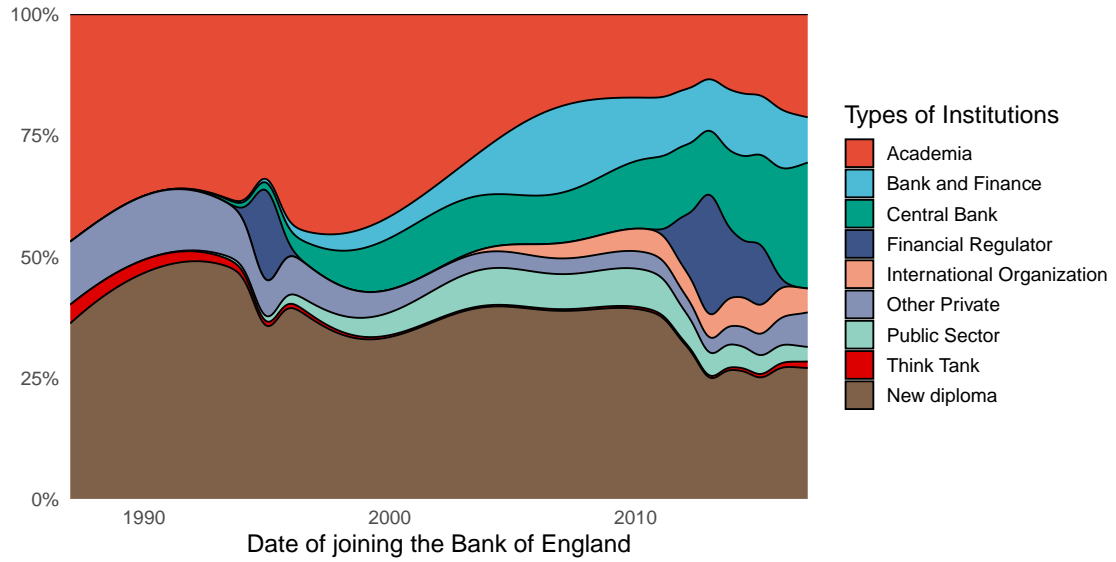


Figure 4: Next Employment after Leaving the Bank of England

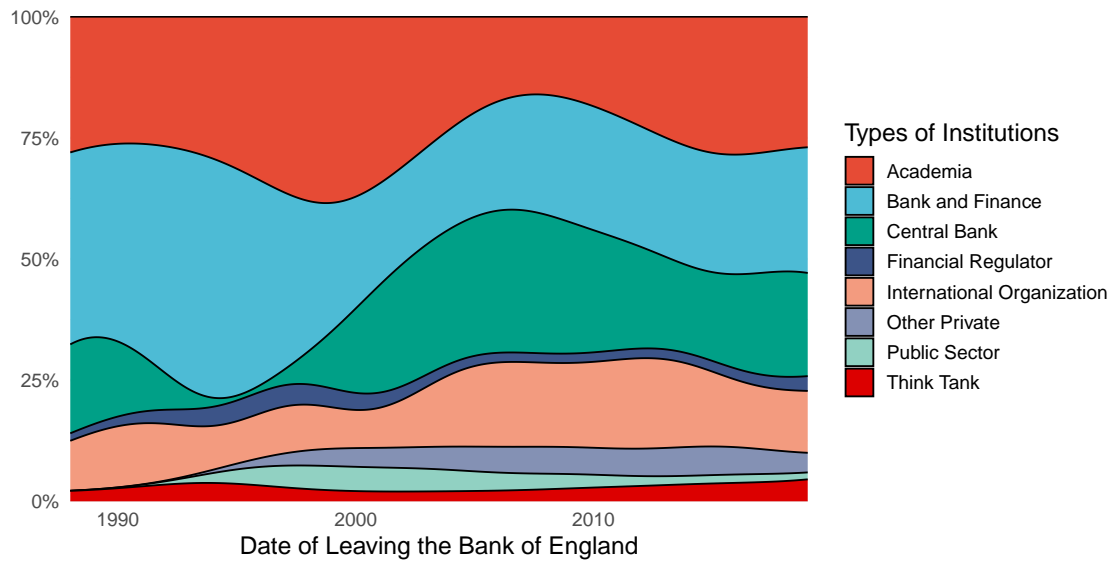


Figure 5: Publications by the Bank

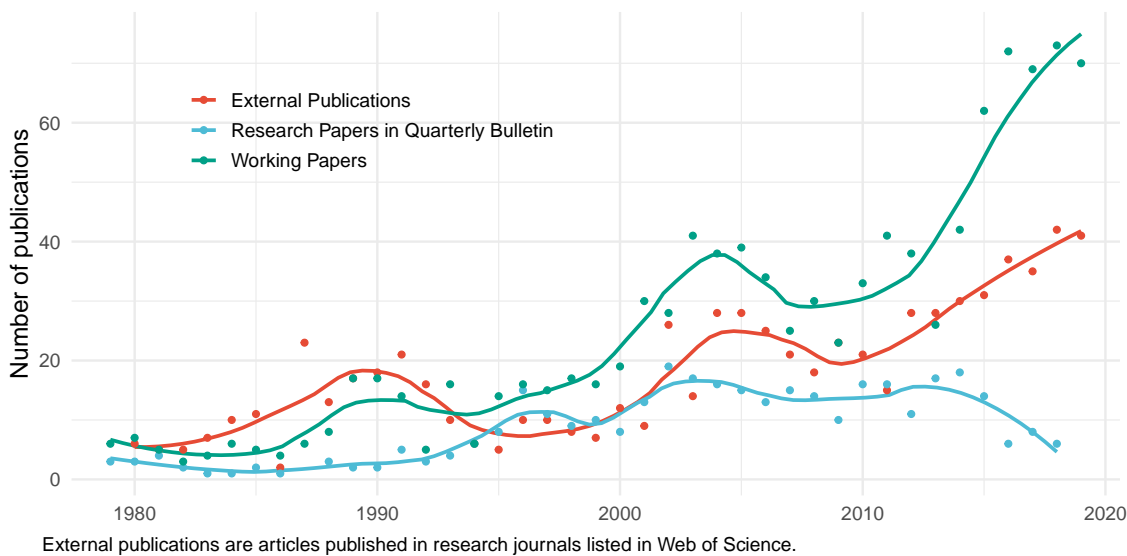


Figure 6: Repartition of Central Banks' Research Journals Publications

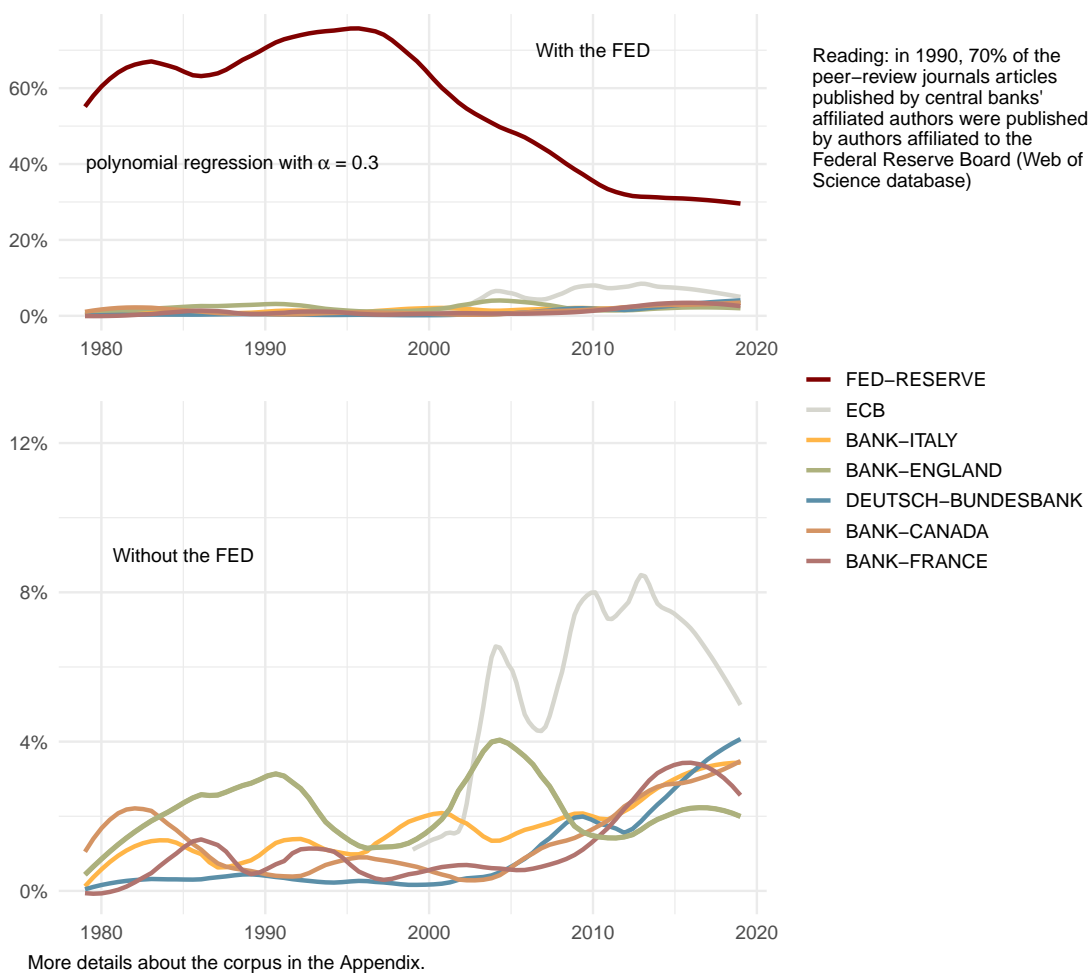


Figure 7: Repartition of Central Banks' Publication in Economics Top 5 Journals

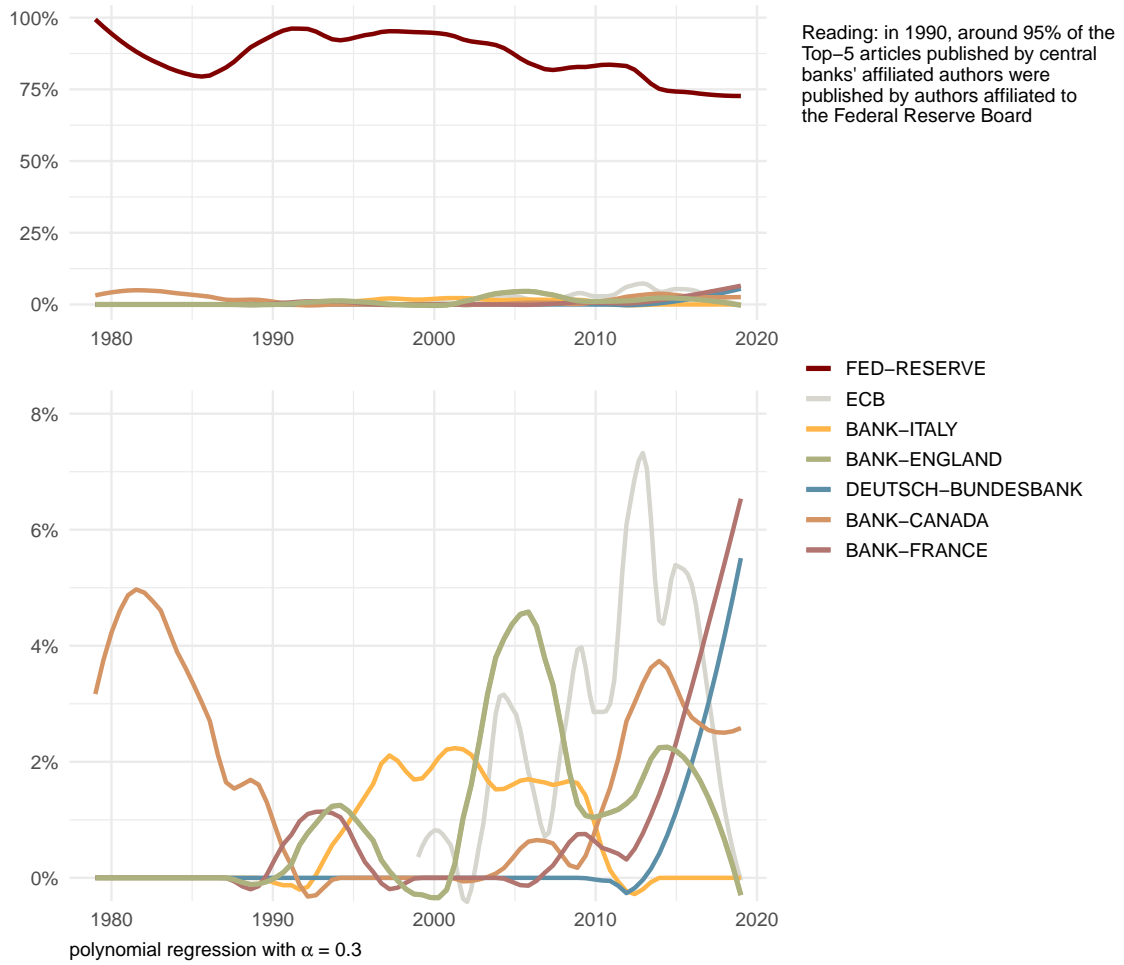


Figure 8: Types of Collaborations for all Research Articles Published by BoE Authors

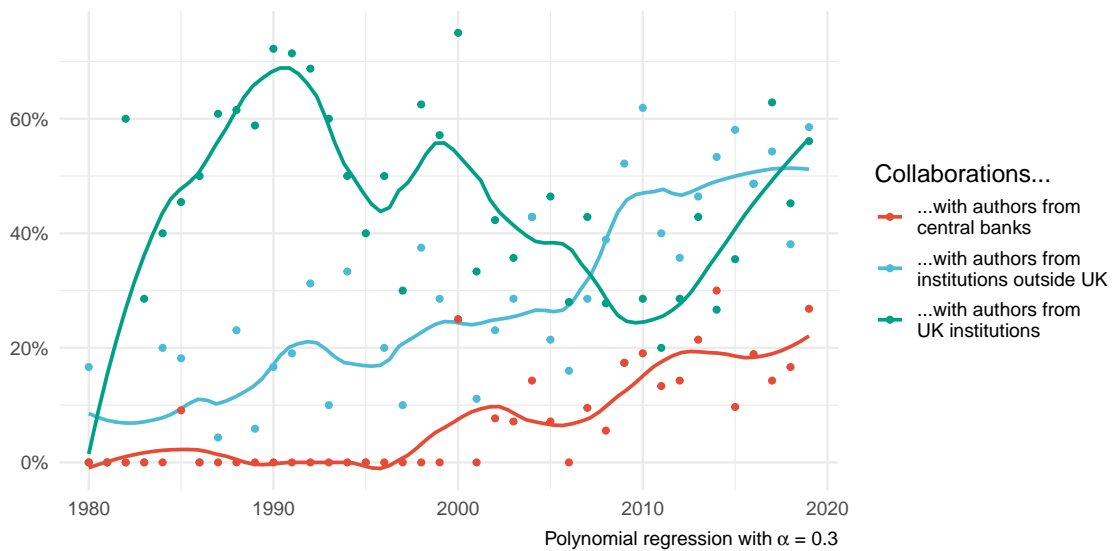


Figure 9: Proportion of BoE Speeches with References to Research Publications

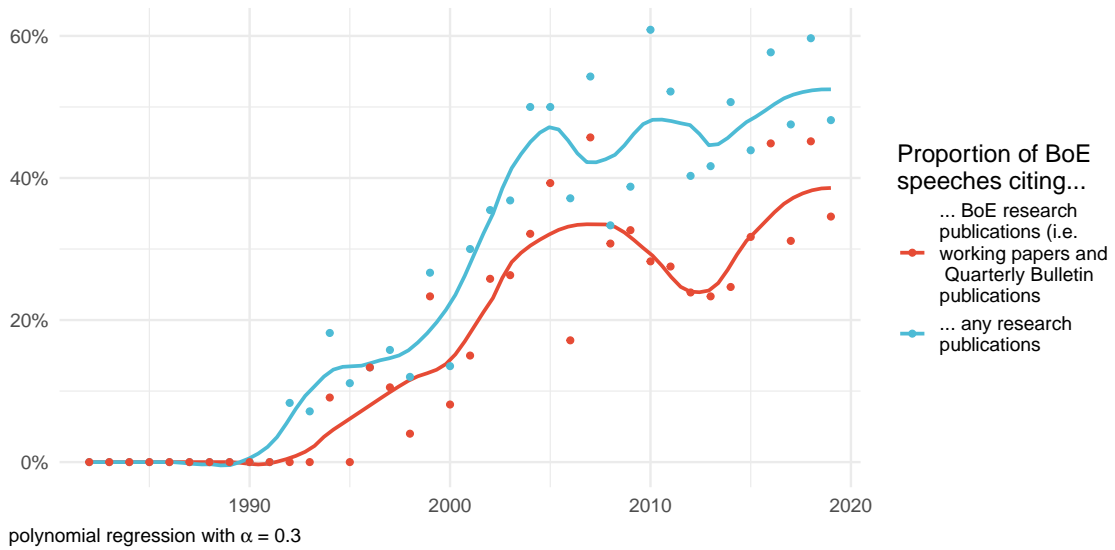


Figure 10: Number of BoE Speeches, by Speaker and by Audience

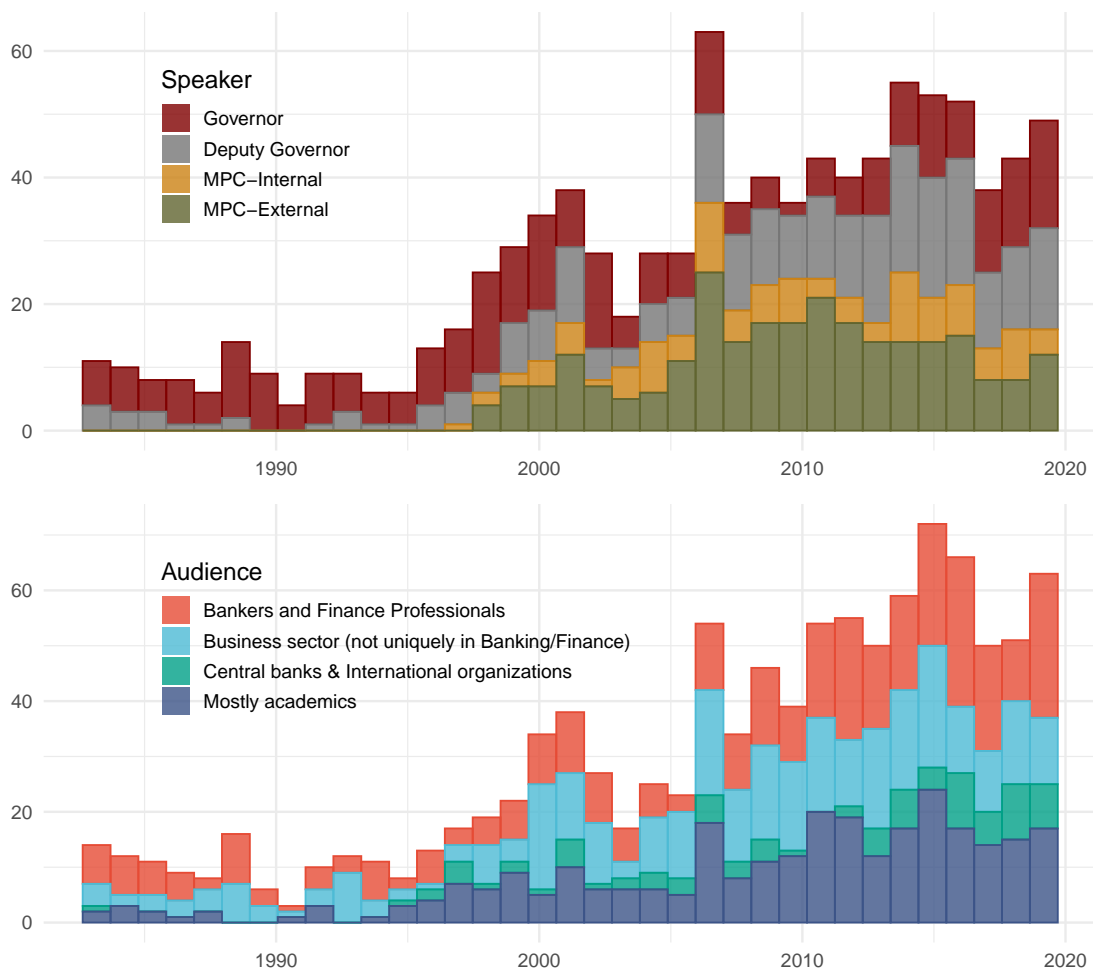


Figure 11: Proportion of BoE Speeches Citing References, by Speaker

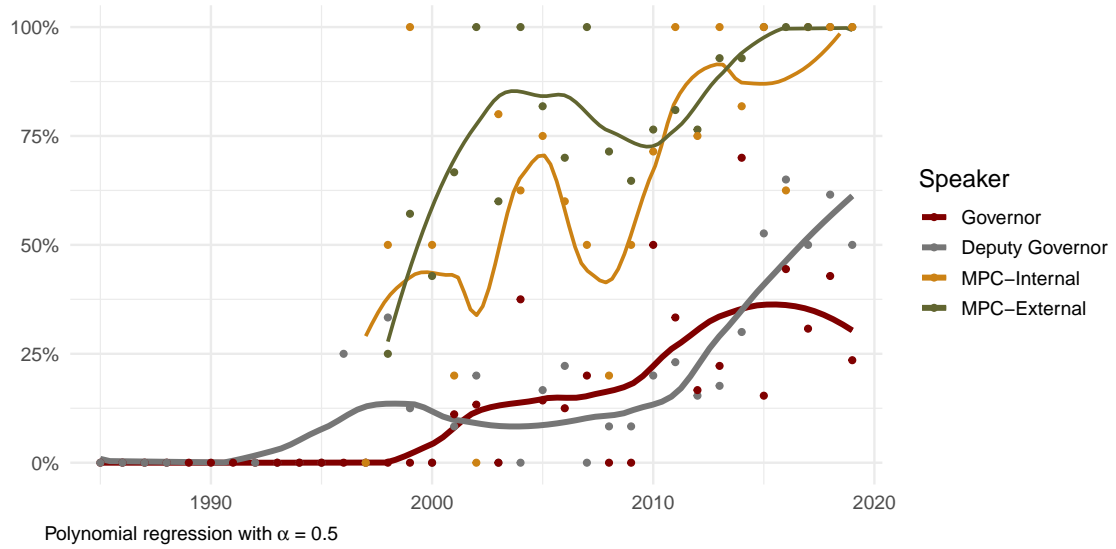


Figure 12: Proportion of BoE Speeches Citing References, by Audience

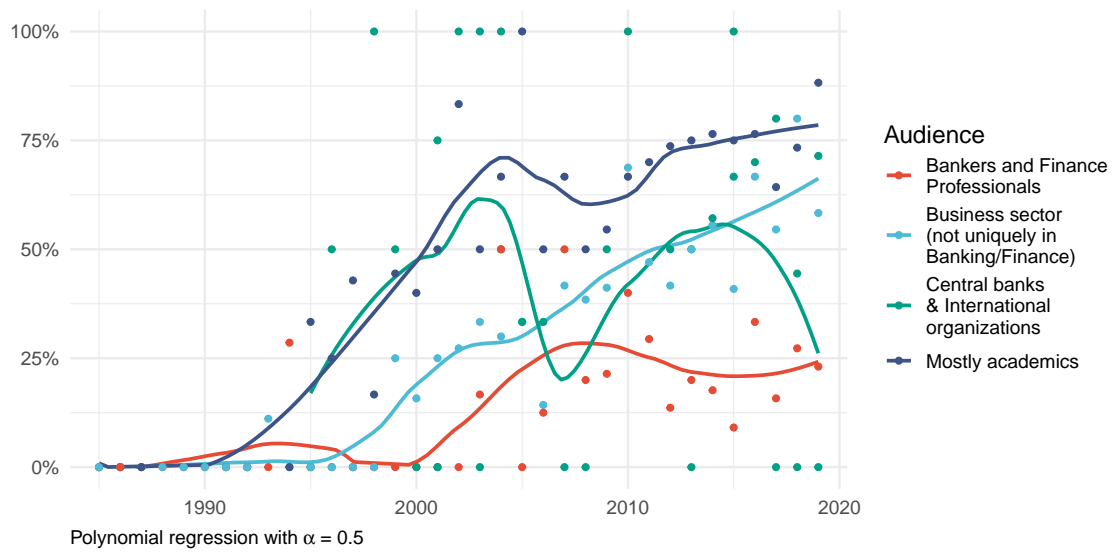


Figure 13: Evolution of Language Indexes in BoE Speeches

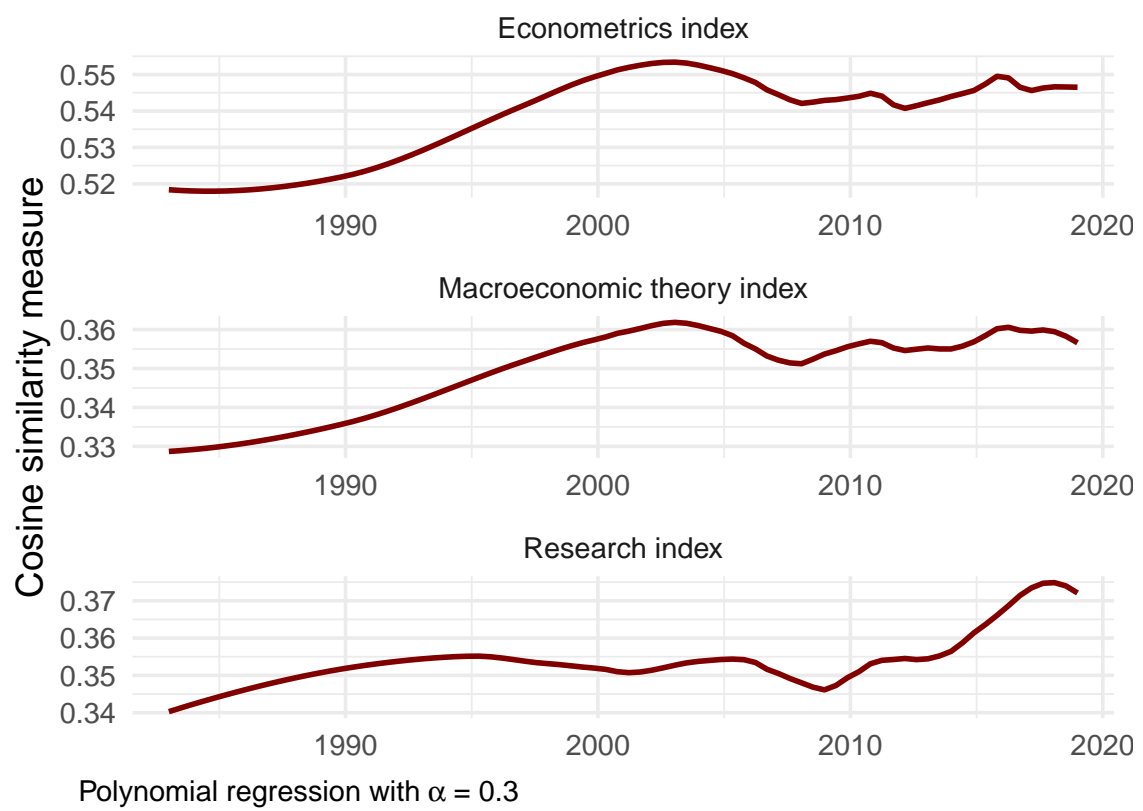


Figure 14: Evolution of Language Indexes in BoE Speeches, by Speaker

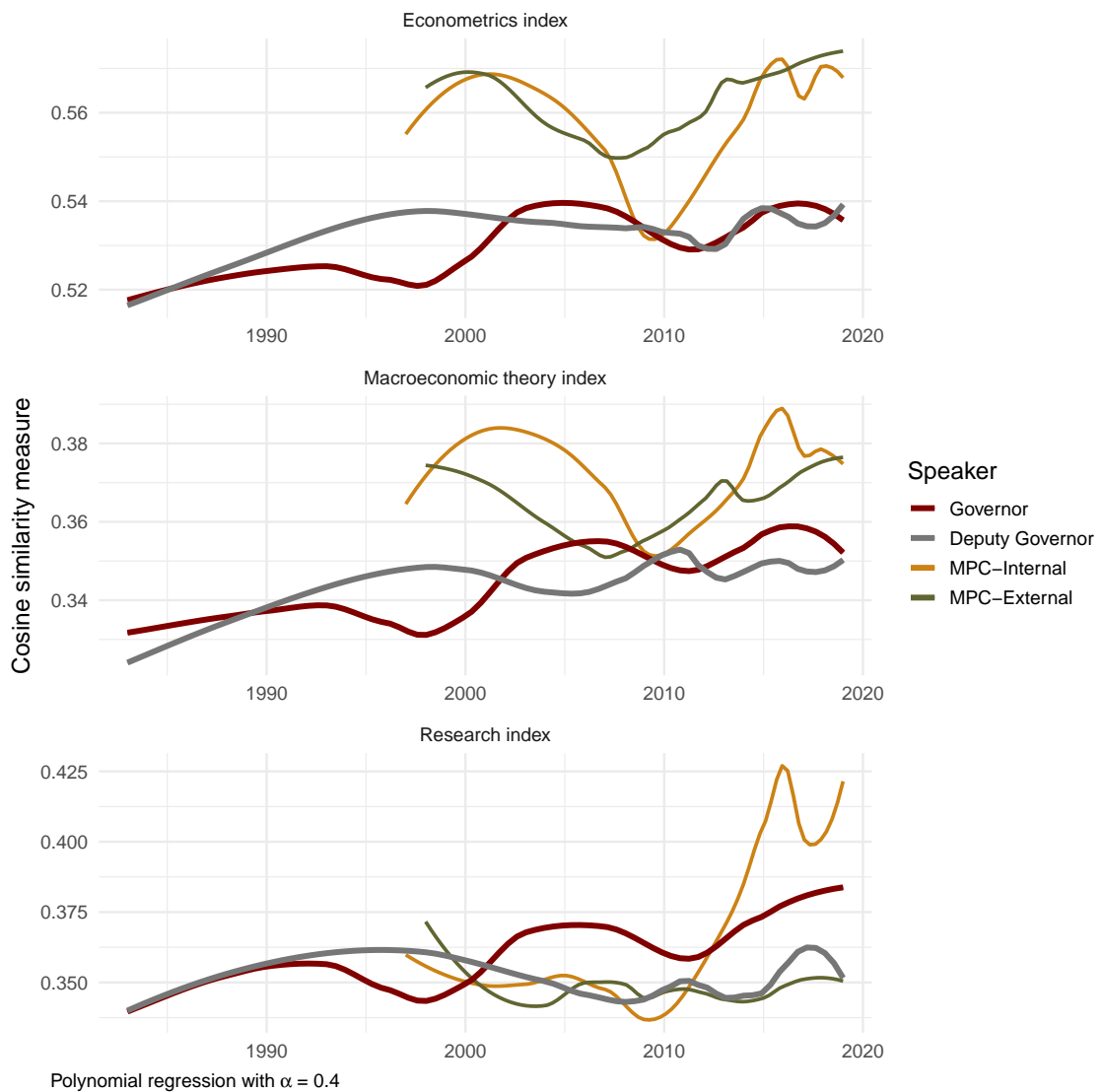
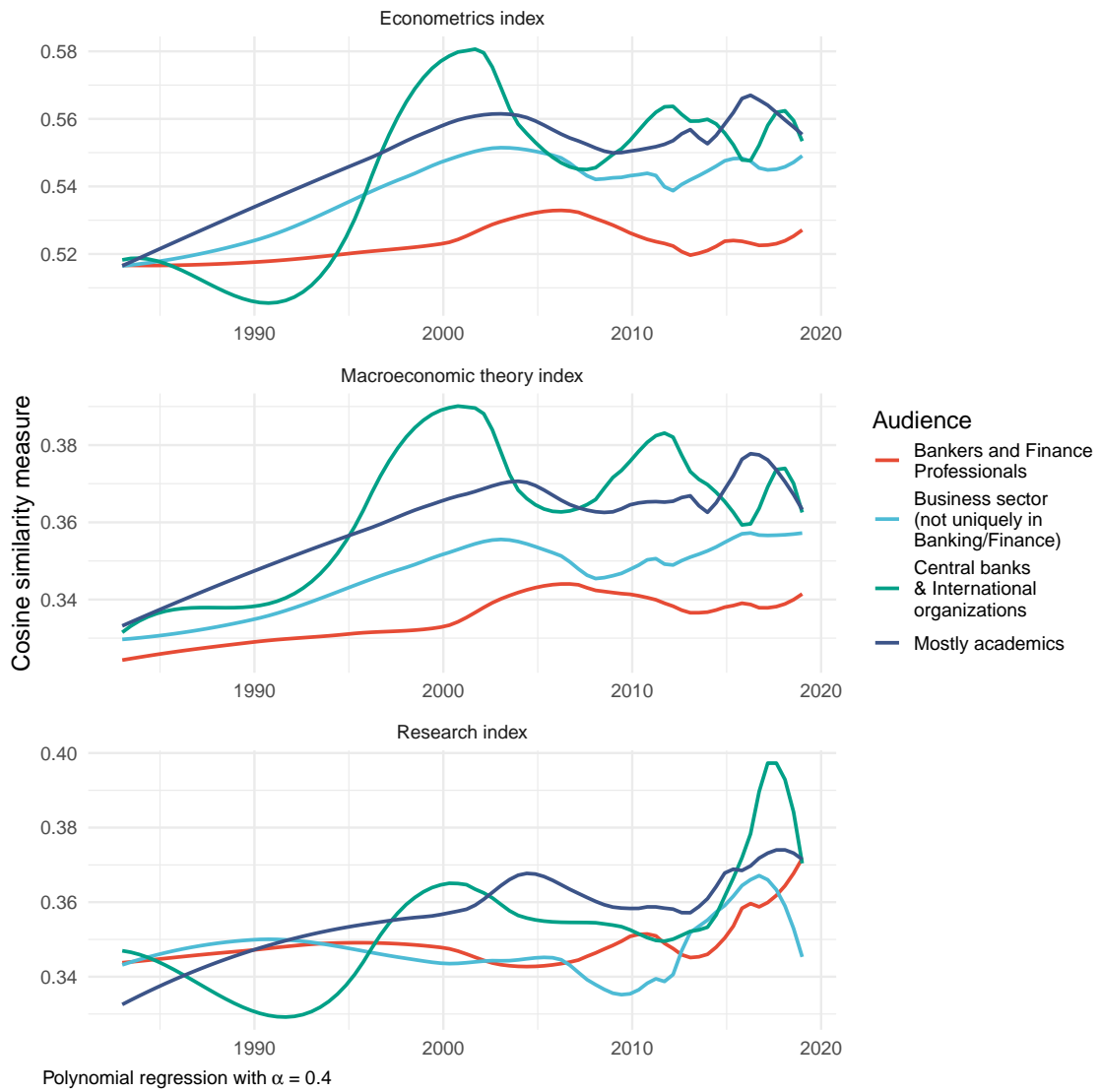


Figure 15: Evolution of Language Indexes in BoE Speeches, by Audience



A.2 Tables

Table 1: Ratio of individuals with a PhD diploma in leadership positions at the Bank of England

Period	Ratio of PhDs
1940-1969	1/8
1970s	0/6
1980s	3/13
1990s	9/14
2000s	6/12
2010s	5/9

Table 2: Ex Ante Positions of external MPC members (1997-2019)

Type of Position	Number of Individuals
Academic	10
Finance Companies	6
Other Private Sector	5
UK Public	3
International Organization	2
Central Banks	1
Public Sector Abroad	1

Note:

Individuals may have occupied different types of position before joining the Bank. In this case, we count every types of position as 1. Thus, the sum of the positions is superior to the number of individuals in this period in our database.

Table 3: Ex Ante Leadership Positions

Type of Position	1970s	1980s	1990s	2000s	2010s
Academic	3	1	6	7	2
Central Banks	0	0	0	1	1
Finance Companies	2	1	3	2	5
Financial Regulator	0	0	1	1	0
International Organization	2	0	1	0	2
Other Private Sector	1	0	3	4	1
Public Sector Abroad	0	0	1	0	2
UK Public	4	0	1	3	2
UK Public Sector	1	0	0	0	0

Table 4: Summary of the Lexical Fields

Lexical Fields	Vocabulary searched (using Regular Expressions)
Research index	research.+; ^academi.+; ^scholar*; ^science*
Macroeconomic theory index	rational-expectations; dsge; general_equilibrium; microfoundations; new-keynesian; natural_rate; euler; intertemporal; optimization
Econometrics index	econometric; estimation; output_gap; lagged; regression; time-series

B Appendix - Databases and Methods

First, we present the three databases we use in the paper. Second, we detail the different methods used in the paper.

B.1 Presentation of the databases

B.1.1 Documents of the Bank of England

The first database includes information on 4545 documents published by the Bank of England (BoE) that we have scraped from its website, with typical information such as `date`, `authors`, `title`, but also with the plain text, and, when available, an extraction of the list of references.

Among these documents, we have isolated what we consider to be *research* documents (n= 1415). The earliest was published on 01 March 1972 and the latest on 14 February 2020. Here is the breakdown of the research documents by category:

- **discussion-paper(pre-1992)** and **discussion-paper-tech_series(pre-1992)**: the working papers published between 1979 and 1992 (n= 103);
- **working-paper**: the main set of research articles, published since 1993 (n= 856);
- **financial-stability-paper**: a specific set of research papers which deals with financial stability, and which is mainly written by the economists of the Financial Stability Directorate (n= 44);
- **external-mpc-discussion-paper**: standard research papers, but requested by external members of the Monetary Policy Committee (n= 51);
- **research-paper-in-quarterly-bulletin**: articles published in the BoE quarterly bulletin as `research` document, and that are not duplicates of other items in our database (n= 352);
- **houblon-norman-paper-in-quarterly-bulletin**: A few invited research articles (n= 9).

The database also includes speeches published by the BoE (earliest 01 March 1972; latest 10 March 2020):

- **speech**: the main set of speeches (n= 1082);
- **speech-in-quarterly-bulletin**: Speeches published in the quarterly bulletin. These speeches are not duplicates of other items in our database (n= 229).

1385 of the other 1819 documents are other items in the Quarterly Bulletin.

B.1.1.1 Classification of speeches We have identified the “audience” of the 1311 speeches published by the Bank of England. The type of audience was decided by looking at the details mentioned in the speeches about the location of the speech, and the organization behind the enunciation of this speech. For instance, such information may look like: “Speech given at Financial Forum, Bruges”. We established a list of 11 different categories of audience: “Business sector (not uniquely in Banking/Finance); Bankers and Finance people; Mostly academics; Politicians; Central bankers; Think tank; Civil Society / Activist; Other public servants; International Organisation; Trade union; Business people (not in Finance)”.

Two human coders took a sample of 100 speeches to decide, independently, to which type of audience the speeches were addressed. Then, we explore the disagreements between the two coders to refine the typology and the criteria to attribute a type of audience to a speech. We reproduce the same process on another sample. Once the method to attribute an audience was more robust, another human coder attributed the audience to the remaining speeches.

In the article, we mix the “Central bankers” and “International Organisation” categories, and we focus on this merged category as well as on “Business sector”, “Bankers and Finance people”, and “Mostly academics”. These four categories are the most represented in the audience for BoE speeches.

B.1.1.2 Identification of references Using the raw text of speeches, we automatically detect bibliography or references in footnotes. We then clean these bits

of text to separate the references. Finally, we identify which references are documents published by the Bank of England, i.e. which documents are part of our BoE database. These documents are most of the time working papers or articles published in the *Bank of England Quarterly Bulletin*.

B.1.2 Prosopographic database

The second database contains prosopographic information about BoE economists. In other words, it is a collective biography aiming at uncovering shared characteristics across individuals. Data came from a systematic search in published information about the selected individuals. We have included in the database all the individuals who meet at least one of the two following criteria:

- Having (co-)authored at least 3 Bank of England research documents (publications in external journals are not counted; see above for the categories of internal research documents);
- Having published at least 1 “discussion paper” between 1979 and 1992. As the Bank counted fewer publications and economists in the 1980s, this was needed to have a larger sample of 1980s BoE economists.

Using these criteria in early 2020 gave us a selection of 368 individuals.³³ The information collected on them include:

- Academic training: the degrees obtained by the individuals, and the place where these degrees were obtained.
- BoE career: the dates of entering and leaving the Bank, the different units (Directorates, Divisions, etc.) the individuals were affiliated to within the BoE, and the period of affiliation to these units.

³³As we have collected the data in early 2020, we have too few individuals that enter the bank in 2018 or 2019. Consequently, we were forced to stop...

B.1.3 Web of Science database

In the article, we also use the Web of Science (WoS) database. We collect bibliometric data on the articles published by authors affiliated to central banks. To do this, we use the WoS data about institutions and email addresses to identify central banks. We extracted 23571 central banks articles from WoS. It allows us to observe the number of research publications of the BoE over time and to compare it with the one of other central banks. It also enables us to observe the evolution of coauthorship patterns of BoE-affiliated authors.

When counting the number of publications by various central banks, we take into account the fact that some article may be co-authored by authors affiliated to different central banks. In the case in which an article has been written by authors from the Bank of England *and* from the ECB, this article will count as 0.5 for the Bank of England and for the ECB. It will be 0.5 even if this article was written by three people from the Bank of England, and only one from the ECB.³⁴

B.2 Details on Word Embeddings

B.2.1 Word Embeddings and Word2vec

Word embeddings are a fundamental concept in the field of natural language processing. It serves as a bridge between the nuances of human language and the computational world of machines. The basic idea is to encode words as numerical vectors. It relies on the idea that words with similar meanings or usages should be represented closely in a numerical space. Thus, words that frequently appear in similar contexts would have similar embeddings. You can then compare words by comparing their respective vectors of numerical values.

Word embeddings are acquired through training on large volumes of text data. The

³⁴In WoS, the affiliations are not per author, but instead per institutional departments per paper. For example, in the case of an article with two authors from the same institution, the institution is listed only once. Consequently, we are not able to know how many authors were from each central bank; we just know that *some* authors were affiliated to one central bank, and some others were affiliated to another central bank.

process involves transforming words into high-dimensional vectors in a continuous vector space, where the proximity of vectors reflects semantic and syntactic similarities between words. Learning word embeddings can be accomplished using various models: the Word2Vec approach is the most influential and widely used approaches. The word2vec model has been developed by Mikolov et al. (2013). It relies on the “Skip-gram” approach: this approach takes a target word and aims to predict the context words within a specified window. The training process in Word2Vec involves adjusting word vectors iteratively to improve their ability to predict context words. This is done through neural networks, where the weights of the network represent the word vectors.

Such model is generally trained on a large text corpus. The text data is tokenized into words and cleaned to remove punctuation and lowercasing. Stop words (common words like “the,” “and,” “is”) may also be removed. For each word in the training corpus, a context-target pair is formed, where the target is the word itself, and the context consists of the surrounding words within a specified window. The neural network is trained using these context-target pairs. During training, the word vectors are updated to minimize the difference between the predicted context and the actual context. As training progresses, word vectors become optimized to represent words in a way that captures their semantic and syntactic relationships. The result of Word2Vec training is a set of word embeddings, where each word is represented as a high-dimensional vector in the embedding space.

B.2.2 Zahner and Baumgartner’s (2022) Approach

Zahner & Baumgartner (2022) applies a variant of Word2Vec, Doc2Vec (Le & Mikolov, 2014). Doc2Vec generates document-level embeddings in addition to word embeddings. The model was applied to a corpus containing approximately 23000 speeches from 130 central banks, to build embeddings of 300 dimensions. This approach allowed them to obtain a language model better suited for analyzing central bank communications than more general models constructed using larger text sources, like Wikipedia.

Given that our paper focuses on central bankers’ communication, such a model proves highly appropriate.

B.2.3 Measuring similarity

We vectorize the words and bigrams of our corpus of BoE speeches by using the word embeddings of Zahner & Baumgartner (2022).

The first step is to obtain embeddings for the paragraphs of BoE speeches. Initially, we calculate the Term-Frequency/Inverse-Document-Frequency (TF-IDF) values for the words and bigrams used in BoE speeches, the document level being the paragraphs of the speeches. For each paragraph, we multiply the TF-IDF values of each word and bigram with their corresponding embeddings. Subsequently, we compute the average of all the vectors of the words and bigrams in the paragraph, resulting in a single vector of 300 dimensions for each paragraph. The use of the TF-IDF allows us to assign a weight to word and bigram embeddings when computing the paragraph-level average: in other words, it ensures that embeddings of the most frequent and characteristic words have a greater influence on the paragraph representation. It should also be noted that we tried to remove the “bibliography” paragraphs, as they do not truly reflect the actual language of the speaker; rather, they primarily indicate the fact of citing scientific references, which we are already measuring through a separate method.

In a second step, we did the same (without the TF-IDF step) for the different lexical fields we have chosen (see Table 4). Each lexical field can thus be represented by a vector of 300 dimensions.

As a third step, we measure the proximity between the vectors of our lexical fields and the vectors of the paragraphs by using the cosine measure:

$$\text{Cosine Similarity} = \frac{\mathbf{A} \cdot \mathbf{B}}{\|\mathbf{A}\| \|\mathbf{B}\|}$$

A and B being two vectors, and $\|\mathbf{A}\|$ being the magnitude of vector A.

In a last step, we regressed the similarity measures between our lexical fields and

paragraphs on speeches’ year? In other words, we take the average of similarity values for each paragraph at the different dates of speech publication, and we want to create a smooth curve that represents the overall trend of the lexical field over time. We are using an estimation method called “loess” to create a smooth curve that connects those average values. The loess method works by fitting a series of local polynomial regression models to the data, with each model centered on a particular point along the x-axis (in this case, the dates). The resulting curve is a smoothed representation of the data that helps to highlight the overall trend while minimizing the impact of random fluctuations or outliers.

The following table shows an extract of the six paragraphs that have the highest cosine measure with each lexical field.

Table 5: Most representative paragraphs for each index

Lexical Fields	Paragraphs with highest cosine measure
Econometrics index	We also experimented with the Hodrick-Prescott filter. Although the choice of an appropriate smoothing parameter is not straightforward a priori, this approach produced broadly similar results to the band-pass filter. See e.g. Harvey and Jaeger (1993) and Canova (1998) for discussions. 15 In what follows, we use Christiano and Fitzgerald’s (2003) optimal finite sample approximation to the band pass filter. An alternative to Christiano and Fitzgerald’s procedure is provided by Baxter and K...
Econometrics index	Unobservable component derived from an estimated Taylor rule equation that allows for serial correlation in the residual (to capture general misspecification and unobserved variables). Equity risk premia implied by dividend discount model for FTSE 100. 11 Predicted series based on estimation results for forward-looking Taylor rule where policy responds to ex-ante forecasts for inflation and output growth at the two-year horizon. pressures and producer output prices ¹² Percentage change on...
Econometrics index	(e.g. Clarida, Gali and Gertler, 2000; and Lubik and Schorfheide, 2004). However, 16 those studies which assign a large role to good luck often suffer from a significant shortcoming in that the demand and supply shocks hitting the economy are typically identified with the residuals in econometric equations. That ignores the fact that better monetary policy may itself affect the impact of the true – but in these exercises unobservable – shocks, thus leading to smaller residuals in the est...

Table 5: Most representative paragraphs for each index (*continued*)

Lexical Fields	Paragraphs with highest cosine measure
Econometrics index	Existing models, empirical and theoretical, often make strong assumptions about agent behaviour. Theoretical models are based on axiomatic assumptions. Empirical models are based on historical Rotemberg (1984), for example, discusses the statistical rejection of rational expectations models for consumption and labour demand. 50 Tuckett and Nyman (2017), Shiller (2017) and Nyman et al (2018). 51 All speeches are available online at www.bankofengland.co.uk/speeches behaviours. These re...
Econometrics index	The synthetic control for UK GDP is calculated as $X_1 - X_0 W^{-1}$, and the causal effect of the Brexit vote on UK GDP is given by $Y_1 - Y_1^{-}$. Comparison with OLS regression A natural alternative of the synthetic control methodology is a simple OLS regression of UK GDP on the control pool, defining the fitted values as the counterfactual. The key difference between the synthetic control and regression methodology is that the synthetic control is a constrained minimisation with non-negative coe...
Econometrics index	Cointegration: for most of the variables, the null of a unit root cannot be rejected (except for the shock variables). To test for cointegration, we use the Maddala – Wu (1996) test. Under this test, using Dickey-Fuller tests for individual countries, the null of no cointegration is rejected ($-2(40) = 139.2$). This test relies on no cross-country correlation. Our use of time dummies should capture much of the residual cross-correlation in the data. When interactions are included, the var...
Macroeconomic theory index	Indeed, Svensson and Woodford have argued that optimal monetary policy can be implemented through a regime of flexible inflation targets (Svensson, 2003a; and Svensson and Woodford, 2005). Contemporary discussion of macroeconomic policy issues is dominated by the New Keynesian/New Classical Synthesis approach that recasts traditional Keynesian macroeconomic thinking in a setting with explicit microfoundations. On the demand side, consumers are intertemporal optimisers, follow the 11 life...
Macroeconomic theory index	Clarida, Richard, Jordi Gali, and Mark Gertler (1999). “The Science of Monetary Policy: A New Keynesian Perspective.” <i>Journal of Economic Literature</i> , 37,1661–1707. Committee on the Global Financial System (2010). “Macroprudential Instruments and Frameworks: A Stocktaking of the Issues and Experiences”, http://www.bis.org/publ/cgfs38.pdf . Eggertsson, Gauti B., and Michael Woodford (2003). “The Zero Bound on Interest Rates and Optimal Monetary Policy”, <i>Brookings Papers on Economic Activity</i> ,...

Table 5: Most representative paragraphs for each index (*continued*)

Lexical Fields	Paragraphs with highest cosine measure
Macroeconomic theory index	<p>See e.g. Christiano, Motto and Rostagno (2008); Curdia and Woodford (2009); Gerali, Neri, Sessa and Signoretti (2008); Goodfriend and McCallum (2007), as well as the earlier work on the broad credit channel discussed in Bernanke, Gertler and Gilchrist (1999). There is also the strand of work stemming from Kiyotaki and Moore (1997). 13 Other recent contributions on the bank capital channel include Aikman and Paustian (2006); Chen (2001); Meh and Moran (2004); Van der Heuvel (2008). 14 Rece...</p>
Macroeconomic theory index	<p>This line of thinking moved effortlessly from economics to finance. Harry Markowitz was a member of the Cowles Commission. In 1952, he wrote a paper which laid the foundations for modern portfolio theory (Markowitz (1952)). In line with his Cowles contemporaries, Markowitz assumed financial returns could be characterised by mean and variance alone – conveniently consistent with normality. That assumption was crucial, for from it followed Markowitz’s mean-variance optimal portfolio rule. A...</p>
Macroeconomic theory index	<p>That should come as no surprise because this equation was itself drawn from theoretical physics. In seeking a solution to their option-pricing problem, Fisher Black, Myron Scholes and Robert Merton drew an explicit link between their contingent-claims pricing problem and the heat transfer equation in physics (Churchill (1963)). If not quite a lift and shift from theoretical physics, the Black-Scholes formula was certainly a genetic mutation. Moving from finance to economics, the dominant ...</p>
Macroeconomic theory index	<p>We also experimented with the Hodrick-Prescott filter. Although the choice of an appropriate smoothing parameter is not straightforward a priori, this approach produced broadly similar results to the band-pass filter. See e.g. Harvey and Jaeger (1993) and Canova (1998) for discussions. 15 In what follows, we use Christiano and Fitzgerald’s (2003) optimal finite sample approximation to the band pass filter. An alternative to Christiano and Fitzgerald’s procedure is provided by Baxter and K...</p>
Research index	<p>years. Roger Farmer and Lawrence Summers – amongst others – have made this point and some of the ideas in Robert Hall’s recent Jackson Hole paper chime with it. Costas Azarides provides a concise overview in the New Palgrave Dictionary of Economics, Second Edition, 2008. For a discussion from a game-theoretic angle, see Russell Cooper (1999), “Coordination games: Complementarities and Macroeconomics”, Cambridge University Press. 5 Much of this literature formalises ideas that are in chapt...</p>

Table 5: Most representative paragraphs for each index (*continued*)

Lexical Fields	Paragraphs with highest cosine measure
Research index	<p>‘To many straight-laced people the [use of the title] “Professor” was bordering on the dubious. It is an offense to use a degree to which you are not entitled, and while professorship is as often as not an honorary designation, being legitimately adopted by unqualified singing masters, boxing instructors and the more elegant vendors of pills in market-places, the unearned professorship of Mr Montagu Norman was, I have the strongest reasons for divulging, frowned upon in the best Universit...</p>
Research index	<p>As a student alumnus of Warwick University myself (MA, 1983; PhD, 1990), and for 10 years a member of staff there, I am delighted to have been invited to address you this evening. The University of Warwick remains one of the top universities in Europe for studying and researching economics (among other subjects) – and has been one of the Bank of England’s top five recruiting universities in each of the past five years. Indeed, two of my fellow directors at the Bank – Spencer Dale and Andre...</p>
Research index	<p>All speeches are available online at www.bankofengland.co.uk/speeches I am honoured to be here at the University of Melbourne to deliver this year’s Finch Lecture. Colin David Finch built his brilliant academic and professional career on nurturing international co-operation on economic and financial matters: in his studies here at the University of Melbourne and at the London School of Economics; in his long and distinguished time at the International Monetary Fund; and, in later life, a...</p>
Research index	<p>All speeches are available online at www.bankofengland.co.uk/publications/Pages/speeches/default.aspx It is a great honour to give this Cairncross Lecture in Wren’s exquisite Sheldonian Theatre. Sir Alec Cairncross was a celebrated economist whose career bestrode public service and academia. Born to a Lanarkshire ironmonger in 1911, he rose, via Glasgow University and Cambridge, to serve as the first head of the Government Economic Service and later, much more illustriously of course, a...</p>
Research index	<p>Lucas, R (1976), ‘Econometric Policy Evaluation: A Critique’, In Brunner, K; Meltzer, A The Phillips Curve and Labor Markets Carnegie-Rochester Conference Series on Public Policy 1 New York: American Elsevier pp 19–46 ISBN 0-444-11007-0 Lucas, R (2009), ‘In defence of the dismal science’, article in <i>The Economist</i>, available at: http://www.economist.com/node/14165405 Macy, M W, and Willer, R (2002), ‘From factors to actors: Computational sociology and agent-based modeling’, <i>Annual review of ...</i></p>