Capturing and comparing transboundary crises: a text-as-data measurement model

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Abstract: Transboundary crises are seemingly ubiquitous in contemporary global politics. While scholarship is divided regarding whether such crises are boon or bane for regional and global governance capacities, there is agreement that they matter. To better understand the effects of transboundary crises, however, systematic comparative research is necessary. So far, this endeavor is hampered by the absence of a robust and consistent measure that would allow to compare crisis prevalence across countries, policy areas and time. This paper develops such a measure. It builds on the intersubjective and perceptive nature of crises to justify a text-as-data measurement model capturing crisis intensity as visible in global public discourse. Specifically, we propose to extract systematic information from large corpora of international news agency reports by exploiting natural language processing algorithms, such as latent semantic scaling and modern text classification approaches. Beyond detailing and justifying this measurement approach, the paper provides a proof-of-concept study covering almost 100.000 newswire reports from the 2014 to 2017 period, when transboundary crises such as the Ebola epidemic and the European migration crisis occurred. Despite remaining pragmatic and methodological challenges, the pilot shows that our model of collecting systematic data for the comparative analysis of transboundary crises provides a viable path.

1. Introduction

In various social science disciplines, research on crises that spread across national borders and different policy areas is booming. Not least due to the rapid succession in the past two decades of various large-scale transboundary crises such as the Global Financial Crisis (GFC) and the COVID-19 pandemic, it seems like we are living through an age of crises – or, as some would claim, interconnected and overarching 'polycrises' (Zeitlin et al. 2019; Helleiner 2024). Such impressions spark high academic interest – and rightly so: arguably, the intersection of globalization, interdependencies, technological innovation risks, environmental degradation, and growing problem complexity gives reason to worry about system failures and contagion effects that spark more and more crises. And it puts into question the aptness and resilience of governance arrangements at domestic and especially international levels that are confronted with unseen challenges.

Crisis research in public administration (PA) and international relations (IR) has taken two main forms. First, contributions in the PA literature, especially, have made important inroads in conceptualizing different forms and types of crises that confront policymakers today. It is here, for instance, that such terms as the 'transboundary crisis' or the 'creeping crisis' were coined (Boin 2019; Boin et al. 2020). This literature also addresses the various and distinct challenges that arise from each type of crisis for domestic, regional, and global governors conceptually. Second, another strand of literature dominated by IR scholarship has concentrated on theoretical work and qualitative studies seeking to understand the governance reactions of institutional actors to crises with international dimensions. Here, the questions are, for example, how such crises affect the autonomy or authority of international organizations (IOs) (Olsson and Verbeek 2018; Kreuder-Sonnen 2019b; Haftel et al. 2020) and to what extent and how collective actors can affect the course of transnational crises (Blondin and Boin 2020). For empirical substantiation, these studies typically revert to one or a small set of intuitive and well-known crisis cases.

As it stands, we seem to gain better and better ideas of the shapes and stakes of crises and we rightly wonder how to tackle the diverse challenges they represent. However, there is literally no consistent empirical data source on the frequency, intensity, temporal development, and transboundary nature of the various types of crises that we would need for an accurate analytical understanding of the problem. Accordingly, there is a blatant lack of truly comparative empirical research to account for and test the theories on the effects of crises on political institutions and the effects of these institutions on crises. This is due to one problem in particular: There is no operational measure for crises that would be applicable across countries, policy areas and time. Existing crisis datasets are typically issue-specific and reliant

on external indicators that are non-transversal (e.g., economic performance measures, death rates). Only a 'universally' applicable measure will allow us to make meaningful cross-sectional and cross-temporal comparisons and find more conclusive answers to the questions that the field is currently grappling with.

This paper proposes such a measure. Its key contribution is to provide a new measurement model that allows to capture and compare crises across countries, policy areas and time. We leverage the perceptive element inherent to all crises to employ a text-as-data approach for the detection of crisis-related vocabulary in public discourse. As theoretical debates about the core nature and constituent features of crises have made clear, for a situation to represent a crisis, it requires the broad intersubjective *perception* of a threat that needs to be addressed under conditions of urgency and uncertainty (e.g. Boin 2004; Widmaier et al. 2007). Therefore, we assume that public crisis perception is a valid crisis indicator travelling across issue areas. We hold that this perception is reflected in public discourse as, for example, represented in news media content. To measure crisis perception, we thus use advanced natural language processing (NLP) tools based on distributional semantics to conduct semi-automated content analyses of large text corpora consisting of newswire reports.

As a proof of concept, this paper applies initial versions of the such NLP algorithms to a manually downloaded sample of 98,565 texts from the 'international news' section of the Associated Press between January 2014 and June 2017, a period including crises such as the European crisis related to migration and refugees and the West African Ebola crisis. These two cases are not only widely acknowledged as transboundary crises, they also stirred intense debates about the IO response capacities to such crises (Scipioni 2018; Börzel and Risse 2018; Heath 2016; Kamradt-Scott 2016) Our initial analysis shows that our measurement approach is apt to reliably detect the intensity, the geographic spread, and the affected issues of crises across the board.

The remainder of the paper will first provide a review of the relevant conceptual and empirical literature that motivates our endeavor of introducing a new crisis measure. Next, we present our text-as-data model and justify the methodological approach. The following empirical section shows first results of an analysis applying the measure to a test corpus and discusses the observations with a view to accuracy and reliability. Finally, we conclude with reflections on the current state of development of our measure, potential validation strategies, and the various possibilities to put the measure to use in different disciplines.

2. What we know about crises and why we need to know more

Most conceptual work on crises is carried out in scholarship on crisis management in public administration. Here, crises are generally defined as situations combining the elements of *threat*, *urgency*, and *uncertainty* as perceived by relevant actors (Rosenthal et al. 1989, p. 10; Rosenthal et al. 2001; Boin 2004).[1] Accordingly, a crisis consists of an existential threat for a referent object (e.g. the political community, the survival of a group, the wealth of societal factions) that requires speedy action to be averted under conditions of incomplete information. The literature recognizes that crises are a matter of social construction: "crises do not exist independently of people's perceptions" (Boin et al. 2020, p. 121; see also Widmaier et al. 2007).

An important development in the PA crisis (management) literature is the increasing differentiation of crisis types. A first key distinction is that between crises whose reach is confined to one jurisdiction or domain and *transboundary crises* that are defined as instances in which a threat is perceived across geographic and/or functional borders (Boin and Rhinard 2008; Boin 2019). For instance, the COVID-19 pandemic was perceived as a threat virtually all over the world and not only affected the health sector, but also economic and social domains, among others. This is the type of crisis that has spurred the greatest interest among scholars and pundits of international politics, because crises that span geographic borders naturally put the question of cooperation and collective action in regional or global governance institutions in the spotlight.

A second important distinction made in PA scholarship on crises is based on the timing of crises' onset and closure. 't Hart and Boin (2001) famously juxtaposed fast-burning and slow-burning crises. The former are marked by a short 'incubation period' and rapid ending whereas the latter are characterized by a slow onset and long periods of simmering crisis perceptions (see also Seabrooke and Tsingou 2019). Hybrid types are 'cathartic' (slow onset, fast closure) and 'long-shadow crises' (fast onset, slow closure) ('t Hart and Boin 2001). These types of crises are thus distinguished by the intensity of crisis perception over time. More recently, PA scholars have introduced a third distinction that focuses on the divergence or convergence between 'objective' crisis developments – understood as relatively undisputed expert assessments about the level of threat and urgency exhibited by a given issue – and 'subjective' crisis attention – understood as public or elite perceptions of the level of threat and urgency. Here, special regard is given to the common scenario that crisis attention is lagging behind crisis development – a situation referred to as a 'creeping crisis' (Boin et al. 2020, 2021; Engström et al. 2021). The HIV/AIDS epidemic of the 1980s and 90s as well as the current

[1] This definition also spilled over into broader IR debates, see Lipscy 2020.

issue of anti-microbial resistance may provide intuitive examples for such creeping crises (Engström 2021; Staupe-Delgado and Rubin 2022).

This literature has made important inroads in the study of contemporary crises by providing the conceptual tools to better understand the variety of crises that contemporary global governance finds itself confronted with. The main take-away for us is that the analysis of crises should happen along three main dimensions: the *intensity*, *temporal dynamics*, and *transboundariness* (i.e. the spread across both geographic and functional policy areas) of crises.

Crucially, however, the literature so far has not provided convincing operationalizations for these dimensions that would make them consistently measurable at scale. The literature predominantly works with a small number of intuitive examples but has refrained from gathering systematic data. Extant efforts to provide datasets on crises are so far limited to the International Crisis Behavior (ICB) Project that focuses on military inter-state conflicts (Brecher 2018) and two projects focusing on *domestic* banking, currency, and sovereign debt crises – one administered by the IMF (Laeven and Valencia 2018, 2020) and one located at the Harvard Business School (Reinhart and Rogoff 2009). As these projects work with issue specific indicators, they do not lend themselves for broad comparative analyses. A crucial building block for the next big step in crisis research is thus currently missing: comparable crisis data across countries, issue areas, and time.

This state is all the more deplorable since much theoretical work in the field of crisis management – at both domestic and international levels – is currently handling conjectures that are often mutually exclusive or contradictory, and thus seem in dire need of empirical testing. In particular when it comes to the effects that crises have on global governance, the field seems divided. Broadly speaking, we discern two opposing camps that see crises as a boon or a bane for IOs, respectively. While contributions based on institutionalist and critical theories expect crises to drive authority transfers to and further institutionalization at IOs, those based on postfunctionalist and realist theories see in crises fundamental challenges for cooperation in and the exercise of authority by IOs.

The first camp is dominated by rationally or functionally institutionalist approaches that portray crises as exposing urgent problems of interdependence driving institutionalized cooperation among states (generally Keohane 1984; Abbott and Snidal 1998; Vabulas and Snidal 2013). In the literature on the European Union (EU), it has almost become a truism to see crises as one (if not the most) important inducement for actors to leave uncompromising positions and transfer authority to supranational institutions (Schmitter 1970; Stone Sweet and Sandholtz 1997; Mattli 1999; Lefkofridi and Schmitter 2015; Schimmelfennig 2018). Also historical

institutionalist research associates crises with an expansion of IO mandates as they represent windows of opportunity to overcome normally existing constraints on agency (Gocaj and Meunier 2013; Braun 2015; Kreuder-Sonnen and Tantow 2023). Finally, contributions rooted in critical security studies (Buzan et al. 1998) have also connected crises to IO empowerment. Focusing on (supranational) executive actor's ability to declare (or even construct) existential threats, it is argued that IOs may exploit crises to assert emergency measures and arrogate new competencies in contravention of established norms (Hanrieder and Kreuder-Sonnen 2014; White 2015; Kreuder-Sonnen 2019b; Rhinard 2019; Heupel et al. 2021).

By contrast, post-functionalists and neo-realists – for very different reasons, respectively – highlight obstacles to cooperation and authority transfers in times of crisis and instead predict a strengthened role for national governments. In the post-functionalist version of the argument, downward pressure on integration is exerted by a public constraining dissensus that follows in the footsteps of the politicization of international authority (Hooghe and Marks 2009). Since crises strongly increase issue salience, they are likely to become moments of particularly intense politicization, especially when distributive questions are at the forefront (Hooghe and Marks 2018). The higher the number of states affected by a crisis – and thus the greater the potential preference heterogeneity – and the more crisis management is politicized domestically – the narrower the range of possible multilateral cooperative agreements (see also Blondin and Boin 2020). From a neo-realist perspective, transboundary crises are expected to undermine existing and inhibit new institutionalized cooperation, because they represent moments of high politics in which states will become entirely self-regarding (Zimmermann 2021). In order to survive under conditions of anarchy in the international system, states' only option is to pursue their short-term parochial interests and try to achieve competitive advantages vis-à-vis other states (Waltz 1979; Mearsheimer 1994/95; Mearsheimer 2018). In times of crisis, when uncertainty is high and distributional implications are substantive, this dynamic is expected to be especially strong (see also Johnson 2020).

As it stands, the literature on crisis effects on international institutions is divided and comes to partially contradictory findings. For some, it seems, transboundary crises are good news for global governance whereas others assume such crises to effectively overburden the governance system. Empirically, the picture is unclear as contributions typically work with a small set of cases in which they find support for their respective claims.[2] If the effects of crises on IOs are non-uniform, however, it is crucial to understand under what conditions they take what shape. For such an endeavor, broader comparative investigations are necessary that are possible only with consistent cross-sectional crisis data. Hence, in order to really advance in

[2] See Haftel et al. 2020; Debre and Dijkstra 2021 for exceptions.

the theory and practice of crisis management, truly comparative research is needed on a larger scale. This will help us get a sense of the prevalence of crises (and of which crises!) in contemporary international politics – also allowing us to gauge the extent to which contemporary talk of the abyss is doomsaying or fair description – and enable us to test our theories about crisis management, which is of highest practical relevance. For all these reasons, we need a valid crisis measure. In the following, we introduce a text-as-data measurement model that we hope will provide the foundation for such analyses.

3. A text-as-data measurement model to capture and compare transboundary crises

To enable truly comparative research on transboundary crises, our target is a data set which equips researchers with systematic information on the intensity of crises (*intensity*), the development of this intensity over time (*temporal dynamics*), as well as the spread of this intensity over geographical units and functional policy areas (*transboundariness*).

Building on the above discussion, our measurement approach starts from the intention to capture whether a given situation is widely perceived as threatening and requiring urgent action under conditions of uncertainty. Broad-based public perceptions – and the intersubjective agreement about a state of crisis that they imply – matter especially for our purposes: if only specialists were to agree on some kind of 'objective' threat, collective decision-making would not switch to crisis mode (Widmaier et al. 2007) while decision-making elites would lack either the political incentive or the societal backing to acknowledge and act upon a crisis (Buzan et al. 1998; Kreuder-Sonnen 2018; Boin et al. 2020). Widespread perceptions of threat, urgency, and uncertainty are thus necessary to speak of a state of crisis and thus form the key observable implication our operationalization focusses on. That is, we want to extract expressions of *threat, urgency, and uncertainty* within and across *functional policy areas* and *geographical units* as they are visible to a wider global public at a given point in time.

When public visibility and, specifically, crisis perceptions are of interest, research routinely resorts to analyses of mass media content (e.g. Kreuder-Sonnen 2019a; Rauh and Parizek 2024; Schäfer et al. 2016). This is because mass media establish contemporaneous public salience in modern societies and provide a mutual source of information for decision-making elites and the wider society alike (e.g. Soroka et al. 2015; van Aelst and Walgrave 2016). Yet, given our interest in transboundary crises across the globe, we cannot solely rely on selective samples of specific national media as often done in research on specific crises. In particular, work on 'news values' reminds us that media can be highly selective in what they cover (cf. Galtung and Ruge 1965; Harcup and O'Neill 2001), with geographical distance to specific

events and developments being one relevant source of bias of media coverage that would undermine our ambition here.

To get at the most encompassing representation of salient topics and issues in global public discourse across longer time periods, we take inspiration from governmental conflict event coding systems (e.g. Schrodt and van Brackle 2013) and build our measurement approach on *newswire reports* from the largest international news agencies. These agencies cater to very different media organizations all over the world and set the agenda of national news retailers, especially as regards global news (Johnston and Forde 2011; Boumans et al. 2018). The primarily factual, and event-oriented reporting that the news agencies sell to downstream media allows us to avoid more of the journalistic selection and framing in specific national media.

For our purposes, newswires offer three further important advantages. First, the almost real-time coverage of newswire agencies at least at daily frequency provides us with temporarily consistent information to measure how crises unfold over time. Second, the fact that all major agencies control large correspondent networks around the globe reporting on a broad range of topics from politics and economics to culture and sports allows us to capture the functional and geographical transboundariness of crises. Third, all major agencies operate an English-language newswire stream which facilitates the consistent application of text-as-data models to extract information systematically at scale. For these reasons, the global stream of newswire reports is, in our view, the best available raw information source to capture the temporal evolution of crisis perceptions and their potential spread across different countries and policy areas.

We have accordingly inquired the archives of all major news agencies and especially aggregator archives such as Nexis and Factiva. This preparatory research shows that we can access the full-text English newswire streams of six leading agencies in principle: Agence France Presse (AFP), Associated Press (AP), United Press International (UPI), Xinhua General News Service, Information Telegraph Agency of Russia (ITAR-TASS), and Jiji Press for the last thirty years (1994-2024).[3] We discuss the significant download restrictions or costs involved below, but once the available archival documents are processed into machine-readable text corpora, recent progress in *natural language processing* (NLP) provides us with innovative means to measure the key concepts of interest here.

The first and most important one of those is *crisis intensity*. That is, we want to infer whether and how much any given newswire text describes a specific event or development to be in the state of crisis. The challenge of extracting this information from text is that such verbal

[3] The only major news agency missing in this sample due to lacking full-text availability is Reuters.

descriptions may use a variety of words to describe a state and/or level of crisis while the respective terminology might also vary from one policy area to the next. Rather than searching for a fixed and literal set of crisis terms only, we thus approach the measurement of expressed crisis intensity as a problem of semantic similarity, as it is typically captured in word embedding algorithms and the resulting word vectors (Pennington et al. 2014; Rodriguez and Spirling 2022).

These advanced NLP approaches encapsulate the idea of distributional semantics according to which 'you shall know a word by the company it keeps' (Firth 1957). The models are trained by moving a fixed window (of, say, ten words) through very large and ideally representative text corpora. They then store word-to-word co-occurrences in each of these snapshots. The resulting co-occurrence matrix is then reduced by PCA-like procedures to a lower dimensional space in which words that regularly co-occur with similar neighbours receive similar vector values across these latent dimensions. Put differently, words that often share similar contexts accordingly 'live' closer together on the respective dimensions of the vector space. This property enables researchers to quantify the similarity in meaning across all words in the vocabulary of a corpus that the model is trained on.

This intuition can then be exploited to locate each word on a polarity that the researcher defines by selecting substantially meaningful antonyms in the vector space – an idea that the recent methodological literature variably calls latent semantic scaling (Watanabe 2021), semantic directions (Taylor and Stoltz 2021), or semantic projection (Grand et al. 2022). That is, researchers collect theoretically meaningful words which capture the poles of the dimension of interest, retrieve the positions of these antonyms in the word-vector space, to then locate all other words in the vocabulary of the model relative to these vectors – typically by calculating and subtracting the vector distances between each word and each pole of the theoretically relevant dimensions. Building on our own prior work in this regard (Rauh 2022; Rauh and Parizek 2024), we can thereby position virtually any word in the English vocabulary on semantic polarities capturing key components of emphasized crisis intensity, e.g. by positioning all words relative to antonym anchor pairs such as 'crisis' on the one hand, and 'stability' on the other.

The thus derived word weights can then be used to score *crisis intensity* in each newswire text by averaging them across the words that the text uses to describe a specific event or development. Aggregating this measure over meaningful units of time offered by the newswire stream then also allows studying the *temporal dynamics* of crises.

The other key concepts we then need to extract are *geographical and functional transboundariness*. That is, we want to use newswire texts to infer how our measure of crisis intensity spreads across different countries as well as across different policy areas.

We classify the *countries* that a newswire covers along the established Newsmap algorithm (Watanabe 2018).[4] This tool starts from seed dictionaries containing country names, adjectives, and major cities (e.g. 'China', 'chinese', 'Beijing', 'Shanghai'), then retrieves document-level co-occurrence frequencies of these seeds across the whole corpus of newswire texts, to finally use this information for estimating the likelihood that each text covers each country along a Naïve Bayes classifier applied to the document-frequency matrix.

To classify which *policy areas* are covered in any given text, we resort to the long-standing coding scheme of the Comparative Policy Agendas (CAP) project (Baumgartner et al. 2019). The key advantage of using this scheme lies in making our dataset readily linkable to a broad array of other research projects in political science or political communication. Very recently, Sebők et al. (2024) published transformer-based large-language-model classifiers that were trained on the massive human-coded CAP data (also including media texts) and achieve high levels of accuracy in classifying especially English-language texts into the 21 CAP policy areas.

Figure 1 summarises our proposed measurement approach to capture the intensity, the temporal dynamics, as well as the geographical and functional transboundariness of crises across the globe. This combination of advanced text analysis tools applied to encompassing corpora of the newswire stream should ultimately result in a *nested panel data set that provides consistent and comparable measures for expressed crisis intensity across all countries of the world as well as across 21 policy areas at high temporal granularity over the three last decades*. This data structure, and its flexibility regarding aggregation options for scholars with different theoretical interests, should significantly support comparative research into the political and institutional effects of such crises.

[4] We initially planned to code the location of the reporter that is typically provided with each agency report. However, preparatory research shows that this creates notable errors, for example where a reporter based in New York reports on United Nations debates about humanitarian emergencies elsewhere in the world. Thus, we rather extract information of the covered country from the text content itself.

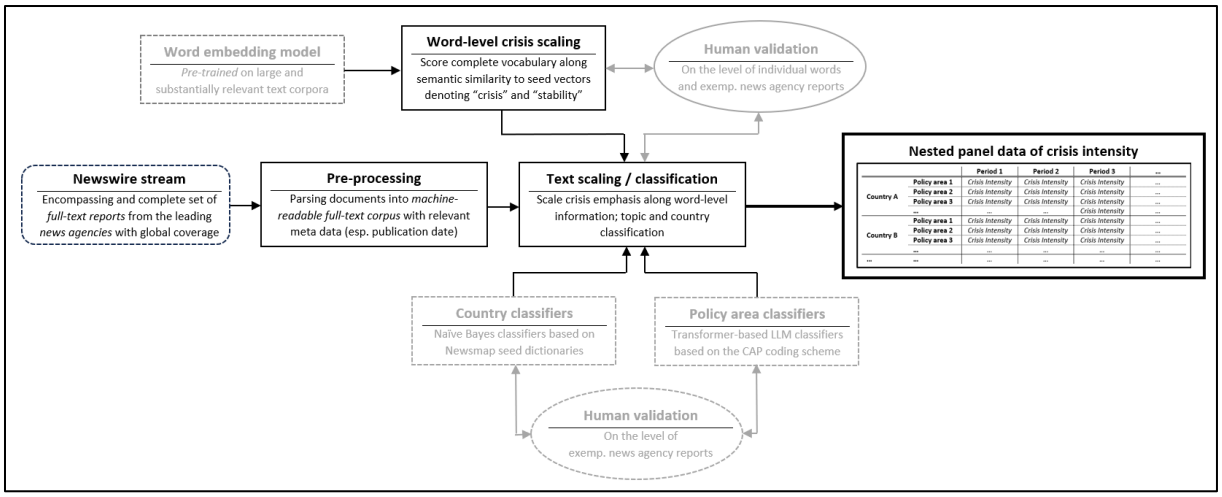

Figure 1: Summary of the measurement model

To ensure high data quality for downstream projects, the automated text scaling and classification approaches require human validation at several steps of the procedure (cf. Figure 1). As the country and policy area classifiers have been extensively validated in the literature already, we plan to resort to checks of random document-level samples (stratified by time and agency) from the newswire stream to estimate conventional performance metrics. More care is needed for validating the crisis intensity scaling and establishing meaningful theoretical thresholds. Here we plan to evaluate the approach both on the word- and on the document level with the help of crowd-sourced coding. As our measure presents a latent continuous scale, a notoriously hard task for human coders, our corresponding validation approach will ask coders for overlapping pairwise comparisons (of individual words as well as of individual newswire texts) which we then scale before comparing them to our automated scores (cf. Benoit et al. 2019).

Before engaging in this investment, however, we first want to get an impression of the feasibility, initial face validity, and usefulness of the measurement model we propose here.

4. Proof-of-concept study: detecting crises between 2014 and 2017

To this end we conduct an initial proof-of-concept study. Besides human validation, one key bottleneck for rolling out the measurement approach sketched above is gaining access to the raw newswire stream at scale. Archive providers have increasingly limited academic access, raised prices for text mining approaches, or removed large-scale raw text access from extant university subscription models.[5] Before applying for respective funding and negotiating offers,

[5] Discuss price tag and copyright restrictions XXX.

we thus need more information on the feasibility and (face-) validity of the approach developed here.

Our respective proof-of-concept study is thus meant to showcase the approach in the broadest scope possible, while dealing with these significant constraints of data access at the same time. More specifically, we accessed the newswire texts for our initial study through an extant university subscription model of Nexis, a leading commercial database for journalistic texts provided by LexisNexis. It offers complete full text coverage of various newswire streams, but it severely and artificially limits web scraping or manual document downloads.[6] Taking these restrictions into account, we had to make two sets of specific choices for the initial study here.

First, with Associated Press (AP) we focus only one of the worldwide leading news agencies for our initial purposes. Being ranked as either the first or the second largest news agency along different metrics, however, AP is highly useful for our initial test. It reports on a broad range of topics (from 'politics', 'science', and 'health' over 'business and finance' to 'religion and faith', amongst others),[7] builds on a large global network with reporters in 231 locations in 93 countries worldwide, and publishes up to 1,000 stories per day.[8] Since this output is still far beyond the official Nexis download limits, we limit our initial data collection further to the 'international news' section of AP's newswire stream. This covers breaking news across the globe and across all sub-topics which AP reporters consider to be of interest elsewhere and is thus closest to our conceptual measurement ideas.

Second, to make the download task manageable we had to limit the time period for our proof-of-concept study. We ultimately opted for the period from January 1st, 2014, to June 30, 2017. This particular choice is driven by our desire to assess the face validity of our measurement model as it offers *two relevant case studies* on the intensity, temporal dynamics, and potential transboundariness of crises. During the 3.5 years we are able to cover here, the world saw both the Ebola pandemic in Western Africa as well as a migration crisis – both of which were discussed extensively with regard to their effects on the WHO or the EU, for example, and should be traceable by our proposed approach.

[6] Nexis has consecutively decreased the maximum batch download size, at the time of writing being limited to 100 documents at once, and also applies artificial IP-based time breaks between repeated search or download request.
[7] https://www.ap.org/content/topics/ (last accessed: 09.09.2024)
[8] https://www.ap.org/about/annual-report/2023-report/2023-ap-by-the-numbers/ (last accessed: 09.09.2024)

Within these restrictions, we then manually downloaded the raw documents.[9] After parsing, splitting, cleaning, and pre-processing the resulting 1,082 download files, the *final corpus* consists of 98,565 newswire reports with machine-readable full-texts and relevant meta-data.[10]

4.1 Crisis intensity scaling

We then created word-level crisis weights on the basis of a pre-trained word-vector model as outlined above. Specifically, our proof-of-concept study resorts to the standard GloVe 6b/300 model, one of the largest pre-trained sets of embeddings for individual tokens in the English language that is publicly available online (Pennington *et al.* 2014).[11] It is trained by extracting word-to-word co-occurrences in a moving context window of 10 words through the full 2014 English Wikipedia Corpus and – importantly for our context – Gigaword, a corpus of almost 10 million newswire texts. On this basis it offers a vocabulary of more than 400,000 words, each of which is positioned across 300 latent dimensions in the vector space.[12]

We than inductively collected a broad range of words that are colloquially used to describe a state of "crisis" and its opposite of "stability". We assessed the consistency of this initial set of terms along the correlations of their vectors and along the parallelism of lines connecting antonym pairs in the vector space (cf. Boutyline and Johnston 2023). On this basis we ultimately opted to anchor our word-level crisis scaling approach in the following noun antonym pairs: 'crisis/stability', 'threat/safety', 'emergency/routine, 'turmoil/tranquillity'.

Then we calculated the cosine similarity of each of the 400.000 words in the full GloVe-vocabulary to the average vector of terms on both the 'crisis' and 'stability' sides of our anchor set and subtracted the latter from the former. Thus, the higher the resulting word-level weights are, the closer they are in meaning to the concept of 'crisis' and the more distant in meaning they are from the concept of 'stability'. To illustrate what we have 'learned' from the pre-trained model along this approach, Figure 2 shows the top-40 words and their estimated weights pulling in either direction of the initial conceptual scale.

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[9] To deal with the download restrictions, the authors applied empty searches for the selected AP source, tailored the time period for each request so that it stays within the maximum batch size, to then create permanent links to each individual search result (with the number of hits <= 100). Along these links, research assistants could then subsequently download the documents manually with appropriate time breaks in between. We are sincerely grateful to Constance Nothomb, Dren Kelmendi, and Hendrik Damerow for assisting us with this task. The manual download steps took about 24 of their working hours in total.

[10] We extract all relevant meta data, esp. publication day and time, reporter and location, and headline provided as separate lines in the newswire report itself. These items except for the headline have then been removed from the full text vector, which then presents the input for the scaling and classification discussed below.

[11] https://nlp.stanford.edu/projects/glove/ (last accessed: March 15, 2023)

[12] Brief discussion of feature selection and errors as well as alternative embedding models here – Google News.

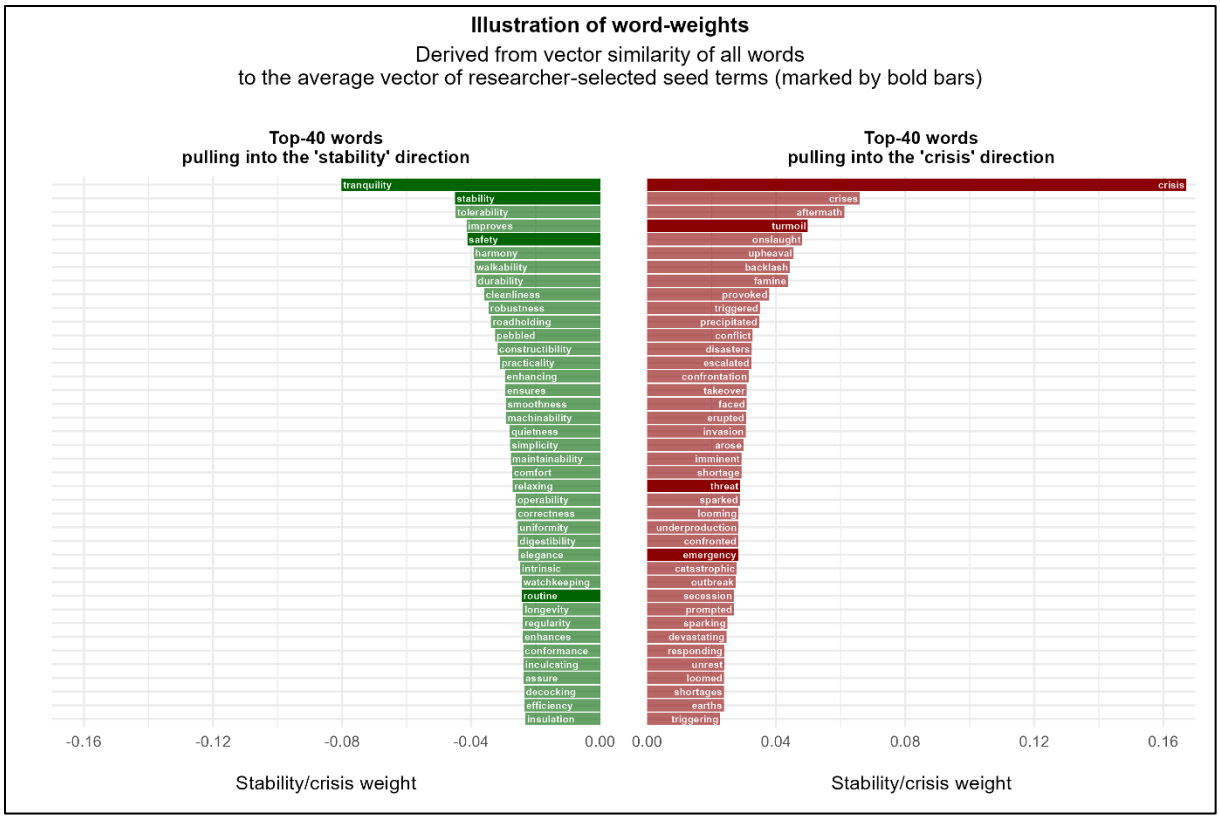

Figure 2: Illustration of word-level weights for expressed crisis intensity derived from word-vector model

Based on this information, we then can scale each individual newswire text in our corpus, by averaging the 'stability-crisis' weights of all the words it contains.[13] Table 1 provides examples of average text length from the upper and lower ends of the thus generated text-level crisis intensity scores.

[13] Note that we excluded a list of conventional English stopwords (as given in R by quanteda::stopwords("english")) to avoid pulling all texts to the same mean, as well as a broad range of geographical identifiers (from the respective English language dictionaries in the R package Newsmap, countrycode, and maps) to avoid respective biases.

Example for high expressed crisis intensity ***EU Council president rejects criticism over migrant crisis*. (August 31, 2015; Score: 0.013)**
European Council president Donald Tusk has rejected criticism of Europe's handling of the migrant crisis and promised further measures to deal with the issue. Tusk said Monday after meeting Slovenia's Prime Minister Miro Cerar that "Europe cannot be blamed for the migration crisis." But, he acknowledged the EU needs to do more "to alleviate the unbearable human suffering and tragedies that have become everyday news." The EU has been criticized as too slow in dealing with the migrant crisis. The International Organization for Migration says so far this year over 332,000 migrants have arrived in Europe. "The migrant crisis will remain a key issue for Europe in the years to come," Tusk said. Slovenia's Cerar noted that "nobody could have imagined that this issue would grow so large."
Example for high expressed crisis intensity ***UN blames South Sudan's leaders for 'catastrophe'*. (December 15 2014; Score: 0.004)**
The U.N. Security Council is blaming South Sudan's "man-made political, security and humanitarian catastrophe" and the threat of famine on its feuding leaders. The council again threatened targeted sanctions against those impeding the peace process. A year after the outbreak of clashes between fighters loyal to President Salva Kiir and supporters of former vice president Riek Machar, the council issued a presidential statement Monday strongly condemning the serious human rights violations and abuses that have caused the death of tens of thousands of civilians and displaced nearly two million people. It demanded that Kiir and Machar end the violence and "make the necessary compromises for peace." Without a credible peace agreement, the council warned, "the risks of famine, state failure and regionalization of the conflict persist.
Example for low expressed crisis intensity ***Europe's bathing water excellent, except in Albania - agency.* (May 25 2016; Score: -0.0014)**
The European Environment Agency says vacationers can safely take dips at bathing sites across the continent. The Copenhagen-based agency said Wednesday that water quality was excellent at 87 percent of the more than 21,000 coastal and lakeside bathing sites it measured last year. It said aquatic quality has consistently improved since 1991, when only 56 percent of sites had excellent water. Luxembourg topped the list, with excellent water quality at all of its 11 bathing sites. It was followed by Cyprus, Malta, Greece, Croatia, Italy, Germany and Austria. Albania was at the bottom of the list, with the highest number of sites with poor water quality. The EEA said that overall, only 1.6 percent of sites were deemed unsuitable for bathing, down from 1.9 percent the previous year.
Example for low expressed crisis intensity ***Jamaica to invest $22M for aviation safety.* (March 21 2014; Score: -0.0023)**
Jamaica is investing $22 million in the next two years to improve aviation safety and security. The director general of Jamaica's Civil Aviation Authority says most of the money will be used to upgrade or replace aging technology to meet international standards. Leroy Lindsay said Friday that the government hopes to install satellite surveillance for air traffic controllers by 2017. He said the government also plans to install a communication network that will allow automatic contact between air traffic control and aircraft systems. Lindsay said the changes will allow air traffic controllers to do less controlling and more monitoring, leading to increased safety.

Table 1: Exemplary newswire texts with particularly high or low crisis intensity scores

4.2 Country and policy-area classification

For classifying the *countries* that a newswire text covers, we used the original Newsmap algorithm ‘off-the-shelve’, based on the English-language seed dictionary of country names, country adjectives, and major cities (Watanabe 2021). Careful inspection of the word weights shows that the Naïve Bayes Classifier learns meaningful additional words for country classification, such as names of country leaders (e.g. ‘jinping’ for China) or terrorist groups (‘taliban’ for Afghanistan). On the document level we observe extremely high fit of the most-likely country and our assessment of actually covered countries in the text. But this still needs

to be quantified and we note a few problematic cases (esp. the Congo republic vs. DR Congo). We also observe few instances in which a newswire text covers two or more countries, meaning that we will experiment with coding units below the document-level and/or likelihood thresholds for the second or third most likely country according to the algorithm.

For classing policy areas, we could not yet resort to the LLM-based CAP classifiers by Sebők et al. (2024). For our initial purposes, here we initially built a crude Naïve Bayes classifier of twelve broad and recurring issue areas we could detect with qualitative inspection of random samples of newswires from our corpus. Following the Newsmap logic, we first detected presence of respective seed words across the full corpus, let the algorithm learn which other words frequently occur in documents that contain these seed words, to then estimate the likelihood that each text falls in either category across the full vocabulary observed in our empirical material. Qualitative inspection shows surprisingly high face validity of this arguably crude and initial classification approach, and we deem a newswire to cover a topic (amongst others) if the estimated odds ratio is larger than .2 on this basis. Table 2 summarizes the topics, the seeds used in their estimation, and the resulting prevalence across the newswire corpus.

Topic name	Seed terms	Estimated prevalence %
Violence	violen*, military, soldier*, terrorist*, marine, navy, army, airforce, police, weapon*, guns, armed, bomb, bombs, knife, attack*	37.37
Crime	crime, criminal*, prison, prosecutor*, suspect*, arrest, homicide, drug*, trial, court	25.75
Politics	politician*, election*, vote*, legisla*, partisan, party, parties, parliament	21.19
Economy	market*, money, bank*, stock*, bond*, industry, company, shop*, trade, investment, business, gdp, import*, export*	16.87
Diplomacy	diplomcy, diplomat*, visit*, embassy, envoy, ambassador*, banquet, delegation, consulate, summit	13.32
Accidents	accident, accidents, crash*, collision*, rescue*	11.00
Culture	culture, art, heritage, festival, cuisine, architecture, painting*, cinema, novel, book*, literature, theater*, film, movie, memorial, fashion, celebrit*, actor, actress*	9.34
Health	health*, hospital, hospitals, patients, medicine, infect*, flu, fever, treatment, virus*, disease, therap*, doctor*, sick, pandemic*	8.84
Migration	migrat*, migrant*, immigrat*, immigrant*, asylum*, refugee*, displace*, visa*, diaspora, flee*, resettle*	8.57
Weather	climate, weather, meteorolog*, storm, wind, rain*, tornado, hurricane, snow, flood*, heat, drought	8.30
Education	educat*, school*, universit*, student*, pupil*, teacher, professor*, predago*, classroom, literacy, campus	6.53
Sports	sport, sports, cup, tournament, olymp*, team, athlete, soccer, football, cricket, tennis, golf	5.88

Table 2: Summary of crude topic area classification

With this material in hand, we can then turn to our substantial face validity tests. For the following exposition we aggregate the crisis intensity scores to the level of country/month/topic combinations. Since we theoretically argue that crisis emphasis is a function of both the

expressed crisis intensity in individual reports and the frequency by which this is repeated for a country/month/topic, we sum crisis intensity scores within each of these units to make them comparable.

4.3 Case 1: The Ebola pandemic in Western Africa

Our first substantial face validity check focuses on the largest and deadliest known Ebola outbreak in history. From an initial case in Guinea in late December 2013, the Ebola Virus Disease (EVD) quickly spread to neighbouring Liberia and Sierra Leone in the first months of 2014. The outbreak escalated rapidly, with thousands of cases reported by August when the World Health Organization (WHO) finally declared it a Public Health Emergency of International Concern. Weak healthcare infrastructure, delayed response, and poor public awareness are said to have contributed to the virus's spread in the three hardest hit countries – Guinea, Liberia, and especially Sierra Leone. By late 2014, the epidemic showed signs of slowing, but it continued into 2015 before eventually being contained.

If our measurement model works in principle, we should see this particular health crisis, as well as its geographical and temporal spread, in our initial data set. Figure 2 thus aggregates expressed crisis intensity across space and time.

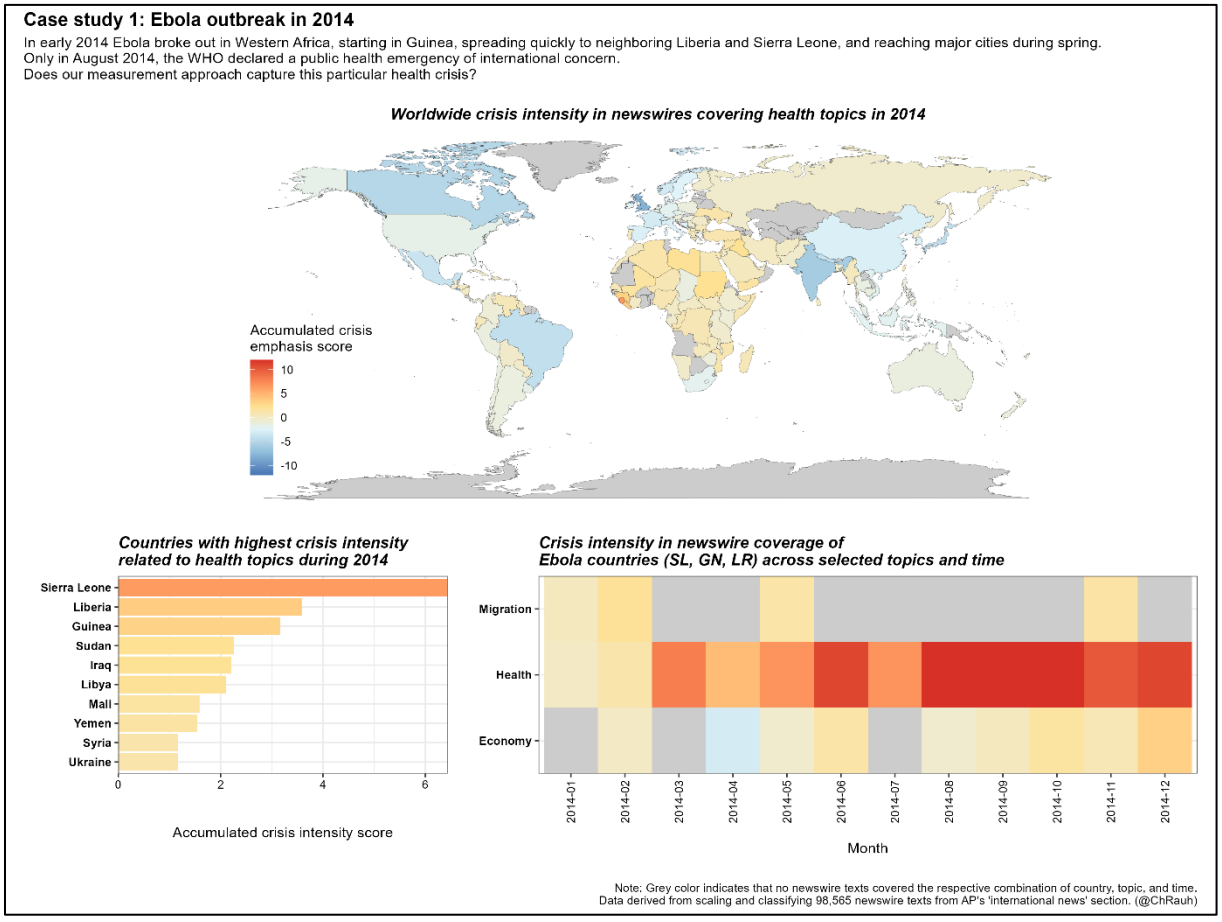

Figure 3: Aggregate results of case study 1

In summary, we see that our data map the geographical facts on the ground quite well. The systematically extracted information contained in newswire texts suggests that expressed crisis intensity in newswire reports related to health issues during 2014 were particularly strong for Sierra Leone, followed by neighbouring Liberia and Guinea (which still score significantly worse than other, especially war-torn countries in Northern Africa and the Middle East).

Zooming in on the three countries most severely affected by the Ebola outbreak, we also see that our data pick up the temporal dynamics of this crisis, especially the epidemic's peaks during summer and early fall of 2014 and slightly declining levels by the end of the year (bottom right panel of Figure 2). For now, this data does not suggest that the crisis was particularly transboundary in functional terms, though. Besides the directly affected issue area of health, we include migration and economy topics as two likely issue areas that might experience contagion. We observe no increased crisis intensity for migration-related reporting for these countries in the selected time-frame and see only slightly increasing crisis emphasis when it comes to the economy in the three covered countries by the end of 2014.

While detailed human validation on the term-, document-, and aggregate level is still needed and the related problem of setting appropriate thresholds remains, this initial patterns of detecting a recent, well-discussed crisis are encouraging for the measurement approach we propose here.

4.4 Case 2: The (supposedly 'European') migration crisis

Another recent and frequently discussed crisis with a particular view to problem-solving capacities beyond the nation state was the (supposedly) European migration crisis, peaking particularly during summer and fall of 2015. The strong increase in numbers of refugees and migrants arriving in Europe, primarily fleeing conflict, persecution, and poverty, was largely driven by temporarily overlapping wars in Syria, Afghanistan, and Iraq, as well as political and economic instability in several African countries.

Over one million people arrived in Europe in 2015, 200,000 during the month September alone, with many losing their lives during dangerous journeys across the Mediterranean Sea from Turkey to Greece or from North Africa to Italy. In late summer, Europe also saw a rise in the number of people traveling the Western Balkan route, particularly through countries like Hungary, which became a focal point of migrant flows until border closures were implemented. Other key countries affected included Germany and Sweden, which received the most asylum seekers. The crisis strained European Union (EU) member states, leading to political tensions over responsibility-sharing, border security, and migration policy reform.

Is our proposed measurement approach detecting and capturing this particular crisis? To answer this question, Figure 4 zooms in on newswire reports covering migration issues during 2015. In temporal terms, the aggregation of our measure to the monthly level across all EU-28 states (bottom right panel of Figure 4) picks up the expected peaks during late summer and early fall 2015. Here we note that crisis intensity scores stay at a very high level also during winter, even though migration flows slowed down while discussions about migration stayed high on the European political agenda. In terms of geographical spread in this aggregation, we need to put the Eurocentric view on this crisis into perspective. Different from the narrative of a 'European' migration crisis, our data instead points to a state of crisis in those countries from which many of the migrants were actually fleeing. Particularly, the war-torn Syria stands out markedly in this regard, followed by Nigeria, Sudan, Iraq, or Yemen. But also transit countries in or close to Europe, such as Hungary, Greece and Turkey figure on the top-10 list of countries affected by a crisis in migration. Also Germany, with its large share of asylum seekers figures prominently on that list. We note, however, that two countries we would have expected to show up more prominently here based on the facts on the ground – Sweden and especially Italy – are not explicitly picked up by our measurement approach. This finding invites further reflection on the validity of our country classifiers for pinpointing geographic transboundariness. The question is whether we measure the location of crisis perception (i.e., where a crisis is experienced) or the location of a crisis source (i.e., where the putative 'threat' is thought to emanate from). In the Ebola case, the answer to these two questions was the same. In the 'European' migration crisis, it was not.

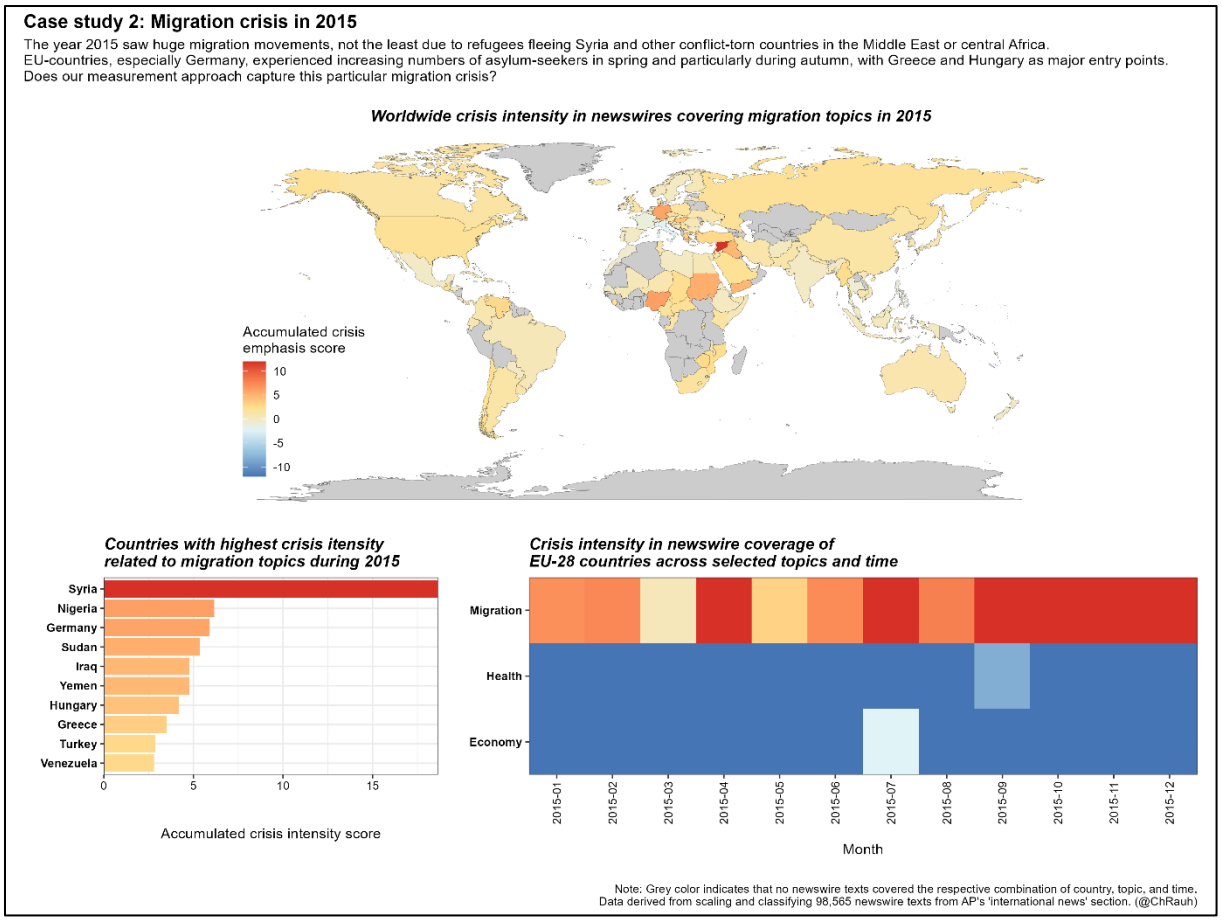

Figure 4: Aggregate results of case study 2

Again, various additional validation approaches are tangible and necessary here. The many countries with missing values on country/migration combination also point to the need to build even bigger newswire corpora for temporarily consistent measurement (even though the absence of reports on specific topics can be interpreted as substantially meaningful from a perceptual perspective on crises). Yet and still, also this second case study shows encouraging face validity for the comparative crisis measurement approach we propose here.

4.5 Country-level correlations of the crisis intensity measure and sectoral indicators

To Do: Scatter growth/crisis intensity economy; refugee arrivals (share) and migration crisis, fatalities (pop share) and health crisis – more/better validation ideas more than welcome!

5 Outlook

Overall, we expect that our crisis measure has a wide array of potential use cases across disciplines. Already in our own field of international relations, there are myriad ways in which

the measure could be fruitfully employed to advance existing strands of research. In line with the above review of the literature, for example, the measure could be used to create a comprehensive dataset of transboundary crises in the past thirty years that can be correlated with existing data on IO authority, capacity, and performance, enabling comparative studies with the goal to understand the conditions under which crises lead to IO empowerment or disempowerment, and – more specifically – what types of crises, e.g., slow- vs. fast-burning crises, have what effects on global governance. More broadly, the measure could also be used to study more systematically the effects of crises on other dynamics of international politics, including conflict management, diplomatic practices, or transnational movements (Della Porta 2022).

Beyond IR, the measure might also enable contributions to debates in disciplines such as economics, law, and sociology, among others. Scholars of political economy, for instance, typically study 'objective' economic indicators to distinguish normal from exceptional times. Our measure based on intersubjective crisis perception could enable conversations about the question of whether and when 'objective' development and intersubjective perception of economic crises converge or diverge and why they do so. This would also put empirical flesh to the bones of the conceptual crisis research in public administration that is increasingly interested in the disconnect between 'development' of and 'attention' to crises. For legal scholars, moreover, the measure could be useful to enrich existing research on the effects of crises on civil liberties, the rule of law, and the separation of powers at the domestic (and sometimes supranational) level (e.g. Gross and Ní Aoláin 2006). Not least the COVID-19 pandemic gave rise to empirical legal scholarship investigating the conditions under which legal systems withstand pressures of emergency rule (Ginsburg and Versteeg 2020). Analyses across countries in one crisis could then be supplemented with analyses across crises. Finally, sociologically oriented research might make use of our crisis measure to study, for instance, the narratives and discourses through which crises are constructed, providing a critical reflection on what gets and what does not get to be perceived as a crisis (at the global stage).

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