

RESEARCH ARTICLE

Taking the pulse of reform: what can a multi-channel analysis of media and parliamentary speeches tell us about public acceptability?

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Abstract

Gauging the extent of public acceptability of reforms is an important concern for policymakers. Timely insights into public perceptions can illuminate how reforms are received and how attitudes evolve over time. In this study, we build on the OECD's Public Acceptability Tool, a framework encompassing four key dimensions of reform acceptability—*Economic*, *Fairness*, *Behavioural*, and *Process*—to evaluate the public acceptability of policy reforms. We take the 2023 French pension reform as a relevant case study, using online media articles and parliamentary speeches as indicators of discourse surrounding the reform. Using word embeddings, we classify these texts according to the four dimensions and apply matrix factorisation topic algorithms to uncover the latent themes within each. Our analysis shows that the *Process* dimension dominated media coverage during the discussion and legislative phases of the reform, consistent with previous literature on pension reforms. In contrast, no particular dimension was predominant in parliamentary speeches, suggesting a mismatch between policy and public debates. Finally, we identify the main topics driving public discussion within each dimension, highlighting notable differences between media narratives and parliamentary discourse that offer further insight into the dynamics of public acceptability.

Policy Significance Statement

Our policy analytics approach explores the dynamics of public debate around a specific, but highly significant, reform by analysing the content of media articles and parliamentary speeches. By applying factorization and related text-analysis techniques, we identify key focal points and compare how the two corpora frame the reform. This methodology illustrates how computational text analysis can be used to monitor and characterise evolving public narratives about policy issues. The insights gained provide a descriptive understanding of public discourse, offering a nuanced view of how different audiences perceive and discuss reforms over time.

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1. Introduction

1.1. Tackling the issue of public acceptability

Countries face increasingly urgent challenges as a result of megatrends, including population aging, climate change, rising inequalities, and the digital transition (OECD, 2024a). The need for policy action to address these challenges is rarely questioned. However, building sufficient public support for necessary reforms in these areas has proven difficult (Duval et al., 2018; OECD, 2019). This paradox has come to be known in policy and public circles as the “Juncker Curse,” following the famous quote by the former President of the European Commission, Jean-Claude Juncker: “*We all know what to do, we just don’t know how to get re-elected once we have done it*” (Buti et al., 2009). It has also led to renewed interest in the political economy of reform and to a growing focus on the role played by public perceptions and attitudes towards policy as important “demand-side” determinants of the acceptability of reforms (Grelle and Hofmann, 2024).

Many of the international organizations tasked with advising policymakers have taken up the research agenda on the public acceptability of reforms. In 2021, the OECD established an interdisciplinary expert group to take stock of the emerging literature and body of evidence on public acceptability.¹ One main outcome was the development of the *Public Acceptability Tool* (PAT), designed to act as a “compass” for policymakers, supporting them in designing reforms that are well-aligned with public views and needs. In doing so, it identifies four key dimensions that policymakers need to take account of when assessing the public acceptability of reforms: the *Economic*, *Fairness*, *Behavioural*, and *Process* dimensions (OECD, 2025).

As a complement to the PAT, OECD (2025) also highlights the potential and the value for policymakers of developing a tool aimed at taking the public’s pulse on reform through the analysis of citizens’ responses to concrete reform proposals. This article presents a policy analytics pipeline that serves as a proof of concept and possible basis for such a tool. The pipeline draws insights for policy from relevant textual data using natural language processing (NLP) techniques. It demonstrates how relevant information on public opinion and acceptability can be obtained from nontraditional data. By doing so, it can contribute to complementing traditional surveys characterised by high costs and limited timeliness.

Nontraditional data, such as social media, internet search trends, and digital news, offer continuously generated, non-mediated insights into public sentiment and emerging concerns (Salganik, 2019; Ferg et al., 2021). These sources allow policymakers to dynamically gauge the public’s reaction to proposed reforms. Using the sources might not only enhance the granularity of the analysis but also help identify public concerns, complementing traditional information-gathering tools.

1.2. Policy analytics as a method for addressing this issue

Over the past decades, novel approaches have been developed to improve evidence-based policymaking and assist policymakers in making informed decisions (OECD, 2020). Building data systems to support evidence-based policymaking is not in itself a new idea. An older expression of the same idea can be found, for instance, in the RAND Corporation’s system analysis, which served as the methodological basis for social policy planning and analysis and for the efficient operation of municipal services (Jardini, 1996). However, traditional approaches to evidence-based policymaking have been limited in dealing with the complexity of current government practices. Policy analytics have been put forward as a promising alternative approach, defined as the “skills, methodologies, methods and technologies, which aim to support relevant stakeholders engaged at any stage of a policy cycle, with the aim of facilitating meaningful and informative hindsight, insight and foresight” (Tsoukias et al., 2013). Proponents of policy analytics have notably underlined the advantages they present in terms of being meaningful (relevant and

¹ The *OECD Expert Group on New Measures of the Public Acceptability of Reforms* brought together experts from academia, international organisations, national governments, and civil society organisations. It sought to explore how relevant insights from the literature and experimental evidence could be harnessed to (i) improve the design and communication of inequality-reducing policies and (ii) integrate considerations of public acceptability more systematically into the reform process.

adding value to the process), operational (practically feasible), and legitimating (ensuring transparency and accountability) (De Marchi G et al., 2016). Policy analytics combine advanced data mining and learning methods, often further enhanced by access to big data, with decision support systems. As such, they present the opportunity to embed analyses to inform decisions throughout the policy cycle, for instance, by enabling a better identification of issues, predicting the possible impacts of policies, improving policy design, simulating policy implementation, and supporting the evaluation and monitoring of implemented policies (Tsoukias et al., 2013).

Examples of the application of policy analytics have grown considerably in the past decades (Deloitte, 2016). Many recent applications have drawn on NLP techniques, enabling analysts to process large quantities of unstructured textual data systematically and yielding meaningful insights for guiding future-oriented policy decisions (Grubmüller et al., 2013). One relevant application area consists of the detection of emergent topics that require the attention of policymakers. For instance, the World Health Organization developed its Early Artificial Intelligence–Supported Response with Social Listening (EARS) platform to inform infodemic management and response by analysing social media during the COVID-19 pandemic (White et al., 2023). By combining a taxonomy on public health based on expert views and NLP technology into a platform for social listening, the tool enabled a better understanding of global narratives relating to the pandemic.

This article proposes a new policy analytics pipeline based on NLP techniques to better understand the public acceptability of reforms. In particular, the research question addressed in this study is the following:

RQ: How can media and parliamentary speeches be analysed to generate insights into the public acceptability of a policy reform using the OECD Public Acceptability Tool framework?

1.3. The main contributions of this article

This article presents a policy analytics pipeline that aims to make sense of textual data relating to a reform, with a specific focus on online news media articles and parliamentary speeches. News media articles from different outlets provide information on the narratives developed and adopted across the political spectrum (Shanahan et al., 2018). Parliamentary speeches provide information on how policymakers view and discuss the same issue and reform. Leveraging data from the most-read French outlets and from the National Assembly, this article takes the 2023 French pension reform as a case for studying the public acceptability of reforms. The article applies word embeddings to classify texts according to the dimensions of the OECD PAT and uses non-negative matrix factorisation (NMF) and coupled matrix factorisation (CMF) to uncover topics within media articles and parliamentary debates. In doing so, this article provides a concrete illustration of how nontraditional data and data science techniques can be leveraged to obtain relevant policy insights on a topic of high importance to governments and citizens alike.

The analysis of media content can provide useful information about public opinion, and hence about public acceptability. However, it is important to bear in mind that the relation between media, in particular digital ones, the public, and policymakers, is often complex and two-way. On the one hand, the media influence public opinion. They do so first by providing the information through which people think about events and issues (including the introduction of a new law in Parliament). They also contribute to determining the salience of topics in public debates and the degree of importance that people attach to them (McCombs, 2002; Barnes and Hicks, 2018). Traditional media studies have emphasised the role of news media as a primary source of the “pictures in our heads” about the larger world of public affairs, which is for most people “out of reach, out of sight, out of mind” (Lippmann and Curtis, 2017). Recent empirical evidence confirms that media content has an ambivalent effect on public views and policy preferences. Media can have a positive effect on public debate by informing people and helping them adjust their preferences in response to policy changes. However, the information provided can have the opposite effect, resulting in greater confusion over issues undermining the public’s capacity to understand and respond coherently to policy changes (Neuner et al., 2019).

On the other hand, the media also act as a conduit that brings public opinion into the public sphere and creates its representation in front of policymakers. This effect has become stronger with the advent of social

media, as traditional media started to increasingly respond to online audience demand (Jacobs and Shapiro, 2011). Further, the media also affect policymaking through their agenda-setting function (Walgrave and Soontjens, 2023), as well as by influencing the “scope of conflict” for policy debates (Grossman, 2022).

Parliamentary speeches offer a unique window into the policymaking process and can provide insights into the public acceptability of reforms. These speeches represent the official discourse of elected representatives and can reflect their personal views, as well as the positions of their parties, and the concerns of their constituents. By analysing parliamentary debates, researchers can track how policy proposals are framed, contested, and potentially modified in the legislative process (Erjavec et al., 2023). Doing so can reveal the main arguments for and against a reform, highlight areas of consensus and conflict, and indicate how policymakers anticipate and respond to public views. Moreover, parliamentary speeches often reference public opinion, media coverage, and expert testimonies, making them a rich source of information on the interplay between various stakeholders in the policy process (Poljak, 2024).

In representative democracies, these speeches act as political signals. They provide voters with important cues about how reforms should be interpreted: to what extent they align with different positions across the political spectrum, whether they are legitimate or desirable, and on what basis. They also participate in the formation of elite views, either by helping build consensus or, on the contrary, by underlining its absence and where the main lines of divide are. These political signals contribute in turn to shape public opinion. Differences in parliamentary discourse, therefore, reflect not only institutional constraints but also responsiveness to electoral concerns and interests, as well as attempts to set the narratives that frame them. In the context of this study, examining parliamentary speeches alongside media coverage can provide a comprehensive understanding of how the French pension reform was discussed and perceived in the public and policy spheres, potentially uncovering discrepancies or alignment between political discourse and media narratives.

To our knowledge, no research to-date has combined policy analytics and nontraditional data and applied them to the question of the public acceptability of reforms. The original nature of our analysis, combined with the work previously done by the OECD in conceptualising the public acceptability of reforms and identifying its main determinants, places this research at the intersection of research in data science and applied public policy. The pipeline presented here is novel and exploratory but builds on the proven potential of NLP-based policy analytics to support evidence-based policymaking. It can serve as a basis for developing a social listening tool that can be applied in specific contexts to monitor public responses to ongoing reform proposals. Integrating social listening tools of this kind into existing policy processes and public communication infrastructure would provide valuable insights for policymakers (Kim and Shim, 2020).

2. Methodology

2.1. The OECD Public Acceptability Tool as a framework for analysis

In 2021, the OECD set up its interdisciplinary *Expert Group on New Measures of the Public Acceptability of Reforms* to take stock of recent advances in this emerging field and explore its potential for improving policy advice. The focus of the Expert Group was on developing policy tools that can help integrate considerations of public acceptability more systematically into the reform process and on identifying relevant sources of data. Its main output consisted of a proposed OECD PAT, designed to act as a “compass”² that can help policymakers:

² The PAT builds on previous OECD work on the political economy of reform across a wide range of policy areas. In particular, it aims to extend the 2006–2010 *Making Reform Happen* exercise, which identified general lessons for the successful implementation of reforms based on cross-country econometric analysis and in-depth case studies of successful and failed reform episodes. These lessons notably highlighted the central importance of public support in enabling durable reform. The main contribution of the PAT consists in incorporating the insights from new data sources and experimental methods to offer a framework that takes better account of the “demand side” of reform and helps policymakers integrate these insights more systematically into the planning and design of policy reforms. One key implication of taking public acceptability seriously is the need for governments to put greater emphasis on

- Map the growing body of evidence provided by perceptual and behavioural data to the main dimensions that matter for understanding public acceptability; and
- Harness the insights from these data to improve the design and communication of needed reforms.

Based on the existing literature, the PAT identifies four key dimensions that are essential for understanding public acceptability across reform areas.

1. *Economic dimension*, which covers the expected net economic impact of a reform on different groups and how it is perceived by the public.
2. *Fairness dimension*, which covers the expected distributional impact of a proposed reform and citizens' views on its overall fairness, including broader evaluations on deservingness and burden-sharing across groups.
3. *Behavioural dimension* of social change, which considers the “demands” that reforms make on individuals, alongside their capacity and willingness to adapt. The PAT identifies behavioural barriers that may undermine the case for reform and limit public support. Some of these barriers vary across reform areas. For the purpose of the analysis conducted in this article, we focus on a subset of behavioural barriers, deemed most relevant for the case studied (i.e., pension reform), termed the “Risk and time” dimension.³
4. *Process dimension*, which aims to capture the sense of legitimacy that a given reform can draw, or not, from the institutional and political processes used to design, implement, and justify it.

The PAT aims to provide a general framework for assessing the public acceptability of reforms, in line with existing models of this type in the literature on political economy (Stokes, 1996).⁴ Its design builds on numerous recent studies focusing on the public acceptability of reforms across policy areas, such as structural reforms (Duval et al., 2018; Alesina et al., 2024), climate policies (Dabla-Norris et al., 2023; Hoy et al., 2023), labour regulation (Duval et al., 2024), and fiscal reform (Bierbrauer et al., 2021; Hoy, 2022). It emphasizes economic impacts and fairness as key dimensions through which citizens assess reform outcomes, supported by evidence on equity-efficiency trade-offs in structural reforms (Causa et al., 2015; Ostry et al., 2021) and experimental findings on perceived efficiency and equity in climate (Maestre-Andrés et al., 2019; Dechezleprêtre et al., 2022) and tax policies (Stantcheva, 2021). The framework also considers behavioural barriers that can limit public support, a focus in the literature on health interventions where addressing such barriers is crucial (Diepeveen et al., 2013; Reynolds et al., 2019). Finally, it includes a process dimension, highlighting how institutional and political factors influence legitimacy, public support, and reform outcomes, as established in political economy studies (Williamson, 1994; Persson et al., 2000) and supported by empirical evidence (Tompson and Price, 2009).

In this article, we build on PAT and operationalise it through an analytics pipeline that demonstrates its potential application to support real-world reform.

2.2. The case study: The 2023 French pension reform

We combined the framework provided by the PAT with the analysis of nontraditional data to extract information on the public acceptability of reform through a retrospective study of a recent and relevant case: the 2023 French pension reform. The reform was announced by President Macron in his 2022

“social listening” and upstream consultation of citizens and stakeholders, as opposed to ex-post communication once a reform is designed and tabled. For a detailed account of the rationale for and development of the PAT as well as ongoing work by the OECD and other international organisations on the political economy of reform, see OECD (2025).

³ The *Risk and time dimension* covers the inter-temporal arbitrage between the short-term costs and long-term benefits of reforms, how people understand the causal relation between the two, and what narratives governments and opponents use to frame their understanding of this relation.

⁴ A more in-depth discussion of the strengths and limitations of this type of general framework, as well as alternative approaches for assessing the public acceptability of reforms, can be found in OECD (2025).

end-of-year speech and introduced in Parliament in February 2023. It was finally adopted in March 2023 through the application of Article 49.3 of the French Constitution, which allows the government to commit its responsibility and pass an executive proposal (*projet de loi*) into law without parliamentary approval, but subject instead to a vote of no-confidence in the government (*motion de censure*). The key elements of the reform included (i) an increase in the minimum legal retirement age from 62 to 64 years, introduced incrementally over a period of 7 years, and (ii) an increase in the necessary contribution period for a full pension to at least 43 years of work.

This case is relevant for the analysis for various reasons. First, the French pension reform was in line with the type of reforms put in place in many comparable countries. In recent years, the legal retirement age has risen in more than half of the OECD member states (OECD, 2023). Second, public acceptability was a critical issue in this case, as the reform sparked widespread opposition and remained under threat of repeal even after it was passed into law (Kagni, 2024). Reflecting this, the implementation of the reform has been temporarily suspended by a subsequent law passed by the French National Assembly on 12 November.⁵ Finally, it followed many national reform efforts in the same field, including two parametric reforms in 2010 (*Loi Woerth*) and 2014 (*Loi Touraine*), as well as a proposed systemic pension reform in 2019, withdrawn during the COVID-19 pandemic.

The four dimensions of the PAT featured prominently both in the government's case for reform and in public debates surrounding it. As such, the PAT constitutes a useful lens for understanding this case.

- *Economic dimension*: The reform aimed to ensure the financial sustainability of the French pension system and eliminate its projected deficit by 2030, addressing concerns over the high level of public expenditure on pensions (13.4% of GDP) compared to the OECD average (7.7%) (OECD, 2023).
- *Fairness dimension*: The government also built its case for reform on fairness grounds, emphasising its role in maintaining the French “pay-as-you-go” system, preserving intergenerational solidarity, and protecting vulnerable populations (Ficek, 2023). Despite this, criticism of the reform in the public debate focused mainly on issues of fairness, notably in terms of its impact on gender equality and on different occupations (Vazquez, 2023).
- *Behavioural dimensions* (limited in our case to risk and time): The behavioural complexities typical of pension decisions were taken into account, to a degree, in the design of the reform, which allowed for a gradual implementation to allow people time to adjust to the new parameters (Government of France, 2023). However, the balance between the present and future benefits was often criticised (Poznanski, 2024).
- *Process dimension*: The case for reform sought to build legitimacy from the fact that President Macron had a clear electoral mandate for pension reform (Macron, 2022). Opponents drew on the use of Article 49.3, an exceptional procedure that bypasses parliamentary approval, to contest the legitimacy of the reform in public debates (Mathieu, 2023).

To operationalise public acceptability in line with the OECD's PAT, we defined a list of keywords for each dimension (available in Supplementary Materials, Annex A). The keywords have been identified in a two-step process. First, a set of keywords was defined by OECD domain experts for each dimension, a priori with respect to reading the corpora used as an input to this research. These keywords were selected for the specific purpose of analysing textual data on the pension reform; hence, they aimed to provide a general description of the dimensions of the framework (i.e., *productivité, discrimination, futur, démocratie*) and explicitly cover topic-specific aspects (i.e., *emploi, régime spécial, ajustement automatique, motion de censure*). These sets of keywords were then used to filter media articles along each of the four dimensions and select only the documents that contained relevant keywords. The keyword selection was

⁵ Article 45 bis of the Social Security Financing Act for 2026 (*Projet de loi de financement de la Sécurité sociale pour 2026 – PLFSS*) postpones the implementation of the measures included in the 2023 pension reform till January 2028. Of particular relevance, this means that the final status of the reform will be contingent on the results of the next presidential elections, which will be held around April 2027, with President Macron unable to run due to term limits.

conducted by experts through a consensus-based process. This collaborative approach ensured alignment with both the conceptual underpinnings of the PAT framework and the specific discourse context of the pension reform. At this point, we performed topic modelling on these subsets of articles, which provided us with a list of topics and related topic descriptors for each of the four dimensions. The topic descriptors of the four topic models were systematically reviewed and binarily classified by domain experts into the four categories. Descriptors that did not align with any dimension were excluded, and while descriptors could theoretically be associated with multiple dimensions, no overlaps were observed during this process. This classification constituted the second step of our two-step keyword identification strategy. The whole two-step process allowed us to obtain final sets of keywords that combine theoretical relevance—as the first set of keywords used for filtering was informed only by the reflections of domain experts—and relevance to the corpus, thanks to the consideration of the topic descriptors.

2.3. The data

We used news media articles published online by a set of the most-read French media outlets as input to this analysis. We complemented these data with parliamentary speeches. In this way, we were able to assess the differences between the two corpora and hence to characterise differences in the way in which the pension reform was discussed in the media and in Parliament.

Our dataset of online media articles consisted of 75k publications about pensions published between November 2022 and June 2023 by French outlets. We retrieved them from the Global Database of Events, Language, and Tone (GDELT⁶), querying for all records whose Themes or V2Themes contained references to pensions or retirement, and we retained only those published by French outlets, identified via GDELT's FIPS country code for France (FR) or a “.fr” domain. We then filtered the articles to include only those from 10 selected influential sources,⁷ identified from the French Alliance for Press and Media Statistics (ACPM) and Statista's consumer surveys. This selection resulted in a final set of 10,141 articles published over the relevant period. To obtain the text of the articles, we analysed the link obtained on GDELT with the Newspaper3k⁸ Python library.

We retrieved data on parliamentary speeches from the open data portal of the French National Assembly,⁹ collecting those on the debates in public sessions in the relevant period. We then filtered them to retain only (i) speeches from sessions specifically dedicated to the 2023 pension reform, identified by analysing the session titles, and (ii) speeches that mentioned “*retraite*,” regardless of the session title. The final dataset contains 1392 speeches.

All textual data in our study were pre-processed for consistency and noise reduction. We used spaCy to perform lemmatisation, reducing inflectional and derivational forms to their base forms (Honnibal, 2015). Stop words were removed to filter out commonly used words that carry little semantic value. Punctuation was also excluded to eliminate non-essential symbols. A detailed description of the preprocessing pipeline is available in [Appendix A](#).

The distributions over time of the media articles and parliamentary speeches we retrieved do not present the same dynamic. [Figure 1](#) shows the daily number of news media articles and parliamentary speeches considered in our analysis. The volume of articles increased from the moment the reform was introduced into the public sphere by the French President Emmanuel Macron in the annual presidential New Year's Eve speech on 31 December 2022. After a small drop in volume around the beginning of March, attention then peaked in the weeks in which the reform was enacted into law, after Article 49.3 was invoked by the government of Prime Minister Élisabeth Borne. Overall, media articles show a clear dynamic over time. On the contrary, the parliamentary speeches we are working with are sparsely

⁶ <https://www.gdeltproject.org>

⁷ The selected sources were: Le Monde, Libération, L'Equipe, Le Figaro, Les Echos, La Tribune, L'Humanité, La Croix, Le Point, and Le Parisien

⁸ <https://newspaper.readthedocs.io/en/latest/>

⁹ <https://data.assemblee-nationale.fr>

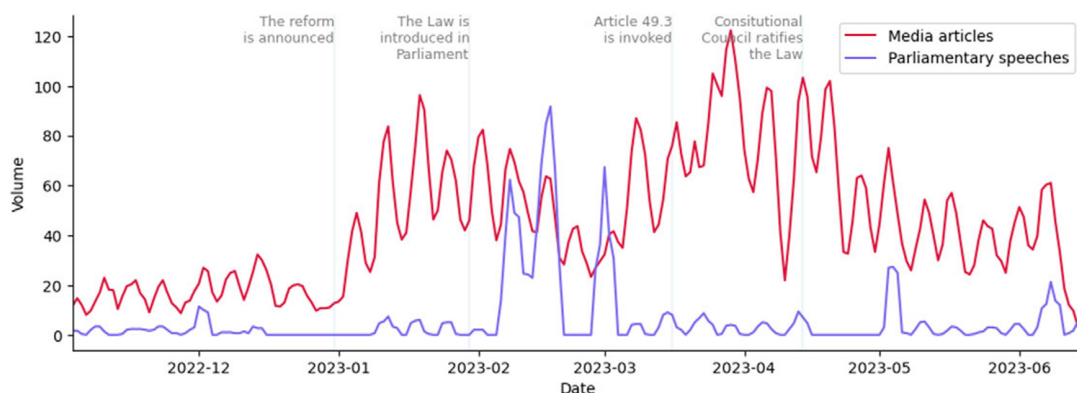


Figure 1. Daily number of news media articles and parliamentary speeches about pensions.

distributed. This characteristic derives from the fact that our data are from the debates in public sessions of the National Assembly. As shown in the plot, many of the parliamentary speeches we collected are condensed in the period between February and the early days of March 2023.

2.4. Document selection

After obtaining news media articles and parliamentary speeches about the reform, we aimed to identify which documents pertain to the four dimensions of the PAT. For this task, we drew inspiration from the field of document retrieval and developed a document ranking method leveraging word embeddings—whose details are presented below and in [Appendix A](#).

First, we trained a Word2Vec model on the two corpora using the Continuous Bag-of-Words (CBOW) model (Mikolov et al., 2013). Word2vec is an NLP technique that generates vector representations of words, capturing semantic relationships based on their surrounding context. By maximising the log conditional probability of a word given its neighbouring words within a fixed-sized window, the CBOW model learns embeddings for each word in the corpora. This results in vector representations for every word in our datasets.

Given a document D comprising a set of words $d_1, d_2, \dots, d_N$, we obtained an embedding representation of the document by computing the centroid of the word vectors. This approach provided a concise representation of the document as the average of its constituent word vectors:

$$\bar{D} = \frac{1}{|D|} \sum_{d_i \in D} d_i \quad (2.1)$$

To measure the relevance of each document to the four dimensions of the PAT, we calculated the similarity $S(W, D)$ between each document vector and the keywords w_i associated with each dimension of public acceptability W . To account for the frequency and specificity of keywords, we applied term frequency-inverse document frequency (TF-IDF) weighting. TF-IDF is a statistical measure that evaluates the importance of a word in a document relative to a collection of documents, increasing the weight of terms that are more specific and less frequent. This dampens the impact of common words and emphasises the importance of more specific and discriminative terms (Sparck Jones, 1972).

The formula for calculating the TF-IDF-weighted similarity score for a document embedding $\bar{D}$ with respect to a dimension W is as follows:

$$S(W, D) = \frac{\sum_{w_i \in W} \left(\frac{w_i \cdot \bar{D}}{\|w_i\| \cdot \|\bar{D}\|} \right) \times idf(w_i)}{\sum_{w_i \in W} idf(w_i)} \quad (2.2)$$

where $idf(w_i)$ is the TF-IDF weight of keyword w_i and denotes the Frobenius norm, which is used to compute the cosine similarity between the keyword embedding w_i and the document embedding $\bar{D}$. By computing this similarity for all the documents in the two corpora of news media articles and parliamentary speeches for each of the four dimensions, we were able to estimate how closely each article corresponds to each dimension. [Figure A1](#) illustrates the distribution of similarities for both news media articles and parliamentary speeches. To facilitate comparison across dimensions, we normalised the distributions between 0 and 1. For each dimension, we then kept the articles and parliamentary speeches with similarity values ≥ 0.9 . To ensure that our results are not overly sensitive to the choice of threshold, we tested the document selection and topic modelling pipeline using alternative cut-offs at 0.95 and 0.85 levels. These thresholds correspond to the top 5%, 10%, and 15% of the similarity *value* distribution, meaning that each dimension retains a different number of documents depending on how many exceed the similarity value. The resulting topic models showed strong convergence in topic structure and descriptors across thresholds, with only minor variations, as shown in [Appendix A](#). The 0.9 threshold is robust and strikes a balance by retaining a sufficiently large number of documents for meaningful topic modelling, while limiting the inclusion of potentially noisy or weakly relevant texts.

To evaluate the embedding-based document classification, we conducted a document intrusion task inspired by the word intrusion proposed by Chang et al. (2009). For each PAT dimension, we sampled 10 sets of four documents: three randomly drawn from those with similarity ≥ 0.90 for that dimension, and one intruder document drawn from documents with similarity ≥ 0.90 to a different dimension. Annotators were asked to identify the document that did not belong. This task assesses whether the documents selected as most relevant to a dimension form a semantically coherent group. Across dimensions, annotators correctly identified the intruder in 74.06% of cases on average, compared to a 25% random baseline expected if selections were made by chance (i.e., one out of four documents). We observed some variation across dimensions: *Process* and *Economic* documents showed the highest performance (92.5% and 87.5%, respectively) while *Risk and time* exhibited lower results (51.25%), still meaningfully above the 25% random baseline but substantially below the other dimensions. This weaker validation may reflect the more overlapping semantic space this dimension occupies in public discourse, as many of its core terms (e.g., those relating to long-term costs and intergenerational trade-offs) also appear in discussions of economic impacts and fairness. Consequently, findings pertaining to the *Risk and time* dimension should be interpreted with greater caution than those for the other three dimensions (see [Appendix A](#)). In general, these results indicate that the document similarity method yields dimension-specific document sets that are meaningfully coherent to human readers.

2.5. Topic modelling with NMF

After identifying documents related to the four dimensions of the PAT, we used topic modelling to uncover latent themes within these sets of documents. Topic modelling is a statistical technique that identifies underlying topics or themes in a collection of documents by analysing the frequency and co-occurrence of words. In this case, we utilised NMF, a classical technique for topic modelling, to extract meaningful insights from our document sets (Paatero and Tapper, 1994). The implementation was performed with the Python package Gensim (Rehurek and Sojka, 2011).

NMF is a dimensionality reduction technique that decomposes a non-negative matrix into two smaller non-negative matrices. Thanks to its non-negativity constraint, it lends itself well to interpreting data from physical applications (Lee and Seung, 1999) and has been extensively used in the field of text mining for topic modelling and document clustering (Pauca et al., 2004). We applied NMF to a term-document matrix where rows represent unique terms, columns represent documents, and the values indicate the TF-IDF frequency of each term in each document.

The NMF algorithm factorises the term-document matrix A into two matrices that capture the underlying structure of the data.

$$V \approx WH \quad (2.3)$$

The first matrix W , called the term-topic matrix, shows the importance of each term to each topic. The second matrix H , known as the document-topic matrix, represents the relevance of each topic to each document in the corpus.

NMF topic modelling requires selecting the number of topics. We chose to extract 10 topics for 2 reasons. First, our goal was to provide policy-relevant insights, and too many topics would reduce usability. Second, coherence analysis, which measures the semantic consistency of topics, showed that coherence decreased with a larger number of topics, making them harder to interpret. We ran this analysis both on the full corpus and on the filtered subsets used for dimension-specific topic modelling. As scores across different coherence measures declined monotonically with increasing number of topics k , we opted for a relatively low number of topics ($k = 10$). While even smaller values of k produced high coherence scores, they lacked sufficient granularity for policy insight. Conversely, higher values led to fragmented and less interpretable topics. Choosing $k = 10$ thus provided a balance between semantic coherence and interpretive usefulness. Details of the coherence analysis and model stability checks are provided in [Appendix A](#).

In line with recommendations from the literature on topic model evaluation, we complemented the coherence analysis with a word intrusion task to assess the semantic interpretability of the learned topics (Chang et al., 2009; Ying et al., 2022). For each topic, we presented eight human annotators with sets of six terms: five high-probability words drawn from the topic and one intruder word sampled from a different topic with low probability weight. Annotators were instructed to identify the intruder, and accuracy is taken as a measure of topic coherence. Across dimensions, annotators selected the correct intruder 71.88% of the time on average, substantially higher than the 16.7% random baseline expected under uniform guessing. While performance was consistently above baseline for all dimensions, we observed modest variation: topics associated with the *Fairness* and *Process* dimensions showed the highest accuracy, whereas topics in the *Risk and time* dimension scored slightly lower (see [Appendix A](#)). These results indicate that the topics identified by the NMF models are interpretable and meaningful to human readers, while also highlighting areas where themes may be more conceptually entangled.

It is worth noting that the word intrusion task, like the document intrusion one, seems to favour dimensions with more lexically distinctive vocabularies. For instance, a dimension like *Process* employs vocabularies that are relatively specialised and distinguishable, whereas *Risk and time* shares substantial lexical ground with *Economy* and *Fairness*, with terms relating to costs, benefits, and intergenerational equity. As a result, the validation scores may also reflect the degree of lexical separability between dimensions rather than solely the conceptual validity of the PAT framework as applied to this corpus. This distinction is important for interpreting the results: dimensions that validate strongly may do so in part because their vocabulary is more distinctive, not necessarily because the underlying concept is better represented in the data.

By training topic models for each dimension of public acceptability and for each corpus obtained by selecting the most relevant decile of documents, we uncover latent topics that characterise the discourse within each dimension. Moreover, by incorporating temporal information on the publication dates of articles and the dates of parliamentary speeches, we are able to analyse the evolution of these topics over time and track their evolution in relation to significant events.

2.6. Corpora comparison with CMF

Beyond analysing topics linked to each dimension of the PAT, we aim to detect analogies and differences in the way in which pension reform is discussed in different corpora. For this analysis, we implemented a comparative approach based on CMF to analyse media articles and parliamentary speeches (De Lathauwer and Kofidis, 2017). This method could in principle be adopted to detect similarities and differences of other corpora, such as the coverage of the reform by left- and right-leaning media outlets or social media content produced by different segments of the population (Barberá et al., 2019).

CMF is a technique that extends traditional matrix factorisation methods to simultaneously decompose multiple matrices. Formally, given two document-term matrices $X^{(1)}$ (parliament) and $X^{(2)}$ (media), CMF approximates each as

$$X^{(i)} \approx B^{(i)} D^{(i)} C^T \quad (2.4)$$

In this factorisation, $B^{(i)}$ represents the document-topic matrix for the i -th dataset, where each row corresponds to a document (e.g., an article or speech) and each column corresponds to the weight of a specific topic. C^T is the shared factor matrix across all matrices $X^{(i)}$, representing the topic-term matrix. Each column of C^T contains the terms associated with each topic, making it a common set of topics across both datasets. The matrix $D^{(i)}$ is a learned diagonal scaling matrix that weights the contributions of the shared topics C^T in each dataset, allowing the topics to be weighted differently across the different sources (e.g., media articles and parliamentary speeches). We do not impose any structure on $D^{(i)}$; rather, it is inferred from the data during optimisation to capture the differential salience of each topic across corpora. All the factor matrices are learned by minimising the reconstruction error across corpora, measured as the sum of squared differences between each original matrix and its approximation. This makes CMF closely related to NMF, but extended to handle multiple datasets with shared topics.

In our context, CMF has been adopted to simultaneously analyse media articles and parliamentary speeches by identifying a single set of topics. This joint factorisation allows us to capture shared thematic structures while still preserving the differences in how these topics are represented in each dataset.

We implemented it using the Python package MatCoupLy (Roald, 2023). We imposed non-negativity constraints on the factors, leading to more interpretable results. Consequently, our implementation of CMF is effectively a simultaneous application of NMF on two corpora, with the added benefit of a shared topic structure.

In our implementation of CMF, we take the two TF-IDF term-document matrices of media articles and parliamentary speeches as input. The factorisation then produces two different document-topic matrices, two different diagonal matrices that define how much each corpus covers each topic, and one shared term-topic matrix. This shared term-topic matrix is used to obtain a list of topics, defined through their respective most relevant terms.

To measure the relative salience of each topic across corpora, we computed the weight of each topic t_i in each corpus as the L2 norm of the topic-specific reconstruction component (based on the factor matrices), normalised by the L2 norm of the full reconstructed corpus. Let $t_i^{(m)}$ and $t_i^{(p)}$ denote the normalised weight of the topic i in the media and parliament corpora, respectively. We then computed their relative divergence:

$$\Delta t_i = \frac{(t_i^{(m)} - t_i^{(p)}) \times 100}{\max(t^{(m)}) + \max(t^{(p)})} \quad (2.5)$$

where $\max(t^{(m)})$ and $\max(t^{(p)})$ are the maximum topic weights in the media and parliamentary corpora, respectively. This formula allows us to quantify the relative difference in topic emphasis between the two corpora, and the normalisation facilitates comparison across dimensions while preventing large weights from dominating the result.

3. Results and discussion

3.1. Studying the evolution of the public acceptability dimensions over time

Figure A2a shows the evolution over time of the volume of media articles related to each of the four dimensions of the OECD PAT. The number of articles assigned to each dimension has been aggregated at a weekly level and normalised over the total of articles published each week for the period between 1 November 2022 and 15 June 2023, to avoid distorting the plotted volumes due to the quantity of articles published. Because documents are assigned to dimensions when their similarity value is ≥ 0.90 , the number of articles associated with each dimension naturally varies, reflecting the relative salience of each dimension in the public debate. It is visually clear that elements relating to the *Process dimension* have dominated the news media coverage of the reform, and the focus on this dimension

increased once the law was introduced in the National Assembly. Conversely, focus shifts away from elements relating to the *Economic*, *Fairness*, and *Risk and time dimensions*, which initially got greater coverage.

We do not observe the same pattern in parliamentary speeches. As shown in Figure A2b, the number of speeches covering the *Process dimension* of public acceptability grows over time, in particular starting from the beginning of March. Yet, this increase does not result in a clear predominance of this topic. Further, it does not co-occur with a decrease in the discussion of other dimensions.

The difference in focus between media articles and parliamentary speeches is not surprising and may simply reflect the fact that topics discussed in parliament are of a more technical nature, more comprehensive and must deal with the legal and procedural aspects of the reform. In turn, the technical nature of parliamentary speeches means that they do not always resonate directly with the broader issues and themes that drive public acceptability. These are more likely to be captured in the public's discussion and in media coverage.

In addition, we should consider that the time distribution of parliamentary speeches is relatively sparse, as shown in Figure 1. The data reflect only speeches made during open sessions of the National Assembly, which limits the overall volume and frequency of speeches compared to the more continuous media coverage, in particular during the period between March and May, when the reform was passed through the use of Article 49.3, and protests were particularly intense. This might contribute to the observed differences in topic focus over time.

3.2. Analysing topics along the four dimensions of the PAT

By performing topic modelling with NMF, we have identified 10 latent topics within the discussion related to each of the four key dimensions of public acceptability identified by the PAT. By considering media articles' publication date, we were then able to combine this information with the 10 topics and plot their evolution over time as time series.

Figure A4 provides information about the discussion on the *Economic dimension* of public acceptability, showing the temporal coverage of four selected topics. These topics were chosen based on policy considerations, with a focus on those that provide deeper insights and reveal meaningful patterns and information on the nuances of public debate relating to this dimension. The time series of the other topics for this and the other dimensions are provided in Supplementary Materials, section B. The topics are represented by the three most relevant words—the topic descriptors—which were identified considering each word's contribution to the topic from the term-topic matrix. The results indicate the salience of the issue of public debt (*dette milliard public*)—one of the main objectives of the reform and a key element in its rationale—in news media coverage. Other relevant topics include discussions about inflation (*prix production consommation*), housing (*logement immobilier taxe*), billionaires (*milliardaire riche fortune*), and private insurance (*assurance fonds assureur*). Furthermore, the evolution in the coverage of different topics can provide an indication of how the focus of public debate responded to external events and to key moments in the legislative process. We can appreciate, for instance, the gradual increase in the coverage of the topic on public debt or a clear focus on inflation—a central economic feature of 2023, often linked to the war in Ukraine and the energy crisis, which was, on average, over the whole 2023, up by 4.9% after +5.2% in 2022 (INSEE, 2024). This topic peaked right before the pension reform was adopted through the use of Article 49.3.

We can further explore the topics by analysing the most relevant documents related to each of them. With respect to public debt, the articles show that reducing public expenditure and ensuring the financial sustainability of the pension system were clearly seen as a goal of the reform (Echos, 2023). Yet, others argued against the reform, claiming it was “emblematic of the government's inability to control public spending, despite its touching desire to do so” (Guyot and Vranceanu, 2023). Looking at insurance and pension savings, the debate highlighted the importance of life insurance as an investment and asset-management tool, as well as its increasing popularity among the French population. Here, the discussion put significant emphasis on the new *plan épargne-retraite* (PER), which came into force on 1 October

2019 and aims to unify existing retirement savings products, whether individual or collective, with a view to making them easier for savers to understand (Boccaro, 2022; Figure A3).

Figure A4 shows the topics surfaced through the analysis of articles relating to the *Fairness dimension*, along with the temporal evolution in their coverage. We find some explicitly economic topics, which is because the reform acts on economic factors (see *emploi an salaire, fonds assurance placement, capitalisation pension cotisation*). Furthermore, we observe significant attention given to topics related to gender dynamics (*femme homme couple*) and how the reform would impact them, to wealth (*riche fortune fiscal*), to the effect of the reform on specific sections of the population, such as agricultural workers (*exploitation agricole agriculteur*), as well as the clergy (*culte maladie ministre*) (Senèze, 2023b). The salience of these topics clearly grew after the reform was announced, often peaking in the period between the introduction of the Law into Parliament and its final passage through Article 49.3.

Considering the most representative media articles for each topic can offer further insights about the public debate, and hence into the issues that drive the public acceptability of the reform. For instance, documents linking the reform to gender issues emphasise how it may discriminate against women, who (i) often tend to work in lower-paid occupations and have smaller pensions as a result; and (ii) find it more difficult to reach the necessary contribution period for a full pension than men, as they are more likely to experience career interruptions or reduce their working-hours due to the uneven and gendered division of caring duties and responsibilities within the household (Vazquez, 2023). Furthermore, analysing the wealth-related aspects of the debate, we find significant discussion on the proportionality of taxation, sharing of the tax burden, and alternative sources of financing. Illustrating this last point, for example, a report by the NGO Oxfam was often mentioned. This report proposed a 2% tax on the wealth of France's 42 billionaires, which, according to Oxfam's projections,¹⁰ would draw sufficient revenue to cover the anticipated deficit in the pension system by 2027 (Dupont, 2023; Oxfam, 2023).

The analysis of the discussion on the *Risk and time dimension* surfaces topics shared with other dimensions, as demonstrated by Figure A5. Clear examples of this can be found, for example, with topics related to private insurance (*assurance fonds assureur*) and women (*femme pension revenu*). The presence of many of the elements pertaining to this dimension in other dimensions suggests that, in the context of the 2023 French pension reform, the *Risk and time dimension* was semantically overlapping with others. As discussed in Section 2.4, the comparatively lower validation score for this dimension could indeed suggest that the topic structure identified here partly overlaps with adjacent dimensions; hence, these results should be considered accordingly.

Finally, we conducted the topic modelling analysis on the set of articles related to the *Process dimension*. Figure A6 shows the 10 topics identified along with their coverage over time. We find mention of the key political actors associated with the reform (*ministre borne macron*),¹¹ but also topics related to parliamentary dynamics, party positions, policy discussion, and voting (*LIOT² proposition groupe, vote texte gouvernement, amendement LFI³ insoumis*). Furthermore, we also find topics that refer to crucial and specific steps in the reform process. First, we detect a focus on the use of Article 49.3 of the Constitution, which allowed the government to adopt the reform without the approval of the National Assembly (*motion censure 49*). Second, the discussion also focused on the reform's review by the French Constitutional Council, which issued a ruling on the legality of the draft law following a challenge filed by opposition parliamentarians. This review found the draft law to be constitutional and rejected an initial

¹⁰ These projections were questioned by experts and within the public debate (Pham, 2023).

¹¹ Though not interestingly, the name of the Labour Minister, Olivier Dussopt, who was nominally in charge of the agenda on pension reform, was largely sidelined in practice and overlooked by public debate. Ownership of the reform was much more closely associated with the Prime Minister, Élisabeth Borne, and the President, Emmanuel Macron.

¹² *Libertés, indépendants, outre-mer & territoires* (LIOT, in English Liberties, Independents, Overseas and Territories) is a parliamentary group in the French National Assembly. Its members are positioned in the centre but in opposition to the Centrist government

¹³ *La France insoumise* (LFI) is a political movement founded by Jean-Luc Mélenchon. It is positioned to the left/far-left, in opposition to the government, and played a key role during the pension reform as the largest party on the French political left.

request for a referendum (*conseil constitutionnel RIP*¹⁴). Considering the temporal evolution of the topics, we find that, for most of them, the coverage started increasing steeply from March, when the most important steps of the reform process took place.

Analysing the most representative articles for each topic, we obtain further insights into their meaning. Considering discussions of the role played by Prime Minister Borne and President Macron, we find them depicted as striving to navigate the public and political tension. Articles describe violent protests and social upheaval, with strong criticism aimed towards the Prime Minister and the President by opposition parties and unions for their use of Article 49.3. Articles underline the high stakes for both of them and suggest that their political futures (at that date) may depend on how well they manage the crisis and navigate the ongoing opposition (Gatinois and Trippenbach, 2023; Quinault-Maupoil and Conruyt, 2023). The documents related to the broad topic *politique social peuple* highlight the fact that there was a sense that the government was becoming increasingly authoritarian and that people were losing faith in the political system. Segments of the population, including researchers, claimed that the reform was determining a violation of the French Constitution (Collectif, 2023). Considering the role of the Constitutional Council, the articles note that its validation reiterated the legal basis of the reform but did not quell public dissatisfaction entirely. Indeed, doubts about the choice of the Council were raised after its decision (Schneegans, 2023).

While the prominence of the Process dimension in media coverage may initially appear predictable, the analysis unpacked the specific institutional and political mechanisms that received attention, such as motions of censure, party amendments, and constitutional review, and showed how media framing evolved over time, highlighting a marked escalation in focus during key legislative moments. Importantly, this detailed analysis of topics and articles verified that the media articles most strongly associated with the Process dimension were not merely reporting on parliamentary speeches. Rather, they conveyed independent narratives that critically engaged with institutional and political dynamics described above. Importantly, our qualitative reading of the most representative articles suggests that the media articles most strongly associated with the Process dimension appeared to convey independent narratives that critically engaged with the institutional and political dynamics described above. For instance, the most *Process*-associated articles focused on themes such as the constitutional implications of Article 49.3, the political strategies of opposition parties, the role of the Constitutional Council, and public protest dynamics. These topics, even if related to legislative events, were framed in the news through distinct journalistic angles rather than as summaries of parliamentary proceedings. To enable readers to evaluate this claim directly, we share data and code, allowing independent verification of the relationship between media and parliamentary framing of procedural themes (see Data availability statement).

3.3. Detecting analogies and differences between media and parliamentary debates

Through CMF, we were able to perform topic modelling on two corpora simultaneously and thereby identify a unique set of topics from both of them. Considering the outputs of the topic modelling, in particular the two document-topic matrices, we were able to assess to what extent a topic was relatively more discussed in one or the other corpus.

Figure A7 shows the result of this analysis, which should be interpreted recognising the structural differences of the corpora. While media coverage can follow the full reform cycle—from early leaks and public reactions to final decisions—parliamentary speeches are more temporally concentrated and shaped by institutional constraints. When considering the *Economy dimension*, we find that the media focused relatively more on private insurance (*PER plan rente, fonds assurance investissement*) and housing (*SCPI*¹⁵ *immobilier rendement, logement taxe immobilier*). Looking at the most representative articles for these topics, we find that they often mention the challenges faced by retirees and future retirees regarding their financial stability, especially in the context of rising living costs and inflation. SCPIs are presented as a viable alternative for retirees to invest in real estate indirectly and receive monthly or quarterly rents,

¹⁴ *Référendum d'initiative partagée* (RIP, in English Shared Initiative Referendum)

¹⁵ *Société civile de placement immobilier* (SCPI) is a collective financial investment in real estate.

potentially offering higher returns than traditional savings accounts (Tribune, 2023). Considering the topics that received greater attention in parliamentary speeches, we find that the most diverging one is about research (*recherche france chercheur*). The most representative speeches for this topic put emphasis on a possible increase in the research budget to 3% of GDP by 2027, with a particular focus on biomedical research. We also find that the coverage of public debt and inflation, in particular in relation to the agricultural sector, was almost equally discussed in the two corpora.

Considering the discussion related to the *Fairness dimension*, we find that the media focused relatively more not only on private insurance plans and investments (*fonds rendement assurance, PER rente plan*) but also on the role of parenting (*pension alimentaire parent*). Regarding this topic, the analysis of articles shows that media outlets frequently linked the pension reform to the newly established public service for child support payments. This service allows a public agency to automatically deduct and distribute child support payments, regardless of the type of separation, as long as the amount is officially determined. In parliamentary speeches, topics that received relatively more attention include special pension regimes (*régime spécial général*), hazardous or arduous jobs (*pénibilité travail métier*), and the effect of the reform on the agricultural sector (*agricole agriculteur exploitation*). Considering the first of the three topics, we find that parliamentary discussions emphasised how the reform aims to prepare for future management of pensions by integrating special regimes into the general system, ensuring stability and fairness for future generations. However, other voices defended the autonomous pension regime of clerks and employees of notaries, which is self-managed, balanced, and does not rely on public funds. They argued for maintaining this well-managed system. When it comes to hazardous or arduous work, the multifaceted nature of the notion was emphasised, describing at least four aspects, including objectively measurable factors, notoriously harmful working conditions, experienced hardships due to health fragility or organisational conditions, and the desire to leave one's job due to these hardships. Further, parliamentary speeches highlight the fact that current regulations only account for objectively measurable forms of arduous work, which applies to a small, specific population exposed to extreme demands for long durations.

The comparison between articles and speeches related to the *Risk and time dimension* does not yield particularly new topics, with one exception. Among the topics discussed almost equally between the two fora, we find one related to special regimes for the clergy (*culte ministre professionnel*). The articles discuss the integration of religious ministers into the French social security system and the specifics of the *Caisse d'assurance vieillesse et maladie des cultes* (Cavimac). The discussion on this topic is informed by two crucial dynamics. First, the number of pensioners covered by this fund has decreased significantly from 67,000 in 2003 to 38,158 in 2020, due to higher death rates compared to new retirees. Second, the number of contributors has been increasing, with a 13% rise from 2018 to 2022, driven by the inclusion of foreign religious personnel and improved affiliation practices (Senèze, 2023a).

Finally, considering the *Process dimension*, we find that only one topic was clearly more discussed in parliamentary speeches, which is related to the left-wing electoral alliance of political parties in France (*groupe banc NUPES*¹⁶). The speeches emphasise that the government does not have a majority in the National Assembly or support from the public for the pension reform. Furthermore, they often contain criticism of the government for undermining democratic principles by bypassing parliamentary debate and disregarding public opinion. The speeches use emotional and forceful language to convey urgency and seriousness. Terms like “madness,” “folly,” and “shame” are used to describe the government's actions. Many topics surfaced in this dimension have been relatively more discussed in the media. Among them are those about unions (*syndicat CGT*¹⁷ *CFDT*¹⁸) and the Constitutional Council (*conseil constitutionnel RIP*). This divergence reflects the roles and logics of the two arenas: parliamentary debate

¹⁶ *Nouvelle Union populaire écologique et sociale* (NUPES, in English New Ecological and Social People's Union)

¹⁷ *Confédération Générale du Travail* (CGT, in English General Confederation of Labour)

¹⁸ *Confédération française démocratique du travail* (CFDT, in English French Democratic Confederation of Labour)

formalises positions within the legislature and is limited to procedural stages, while media coverage tracks protest dynamics and institutional milestones in near real-time. Furthermore, this unequal coverage of topics between media and parliament might result from the fact that only a minority of the speeches analysed were delivered in the months after the first week of March (see Figure 1). This is the result of using only the speeches about pensions made during the open sessions of the National Assembly. Using different data directly produced by policymakers, such as press releases or interviews, would probably result in a different distribution of topics among the two corpora.

4. Conclusion

In this study, we presented a policy analytics pipeline to analyse public debate on reform using the OECD's PAT as a framework, and we applied it to the study of a specific case: the 2023 French pension reform. By analysing a corpus of online news media articles and parliamentary speeches, we aimed to uncover how different dimensions of public acceptability were articulated over time and across different arenas. Our findings contribute to the understanding of public discourse dynamics and provide insights that can help inform policymaking and communication strategies.

First, we sought to operationalise the framework established by the OECD PAT, which identifies four key dimensions for assessing the public acceptability of reforms: *Economic impact*, *Fairness*, *Risk and time*, and *Process*. This framework provided the conceptual lens through which we categorised and analysed the public and policy debates surrounding a specific pension reform in France. Each dimension of the PAT represents a crucial element through which people perceive the effects of policy changes, evaluate their legitimacy, and respond to them. As such, this multidimensional framework offers a comprehensive view of the drivers of public acceptability and their possible interactions, as well as a means to analyse these dynamics within public discourse.

Our analysis revealed significant temporal dynamics in the way each dimension of public acceptability was discussed. For instance, the Process dimension garnered increased media attention during critical legislative phases, such as the use of Article 49.3 by the government, while other dimensions, like *Economic impact* and *Fairness*, showed varying levels of prominence over time. Understanding these temporal patterns helps to better contextualise public reactions and policymaking responses within specific historical moments.

Through NMF, we identified latent topics within each dimension. This approach allowed us to uncover the main themes and concerns expressed in media articles and parliamentary speeches. Topics such as public debt, inflation, tax fairness, and legislative process dynamics emerged as central themes shaping public debates on pension reform. By tracing the evolution of these topics over time, we gained insights into how media attention shifted and responded to external events and policy developments, possibly reflecting public concerns and priorities regarding the reform. Understanding these shifts helps shed light on the aspects of the reform that were seen as more pressing or contentious by the public, thereby offering a clearer picture of the factors influencing public acceptability in this specific case.

Using CMF, we compared the content of discussion in media articles and in parliamentary speeches, revealing divergences and convergences in topic emphasis between these two corpora. Media outlets tended to focus more on economic impacts such as private insurance and housing, whereas parliamentary discussions often centred around policy details, special retirement regimes, and legislative procedures. Understanding these differences provides a clearer picture of how different stakeholders perceive and prioritise issues related to pension reforms, issues that can be crucial for the public acceptability of the reform.

Our pipeline can offer relevant insights for policymakers and public communications experts by providing a clearer understanding of the dimensions and topics that resonate most with the public and with policymakers. By identifying which dimensions and topics dominated public and policy debates around the 2023 French pension reform, our study underscores the importance of social listening. Policymakers can use the insights from social listening to design policies that are better aligned with public expectations, thus enhancing their social and political acceptability. Furthermore, understanding

the nuances expressed in public debates, governments can develop more targeted communication strategies and messaging that respond to public concerns more dynamically, building broader public support for reforms.

Looking ahead, future research could expand on our methodology in at least six directions.

- First, it could incorporate additional data sources. Media and parliamentary discourse are only partial proxies for public opinion. Neither of them captures citizens' lived experiences and positions. Future work could include additional data, such as public opinion polls, civic participation datasets, or protest activity records, to provide a more complete picture of societal reactions. Furthermore, integrating user-generated content could provide deeper insights into public acceptability at the user level. In this context, sentiment or stance analysis would be particularly valuable, enabling researchers to move beyond topic salience and dimensional mapping to capture more explicitly the emotional and attitudinal aspects of public response. This could be implemented using automated techniques, though it would be important to ensure the validity and replicability of results, in line with best practices (Van Atteveldt et al., 2021).
- Second, future research could test the analytical pipeline proposed here in other contexts, such as reform projects in other areas or countries, which would allow us to explore its potential and improve it. These would represent further steps towards the development of a tool that can offer policymakers real-time insights into the public acceptability of specific reforms. In particular, we acknowledge that our case study provided a great wealth of textual information, and the applicability of our pipeline would also need to be tested in contexts with less data.
- Third, while our analysis was conducted retrospectively, the pipeline could be adapted for real-time applications, provided a continuous stream of textual data, and appropriate infrastructure can be set up. In this context, future work could also explore strategies to optimise for consistency of outputs over time, enabling robust monitoring of longitudinal discourse dynamics.
- Fourth, our methodology to compare corpora lends itself well to exploring other insightful comparisons. For instance, instead of dividing documents according to their relevance to different dimensions of public acceptability, researchers could divide them on the basis of their publication date, obtaining a longitudinal perspective on the relation between the two corpora. Furthermore, the distinction could be based on the political leaning of the members of Parliament, the media outlets, and the people (Budak et al., 2016; Zhitomirsky-Geffet et al., 2016; Stefanov et al., 2020). This would allow policymakers to better explore the heterogeneity of opinions and hence to appreciate the plurality of perspectives that underpins the public acceptability of reforms.
- Fifth, our current approach classifies documents at the article or speech level, a choice which involves certain trade-offs. Document-level labelling ensures tractability across large corpora. However, it may overlook internal heterogeneity, where a single document touches on multiple dimensions of acceptability. Future developments could explore sentence- or paragraph-level classification, enabling more granular mappings of how different arguments and perspectives co-occur within individual texts (Yessenalina et al., 2010; Ng et al., 2025).
- Finally, while the PAT provides a useful conceptual lens, our empirical application also points to potential limitations in how easily its dimensions can be mapped onto real-world discourse. Our human validation approach might be sensitive to lexical distinctiveness. Future research could explore ways to adapt or extend the PAT framework to account for overlaps across dimensions, context-specific language, or emergent frames not originally anticipated by the model.

Our study illustrates the benefits of combining advanced analytical techniques with policy frameworks, leveraging non-traditional data, to illuminate the complex landscape of public acceptability. By unpacking the multidimensional nature of public discourse on a specific case of pension reform, we have provided a detailed account of how the different dimensions of public acceptability and related topics play out in the public discourse. This knowledge can support the design of more inclusive and effective

strategies for reform. Furthermore, leveraging these insights to better communicate evidence and engage more actively with citizens throughout the reform process can help foster public trust (OECD, 2024b). Rather than treating public acceptability as a hurdle to overcome, our approach contributes to bringing citizen perspectives closer to the policymaking process—helping ensure that reforms are not only technically sound but also democratically responsive.

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Data availability statement. Data and code to understand, verify, and replicate findings can be found in Harvard Dataverse: <https://doi.org/10.7910/DVN/5DSSQR>.

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Ethical standard. The research meets all ethical guidelines, including adherence to the legal requirements of the study country.

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Appendix

A.1. Keywords

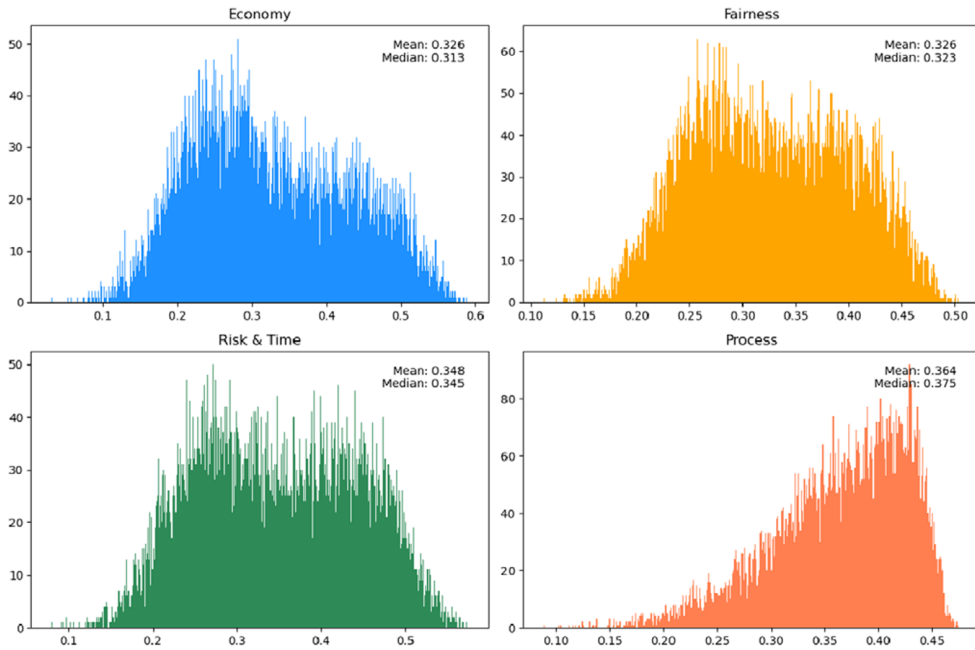
Economic dimension: compte, finance, investissement, croissance, compétitivité, soutenabilité, financement, pérennité, chômage, emploi, pib, prix, coût transition, incitation, espérance vie, départ anticipé, euro, contribution, productivité, dette, déficit, achat, démographique, attractivité, inflation, naissance, population, prime, travailleur, valeur, public, entreprise, banque, crise, cdc, industriel, territoire, fiscal, insee, revenu, cotisation, niveau, 62, argent, agriculture, industrie, totalenergie, cor, 64, actif, patrimoine, milliard, taux, cadre, travail, budget, direction, caisse, million, capital, salaire, pension, paiement, cotiser, facture, point, bourse, consommation, travailler, immobilier.

Fairness dimension: gagnant, perdant, justice, morale, inégalité, riche, pauvre, pénibilité, solidarité, décent, bonne santé, régime spécial, régime, Agirc-Arrco, redistributif, femme, cotisation, équité, égalité, discrimination, privilège, richesse, classe sociale, précarité, 65, prime, fonctionnaire, public, mari, police, sncf, mixte, cheminots, niveau, edf, agriculture, industrie, ratp, fraude, jeunesse, totalenergie, usine, 64, marier, milliardaire, minimal, jeune, patrimoine, index, policier, taux, couple, cadre, plafond, homme, ouvrier, partage, social, capital, fortune, enseignant, smic, senior, agriculteur.

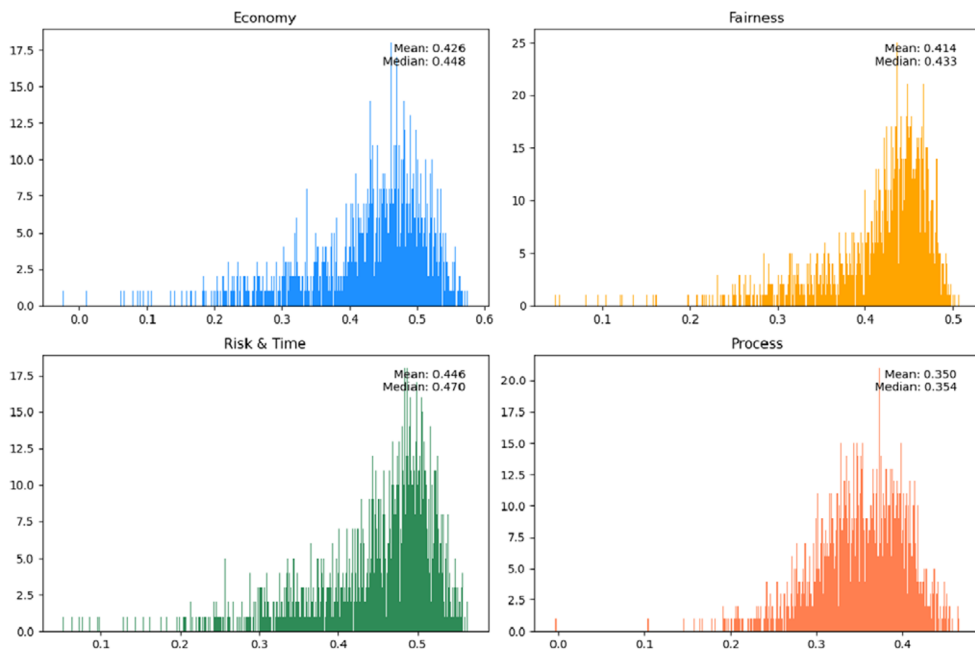
Risk and time dimension: assurance, futur, génération, enfant, protection, mutualisation, myopie, déséquilibre, compréhension, ajustement automatique, ajustement, décote, bonus, malus, long terme, court terme, durabilité, vulnérabilité, incertitude, volatilité, sécurité, aléas, imprévisibilité, imprévisible, scénario, jeune, climat, dette, 65, crise, cdc, vie, climatique, carbone, jeunesse, cor, soin, plan, index, temps, population, enfance, trimestre, naissance, ehpad.

Process dimension: processus, vote, consultation, social, dialogue, partenaire, grève, manifestation, communication, confiance, polarisation, démocratie, 49, COR, motion, censure, transparence, négociation, consensus, référendum, compromis, mobilisation, syndicat, liot, peuple, amendement, anti, populaire, crise, report, cgt, commission, police, intersyndicale, gauche, article, loi, leader, pause, examen, martinez, manifestant, motion, texte, dussopt, macron, projet, bloquer, borne, initiative, proposition, gouvernement, nupes, grenade, policier, censure, droit, rn, syndical, berger, obstruction, presse, mouvement, medef, crs, constitutionnel, lr, droite, force, ordre, bardella, accord, cnr, groupe, communiste, etat, riester, garde, rip, politique, dysfonctionnement, voter, journaliste, cfdt, revendication, retrait, juge, tribunal, maire, vert, violence.

A.2. Document selection thresholds

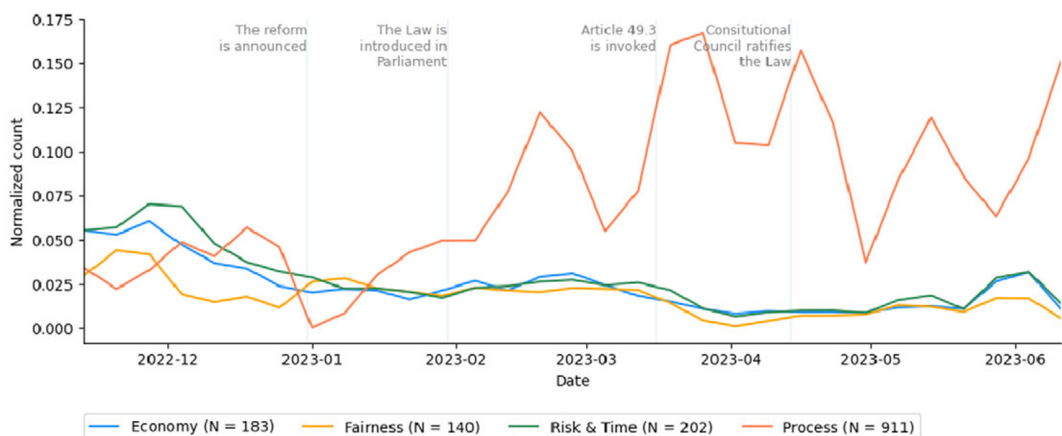


(a) Similarity of media articles and the dimensions of public acceptability.

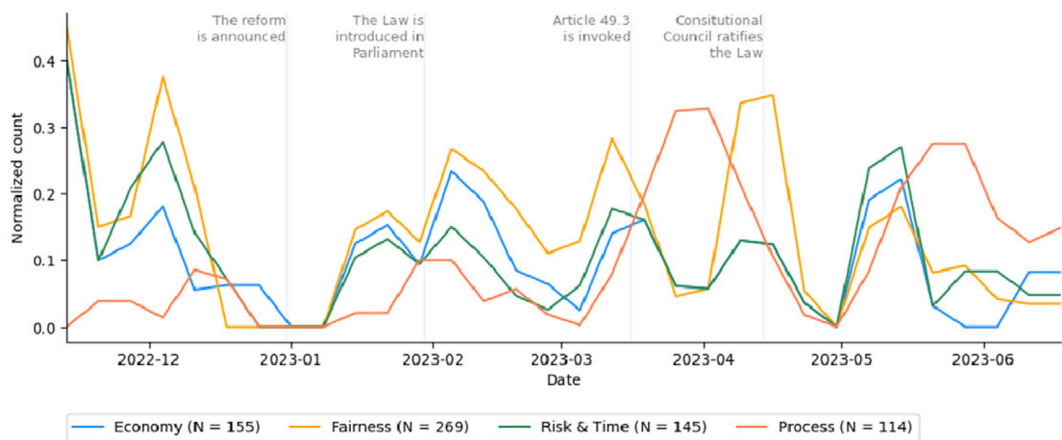


(b) Similarity of parliamentary speeches and the dimensions of public acceptability.

Figure A1. Cosine similarity between the four dimensions of public acceptability operationalised through the keywords and each document in the corpus of news media articles (a) and parliamentary speeches about pensions (b).



(a) Weekly media articles about each dimension of public acceptability.



(b) Weekly parliamentary speeches about each dimension of public acceptability.

Figure A2. Weekly number of documents classified as belonging to each dimension of public acceptability in news media articles (a) and parliamentary speeches about pensions (b). The values are normalised over total documents published each week.

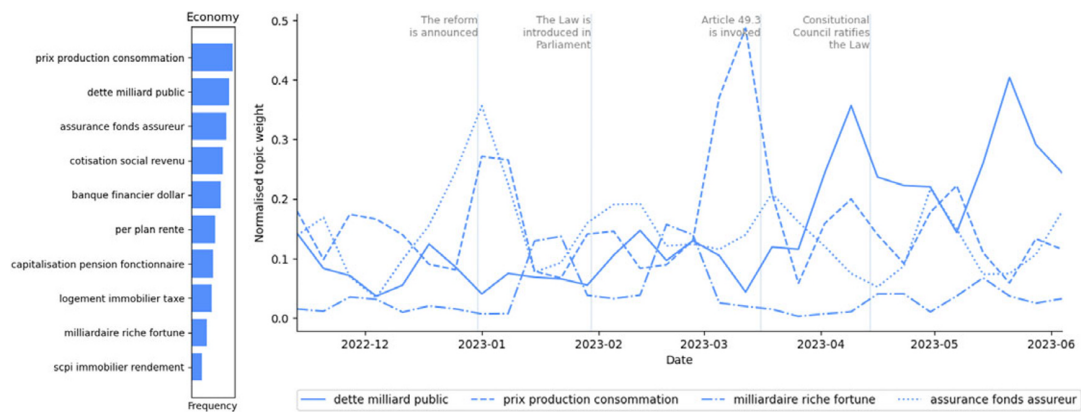


Figure A3. Economy dimension in media: Evolution of selected topics.

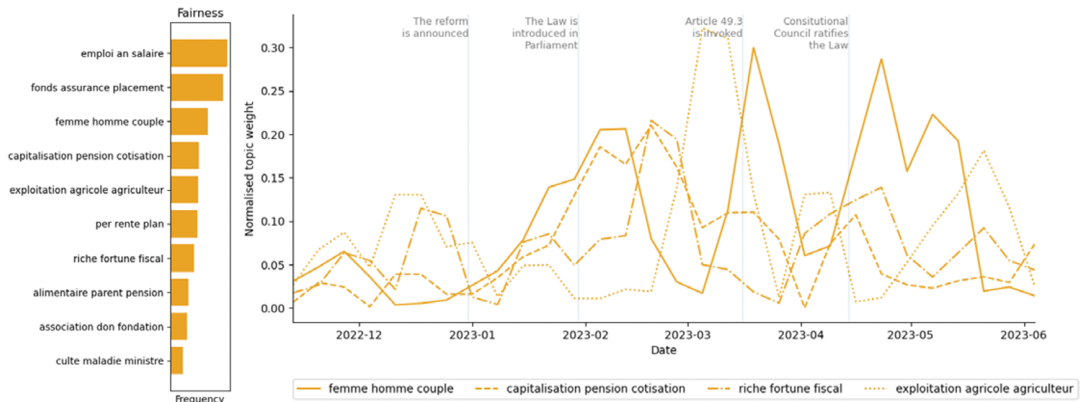


Figure A4. Fairness dimension in media: Evolution of selected topics.

A.3. Preprocessing pipeline and word embedding parameters

A.3.1. Preprocessing steps

Text preprocessing was carried out as follows:

1. Lemmatisation using spaCy (fr_core_news_sm model)
2. Lowercasing
3. Stopword removal based on spaCy's default French list, extended with task-specific terms (e.g., *réforme*, *retraite*, *monsieur*)
4. Punctuation removal
5. Whitespace and newline cleanup
6. Token re-joining into clean processed strings

A.3.2. Word2Vec embedding training

We trained a Word2Vec model using the `gensim` library on the entire corpus (including both media and parliamentary documents). The model was trained with the following hyperparameters:

Table A1. Word2Vec training hyperparameters

Parameter	Value
Vector dimensionality	100
Context window size	5
Minimum word count	1
Sampling method	Negative sampling
Negative samples	5
Number of epochs	5
Architecture	CBOW
Workers	4

Document embeddings were computed as the mean of all word vectors in a document. To mitigate sparsity, we ensured that only documents containing at least one valid token (with an available word vector) were considered.

A.3.3. TF-IDF weighting

TF-IDF scores were calculated using a custom function that computes term frequency within each document and inverse document frequency across the full corpus. These weights were used to compute cosine similarity between document vectors and keyword vectors for each PAT dimension.

A.3.4. Out-of-Vocabulary (OOV) handling

Words not present in the Word2Vec vocabulary were excluded from the centroid calculation. A document vector was only computed if it contained at least one in-vocabulary word.

A.4. Document intrusion

To assess whether the embedding-based document selection procedure produced semantically coherent groups of documents for each PAT dimension and classified documents well, we conducted a document intrusion task. For each dimension, eight annotators were shown sets of four documents—three from the top 10% most relevant to that dimension and one document from a different dimension—and were asked to identify the intruder. Higher accuracy indicates greater semantic coherence of the selected document sets and a good classification of the documents into the PAT dimensions.

Table A2. Document intrusion results per dimension

Dimension	Average classification accuracy (%)
Economy	87.50
Fairness	65.00
Risk and time	51.25
Process	92.50
Total	74.06

A.5. Topic number selection, coherence analysis

To inform our choice of the number of topics k in the topic modelling, we conducted a coherence analysis across a range of topic numbers using two standard metrics: c_{UMass} and c_{NPMI} . Figures A13 and A13 show the average results based on 100 runs with random seeds. This analysis was performed both on the full corpus and on the filtered subsets used for dimension-specific topic modelling.

Across all metrics and datasets, we observed a consistent decline in coherence as k increased, suggesting the need to opt for low values. While very low values of k achieved high coherence, they yielded topics that were too broad to provide meaningful distinctions within public debate. On the other hand, large values of k fragmented the topics excessively, making them difficult to interpret, given the poor coherence. Based on this trade-off, we selected $k = 10$ as a point that offered semantically coherent, stable, and insightful topics.

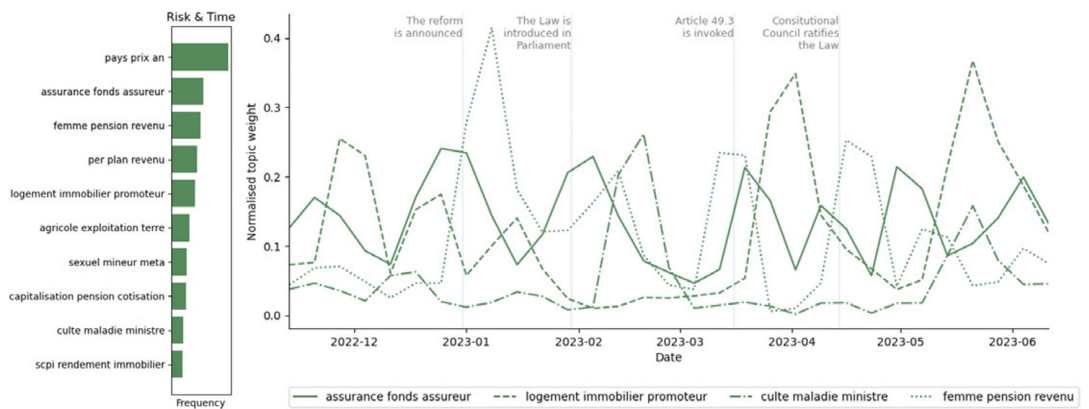


Figure A5. Risk and time dimension in media: Evolution of selected topics.

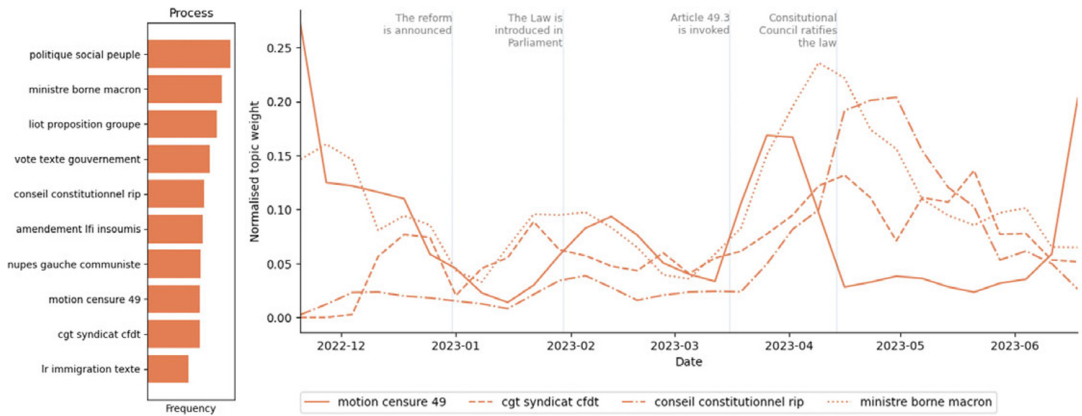


Figure A6. Process dimension in media: Evolution of selected topics.

To assess stability, we also re-ran the NMF models with different random seeds. The resulting topics showed high consistency in their top descriptors and overall structure, indicating that the modelling outcomes are robust to initialisation variance.

A.6. Word intrusion

To evaluate the coherence and interpretability of the topics learned via NMF, we performed a word intrusion task. For each topic, eight annotators were presented with five of its highest-weighted words and one intruder word drawn from a different topic, and asked to select the intruder. Higher accuracy reflects greater semantic clarity of topic representations.

Table A3. Word intrusion results per dimension

Dimension	Average classification accuracy (%)
Economy	73.75
Fairness	71.25
Risk and time	68.75
Process	73.75
Total	71.88

A.7. Topics coverage over time

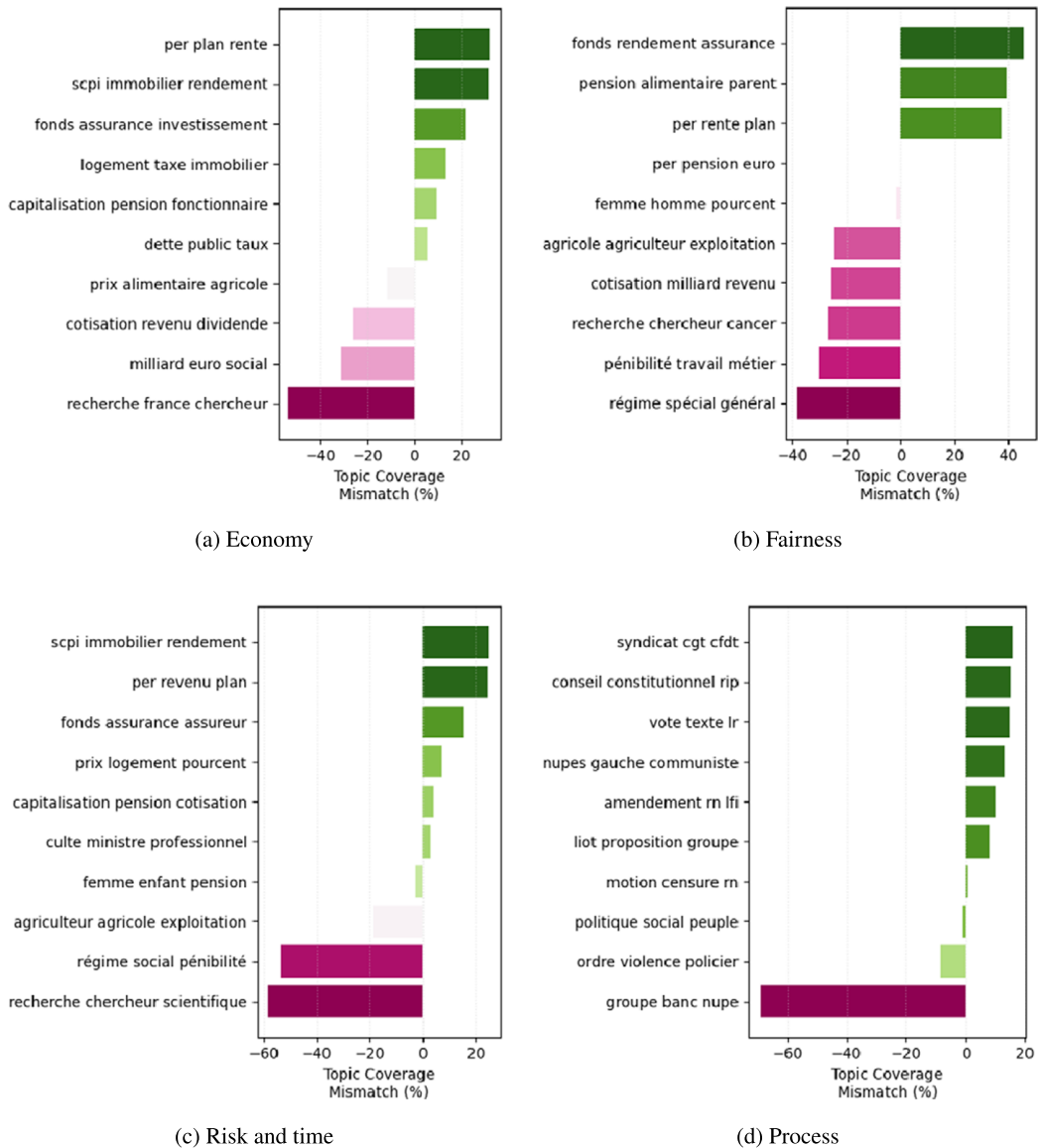


Figure A7. Comparison of topics in topic coverage in media articles and parliamentary speeches in the four dimensions of public acceptability. Bars leaning to the left (in purple) indicate that the topic was more discussed in parliamentary speeches, while those on the right (green) indicate that the topic was more discussed in the media.

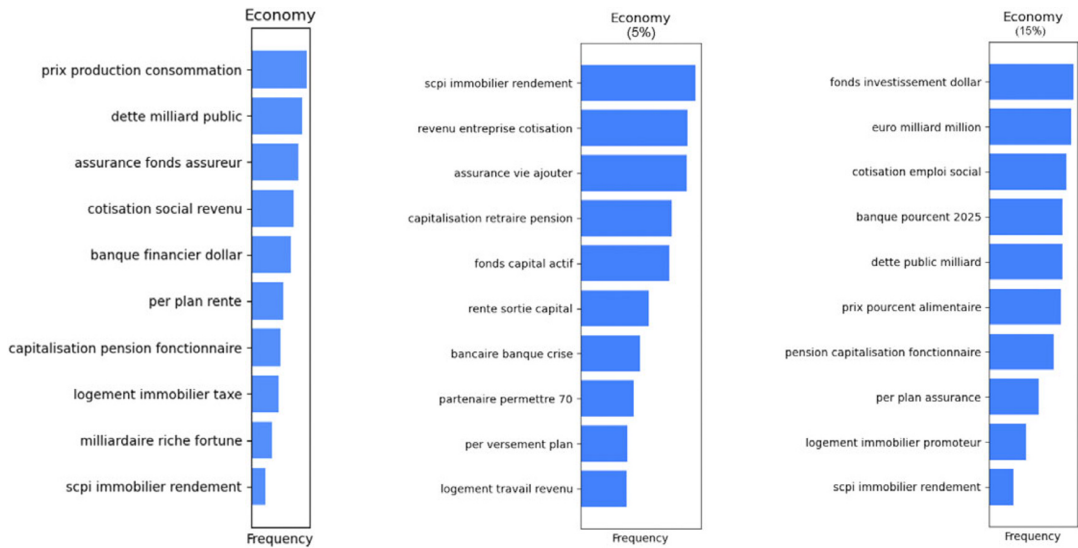


Figure A8. Economy dimension in media: Topic modelling under different filtering thresholds (0.90; 5% = similarity ≥ 0.95 ; 15% = similarity ≥ 0.85).

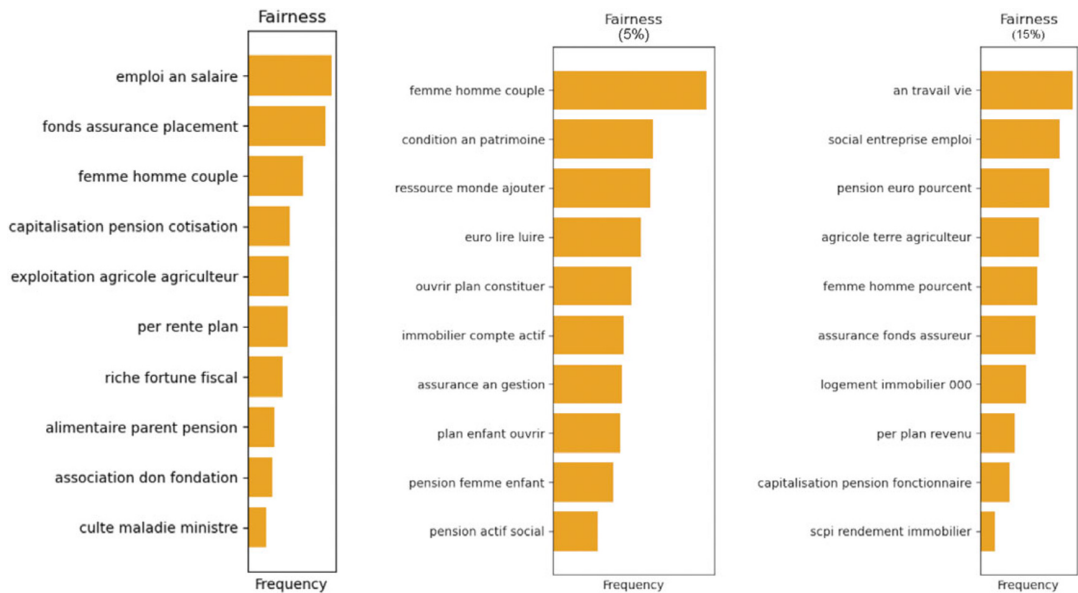


Figure A9. Fairness dimension in media: Topic modelling under different filtering thresholds (0.90; 5% = similarity ≥ 0.95 ; 15% = similarity ≥ 0.85).

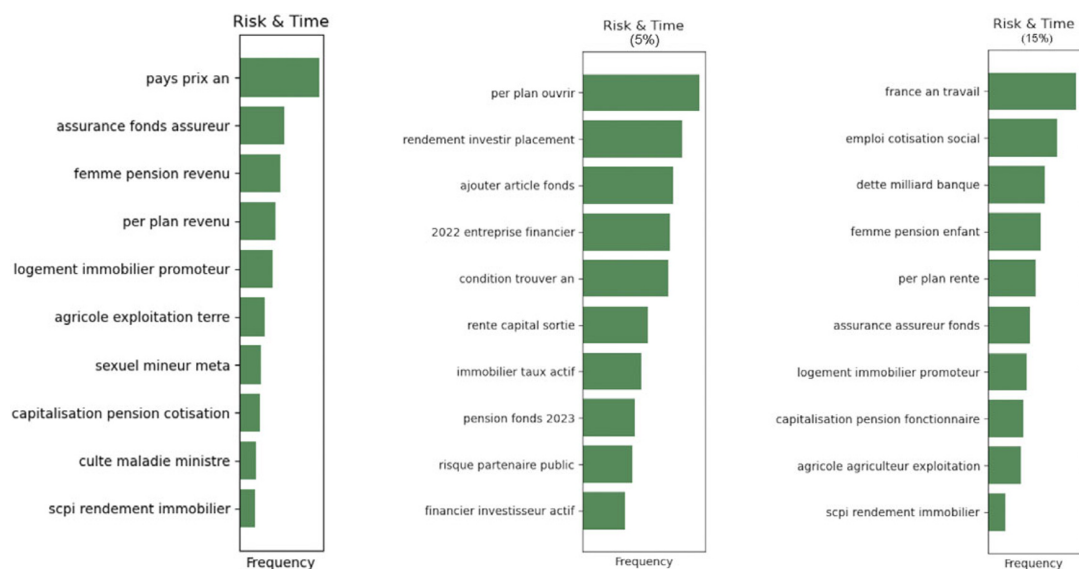


Figure A10. Risk and time dimension in media: Topic modelling under different filtering thresholds (0.90; 5% = similarity ≥ 0.95 ; 15% = similarity ≥ 0.85).

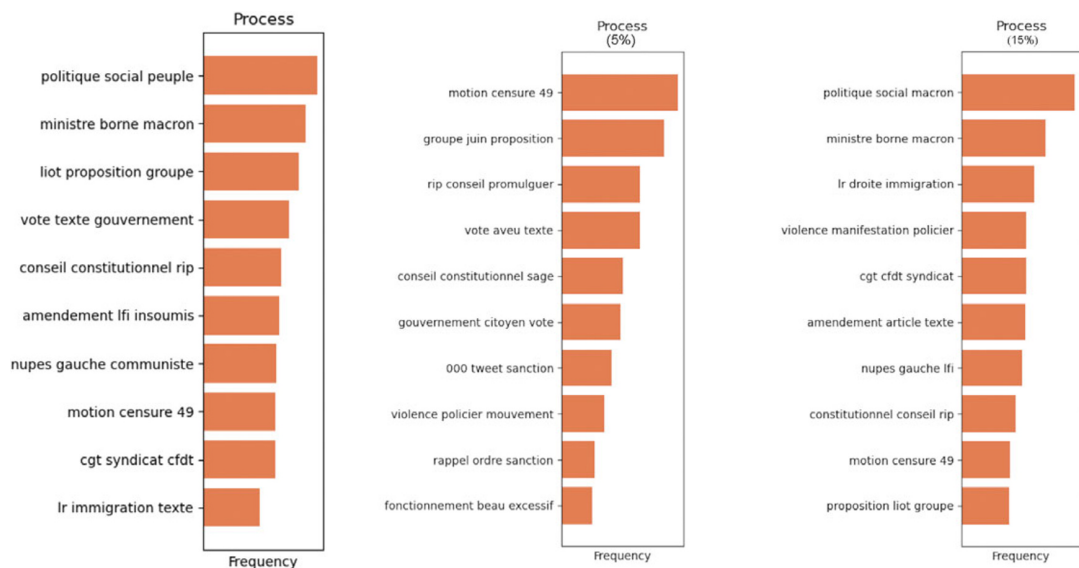
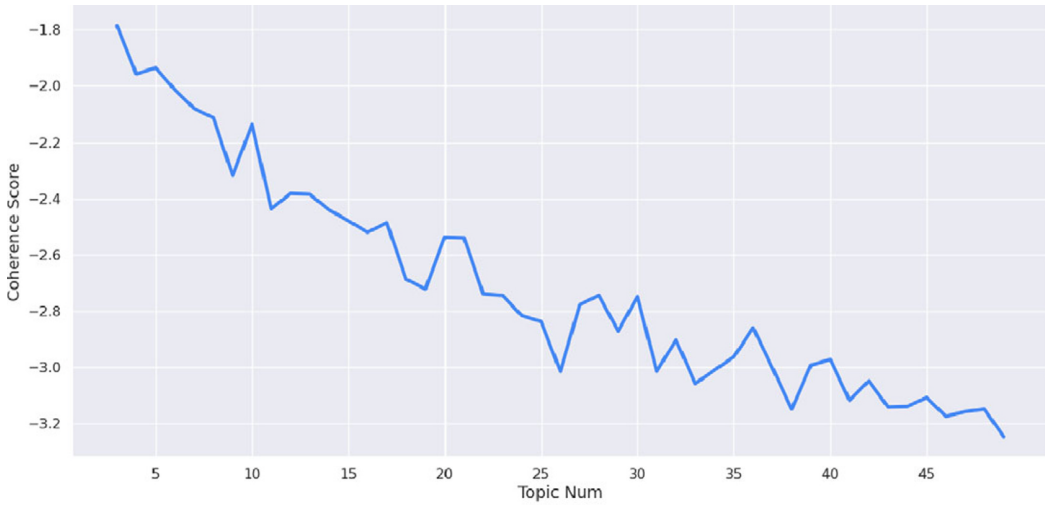
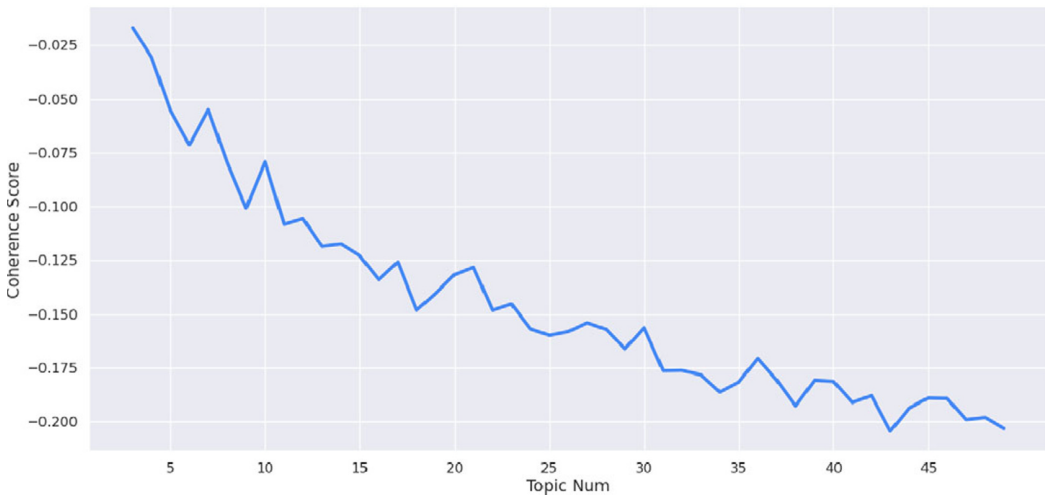


Figure A11. Process dimension in media: Topic modelling under different filtering thresholds (0.90; 5% = similarity ≥ 0.95 ; 15% = similarity ≥ 0.85).

(a) Coherence scores for c_UMass .(b) Coherence scores for c_NPMI .**Figure A12.** Topic coherence scores by number of topics k for the full media corpus.

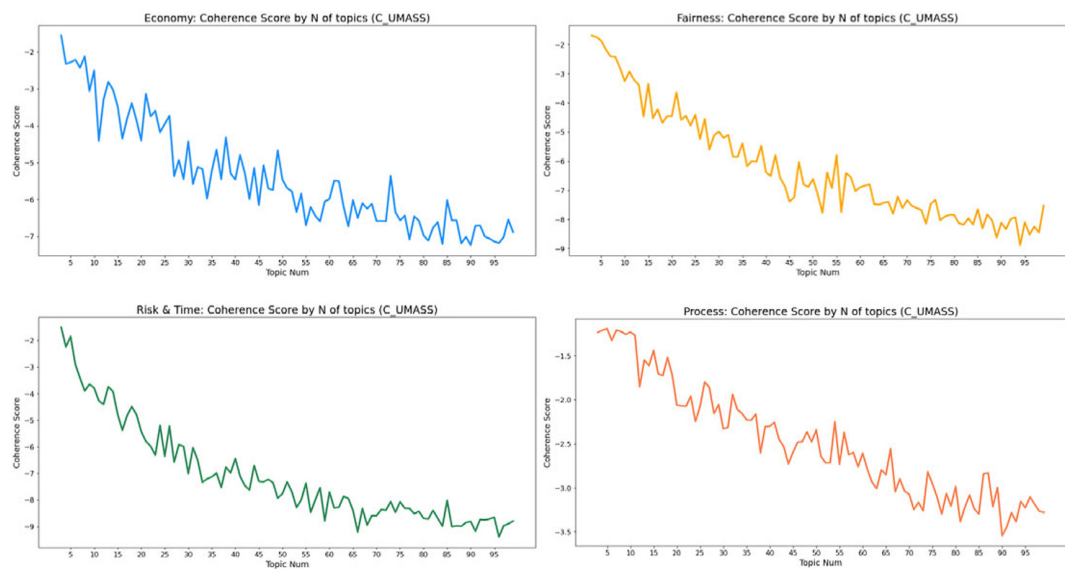
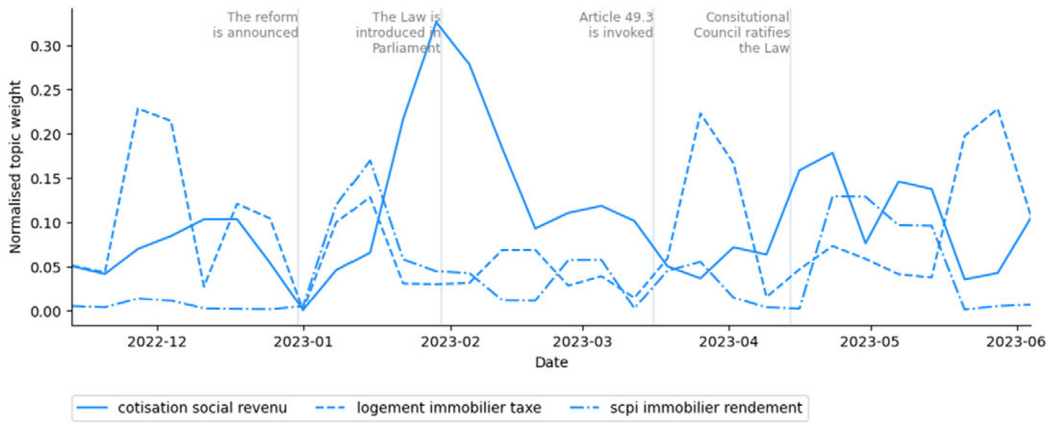
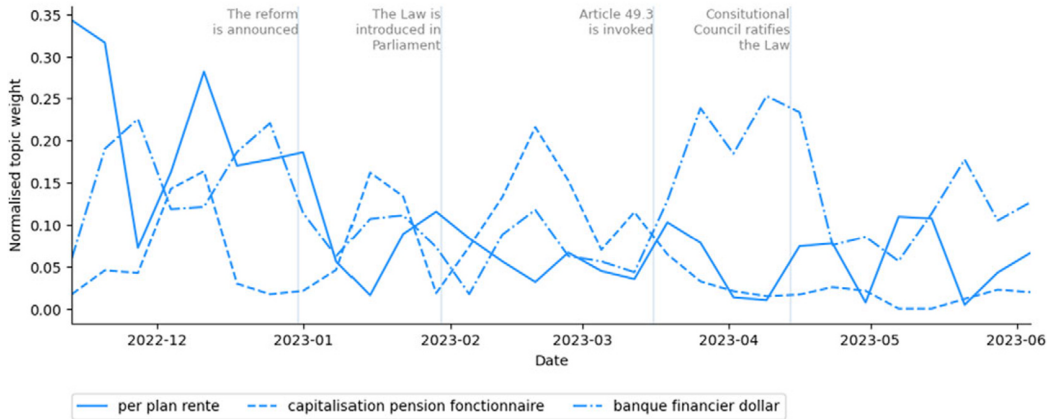


Figure A13. Topic coherence scores (c_{UMass}) by number of topics k for filtered articles per dimension.

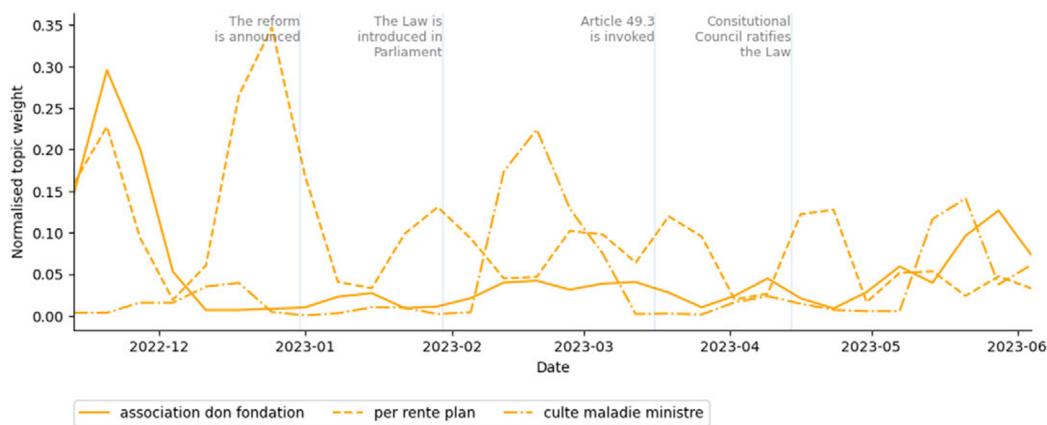


(a) Economy dimension in media: evolution of topics.

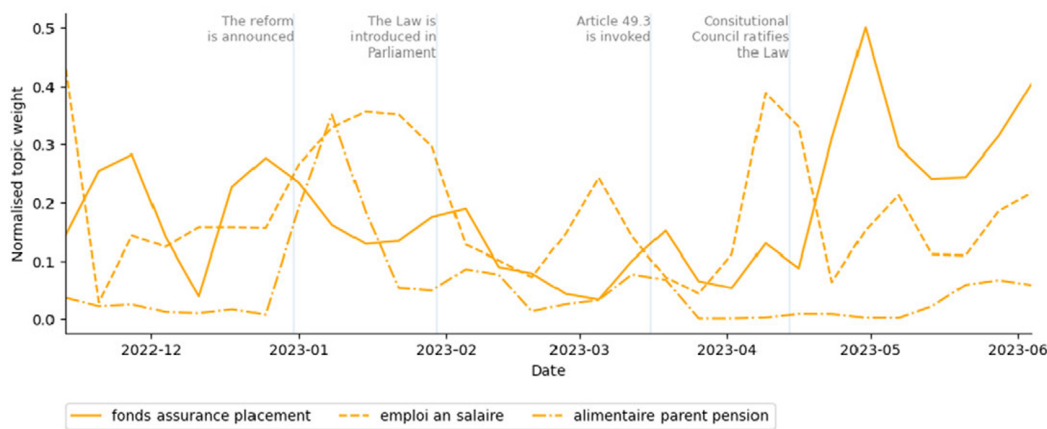


(b) Economy dimension in media: evolution of topics.

Figure A14. Temporal evolution of the other topics in the Economic dimension.

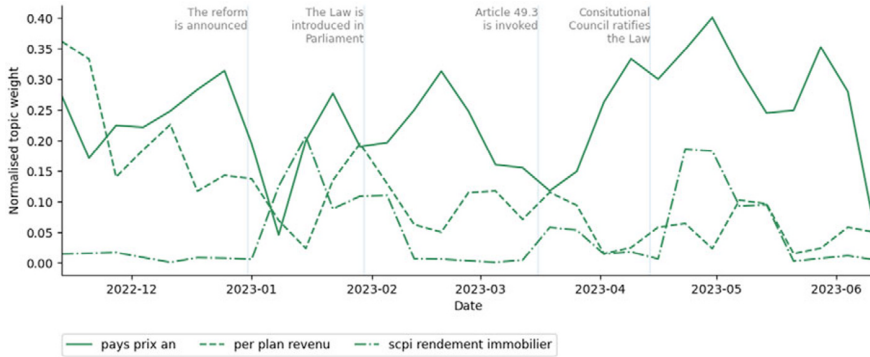


(a) Fairness dimension in media: evolution of topics.

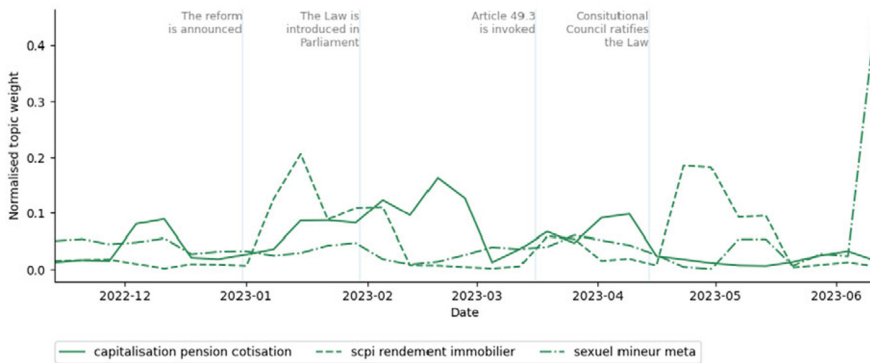


(b) Fairness dimension in media: evolution of topics.

Figure A15. Temporal evolution of the other topics in the Fairness dimension.

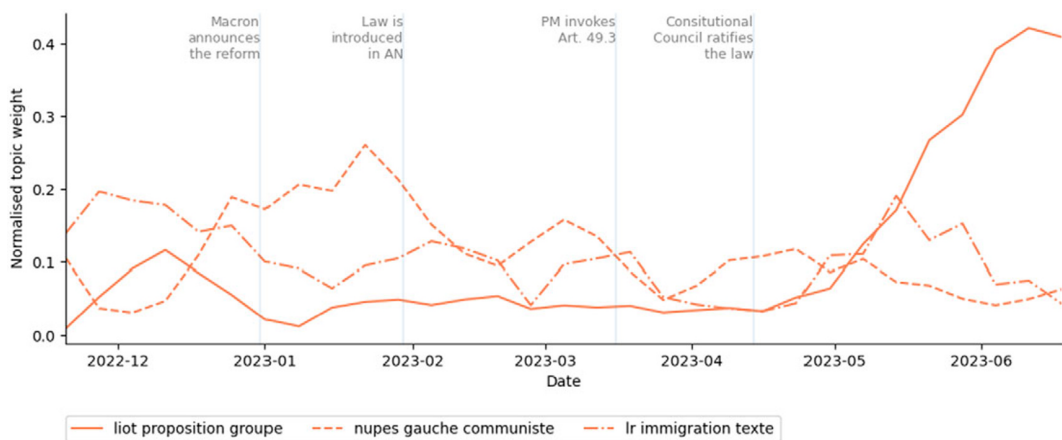


(a) Risk and time dimension in media: evolution of topics.

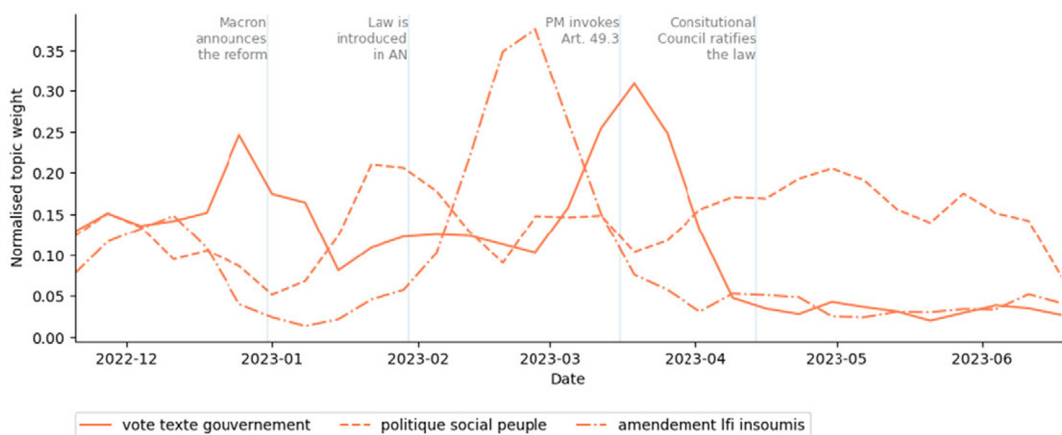


(b) Risk and time dimension in media: evolution of topics.

Figure A16. Temporal evolution of the other topics in the Risk and time dimension.



(a) Process dimension in media: evolution of topics.



(b) Process dimension in media: evolution of topics.

Figure A17. Temporal evolution of the other topics in the Process dimension.