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Speaking in unison? Explaining the role of agenda-setter constellations in the ECB policy agenda using a network-based approach

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ABSTRACT

Policy agendas are a well-studied institutional level phenomenon that capture the set of policy issues that an institution pays attention to over time. They are emergent in nature in that individual behaviour shapes institutional level outcomes when policy makers allocate attention to policy issues. To examine the link between individual-level actions and system-level outcomes we introduce the concept of the agenda-setting constellation, defined as a group of policy makers paying attention to a set of policy issues. Taking the European Central Bank as a case study, and using a combination of text-analysis and networks-analysis techniques, we demonstrate how these meso-level structures shape the evolving policy agenda. We then examine the roles of personal experience, institutional constraints, and policy context in driving agenda-setter constellation membership. Our results show the value of studying policy agendas as networked processes and the key role that agenda-setter constellations play in driving policy agenda dynamics.

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Introduction

In the study of policy-making institutions, accounting for why certain policy issues gain attention while others fall by the wayside is a key part of

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understanding institutional decision-making processes. This attention allocation process is encapsulated by policy agendas: the catalog of issues gaining the attention of an institution over time (Baumgartner & Jones, 1993). While significant academic attention has examined policy agendas as macro-level manifestations of institutional interest, the interplay between individual attention allocation decisions and system-level outcomes remains under-explored. This inspires the following research question: How do individual issue attention allocations combine to shape the evolution of institutional policy agendas?

To answer this question, the current study elaborates a network-based framework to capture policy agenda structure and introduces the concept of agenda-setting constellations – aggregates of policymakers sharing a common focus on a set of policy issues – as a way to link individual behaviour to institutional outcomes. We argue that these meso-level structures have been overlooked in previous literature and play an instrumental role in shaping policy agenda dynamics. We further argue that far from being random, the emergence of these agenda-setting constellations is driven by factors including policy makers' personal experiences, the institutional constraints they function under, and the policy context in which they must allocate their attention.

To empirically explore these claims, we take the European Central Bank (ECB) policy agenda as our object of study. This institution is at the centre of economic policy making and analysis in the euro area. Understanding the factors that shape the ECB's attention to different policy issues is therefore of fundamental importance as it can help us understand policy outcomes at the European level. While the ECB policy agenda has been considered from the macro-level perspective in previous work (Cross & Greene, 2020; Ferrara, 2019; Moschella & Diodati, 2020), we know next to nothing about the meso-level structures that shape issue attention in this context. By leveraging a blend of text analysis and network analysis techniques, we trace the formation of agenda-setting constellations and their influence on the ECB's evolving policy agenda. Our results demonstrate that policy agendas are best described as dynamic and networked processes that are shaped by agenda-setting constellations. These emergent structures are in turn, influenced by individual policymaker characteristics, institutional roles/constraints, and the economic context in which issue attention is allocated.

Related literature

Policy agendas

Policy agendas have received a significant amount of attention in the field of public administration (Baumgartner *et al*., 2009; Baumgartner & Jones, 1991,

2002). The policy-agendas literature builds on insights from behavioural organisation theory (Barnard & Simon, 1947) and demonstrates that across many different organisational contexts, policy-agendas exhibit punctuated-equilibrium dynamics (Baumgartner *et al*., 2006; Bayerlein *et al*., 2022; Breunig & Jones, 2011; Citi, 2013; Princen, 2013; Yildirim, 2022). These dynamics emerge due to frictions associated with boundedly rational decision-makers making decisions in an information-rich policy environment while acting under significant institutional constraints (Fagan *et al*., 2017; Walgrave & Vliegenthart, 2010).

Constraints on information processing manifest at both the individual and institutional level in the form of cognitive frictions and institutional frictions, respectively (Jennings & John, 2009; Jones, 2017; Jones & Baumgartner, 2005). Cognitive frictions at the individual level refer to the mental constraints that can hinder people's ability to process new information and make decisions (Jones, 2003). They include limited attention spans, rational ignorance, and the limitations of existing mental models and decision heuristics based on past careers and experience.

Cognitive frictions are particularly acute in contexts like central banking, where policymakers face a large amount of complex and sometimes conflicting information emerging from the policy context in which they function. They may experience difficulty making sense of the information they are confronted with and may resort to existing beliefs, heuristics, and biases when allocating attention to novel informational content. This can lead to a misallocation of cognitive efforts and the emergence of stick-slip dynamics that are thought to drive punctuated equilibrium dynamics at the institutional level (Breunig & Jones, 2011; Jones & Baumgartner, 2005).

Institutional frictions, on the other hand, refer to the contextual, bureaucratic, or organisational barriers that can hinder the ability of policymakers to share and process policy-relevant information (Baumgartner *et al*., 2009; Jones, 2017; Jones *et al*., 2003). Institutional frictions can arise when there are conflicts between different policy sub-systems within the broader institutional framework and where institutional procedures inhibit the processing of incoming policy-relevant information. For example, if the ECB Executive Board and the NCB Governors have different information sets and institutional rules and procedures that inhibit the sharing of information across policy subsystem boundaries, it can be difficult to reach a consensus on appropriate policy solutions. This results from the fact that each policy subsystem acts as an information silo, focusing on its own interests and goals without effectively communicating across inter-institutional boundaries. Importantly, in many cases, these dynamics are not deliberately triggered by policymakers jealously guarding private information but instead emerge due to the frictions associated with sharing policy-relevant information in a complex multi-level policy-making system (Robinson *et al*., 2007).

While the mechanisms described above provide a rich account of the sources of continuity and change in institutional policy agendas, the links between individual behaviour and institutional outcomes remain under-explored. We turn our attention to the European Central Bank to address this gap in the literature.

The European Central Bank as a case study of policy agenda dynamics

The European Central Bank (ECB) provides an interesting context for observing emergent policy agenda dynamics in central banks (Ferrara, 2019; Moschella & Diodati, 2020). Comprising of 20 national central banks (NCBs) and a European-level institution based in Frankfurt, the ECB's institutional setting is intricate and hybrid, influencing its capacity to address emerging policy issues (Howarth, 2009). Previous work has demonstrated that at an individual level, the behaviour of central bankers seems to be shaped by personal experiences, institutional constraints, and the policy context they operate within (Adolph, 2013; Bordo & Istrefi, 2018; Malmendier *et al*., 2020). They do so in the Governing Council, which plays a pivotal role in setting the institutional policy agenda, providing a platform for policy debates and coordination. Issues absent from the ECB Governing Council's agenda are unlikely to shape policy outcomes (Cohen *et al*., 1972). The Governing Council has demonstrated its ability to adjust to emerging policy challenges in a more incremental manner compared to other policy-making systems. This ability is credited to its robust research capacity, streamlined policymaking processes, and a narrowly defined mandate (Cross & Greene, 2020).

What is absent in the current literature on central banking is the link between individual-level behaviour and institutional-level outcomes. A comprehensive understanding of policy agenda formation requires a holistic view of the relationship between individual policymakers, policy issues, and policy context. We address this literature gap by examining the ECB policy agenda from a network perspective, allowing us to identify emergent agenda-setter constellations and their influence on the policy agenda. We delineate this theoretical framework in the following section.

Theoretical framework

Conceptualising the policy agenda from a network perspective

We begin from the assertion that Governing Council speeches reflect the policy agenda of the sub-systems of the Eurosystem from which they emerge. Speeches allow individual speakers to set forth their policy views, respond to the views of others, and justify past, current, and future policy

decisions. Taken together at the institutional level, speeches can be conceptualised as a policy agenda that exhibits a complex set of dynamic structural properties.

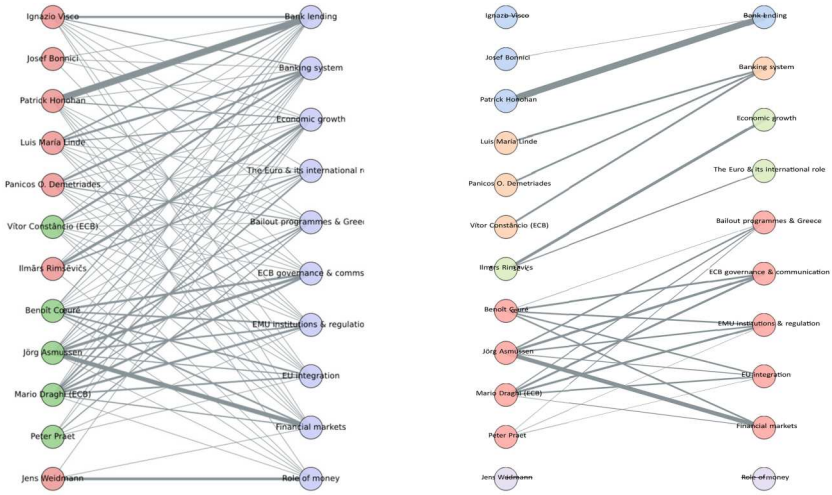
While the policy agendas literature often refers to the structure of policy agendas as a determining factor in policy outcomes, to date, an empirical framework capable of capturing such structures has been lacking. We elaborate upon a network-based representation of the policy agenda capable of capturing the complex set of relations between speakers, the issues they speak about, and the contextual factors that shape issue attention. Our argument proceeds in three steps. We first outline the network structure used to represent the policy agenda, and then proceed to describe the emergent structural properties of this network that can be used to identify influential clusters of policy-makers pushing particular issue configurations in the policy agenda. With this in place, we can then integrate a set of explanatory variables related to individual speaker characteristics, institutional mandates, and economic context, which are expected to influence the policy agenda.

A network-based model of policy agendas

Studying the evolution of the policy agenda using networks takes inspiration from discourse network analysis, which has proven to be a fruitful approach for providing insights into policy debate dynamics (Leifeld, 2014; Leifeld & Haunss, 2012). The fundamental building blocks of Leifeld's discourse network are speakers, the issues they address when engaging in the discourse, and the positive or negative sentiment they attach to the issues at hand. Since here we are interested in the policy agenda rather than policy discourse, and policy agendas focus on issue attention rather than whether or not an actor is advocating for or against a position, we adapt this framework in a number of ways. We maintain two distinct node types (speakers and issues), but edges connecting speakers to issues in a policy agenda network are formed when a speaker mentions an issue in a speech. The edge is weighted by the number of times a speaker speaks about a given issue in a given time window. These building blocks can be represented as a bipartite network, in which speakers and topics are represented as two distinct node types, with edges between them implying a speaker addressed a topic in the time window under consideration. Figure 1 provides an example of what such a policy agenda network looks like in practice.

Emergent properties of policy agenda networks: agenda-setter constellations and issue configurations

The added value of a network representation of the policy agenda is that it can reveal constellations of actors paying attention to sets of policy



(a) Weighted bipartite policy agenda network (b) Partitioned policy agenda network

Figure 1. Visualisation of the weighted bipartite policy agenda network for the time period around Mario Draghi's famous 'whatever it take' speech (2012-Q3). On both panels, speaker nodes are shown on the left and the topic nodes are shown on the right. The weight of edges between speakers and topics is indicated by the thickness of the corresponding line. Panel a shows the full network, while Panel b shows the partitioned network, demonstrating the existence of five agenda-setter constellations paying attention to five distinct issue configurations. While most speakers speak about multiple policy agenda items, there is a huge level of variance in relative attention, suggesting accounting for edge-weights is fundamentally important when modelling the network.

agenda items at a particular point in time. Such structures are not evident when considering individual contributions to the policy agenda in a tabulated format.

Here, our targets of interest are the constellations of policymakers driving the policy agenda and the issue configurations they focus on. We refer to these groups of actors as *agenda-setter constellations* and the groups of issues they focus on as *issue configurations*. Competing agenda-setter constellations are composed of sets of speakers focusing on different issue configurations.[1]

Agenda-setter constellation membership and the issue configurations focused upon are dynamic in nature and co-evolve. These emergent structures are empirically observable in the topology of the network. Agenda-setter constellations can be based on policymakers deliberately and strategically pushing agenda items to achieve a policy goal or can emerge naturally as a function of policymakers updating their beliefs and understanding of the policy environment. Either way, the more actors that promote an issue

configuration, the more dominant that issue configuration and the associated agenda-setter constellation becomes in the policy agenda.

Accounting for speaker attributes, institutional roles, and policy context

Agenda-setter constellations do not emerge in a vacuum, and it is important to account for individual speaker characteristics, institutional roles, and contextual factors when seeking to explain agenda-setter constellation membership. We conceptualise agenda-setter constellation membership in terms of speaker dyads, with each speaker dyad in a given time window appearing in the same agenda-setter constellation or not. We expect that similarities in personal characteristics and experience will be shaped by homophilic processes, with speakers with shared characteristics tending to speak about similar issues. The effects of institutional roles and policy context are more complicated to predict because both homophilic processes based on similarities and heterophilic processes based on differences can be expected to drive attention to an issue. We next explore a series of expectations based on these network-based processes.

Personal characteristics and experience

Our first set of expectations relates to the personal characteristics and previous experience of speakers. Agenda-setter constellation membership is expected to be driven by the well-established concept of homophily in network science. Homophily describes a situation in which network nodes with similar attributes are more likely to be connected to one another (McPherson *et al*., 2001). It is thought to be an important aspect of many social behaviours and phenomena, including group influence, contagion, and information diffusion (Aral *et al*., 2009; Bakshy *et al*., 2012; Shalizi & Thomas, 2011).

In a policy agenda network setting where we are interested in explaining agenda-setter constellations, homophily refers to the degree to which speakers with similar characteristics talk about similar topics through a process of assortative mixing. Each speaker possesses personal experiences gained from life events, education, and their career, and these experiences are expected to shape their behaviour (Adolph, 2013; Baerg, 2020; Bodea & Kerner, 2022; Bordo & Istrefi, 2023; Malmendier *et al*., 2020; Masciandaro & Romelli, 2018).

To account for similarities in personal background, we examine the influence of nationality (H1.1), gender (H1.2), academic background (H1.3) and training (H1.4), and previous work experience in academia (H1.5), a central bank (H1.6), national government (H1.7), the IMF (H1.8) or World Bank (H1.9), or banking/finance (H1.10) on constellation membership. Our

hypotheses are based on the idea that when speakers in a dyad share similar personal attributes, they are more likely to be in the same agenda-setter constellation.

Institutional rules and roles

Institutions and their associated rules and structures are widely recognised to constrain actor behaviour (Hall & Taylor, 1996). The most salient institutional constraints faced by speakers in the ECB Governing Council are the formal roles allotted to them. We differentiate between Executive Board members based in Frankfurt and NCB Governors based in their respective national central banks.[2] We propose two competing hypotheses about the effect of Executive Board membership. If homophilic processes dominate, then we expect that Executive Board members are more likely to speak about similar policy agenda items to other Executive Board members, as they aim to present a united front to outside audiences (H2.1). This dynamic will be reinforced by the fact that Executive Board members can call on the same sources of internal ECB research, expertise, and speech-writing teams, implying that the data-generating process behind their speeches will have similar sets of inputs. If, on the other hand, heterophilic processes dominate, then Executive Board members are expected to be less likely to speak about the same topics as other Executive Board members (H2.2). Each Executive Board member leads a different DG within the ECB with a different substantive focus. These institutional structures are expected to shape their issue focus, leading them to speak about different issues, thus ending up in different agenda-setter constellations.

Central bank mandates are also likely to shape the policy agenda but can again cut in two directions. Central banks in the Eurosystem are highly institutionalised bodies that are mandated with very specific policy-making powers (Masciandaro & Romelli, 2018). The ECB is primarily mandated with executing monetary policy to maintain price stability but gained supervisory powers over systemic banks in 2014 when the Single Supervisory Mechanism was established. While they have ceded monetary policy to the European level, NCBs within the Eurosystem vary in the degree to which they are mandated banking supervision roles. If homophilic processes dominate, then we would expect that speakers with similar supervision mandates are more likely to speak about similar policy-agenda items and thus appear in the same agenda-setter constellation (H2.3). In contrast, if heterophilic processes dominate, then differences in supervision mandates drive disassortative mixing and lead speakers with different mandates to pay attention to similar sets of issues (H2.4). Intuitively, those with weak supervision powers talk about the need to have them, while those with strong supervision powers talk about how they use them.

Economic conditions

The economic context in which a speaker makes a speech should shape what a the speaker speaks about and the agenda-setter constellations that structure the resulting policy agenda. To capture these dynamics, we account for a set of economic indicators commonly discussed in the context of macroeconomic policymaking: inflation levels and change (H3.1.1; H3.2.1), unemployment levels and change (H3.1.2; H3.2.2), GDP levels and change (H3.1.3; H3.2.3), and long-term interest rates and change on government bonds (H3.1.4; H3.2.4). The variables for each indicator are constructed as distance measures, with larger values representing bigger differences between speakers in a dyad for the economic indicator of interest.

Once again, we differentiate between homophilic and heterophilic processes that drive assortative and disassortative mixing, respectively. If homophilic processes dominate, then reducing the absolute distance between each speaker in a dyad will increase the likelihood that they are in the same coalition and vice versa. As the economic context becomes more similar, the likelihood of being in the same agenda-setting constellation increases. On the other hand, if heterophilic processes dominate, then larger differences between economic conditions will increase the likelihood that two speakers will pay attention to the same set of issues. Taking unemployment as an illustrative example, speakers from high-unemployment countries are expected to talk about unemployment because it is too high, while speakers from low-unemployment countries are expected to allocate attention to unemployment as things are going well. This speaker dyad ends up in the same agenda-setting coalition but for different reasons (Table 1).

Table 1. Summary of expectations.

No.	Variable	Mixing process	Expected effect
1.1	Nationality	Assortative	+
1.2	Gender	Assortative	+
1.3	Academic background	Assortative	+
1.4	PhD	Assortative	+
1.5	Academia	Assortative	+
1.6	Central bank	Assortative	+
1.7	Government	Assortative	+
1.8	IMF	Assortative	+
1.9	World Bank	Assortative	+
1.10	Banking/Finance	Assortative	+
2.1; 2.2	Executive Board	(Dis-)assortative	+/−
2.3; 2.4	Banking supervision	(Dis-)assortative	+/−
3.1.1	Inflation (distance)	(Dis-)assortative	+/−
3.1.2	Unemployment (distance)	(Dis-)assortative	+/−
3.1.3	GDP (distance)	(Dis-)assortative	+/−
3.1.4	Bond yields (distance)	(Dis-)assortative	+/−
3.2.1	Inflation (Δ)	(Dis-)assortative	+/−
3.2.2	Unemployment Δ (distance)	(Dis-)assortative	+/−
3.2.3	GDP Δ (distance)	(Dis-)assortative	+/−
3.2.4	Bond yields Δ (distance)	(Dis-)assortative	+/−

Research design

The corpus

In order to capture the policy agenda of the ECB Governing Council, we analyse a corpus of English-language speeches from the ECB Governing Council. We focus on the time period from January 1999, when the ECB gained sole responsibility for monetary policy in the euro area, to June 2018. The Governing Council consists of an Executive Board with a President and Vice-President and four other members. The Executive Board is joined by the Governors of the National Central Banks of the 19 euro area countries to form the Governing Council.[3] Speeches by the NCB Governors are included in the analysis, because they are Governing Council members and can substantially affect the policy agenda with their interventions.

The data generating process behind speeches is driven by the NCBs and the Directorates General (DGs) of the ECB. Each speech is drafted by a dedicated speech-writing team that is embedded in a broader institutional environment of the central bank in which they work. For NCB Governors, the policy sub-systems of their bank and national policy-making environment shape what speech-writing teams focus on when drafting speeches for outside audiences. Speakers based at the ECB share at least some of the speech-writing supports of that institution, but each speaker also has a distinct role in the Executive Board as a head of a different set of ECB DGs (e.g., DG Economics, DG Macroprudential policy, DG Statistics etc.). The key point is that far from being random, the issues discussed in speeches represent the output of a complex set of internal institutional processes, and are contingent on the people involved in drafting the text, and the time and context in which it is drafted (Holmes, 2013).

We divide the corpus into 78 quarterly 'time windows' in order to account for policy agenda dynamics while also matching available economic data sources. Individual speeches are split into paragraphs to provide short, coherent documents as the units for analysis in a topic model. The justification for splitting longer speeches into shorter paragraph-based segments is that paragraphs can be thought of as distinct sections of a larger text, usually dealing with a single theme or topic. Each paragraph represents a 'document' in the context of the topic modelling algorithm. We analyse 3081 speeches, which are broken down into 101,145 individual paragraphs. We apply the pre-processing steps described in Appendix A to each of the 78 quarterly time windows represented in the overall corpus. This results in a corresponding set of 78 document-term matrices representing the ECB Governing Council agenda in each quarter between January 1999 and June 2018.

To test our theoretical assertions empirically, we combine quantitative text analysis and network analysis techniques to generate an empirical

representation of the policy agenda emerging from the ECB Governing Council. We first employ a dynamic topic model to extract the thematic content of ECB speeches over time, equating the topics retrieved to observable aspects of the policy agenda (Greene & Cross, 2017). We then use the fact that policy agenda items can be associated with individual speakers to construct a network-based representation of the ECB policy agenda. The resulting bipartite network captures the relations between speakers and issues through their relative emphasis on different agenda items over time.

Once our network representation of the ECB policy agenda is in place, we employ community-detection techniques based on network modularity to identify distinct agenda-setter constellations (Barber, 2007; Fortunato, 2010; Newman & Girvan, 2004). These methods allow us to partition our policy agenda networks into distinct agenda-setter constellations while accounting for not just shared attention to a given issue configuration but also the *relative emphasis* each actor puts on each policy agenda item. With agenda-setter constellation membership in hand, we can then explore how individual characteristics, institutional constraints, and policy context shape the policy agenda.

Quantifying the observable aspects of the policy agenda in text

The first major methodological challenge we must confront in this project is detecting and extracting coherent topics from the corpus of speeches made by Governing Council members. In recent years, automated methods for exploring and classifying the content of unstructured texts in the form of topic models have been developed (Blei & Lafferty, 2006; Boydstun *et al*., 2013; Roberts *et al*., 2013). Topic models attempt to uncover latent structure within an unstructured collection of text without relying on any form of hand-coding or training data. In this work, we employ a dynamic topic model based on non-negative matrix factorisation (NMF) (Greene & Cross, 2017).

Taking an input corpus of n documents (the speech paragraphs), we construct a document-term matrix $\mathbf{A} \in \mathbb{R}^{n \times m}$, where m is the number of unique terms present across all speech paragraphs (i.e., the vocabulary). Applying NMF to $\mathbf{A}$ results in two non-negative factors, $\mathbf{W}$ and $\mathbf{H}$, which approximate the original matrix $\mathbf{A}$. The rows of the factor $\mathbf{H} \in \mathbb{R}^{k \times m}$ represent k topics, defined by non-negative weights for each of the m terms in the corpus vocabulary. Ordering each row provides a ranking of all vocabulary terms relative to the corresponding topic. Essentially, the ordered row entries of the matrix $\mathbf{H}$ allow us to identify the most common terms characterising each topic, thus allowing for substantive interpretation. The columns in the matrix $\mathbf{W} \in \mathbb{R}^{n \times k}$ provide membership weights for all n documents with respect to each of the k topics. The columns in matrix $\mathbf{W}$ can be used to associate each speech paragraph with the topics to which they are associated. For temporal data, such as

the ECB speech corpus, we apply this NMF topic modelling process to the speech paragraphs in each time window. When this information is combined with speech metadata relating to speaker ID and speech date, we can measure each speaker's contribution to each topic in a given time period.[4]

Unlike many probabilistic topic models that tend to smooth over such language changes, the NMF approach used here accounts for policy agenda evolution by allowing the set of terms associated with each topic to evolve over time (Greene & Cross, 2017). Finally, to simplify interpretation and translate our topic-model outputs into a data structure that can be represented as a network, we employ a single-membership parameterisation of the topic model, where we assume that each short speech paragraph relates to a single topic, with topics assigned based on the maximum value of each column in matrix **W** (see Online Appendix for more discussion).

From policy topics to policy agenda networks

The topics detected using the process discussed above help us link speakers to one another based on co-occurring topic attention in a given time window. The policy agenda network analysis framework adapted from the work of Leifeld (2009, 2010) is a useful way in which to conceptualise the relations between speakers and topics that we are interested in and thus get an empirical handle on the emergent structure of the policy agenda. In this framework, topics and speakers are thought of as two distinct types of network nodes, and the link between these nodes can be represented in a two-mode network architecture. The policy agenda network is represented as a bipartite graph $G = \{U, V, E\}$, where U and V are disjoint sets of nodes representing speakers and topics, respectively. $E = \{(u_i, v_j): (u_i \in U, v_j \in V\}$ is the set of edges linking these nodes. An affiliation network can also be represented as a rectangular bipartite adjacency matrix.

X, where each value x_{uv} indicates the edge weight between speaker u and topic v.

We construct 78 distinct policy-agenda networks connecting each speaker to each topic they address in each time window covered by our corpus using the output of the dynamic topic modelling process described in Section 4.2.

Detecting agenda-setter constellations

Identifying agenda-setter constellations in policy agenda networks is an example of the broader problem of community detection in network science (Fortunato, 2010). To capture agenda-setter constellations, we employ the concept of modularity, which measures the extent to which network nodes (speakers or topics in our application) are partitioned into separate subsets, referred to as modules. Modularity is captured by assessing the degree to which edges in the network occur within modules rather than between modules relative to a null model (Barber, 2007; Newman & Girvan,

2004). Network modularity is useful in our context as it can help us partition our policy agenda network into constellations of speakers that promote similar issue configurations.

The policy agenda networks we are analysing have a number of attributes that need to be accounted for when selecting an appropriate module detection method. The first is that the network is bipartite in nature, with speakers choosing to speak about certain issues (and not others) in a given time window. Speakers are only linked to other speakers through *shared attention* to issues – i.e., direct edges between speaker-speaker dyads or issue-issue dyads are impossible. This structure must be accounted for when assessing network modularity.

The second policy agenda network attribute to account for is that the edges between speakers and issues are weighted in nature, and the weighting is substantively important in terms of the dominance of a given issue configuration and the agenda-setter constellations pushing it. A speaker who talks extensively about monetary policy can be assumed to be much more strongly connected to this issue and its associated agenda-setter constellation than a speaker who mentions it once in passing. If edge-weights are ignored then the varying strength of connections between speakers and issues is lost, distorting the topology of the resulting policy agenda network and our representation of which agenda-setter constellations shape the policy agenda at a given point in time.

We identify agenda-setter constellations and their evolution over time by employing the DIRTLPAwb + community detection algorithm proposed by Beckett (2016). This approach is appropriate as it allows us to account for the full weighted bipartite network structure without first requiring us to project to a one-mode network, which would involve losing edge-weight information. The approach is based on the idea of identifying a set of disjoint communities or modules that maximises a variant of Newman and Girvan's (2004) widely-used modularity function, which was adapted for weighted bipartite networks by Dormann and Strauss (2014). This is done by assessing the extent to which weighted edges in the network occur within modules rather than between modules relative to a null model. Formally, *weighted bipartite modularity* Q_W is defined as:

$$Q_W = \frac{1}{M}\text{tr}(\mathbf{R}(\mathbf{W} - \mathbf{E})\mathbf{C}) \tag{1}$$

where **W** is the weighted bi-adjacency matrix of the network and **E** is the corresponding null expected interaction matrix. The two matrices **R** and **C** are the binary module membership matrices for the network's two node sets, respectively, while M is a normalisation factor equal to the sum of the weighted degrees in the network. A higher value for Equation (1) indicates a more coherent module with respect to the null model.

Rather than manually specifying the number of communities as an input parameter, in DIRTLPAwb + this value is automatically determined via an agglomerative process that aims to merge smaller modules until the weighted modularity Q_W is maximised. The resulting communities are disjoint (nodes can only be members of one agenda-setter constellation) and consist of nodes from both node sets – i.e., both speakers and issues. We apply the implementation of DIRTLPAwb+ provided by the R *bipartite* package (Dormann *et al*., 2008) to the policy agenda network for each of the 78 quarterly time windows in our data. For each network, we re-run the process 20 times to stabilise modularity computation. The resulting allocation of speakers to communities represents our agenda-setter constellations of interest.

Explaining agenda-setter constellation membership

Our final task is to explain what drives agenda-setter constellation membership. The challenge that must be overcome to do this is identifying an appropriate way to model agenda-setter constellation membership in a context where the set of speakers and the set of issues they discuss co-evolve. We do this by focusing on the joint membership status of each of the set of possible dyadic relations between two speakers who made a speech in any given window.[5] We create a dummy variable capturing whether or not a given speaker dyad is in the same agenda-setter constellation in a given time window. Across all 78 quarterly time windows, we identify a total of 6084 dyads for which agenda-setter constellation are possible.

To explain agenda-setter constellation membership, we consider similarities and differences between dyad members in terms of their individual characteristics, experience, institutional constraints, and economic conditions at the time of speaking. We utilise data collected by Masciandaro and Romelli (2018)[6] to capture variation in the mandate of the euro area central banks under consideration, specifically looking at whether or not speakers have a mandated role in banking supervision in their respective jurisdiction (0 = no bank supervisors in dyad; 1 = one bank supervisor in dyad; 2 = two bank supervisors in dyad). To create dyad-level measures of these variables, we create a set of factor variables as follows:

- Nationality (0 = different nationality; 1 = shared nationality)
- Academic background (0 = different academic background; 1 = same academic background)
- PhD (0 = no PhDs in dyad; 1 = one PhD in dyad; 2 = two PhDs in dyad)
- Gender (0 = both male; 1 = mixed; 2 = both female)
- Experience in academia/IMF/World Bank/central bank/government/banking-finance (0 = no experience; 1 = one dyad member with experience; 2 = both dyad members with experience)

- Member of the Executive Board of the ECB (0 = neither an EB member; 1 = one an EB member; 2 = two EB members)
- Bank supervision (0 = no bank supervisors in dyad; 1 = one bank supervisor in dyad; 2 = two bank supervisors in dyad)

Economic variables of interest are based on quarterly measures of inflation, unemployment, change in unemployment, real GDP, change in real GDP, the 10year interest rate and the change in the 10-year interest rate for each euro area country, and the Euro area averages for each Executive Board member.[7] Each of these variables captures aspects of the economy that directly impact upon the ability of the euro area central bankers to fullfill their respective mandates. We are interested in how *differences between dyad members* in these economic factors affect the likelihood that two speakers are in an agenda-setter constellation together, so each of these variables, x, is constructed as an absolute distance measure, D, capturing differences in the respective dyad members i, j national economies as follows:

$$D_{i,j} = |x_i - x_j| \tag{2}$$

We employ a multilevel logistic regression to explore the link between speaker dyad agenda-setter constellation membership and contextual factors including policy context, mandate powers, and speaker characteristics. We add fixed effects for each time window and robust standard errors for the model in question.

Results

The results section first provides descriptive insights into the structure of the ECB policy agenda by considering an example of a policy agenda network relating to 2012-Q3 at the height of the euro crisis. We demonstrate how community detection techniques can help unveil the latent agenda-setter constellations that shaped the ECB's issue attention at this time. We then examine how agenda-setter constellation structure evolves over time before concluding with an examination of the factors that drive agenda-setter constellation formation.

'Whatever it takes': A policy agenda network case study around Draghi's famous intervention in 2012-Q3

We first consider an example of a policy agenda network capturing the relations between speakers and issues for the time period around ECB Governor Mario Draghi's famous 'whatever it takes' speech in the third quarter of 2012. We focus on this time period as the agenda-setter constellation structure surrounding Draghi at this time should illuminate how dominant his

agenda-setter constellation was in the Governing Council. Returning to the network visualisation presented in Figure 1, recall that two node types were represented (speaker and issue), and we colour-coded the speaker nodes by their central bank affiliation (ECB or NCB). Edge weights, which capture the number of paragraphs each speaker dedicated to each issue, were represented by varying the thickness of the edges between the two network modes. The complexity of the policy agenda at the time is self-evident in Figure 1. While most speakers speak about multiple issues, there is a huge level of variance in relative attention, suggesting that the policy priorities of different groups of Governing Council members differed in important ways.[8]

For instance, Draghi allocates issue attention in a similar manner to all Executive Board members except Constâncio, while the Governor of the Bundesbank, Weidmann looks isolated with his focus on the role of money. There is also a strong connection between Honohan, the Governor of the Irish Central Bank, and bank lending, which was the issue at the heart of the Irish crisis experience.

Formalising agenda-setter constellation detection

While the network visualisations presented in Figure 1a suggests interesting topological structure in our policy agenda networks, to formalise these impressions and take full advantage of the network-based representation of the ECB agenda over time, we next employ the DIRTLPAwb+ algorithm as a means to identify agenda-setter constellations.

Returning to our example time window, Figure 1b demonstrates the partition suggested by the DIRTLPAwb+ algorithm on the bipartite affiliation network. Figure 2 displays this analysis as an adjacency matrix heatmap. The agenda-setter constellation between Mario Draghi, Benoit Cœuré, Jörg Asmussen and Peter Praet is clearly identified. The NCB governors are split into two distinct agenda-setter constellations, one focused on bank lending (Visco, Bonnici, Honohan) and one focused on the banking system (Linde, Demetriades, Constâncio). The subtle^ difference between these agenda-setter constellations is only revealed when the full weighted bipartite graph structure is accounted for. Jens Weidmann remains very clearly out on his own, talking almost exclusively about the role of money and not taking part in any agenda-setter constellation as a result.

Agenda-setter constellation stability and change

The picture that emerges from 2012q3 is of a disjoint policy agenda structured by distinct agenda-setter constellations allocating attention to different issue configurations. Agenda-setter constellation membership can

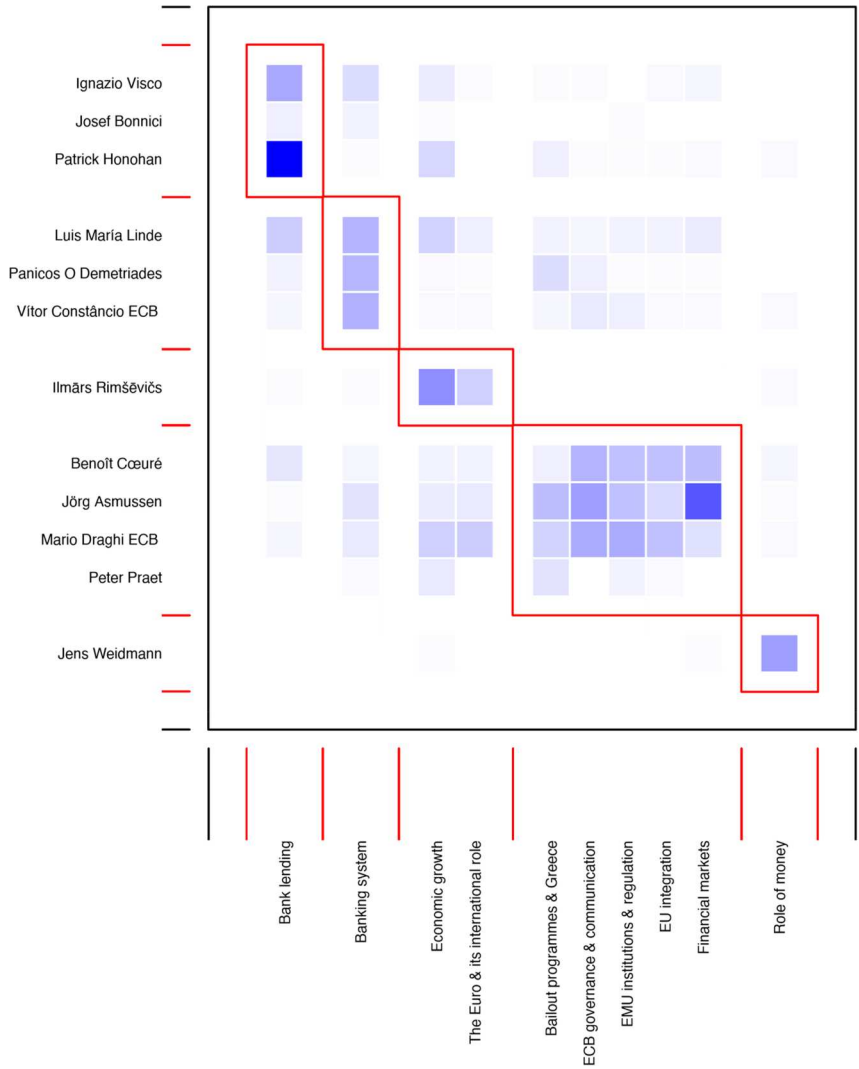
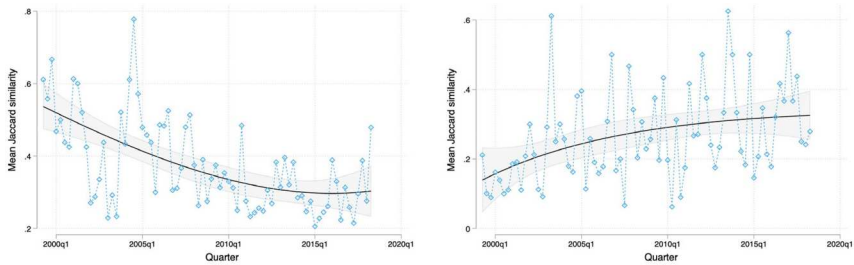


Figure 2. Adjacency matrix presented as a heatmap, with the modules detected by the DIRTLPAwb+ algorithm for 2012-Q3.

change and evolve over time as new issues arise on the policy agenda and actors react to each other and the policy context in which they find themselves. To complete our empirical picture of the evolution of policy agenda networks between 1999 and 2018, we repeat the module detection procedure for each time window. Agenda-setter constellations are formed by sets of speakers, so to capture the degree to which these sets are stable across windows, we measure the agreement between the results for consecutive windows $(t,\ t+1)$ as follows. We calculate the Jaccard set similarity



(a) Coalition membership stability over time (b) Topic-module stability over time

Figure 3. Coalition membership and topic-module stability over time, based on mean Jaccard similarity scores between sets of speakers in the agenda-setter constellation in consecutive time windows. We employ a fractional polynomial with associated confidence intervals to demonstrate underlying trends over time.

between all sets of speakers in window t and those in $t+1$, and we then compute the mean similarity based on the best matching pairs. We do the same for issue configuration evolution over time. The results of this analysis are presented in Figure 3.

Agenda-setter constellation membership appears to be far more stable in the earlier period of the ECB's history than for later periods, while issue configurations become slightly more stable over the same period of time. When taken together, these two trends suggest a policy agenda that becomes more coherent over time despite the fact that agenda-setting constellation membership becomes more dynamic. The institution as a whole seems to become more settled on the issues that should be discussed together, while the speakers involved become more comfortable speaking about different parts of the broader agenda.

Explaining agenda-setter constellation membership

Our final set of analyses seeks to explore the determinants of agenda-setter constellation membership based on the results of the community detection techniques presented in the previous section. Table 2 presents the odds ratios related to agenda-setter constellation membership, which are derived from a two-level random intercept logistic regression with quarter fixed effects and robust standard errors. The coefficients are exponentiated to represent odds ratios and aid in interpretation. Figure 4 presents the marginal effects of a selection of variables of interest.

Of the individual characteristics considered, gender (H1.2) seems to matter the most for agenda-setter constellation formation. Female-only dyads are much more likely to form agenda-setter constellations than male-only dyads (odds ratio of 6.28). This large effect should be interpreted within

Table 2. Two-level random-intercept logistic regression with quarter-clustered standard errors.

	Coalition membership	
	Odds ratio	*SE*
Shared nationality	0.908	(−0.54)
Shared academic background	0.882	(−1.64)
Ph.D. (count) = 1	1.199*	(2.04)
Ph.D. (count) = 2	1.17	(1.29)
Female (count) = 1	0.692*	(−2.50)
Female (count) = 2	6.282*	(2.25)
Academic experience (count) = 1	1.041	(0.37)
Academic experience (count) = 2	1.295	(1.37)
IMF experience (count) = 1	1.071	(1.13)
IMF experience (count) = 2	0.986	(−0.13)
WB experience (count) = 1	0.939	(−0.66)
WB experience (count) = 2	0.826	(−1.14)
Central bank career (count) = 1	1.087	(0.18)
Central bank career (count) = 2	0.942	(−0.13)
Government career (count) = 1	1.136	(0.57)
Government career (count) = 2	1.305	(1.13)
Banking/finance career (count) = 1	1.048	(0.65)
Banking/finance career (count) = 2	0.923	(−0.84)
Executive board member (count) = 1	0.741	(−0.70)
Executive board member (count) = 2	0.675*	(−2.15)
Banking supervision (count) = 1	0.687***	(−4.07)
Banking supervision (count) = 2	0.545***	(−4.53)
Inflation (distance)	1.012	(0.10)
Real GDP (distance)	1.000	(−0.49)
Unemployment (distance)	1.019*	(2.11)
Bond yields (distance)	0.947*	(−2.16)
ΔReal GDP (distance)	0.981	(−0.99)
ΔUnemployment (distance)	1.019*	(2.21)
ΔBond yields (distance)	0.998*	(−2.21)
Constant [Quarter]	1.042	(1.94)
Observations	6068	

Note: Exponentiated coefficients; *t* statistics in parentheses $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

the context of there being very few possible female-only dyads over the course of the time period considered. The Governing Council had three female members in the time period considered and the only observed dyad was between Chrystalla Georghadji (Governor of the Central Bank of Cyprus from 2014-Q2 until 2019-Q2) and Sabine Lautenschläger (Member of the ECB Executive Board from 2014-Q1 until 2019-Q4), who appeared in the same agenda-setter constellation six times during their time on the GC.

We also find that dyads in which one member has a Ph.D. but the other does not are nearly 20 per cent more likely to appear in the same constellation than dyads in which neither member has a Ph.D. (H1.4). The preponderance of Governing Council members with Ph.D.s is likely to explain this finding.

Both mandate related variables are found to be significant. Two Executive Board members are 32.5 per cent less likely to appear in the same agenda-setter constellation than two NCB Governors, suggesting that a speaker's role in the Governing Council drives attention to agenda items (H2.2).

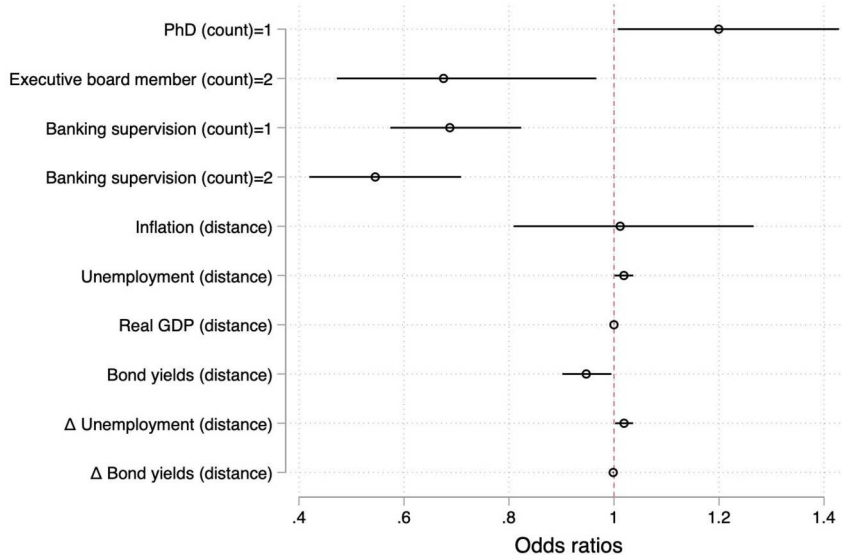


Figure 4. Odds ratios for a selection of variables of interest. Note that the results for gender are not included as they are significantly larger than the other effects and the resulting figure becomes unreadable.

Dyads in which neither speaker has banking supervision authority (the baseline condition) are more likely to be in the same agenda-setter constellation than dyads where one (H2.3 – odds ratio of 0.69) or both (H2.4 – odds ratio of 0.55) speakers have banking supervision authority. Homophilic pressures appear to be far more for influential for central banks without a financial supervision mandate than for those with one.

Of the economic distance variables, increased unemployment distance (H3.1.2) is associated with an increased probability of agenda-setter constellation co-membership. Each additional percentage point difference in unemployment levels in a dyad leads to a 0.19 per cent increase in the odds that two speakers are in a coalition. This provides evidence supporting H3.1.2, with a disassortative effect for similar levels of unemployment driving agenda-setter constellation formation, but is not robust to alternative model specifications (see Appendix E).

Differences in bond yield levels between dyad members appear to have an assortative effect, with each additional unit decrease in bond yield distance increasing the odds that two speakers are in an agenda-setter constellation by a factor of 0.95. This is in line with our expectation that central bankers facing similar market bond market conditions are likely to emphasise the same policy agenda items.

Of the three variables associated with the changes in economic conditions, unemployment and bond yield changes seem to matter, but with rather small

effect sizes. A 1 per cent increase in the difference between unemployment rates in a dyad leads to a 0.19 per cent increase in the odds that two speakers are in a coalition (H3.2.2). Similarly, a 1 per cent increase in the difference between bond yields in a dyad decreases the odds that two speakers are in the same agenda-setting constellation (H3.2.4).

Conclusion

In this study, we have sought to examine the role of agenda-setter constellations in structuring the ECB policy agenda by considering the topical focus of different Governing Council members in the public speeches. We first employ a topic modelling framework to identify policy agenda items and then use a network-based approach to examine the degree to which different policy agenda items are used by different actors to shape the agenda over time. We then apply a novel community detection method to identify agenda-setter constellations in the policy agenda network that takes account of the bipartite nature of the networks and the key role that issue salience (edge weights) play in shaping these networks. Having identified agenda-setter constellations, we conclude with an analysis of what drives speaker dyads to focus on (dis-)similar policy agenda items. We elaborate a set of hypotheses based on associative and disassortative mixing processes and demonstrate how these processes shape agenda-setter constellation membership.

With the exception of gender and having a PhD, individual characteristics are not found to drive agenda-setter constellation membership. In many regards, this is reassuring. Past career experience is, of course, relevant to executing their role, but we would not want a situation to arise where, for instance, those with a finance background stick together and consistently drive attention towards issues of little interest to those with experience in government or international organisations. Such biases would undermine the reputation of the ECB as an independent policy-making institution, as those represented on the Governing Council would speak in a manner biased by their past experience and background. Our results suggest this does not happen, at least in a systematic manner that is reflected in the policy agenda that is considered here.

Institutional roles, on the other hand, should constrain behaviour, and we demonstrate this is the case but in different ways. Executive Board members hold different roles in the ECB, heading up separate DGs, and these roles tend to differentiate what they speak about, leading them to end up in different agenda-setting constellations. This dynamic outweighs incentives to present a united front, at least in terms of the sets of issues they place an emphasis on. Effective policymaking is facilitated by people fulfilling their respective roles, so this result can be seen as a positive.

In contrast, we should want our central bankers to make policy while considering the institutional constraints they are supposed to function under. These concerns are at the heart of fulfilling their mandate, guarding their reputations as capable and effective policymakers, and thus maintaining sources of both input and output legitimacy (Baerg & Cross, 2022; Moschella & Pinto, 2018; Schmidt, 2008). Our results suggest that speaker dyads where one or both speakers hold supervisory authority over the banking system appear in less agenda-setter constellations together than when neither speaker holds supervisory authority.

Of the economic factors considered, bond yields appear to be the most important driver of agenda-setter constellation membership. As bond yields converge within a given speaker dyad, they are more likely to appear in an agenda-setter constellation together. This assortative mixing makes sense in a context where bond yields relate to the sustainability of national debt – an issue that became highly salient during the Eurozone crisis.

Taking a step back from the specifics of the ECB policy agenda, we have demonstrated that combining quantitative text analysis methods and network analysis methods is a useful approach that promises to provide new insights into what structures policy agendas. To date, most of the empirical focus on policy agendas has considered very high-level macro indicators of policy agenda change, focusing on the shape of the distributions of agenda changes within and across policy-making systems (Cross & Greene, 2020; Epp, 2017; Epp & Baumgartner, 2017). Our approach instead zooms in on the meso-level policy agenda structures that emerge as different agenda-setter constellations place emphasis on different issue configurations over time. We show that in the ECB case, institutions and context matter, but we do not yet know whether similar dynamics emerge in other policy settings. We are at the beginning of understanding what shapes these emergent structures, and much work remains to be done. We hope that this study can act as a catalyst for the further integration of network analysis into the study of policy agenda dynamics in central banking and beyond.

Notes

1. Similar to epistemic communities (Haas, 1989; Mai'a K, 2013), they are a network of policy actors that share a broad understanding of the field of central banking, but unlike these groups, they all belong to the same institution and membership of an agenda setter-constellation can change between time periods. This also differentiates them from transgovernmental networks (Slaughter & Hale, 2010) and transnational advocacy networks (Keck & Sikkink, 1998), both of which share a loose network structure, but both of which also possess a transnational and extra-institutional component that does not apply to agenda setter-constellations.

2. The inclusion of NCB Governors in the analysis is important as they possess (rotating) voting rights in the Governing Council, and are tasked with both representing their NCB in Frankfurt and justifying decisions made in Frankfurt to domestic audiences.
3. Euroarea membership has expanded from 11 initial members to the current cohort of 20. This is reflected in a growing number of speakers appearing in our dataset over time.
4. The dynamic topic model used here elaborates upon that implemented by Greene and Cross (2017) by including n-grams in our document representation – i.e, contiguous sequences of n words from a given document. This allows us to capture the technical terminology present in central bank communications and important concepts referred to via multi-term phrases (for instance, 'interest rates', 'quantitative easing', 'monetary policy strategy').
5. This approach is inspired by gravity models commonly found in the literature on international economics. We also experimented with more complex stochastic actor-orientated models, but found that they would not converge given the complexity of the networks under consideration.
6. The authors of this paper kindly provided an updated version of the dataset to cover the period 2014–2018.
7. The data sources for each of these variables is described in Online Appendix D.
8. These impressions are further explored using network projections in Online Appendix E.

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