Economic Letter

# From Forward Guidance to Data Dependence: Temporality and Complexity in ECB Communication After the Pandemic

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*David Byrne*[*], *Robert Goodhead*[†], *Michael McMahon*[‡], *Matthew Naylor*[§], *Conor Parle*[¶]

The ECB's communication strategy has changed in recent years, driven first by reforms from the 2021 Strategy Review and then by the post-pandemic inflation surge. Its communication has shifted rapidly from forward guidance to giving detailed information on its reaction function and its evaluation of data. Focusing on the Monetary Policy Statement, which is delivered at ECB press conferences, we examine these changes through the dimensions of temporal orientation and textual complexity. We find that the reforms led communication to be less semantically complex and to have fewer references to the past, reflecting reduced emphasis on evaluating data. However, as inflation rose and the ECB became "data-dependent", its discussions of past data became more detailed again. While communication remained less semantically complex, it became more *conceptually* complex. This suggests a trade-off: giving more information on data and the reaction function may result in more conceptually complex communication.

## Introduction

The euro area economy has faced a sequence of highly complex shocks in recent years, including the Covid-19 pandemic and the energy price increases following Russia's invasion of Ukraine.[5] Over this period, the stance of euro area monetary policy shifted from expansionary to increasingly restrictive, with the unwinding of net asset purchases and a sequence of large increases in policy rates. These shifts in policy stance were also matched by shifts in communication strategy. Forward guidance had been a central pillar of ECB communica-

[5]The nature and composition of these shocks is still debated (in particular the relative role of supply and demand). For a recent discussion, see Lane (2024).

tions during the low inflation period, and was retained following the 2021 Monetary Policy Strategy Review. As the ECB tightened its policy stance, communication transitioned to emphasise "optionality" and a "meeting-by-meeting" approach to policymaking, with a commitment to "data-dependence". The focus of this communication was to provide clarity on the reaction function – how the Governing Council responds to data.

ECB data-dependence was later distilled into "three criteria": assessing the developments in underlying inflation, in monetary policy transmission, and in the outlook for inflation. The former two criteria were backward-looking in nature, with the outlook for inflation being forward-looking. Using textual data, this Letter quantifies the shift toward a more data-dependent communication strategy. Moreover, this Letter also examines how the greater complexity of both the economic outlook and the ECB's reaction function may have triggered more complex communications by the ECB. We apply tools from the Natural Language Processing (NLP) literature to shed light on these questions.

We examine ECB textual data across two dimensions: the temporal orientation of the text and its complexity. Quantifying temporal orientation allows us to track changes in the nature and role of forward guidance over time, as well as shifts in evaluations of recent data, which involves discussion of the past. To examine temporal orientation, we use the indicators of Byrne et al. (2023a). Our examination of textual complexity is motivated by the 2021 Strategy Review. One outcome of this Review was an emphasis on simplifying communication. Following McMahon and Naylor (2023), we distinguish between semantic and conceptual complexity. Semantic complexity, the focus of much of the literature, looks at the structural features of text, such as average word and sentence length. Conceptual complexity instead measures the difficulty in comprehending the content itself, for instance from not understanding new words or the interrelationships between words.

We focus on textual data from the Monetary Policy Statement, which precedes the Q&A sessions of ECB Press Conferences, and provides an overall summary of the economic environment, as well as the rationale for decisions made.[6] After the 2021 Review, the ECB made structural changes to the statement by streamlining and simplifying the text. We find that these changes led to an immediate reduction in discussion of information about the past. Subsequently, as the interest rate hiking cycle began and communication shifted toward data-dependence and the meeting-by-meeting approach, discussions of the past were re-introduced into the text. The adoption of the three criteria consolidated this trend. We interpret these shifts as reflecting an increased emphasis on the evaluation of recent data in the particularly complex post-pandemic economic environment and the increased sensitivity of the ECB's reaction function to data outturns.

The 2021 reforms resulted in a measurable reduction in semantic complexity (the Flesch-Kincaid measure) of the text, which we interpret as the effect of removing detailed discus-

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[6]In robustness exercises, we also consider speeches by ECB Executive Board members.

sions of recent data. Semantic complexity has remained persistently lower in the years since. However, with the onset of the high inflation period, the Governing Council began to discuss data in greater detail to provide more information on its reaction function. One result of this was an increase in the conceptual complexity of the Monetary Policy Statement. This is suggestive of a communications trade-off: providing more information on the reaction function can reduce uncertainty around policy, but at the cost of increased complexity. McMahon and Naylor (2023) show that conceptual complexity is particularly important for comprehension.

Our results suggest that central banks must carefully weigh the benefits of increased discussion of their reaction functions against potential draw-backs in terms of conceptual complexity. However, in this Letter we do not take a stand on where to strike this balance, and the optimal communication approach will no doubt depend upon the particular configuration of shocks with which the central bank is faced. We leave normative treatments of these issues for future work.

## Natural Language Processing Tools

We follow a growing literature that has used NLP techniques to analyse central bank communication. Quantitative measures of topic and tone have been extracted from textual data based on statements by monetary policymakers (Lucca and Trebbi, 2009; Apel and Blix Grimaldi, 2012; Hansen and McMahon, 2016). Less is known about the role of time in such communications. Byrne et al. (2023a) find that indicators of temporal orientation (towards the past and future) can be helpful for explaining asset price responses during meeting days. While it is intuitive that information about the future would shift forward-looking asset prices, the study also documents that markets react to information about the past. This finding is rationalised in a framework where market participants are responding to past-focussed evaluation by central banks. Importantly, central bank evaluation is shown to be closely associated with discussions regarding recent data, which contain frequent references to the past.

We update the temporal indicators of Byrne et al. (2023a), to include the period from January 2020 to October 2024, and apply the analysis to the Monetary Policy Statement. The indicators employ algorithms based on the SUTime tagger of Chang and Manning (2012), and the Tense Mood Voice (TMV) tool of Ramm et al. (2017).[7] Specifically, one can isolate three forms of temporal reference:

1. Grammatical, e.g. "we will raise";

2. Numerical, e.g. "next year", "June 2024", "the third quarter of the year";

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[7]Full details on the algorithm can be found in Byrne et al. (2023b).

3.  Categorical, "in the future", "in the medium-run".

We can compute indicators of the fraction of sentences that contain at least one grammatical, categorical, or numerical reference to the past (future), which gives us measures of "temporal focus" during the post-pandemic period.

An important limitation on the effectiveness of central bank communication, particularly with respect to the general public, is the high complexity of the language and concepts used (Haldane and McMahon, 2018). The question of how to best measure the complexity of central bank text is a point of debate in the literature. To examine *semantic* complexity, we use the popular Flesch-Kincaid measure (Flesch, 1948; Kincaid et al., 1975). The measure is based on the length of sentences and the number of syllables per word.

To measure *conceptual* complexity, we use the Conceptual Complexity Index (CCI) of McMahon and Naylor (2023). The CCI is designed to track the difficulty a reader faces when encountering jargon words, which may relate to each other in an unknown manner. A text is more conceptually complex when: (1) more jargon terms are used overall; (2) there are more distinct economic topics included; or (3) more distinct jargon terms are used in a given topic. In an experimental setting, McMahon and Naylor (2023) demonstrate that increases in conceptual complexity affect comprehension more severely than increases in semantic complexity.

## Changes to ECB Communication Strategy, 2020-24

In this Section we summarise changes to the ECB strategy in the post-pandemic period in greater detail. The initial impact of the Covid-19 pandemic and associated lockdowns was judged to be deflationary by ECB policymakers, and by December 2020, headline inflation had fallen to negative 0.3%.[8] The ECB therefore maintained its pre-crisis forward guidance throughout the early phase of the Covid-19 pandemic.[9] In July 2021, the ECB announced the results of its Strategy Review, its first since 2003. In light of the Review, and its judgement that "price pressures will likely remain subdued for some time"[10], the Governing Council strengthened its forward guidance further.[11] The ECB advised that their approach "may

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[8]See discussions in the Press Conference of 10th December 2020.

[9]Immediately prior to the pandemic, the ECB had communicated that rates would "remain at their present or lower levels until it has seen the inflation outlook robustly converge to a level sufficiently close to, but below, 2% within its projection horizon, and such convergence has been consistently reflected in underlying inflation dynamics". This formulation was introduced as part of the decision of September 2019, and remained in place up to the meeting of June 2021.

[10]President Lagarde, ECB Press Conference, 22nd July 2021.

[11]The guidance now stated that the ECB "expects the key ECB interest rates to remain at their present or lower levels until it sees inflation reaching two per cent well ahead of the end of its projection horizon and durably for the rest of the projection horizon, and it judges that realised progress in underlying inflation is sufficiently advanced to be consistent with inflation stabilising at two per cent over the medium term".

also imply a transitory period in which inflation is moderately above target". Additionally, the ECB altered the format of its communications, introducing a more streamlined and layered approach.

By December 2021 headline inflation had risen to 5%, driven largely by energy prices, and supply bottlenecks in certain sectors. With inflation still forecast to be below target in 2023, the ECB kept its forward guidance policies in place.[12] The Russian invasion of Ukraine in February 2022 led to further sharp rises in energy prices. In response to the strength of inflation pressures, the ECB rolled back its previous policy of forward guidance with commitment. In the April 2022 meeting, the Governing Council emphasised that it would maintain "optionality, gradualism and flexibility in the conduct of monetary policy". In June 2022, the ECB concluded that its forward guidance conditions were "satisfied", and that it "anticipates that a gradual but sustained path of further increases in interest rates will be appropriate". The ECB then undertook a series of large rate increases, beginning in July 2022, to suppress inflation.

While the ECB repeatedly emphasised that it would be following a "meeting-by-meeting approach", the Governing Council continued to provide guidance regarding future rate increases during the period of consecutive rate hikes. In December 2021, for example, the ECB increased its policy rates by 50bp, while advising that it "expects to raise them further". One feature of ECB guidance during this period was that, despite the absence of pre-commitment, relatively unambiguous signals were sent about decisions in future meetings.[13] As argued by President Lagarde, at the time there was an "important emphasis on signalling, i.e. demonstrating... that monetary policy would cover the necessary ground decisively". However, during the early phases of rate hikes it was also true that "an emphasis was on data dependence was less important because monetary policy had distance to cover across all scenarios" (Lagarde, 2023).

Prior to reaching the apex of its rate increases, the ECB altered its communication strategy again. The Governing Council provided more information regarding the nature of its data-dependence. The ECB introduced "three criteria", advising that decisions "will be determined by its assessment of the inflation outlook in light of the incoming economic and financial data, the dynamics of underlying inflation, and the strength of monetary policy transmission". The ECB also communicated that it would shift toward the backward-looking criteria, and away from its forecasts, as uncertainty increased. The three criteria were used not only during the last steps of the tightening phase, but also during the holding phase in which policy rates were maintained at contractionary levels, as well as the phase during

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[12]The Policy Statement of 16th December 2021 did include the following clause: "In view of the current uncertainty, the Governing Council needs to maintain flexibility and optionality in the conduct of monetary policy".

[13]For example, the ECB increased rates by 50bp in February 2023. The accompanying press release stated that "the Governing Council intends to raise interest rates by another 50 basis points at its next monetary policy meeting in March and it will then evaluate the subsequent path of its monetary policy."

which the ECB began to reduce rates (Lagarde, 2024).

In summary, ECB communications during the pandemic and recovery period can roughly be divided into four stages: (1) a period of forward guidance, prior to the 2021 Strategy Review (2020M1-2021M6); (2) a period of forward guidance, incorporating formulations from the 2021 Strategy Review (2021M7-2022M3); (3) a period of "optionality" and "meeting-by-meeting" decisions, with the emphasis upon signalling upcoming consecutive rate increases (2022M4-2023M2); (4) a period during which communication focussed on the reaction function, using three criteria (2023M3-2024M10). Of course, by its nature, such a categorisation is relatively crude, and the sub-samples will share overlapping characteristics to some extent. In the following section we study these changes using quantitative metrics based on textual data.

## Results

Figure 1 provides average values of our temporal indicators across the four sub-periods between 2020 and 2024 identified in the previous section.[14]

**The 2021 ECB Strategy Review led to an immediate reduction in references to the past.** As can be observed in Figure 1 Panel (a), this occurred exactly at the time the Policy Statement was "streamlined", in response to the recommendations of the 2021 Strategy Review.[15] This was driven by the falls in numerical and grammatical references to time. From inspection of the textual data, we have found this can be explained by two key changes to the statement: i) justifications of past unconventional policies were largely removed; ii) discussions of economic data were simplified, with greater focus on the outlook, as will be discussed below. In Panel (b) of Figure 1 we see limited evidence for any strong shift in references to the future in the post-pandemic period.[16]

**Increased discussion of the past was gradually re-incorporated into the Monetary Policy Statement over time, as the ECB undertook its hiking cycle.** This was driven by a secular upward recovery in grammatical and numerical references to time, as displayed in Figure 1. In order to shed light on the drivers of these movements, we break the Policy Statements into broad topics. We do this manually, by assigning paragraphs to defined subsections.[17]

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[14]We display the full time-series for the 2020-2024 period at meeting-frequency in Appendix Figure A.1. Appendix Figure A.2 presents broad time-trends over the history of the ECB, for reference.

[15]This can be seen clearly in the time-series plot of Appendix Figure A.1 Panel (a).

[16]There is a shift towards future orientation in the aftermath of the Russian invasion of Ukraine, though estimates are imprecise, as seen in Panel (b) of Appendix Figure A.1. With respect to pre-pandemic movements, the fall in the past share in 2021 is rapid, as displayed in Appendix Figure A.2. We also see evidence for that the overall future orientation of the Policy Statement has increased, relative to the pre-pandemic period, even if changes *during* the post-pandemic recovery were mild.

[17]Note that the Policy Statement is a highly structured document, which is formatted in a relatively consistent manner from one meeting to the next, though there are some structural changes. Our goal here is to sub-divide the corpus into its broad sections, not to assign topics to sentences using an unsupervised learning

## Figure 1: Temporal References in the ECB Monetary Policy Statement

### (a) References to the Past
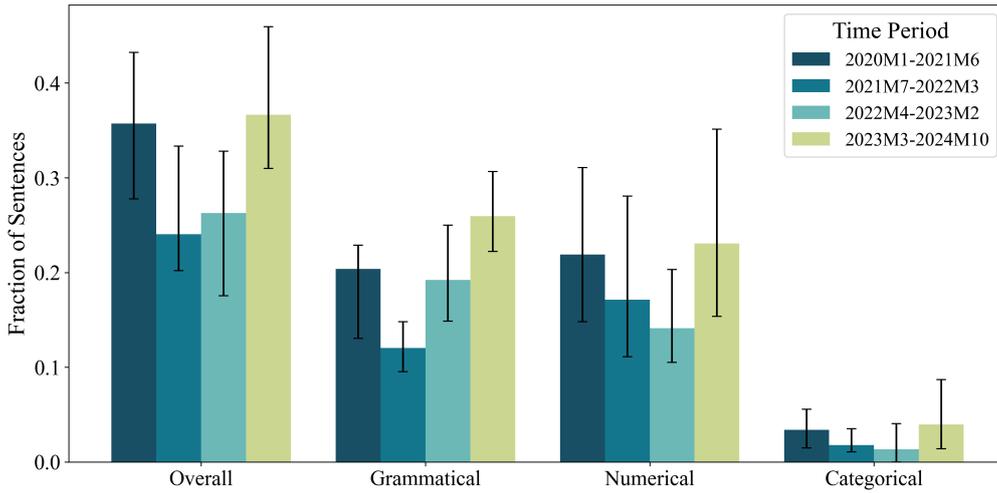


### (b) References to the Future
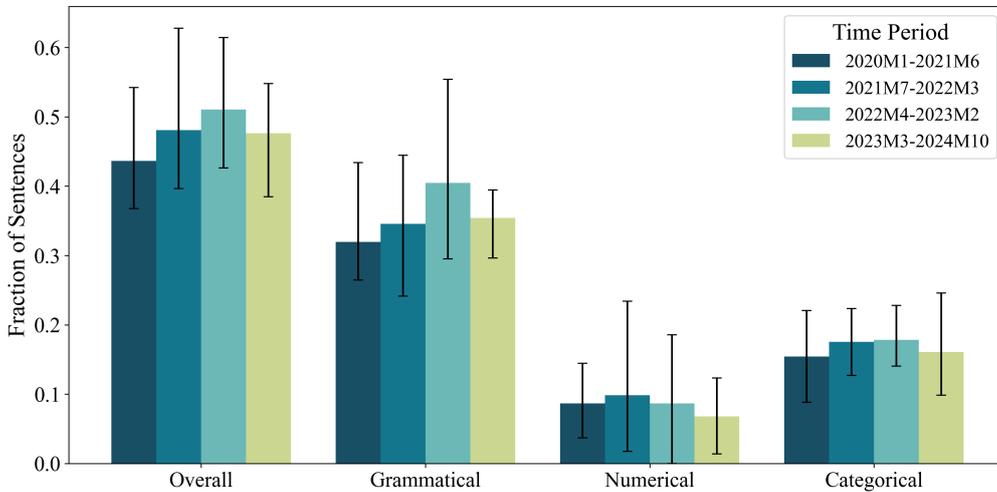


Notes: Figure shows averages across sub-periods of the fraction of sentences with temporal tags. We tag grammatical, numerical, and categorical references to time. The overall measure is the fraction of sentences with at least one tag of any type. Min-max ranges are also plotted for the sub-periods. The textual data are ECB Monetary Policy Statements.

We find that the post-2021 increase in references to the past is most pronounced in sub-sections relating to Projections, Inflation, and Monetary Analysis/Financing Conditions (see Appendix Figure A.3). From inspection of the statements, we have found these effects to be driven by increasingly developed discussions of recent data, as the ECB focussed more on communicating its data-dependent approach as it neared the end of its policy rate increases. Notably, the increase in past references to the inflation topic occur just as the ECB introduced its three criteria, and reflect focussed discussions of data during the inflation surge.

To give a concrete example, our algorithm identifies seven grammatical references to the past in the July 22nd 2021 Monetary Policy Statement, only two of which included references to past data ("the economy rebounded", "Inflation was 1.9 per cent in June"). This was the statement immediately after the Strategy Review. However, in the statement of September 12th 2024 three years later, we detect 24 uses of the past tense, many of which relate to the discussion of recent data. Similarly, in the July 2021 statement we tag seven past numerical references, whereas in the September 2024 statement we tag 26 past numerical references, many of which can be found in the portions where inflation data and financing conditions are discussed. To demonstrate this point, Table 1 displays excerpts from the July 2021 and September 2024 statements, respectively, which allow us to compare the formulation of the paragraph immediately following the inflation sub-section. We observe that the discussion in September 2024 contains frequent, detailed references to past data, relative to the broad summary found during the discussion from 2021.

**The introduction of the three criteria consolidates previous trends in temporal orientation, and does not represent a structural break in temporal focus.** While our indicator of temporal references to the past shifts sharply immediately following the ECB 2021 Strategy Review, we do not observe evidence for similar shifts in response to the introduction of the three criteria of the reaction function, introduced in March 2023.[18] The previous increases in past focus, which were already underway after the reductions in 2021, continue throughout the period nonetheless. Therefore, at least as far as temporal focus is concerned, the three criteria can be viewed as a consolidation of previous communication strategies, rather than a step-change in approach.[19]

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approach, such as the popular LDA algorithm (Blei et al., 2003). The subsections are: "Decision/Monetary Policy Rationale", "Projections", "Economic Analysis", "Fiscal Policies", "Inflation", "Balance of Risks", "Monetary Analysis/Financing Conditions", "Cross Check", and "Strategy". We do not report estimates for "Fiscal Policies", "Cross Check", and "Strategy", since these paragraphs are short, and our measures display high volatility, and many null values, with no temporal references. There are also several discursive categories that we do not analyse: "Title", "Introduction", "Pleasantries", "Conclusion".

[18] See the final two years of the sample in Appendix Figure A.1a.

[19] In order to assess robustness across other forms of communication, we also examine the speeches of Executive Board members. Results are displayed in Appendix Figure A.4. While the heterogeneous nature of these data generate noisier estimates, we do report some evidence that ECB speeches became more past-focussed, and less future-focussed, during the inflation surge period in which communications followed a data dependent approach.

Table 1: Comparison of Grammatical and Numerical References to the Past in Monetary Policy Statements

| **July 2021 MPS Excerpt** |
|---|
| *Inflation* **was**[G] *1.9 per cent in* **June**[N]. *We expect inflation to increase further over the coming months and to decline again next year. The current increase is largely being driven by higher energy prices and by base effects from the sharp fall in oil prices at the start of the pandemic and the impact of the temporary VAT reduction in Germany* **last year**[N]. *By early 2022, the impact of these factors should fade out as they fall out of the year-on-year inflation calculation.* |
| **September 2024 MPS Excerpt** |
| *According to Eurostat's flash estimate, annual inflation* **dropped**[G] *to 2.2 per cent in* **August**[N], *from 2.6 per cent in* **July**[N]. *Energy prices* **fell**[G] *at an annual rate of 3.0 per cent, after an increase of 1.2 per cent in* **the previous month**[N]. *Food price inflation* **went**[G] *up slightly, to 2.4 per cent in* **August**[N]. *Goods inflation and services inflation* **moved**[G] *in opposite directions. Goods inflation* **declined**[G] *to 0.4 per cent, from 0.7 per cent in* **July**[N], *while services inflation* **rose**[G], *to 4.2 per cent from 4.0 per cent.* |

Past Tags:  [G] – grammatical    [N] – numerical

Notes: Tagged excerpts from two Monetary Policy Statements of the ECB. These excerpts are the paragraphs immediately following the "Inflation" sub-section.

**While the ECB focusses on the past largely to the same extent in 2024 as it did prior to the Strategy Review, the semantic complexity of its discussions has fallen on a persistent basis.** The restoration of discussions of the past following the inflation surge was not accompanied by increases in semantic complexity. In Figure 2, we display the Flesch-Kincaid measure of semantic complexity for our corpus. We observe a sharp fall in 2021, as the statement was streamlined. The fall in semantic complexity is persistent.

**Measures of conceptual complexity, however, have risen steadily since early 2022.** When we consider the CCI of McMahon and Naylor (2023), we can observe two key features. Firstly, this measure underwent a notable decline between 2019 and 2022. Changes implemented as part of the 2021 Strategy Review did not lead to an abrupt change in conceptual complexity, as is evident for semantic complexity. However, as we move into the hiking cycle, conceptual complexity increases again, stabilising at levels that are comparable to the period before 2019. The increase in conceptual complexity likely reflects the particularly complex economic environment following the pandemic and Russia's invasion of Ukraine, and a reaction function that had become more sensitive to incoming data.

Figure 2: Measures of Complexity of the Monetary Policy Statement

CCI and Flesch-Kincaid Grade Over Time
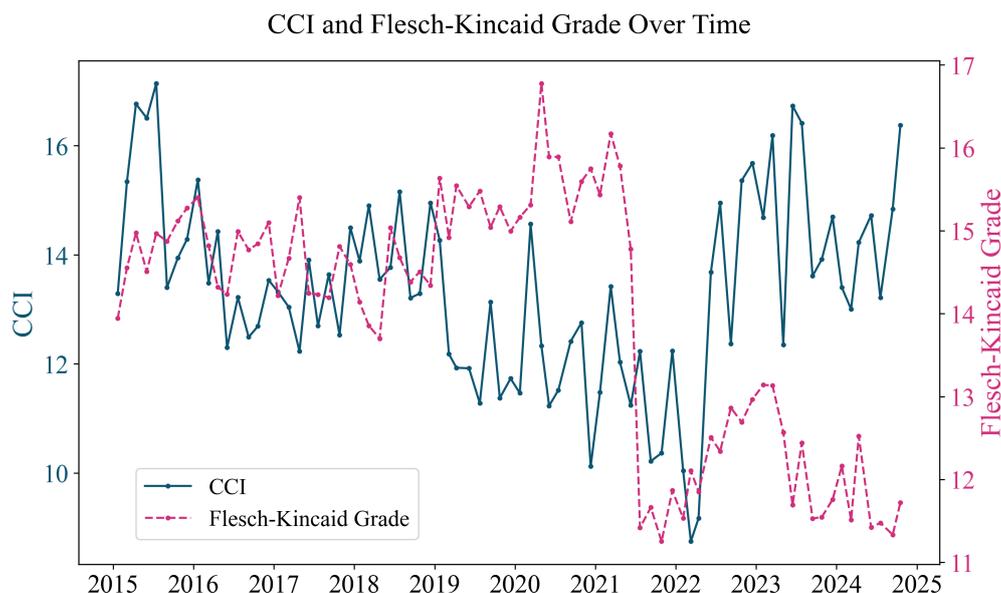


Notes: Figure shows the time-series of indicators of complexity: (1) the Conceptual Complexity Index (CCI); (2) the Flesch-Kincaid index (right-hand y-axis). The textual data are ECB Monetary Policy Statements, 2015-2024.

# Conclusion

In this Letter we have studied recent shifts in ECB communication through the dimensions of temporality and complexity. By isolating references to time in ECB Monetary Policy Statements, we have uncovered two major patterns. First, efforts to streamline the Monetary Policy Statement as part of the 2021 Strategy Review led to an immediate reduction in discussions of the past. Second, the shift towards data-dependence during the hiking cycle was accompanied by a re-incorporation of such discussions. This occurred because reforms introduced to simplify the Monetary Policy Statement had the side-effect of removing detailed evaluation of recent data. With inflation increasing following a sequence of complex shocks hitting the euro area economy, the Governing Council re-introduced such evaluation. It became increasingly necessary for the ECB to make clear its reaction function and its assessments of the incoming data.

We have also documented that a previous secular downward movement in conceptual complexity was unwound during the data-dependence period, with the measure rising during the hiking cycle. Overall our evidence suggests a communications trade-off. While ECB policymakers may have judged it necessary to focus more on discussions of the reaction function, this shift was accompanied by increases in conceptual complexity. This suggests that policymakers must carefully balance the need to provide more information regarding their reaction function at particular points in time, against the risk of reducing comprehension. A full normative treatment of this issue is left for future work.

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# Appendix

Figure A.1: Temporal References in the ECB Monetary Policy Statement
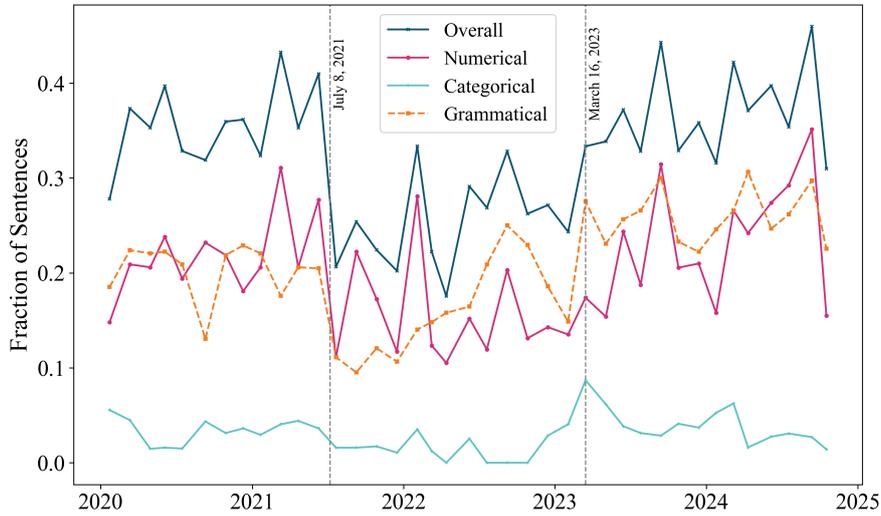
(a) References to the Past



(b) References to the Future
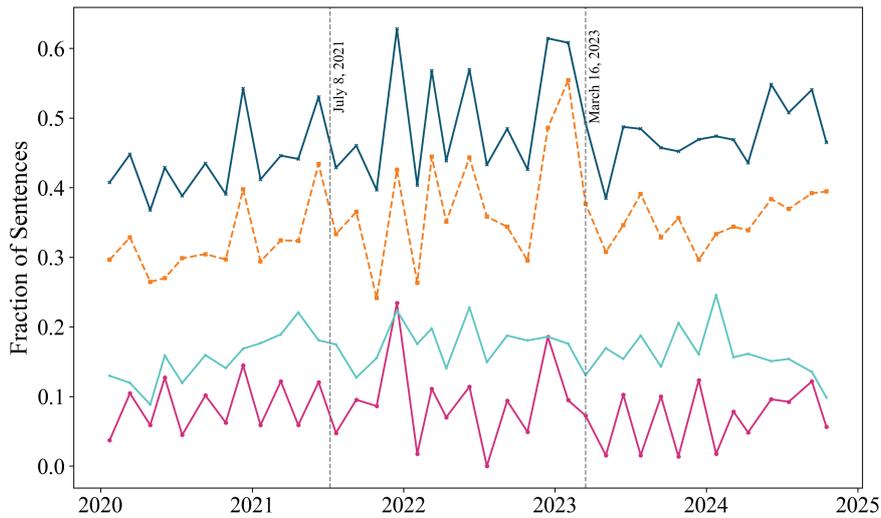


Notes: Figure shows the time-series of indicators of the fraction of sentences with temporal tags. The textual data are ECB Monetary Policy Statements, 2020-2024. We tag grammatical, numerical, and categorical references to time. The overall measure is the fraction of sentences with at least one tag of any type.

Figure A.2: Temporal References in the ECB Monetary Policy Statement - Longer Time-Span
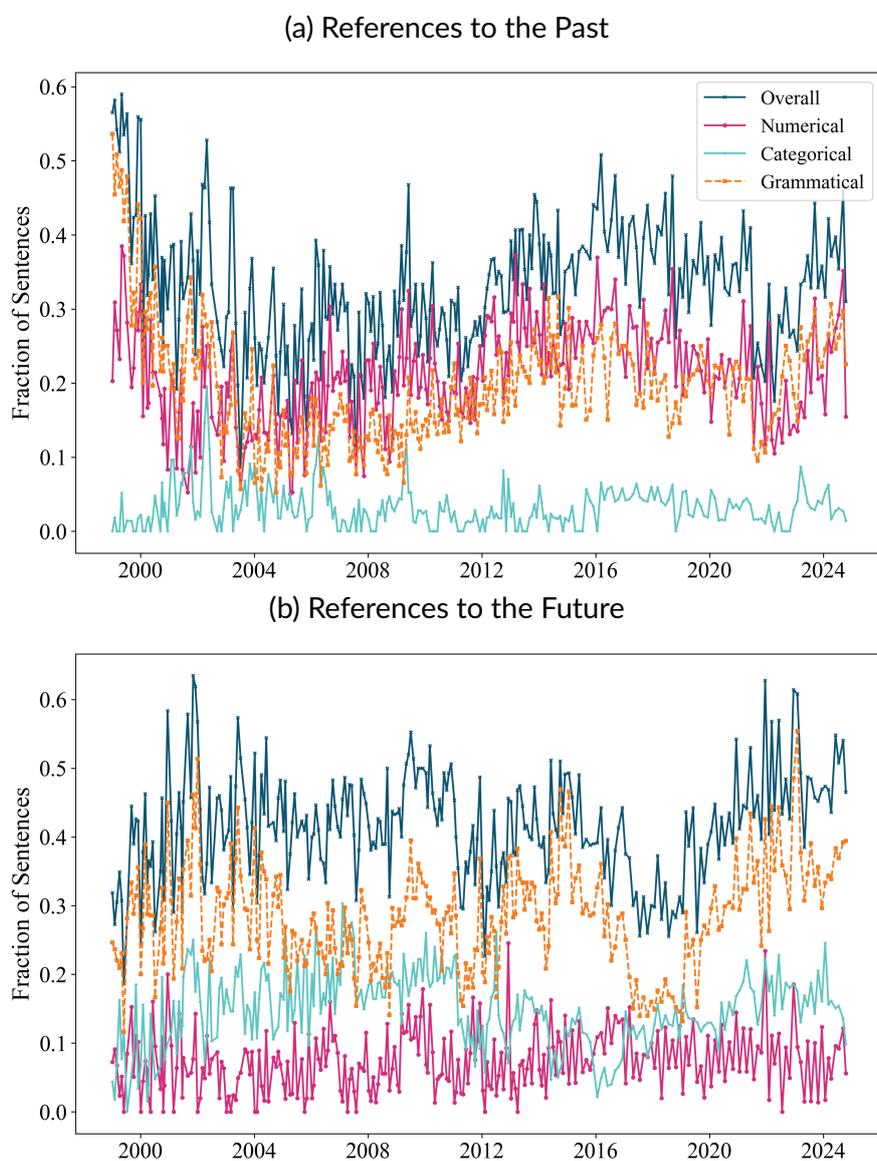
(a) References to the Past



(b) References to the Future



Notes: Figure shows the time-series of indicators of the fraction of sentences with temporal tags. The textual data are ECB Monetary Policy Statements, 1997-2024. We tag grammatical, numerical, and categorical references to time. The overall measure is the fraction of sentences with at least one tag of any type.

## Figure A.3: References to the Past by Topic
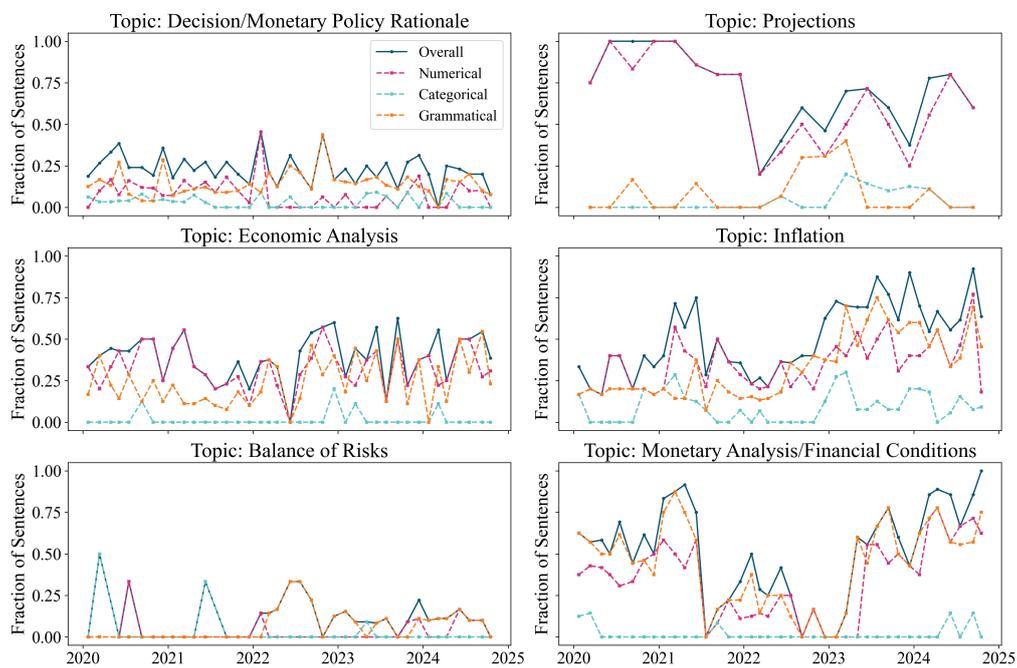


Notes: Figure shows the time-series of indicators of the fraction of sentences with temporal tags. The textual data are ECB Monetary Policy Statements, 2020-2024. Prior to computing time-series, the sentences are separated into topics. We do this manually by dividing statements into broad sub-sections. We tag grammatical, numerical, and categorical references to time. The overall measure is the fraction of sentences with at least one tag of any type.

## Figure A.4: Temporal References in ECB Executive Board Speeches

### (a) References to the Past
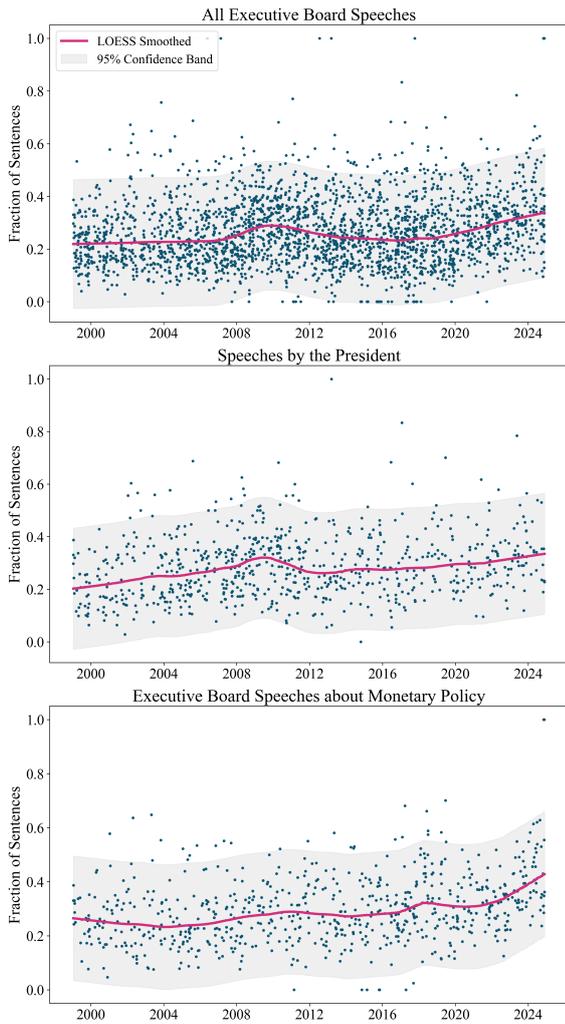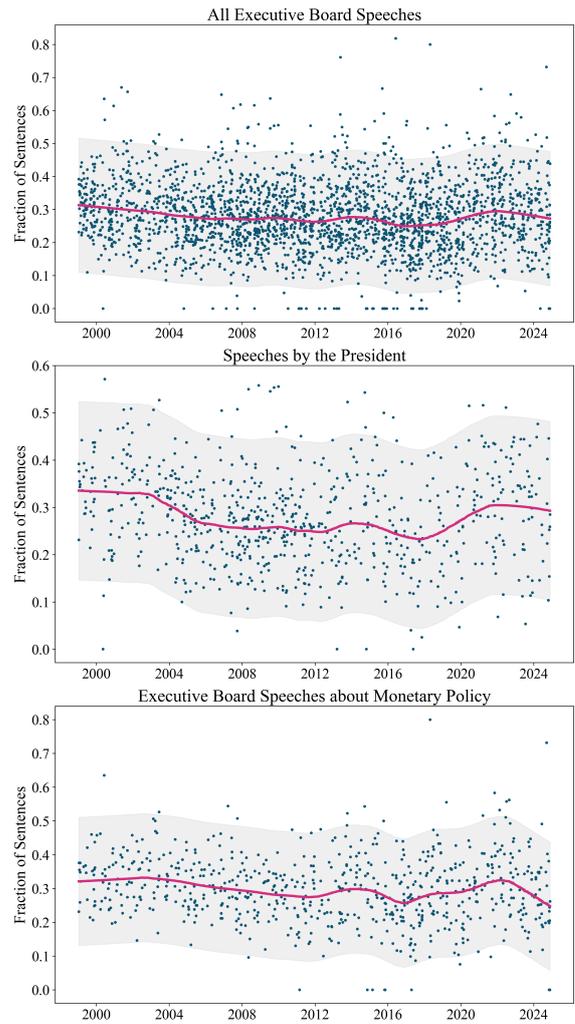


### (b) References to the Future



Notes: Figure shows the time-series of indicators of the fraction of sentences with temporal tags. The textual data are ECB Executive Board Speeches, 1999-2024. We tag grammatical, numerical, and categorical references to time. We display the overall measure, which is the fraction of sentences with at least one tag of any type.