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Expecting the Unexpected

A new Uncertainty Perception Indicator (UPI) – concept and first results

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Abstract

The phenomenon of economic uncertainty has attracted considerable attention in recent years. New indicators have been introduced aiming at measuring uncertainty and its potential economic consequences. Still, the Corona pandemic has hit the world economy virtually out of the blue. In this paper, we argue that, while it is clear that true uncertainty, by definition, cannot be forecasted, better early warning systems could be built.

To further this goal, we propose a new taxonomy of economic uncertainty and construct a news-based indicator that captures different kinds of uncertainty, some of which may precede others. If we are able to detect the preludes of an uncertainty shock, we may be able to gauge its size and potential economic impact early on.

In earlier writings (Müller et al. 2018, Müller 2020a) we demonstrated the feasibility of Latent Dirichlet Allocation (LDA) for gauging uncertainty. Here, we base our analysis on an enhanced data set, a broader query, and we propose a routine to scan the recent past for new sources of uncertainty.

Based on a text corpus of more than 750.000 newspaper articles published since 2008, we run several topic models of the LDA type. As an unsupervised text mining technique LDA has the potential to make economic indicators more sensitive to hitherto unknown – or overlooked – factors of economically relevant uncertainty.

Our results are preliminary, yet encouraging. The notion that economic uncertainty comes in three types, two of which, *market-based* and *economic policy uncertainty*, may reinforce one another, while the third type is *truly exogeneous*, is broadly supported by our empirical approach. The Uncertainty Perception Indicator (UPI) is able to shed light on the links between the three categories of uncertainty and is systematically open to new developments; it is designed to detect not merely *known unknowns* (e.g. fiscal and monetary policy, trade policy, regulation), but also *surprising unknowns* (e.g. technological, ecological, social changes).

„It probably occasions surprise to most persons the first time they consider seriously what a small portion of our conduct makes any pretense to a foundation in accurate and exhaustive knowledge of the things we are dealing with."

Frank H. Knight (1921: 210)

1. Introduction: Why didn't we see it coming?

When Frank Knight published his seminal book "Risk, Uncertainty, and Profit" in 1921 the world had just been through a phase of violent uncertainty. Tens of millions of people had died in World War I. In its aftermath, centuries-old empires had vanished; formerly solid states like the newly-democratic German Reich were on the brink of bankruptcy, hyperinflation, and civil war. A pandemic, the Spanish Flu, had just killed millions around the world. It was an era when recent experience painfully showed the fundamentally uncertain nature of the world – a world in which individuals and institutions could only strive to survive the unexpected, but hardly manage it.

The scenario Knight was confronted with in his time contrasted sharply with the stable, prosperous, and (relatively) peaceful pre-WW I era, that had ended only seven years earlier. Before the war, there had been "a golden age of security", as Stefan Zweig would later explain to subsequent generations. "Nobody believed in wars, revolutions, and upheavals (…) With contempt one would look down on earlier epochs with their wars, famines, and revolts as a time when people had simply not been mature and enlightened enough" (Zweig, 1944, pp. 18–19 translations by the authors). The world Zweig described is now known as the *first globalization*. The inhabitants of these stable times, stretching from about 1870 to 1914, would have deemed Frank Knight's notion of ubiquitous uncertainty as overly somber and pessimistic. Yet, in 1921 he struck a nerve. And so he does again today, as a new era of major uncertainty shocks dawns.

Uncertainty and its economic impacts have drawn considerable attention in recent years, particularly in the wake of the financial crisis of 2008 and again since the advent of populist politics in the second half of the last decade. Indicators have been constructed to measure uncertainty and to make its economic impacts more predictable, such as the Economic Policy Uncertainty Index (EPU) by Baker, Bloom and Davis (2016). Institutions like the World Economic Forum have been publishing risk reports based on experts' analyses in order to reveal the probabilities of occurrence of the unexpected (e.g. World Economic Forum (WEF), 2020).

Still, here we are in 2020, confronted with a severe pandemic that shatters the global economy and loosens its political and social moorings. The Covid-19 epidemic can be characterized as a "Green Swan event" (Bolton et al., 2020), i.e. a major risk whose occurrence is "highly likely or certain" but whose "timing of occurrence and materialization" is uncertain and whose properties are "too complex to fully understand"(da Silva, 2020, p. 6). Worse, Green Swans may become more frequent as global warming speeds up and related risks materialize. According to the BIS, humanity should prepare for an era of severe global shocks. Again, we have to make decisions, as Knight put it, without "a foundation in accurate and exhaustive knowledge of the things we are dealing with". Nevertheless, we have to act swiftly, decisively,

collectively without knowing what's really going on, or what the exact consequences of our actions might be.

Unfortunately, we didn't see the Corona pandemic coming. Early warning indicators failed, including the popular EPU which didn't show elevated levels of uncertainty until early April 2020. By that time, China's Hubei region, a manufacturing hub of global significance after all, had already been under lock-down restrictions for more than two months. Shutdowns in Italy, France, Spain, Germany and other major economies had followed a few weeks later. Financial markets had already tanked and forecasts for economic growth had been revised downward sharply. Still, it took another month or so until the EPU shot up to unprecedented highs. If the BIS is correct in its prediction of a dawning new era of the unpredictable, i.e. of Green Swan events, we should strive for better early warning indicators.

In this paper we present a more refined approach to gauge uncertainty, the Uncertainty Perception Indicator (UPI). Like the EPU of Baker et al. (2016) our indicator is based on newspaper content. But it makes use of unsupervised text mining techniques, namely Latent Dirichlet Allocation (Blei et al., 2003), that have the potential to make EPU-like indicators more sensitive to hitherto unknown – or overlooked – factors of economically relevant uncertainty. In earlier writings (Müller, 2020a; Müller et al., 2018) we demonstrated the feasibility of LDA for gauging uncertainty. Here, we base our analysis on an enhanced data set, a broader query, and we propose a routine to scan the recent past for new sources of uncertainty.

This paper is organized as follows: In section 2 we provide a brief overview of the literature on news-based indicators. Section 3 shows our methodology and data base. Section 4 presents some core results (detailed results can be found in the appendix). Section 5 proposes a way to spot changes in the composition of overall economic uncertainty in the most recent past. Section 6 draws some conclusions and discusses possible paths to further improve the UPI. An extensive appendix presents the characteristics ("Top Words", "Top Texts", frequency over time) of each topic used in the analysis.

2. Gauging Uncertainty

In our reasoning economic uncertainty comes in three varieties:

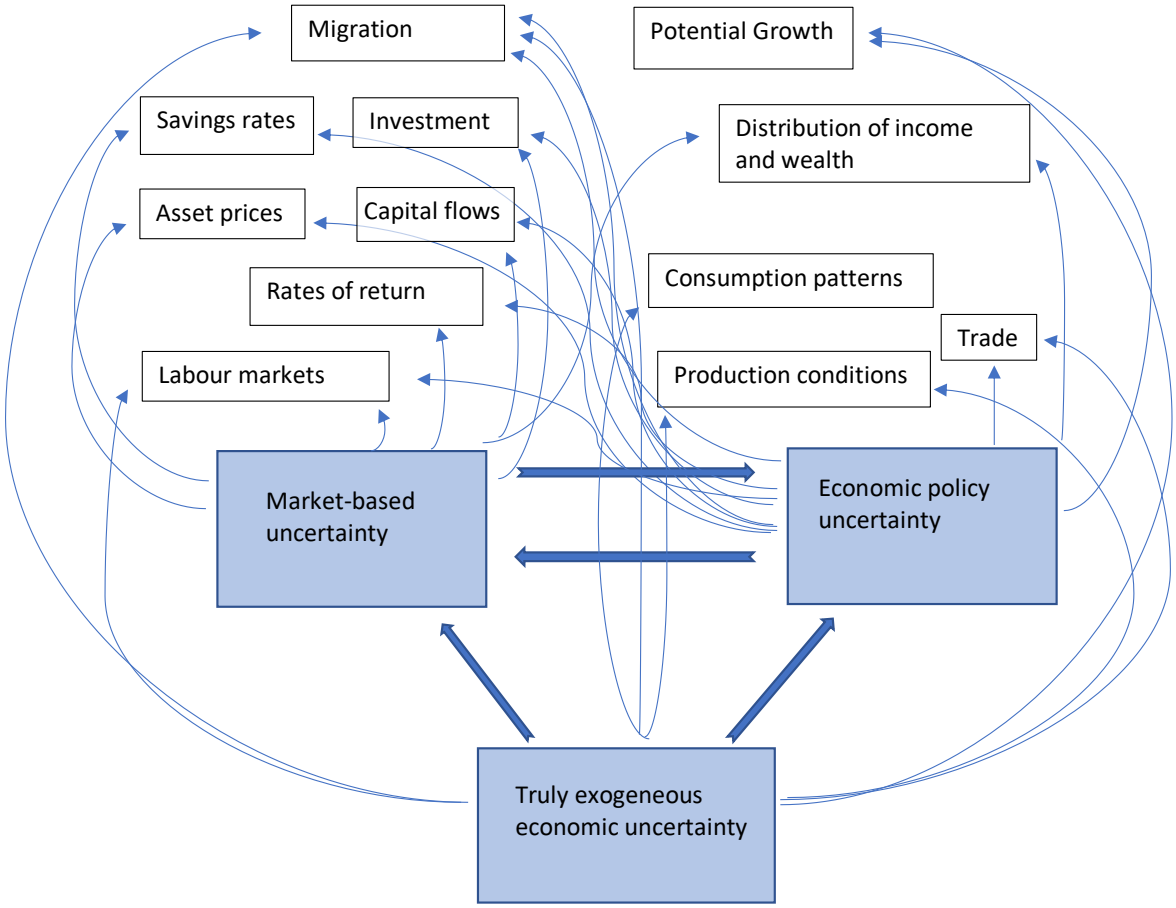
Market-based uncertainty encompasses events like sudden shifts in market sentiment, the bursting of bubbles, or the spreading of pessimistic expectations. The sources of this type of uncertainty are located in the market itself but cannot be forecasted due to limitations of economic models and data availability.

Economic policy uncertainty refers to unforeseen developments in the realm of politics that may have economic consequences. Surprising election outcomes (e.g. the Brexit referendum and Donald Trump's elevation to the US presidency, both in 2016) fall in this category, as well as the implementation of specific policy instruments and their precise consequences (e.g. the introduction of tariffs, novel central banking tools such as quantitative easing, or the recent price war in global oil markets).

Truly exogenous economic uncertainty derives from factors that are located outside of both the market and the political system. Possible sources of this type of uncertainty are plentiful:

uncertainty about evolving technological standards (e.g. car engine technologies), technological failures (like the Fukushima nuclear reactor disaster of 2011), earthquakes, volcanic eruptions, pandemics (such as Corona), meteor impacts, severe weather events (e.g. major floods, hurricanes, droughts), to name just a few.

Fig. 1: Three types of economic uncertainty and their potential (direct) economic impacts



Source: authors

The three types of uncertainty should not be interpreted as strictly separated but as interconnected: when a truly exogenous shock hits, unforeseen policy reactions may lead to adverse market-based reactions. At times, the three categories may interact as an inverse cascade of uncertainty that influences the economy via various direct channels; figure 1 provides an overview (endogenous interactions within the market system are not depicted). Think of the Corona pandemic: *truly exogeneous economic uncertainty* arises from a novel virus and its initially unknown infectious properties, prompting authorities and central banks to act in, at first, unknown ways with uncertain consequences (*economic policy uncertainty*), which, in turn, influences economic sentiment in detrimental ways, potentially leading to the bursting of bubbles and other peculiarities of *market-based uncertainty*.

In contrast, the initial shock of the financial crisis of 2008 came from the markets themselves. A loss of confidence led to the withdrawl of funds from the US investment bank Lehman Brother that started a chain reaction. As governments and central banks stepped in, their actions created an extra dose of uncertainty since market participants could hardly gauge the timing and effects of the new tools. This effect subsided over time as market participants

learned to understand policy tools and signals better and as central banks enhanced their communication (Müller, 2020b).

Indicators based on financial market variables may show the effects of economic uncertainty, but not its causes which are, by definition, exogeneous and therefore unpredictable within the context of economic models (Moore, 2017). To quantify policy uncertainty, different indicators of news media content have been constructed in recent years. This strategy seems justified since economically relevant political developments should be reflected in day-to-day news reporting at early stages. Whether this is also the case for reporting on scientific, technological or social developments that may lead to economic uncertainty remains to be seen. The most popular indicator of this type is the affore mentioned EPU (Baker et al., 2016) that makes use of a broad set of international newspaper corpora. The EPU is available for a growing variety of countries and specific kinds of uncertainty (trade, monetary policy etc.). News-based approaches have also been proposed by Brogaard and Detzel (2015), Caldara and Iacoviello (2018), Larsen (2017), Manela and Moreira (2017) and Azzimonti (2018).

A growing body of literature uses EPU data. For instance, Antonakakis et al. (2019) measure Europe-wide uncertainty shocks originating in the Greek debt crisis. Chen et al. (2019) show in an EPU-based analysis how oil price shocks are affecting Chinese economic growth. Degiannakis et al. (2019) find that economic uncertainty not just originates in politics but that there is also a feedback loop from finanical markets to politics. Fang and Sun (2018) show that global economic policy uncertainty leads to increasing volatility of financial market indicators. Alqahtani et al. (2019) come to the conclusion that US EPU spills over to the Gulf region‘s stock markets, while Caggiano et al. (2020) calculate that it effects unemployment rates in Canada and the UK. Nguyen et al. (2020) associate elevated EPU levels with decreasing global credit supply; Dash et al. (2019) find decreasing stock market liquidity in G7 economies with increasing EPU levels.

Indicators to gauge unforeseen developments affecting the economy should seek to capture all three types of uncertainty discussed above. At the same time, they should filter out the irrelevant stuff. This is no easy task. If an indicator is to be open to new developments, it is likely to capture all kinds of issues that will never cause any economic uncertainty whatsoever. If, on the other hand, the indicator is focusing primarily on *known unknowns* (i.e. factors that economic uncertainty derives from according to experience), it is bound to miss *unknown unknowns* (i.e. all the new stuff that’s currently happening). Hence, any meaningful economic uncertainty indicator has to strike a balance between the two objectives.

Naturally, news-based indicators can only find what editors at media outlets considered worth reporting. That’s why we call the UPI a *perception* indicator. What we actually measure is the amount of uncertainty-related news stories that citizens are confronted with, shaping their perception of reality and their expectations. By accumulating content from several news media over extended periods of time indicators may extract additional information about prevalent issues. News media are reporting on a huge variety of issues, some of which will become economically relevant in some way along the line, but also deal with a wide array of matters that will not. Unfortunately, *ex ante* researchers simply do not know what to look for exactly.

Uncertainty indicators of the EPU-type short-cut the search by presupposing distinct policy areas. The EPU filters for articles that deal with economic uncertainty in the context of monetary and fiscal policies, taxation and regulation. This concept has worked well in the past. But it may prove too narrow to capture other and particularly new sources of uncertainty, such as the Corona pandemic.

These considerations call for analytical methods that lend themselves to discovering not just *known unknowns* but also *surprising unknowns*. Topic modelling such as LDA provides such an approach.

3. Methodology and Data

Latent Dirichlet Allocation (Blei et al., 2003) is a method to analyze large text corpora in an unsupervised fashion. The algorithm groups articles into clusters ("topics") of related content without involving choices of human researchers. However, researchers still have to take important decisions, most notably concerning the media to be analyzed, the queries used, and the calibration of model parameters. Human interpretation is also essential throughout the process of analysis to add meaning to the text clusters. LDA results shed light on the content structure of the corpora. Thereby, underlying issues, themes, assumptions, frames, and narratives of public discourse can be made visible and measurable (for recent examples of this approach see (for recent examples of this approach see Hase et al., 2020; Puschmann et al., 2020). Unsupervised topic modelling methods are fundamentally open to new developments making them valuable instruments for the research in economic uncertainty.

The LDA topic clustering process operationalizes characteristics of language by putting words in a thematic context depending on how often they co-occur in a document. A central assumption of LDA is the bag-of-words hypothesis that implies that the actual order in which words appear in a text is irrelevant. LDA is not about semantics or grammar. What matters is the frequency of word occurrence. For each text cluster ("topic") the algorithm produces a list of characteristic words ("top words") and characteristic texts ("top texts"), i.e. the ones with the best statistical fit to the model. The frequency of a topic over time can be depicted graphically, which is of particular relevance for the analysis of newspaper corpora, since news reporting tends to be driven by events and often follows a typical pattern, a "bell-shaped curve skewed to the right" (Shiller, 2017, p. 17) triggered by a specific events. In statistical analyses of news cycles this distribution is known as a "shifted Gompertz function" (Bauckhage et al., 2014). In communication science issue attention cycle theory (e.g. Downs, 1972; Miltner & Waldherr, 2013) describes compatible patterns.

While the clustering process is unsupervised, LDA still needs human researchers to interpret what has actually been found. Lists of top words, top texts, and frequencies over time provide three starting points to analyze a topic's content. Topics are labelled by key words and may be characterized in a simple sentence or phrase. If two (or more) researchers come to similar conclusions about the content of a particular topic, results can be considered as valid.

Furthermore, a key parameter has to be chosen in advance: the number of topics the algorithm is set to produce. This parameter, *K*, can be likened to a lens' focal length: larger values of *K* sort a corpus into rather narrow clusters, zooming into details; smaller values of *K* provide broader categories of texts, like a wide-angle lens. Each corpus behaves differently in

the LDA process, so results for different *K* values need to be examined. Some *K* values may produce a blurred picture, in the sense that some topics are not sufficiently interpretable, and should therefore be excluded from the analysis.

Thus, LDA is an explorative method that is systematically open to find *surprising unknowns*. If, as we envisage, a new LDA is run in regular intervals, the topic structure may indeed change as the underlying corpus' content changes. Should a prominent new theme or frame appear, it can be expected to form a new topic. However, newspapers report on all kinds of issues. If we ran a decade or more of news reporting through the algorithm, we'd end up with rather unspecific results. To avoid this trap, the entirety of texts needs to be narrowed down. A query is needed to produce a sub-corpus of texts relevant to the specific aim of research. In (Müller et al., 2018) and Müller (2020a) we used a combination of search terms similar to the one used in the EPU for Germany. This is a three-dimensional query containing a) words concerning *uncertainty,* b) *economic* aspects, and c) certain areas of *economic policy*. The EPU for Germany consists of the following search words (www.policyuncertainty.com):

> „unsicherheit« OR »unsicher« OR »unsicherheiten«
>
> AND »wirtschaftlich« OR »wirtschaft«
>
> AND »steuer« OR »wirtschaftspolitik« OR »regulierung« OR »regulierungs« OR »ausgaben« OR »bundesbank« OR »EZB« OR »zentralbank« OR »haushalt« OR »defizit« OR »haushaltsdefizit«.

As already mentioned, the third line of the query may be overly specific when new sources of *truly exogeneous economic uncertainty* arise, since it excludes articles that could hint to sources of uncertainty other than monetary and fiscal policy, taxation and regulation. The EPU is basically a count of articles that contain these search terms. LDA, though, provides a kind of filter in itself. So, a broader query can be applied. For this reason, we scrap the third line of the EPU query in the exercise presented in this paper.

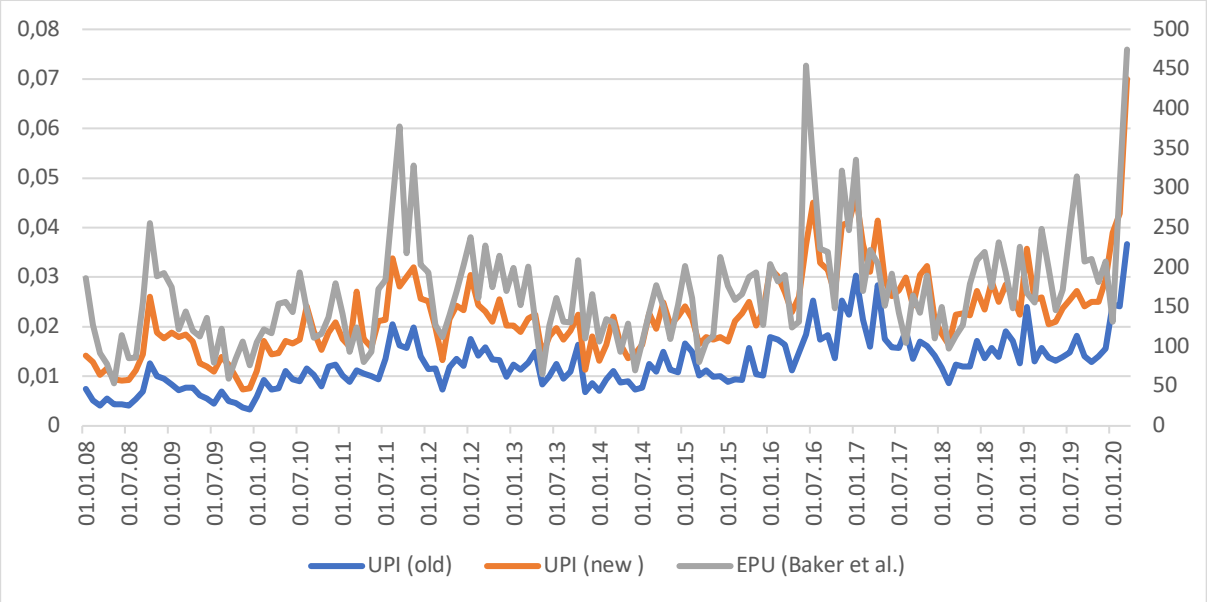
We use newspaper corpora of two leading nation-wide German newspapers, Die Welt and Handelsblatt. The data was provided by the publishing companies and by LexisNexis. We review a period from January 2008 until March 2020. These two newspapers are merged into a single corpus containing 752.000 articles. Applying the original EPU query yields an analysis corpus of 8295 articles; the broader query, without filtering for certain policy areas, contains 15.077 articles.

For each of these sub-corpora we compute LDAs with several *K*-values (6, 8, 10, and 12). After reviewing the results, the models with parameter values *K*=10 and 12 were considered the most promising and were consequently analyzed in greater detail. The analysis was conducted using tosca, an R package for statistical content analysis developed by DoCMA researchers (Koppers et al., 2020).

4. Results: Surprising Unknowns

Fig. 2 shows UPI frequency patterns – "UPI old" uses identical search terms as the EPU, "UPI new" the more open variant described above – and compares them with the EPU for Germany for the period from January 2008 to March 2020. Due to the methodology, the EPU's peaks are more pronounced, but overall all three graphs share broadly similar shapes, with major maxima in the fall of 2008 (financial crisis), 2011 (Euro crisis), the Brexit Referendum (June 2016), Trump's election (November 2016) and the Corona crisis (2020). However, there are a couple of developments where the indicators diverge: in the spring of 2010 the EPU seems to react slightly more sensitive to the early stages of the Euro crisis, particularly Greece's fiscal troubles. In March 2011 our indicator (new query) reacts to the nuclear disaster at the Japanese power plant in Fukushima and the ensuing shift in Germany's energy policy, an event that the EPU misses. In the first half of 2017 the UPI shows a spike that can be traced to the British elections in the context of difficult Brexit negotiations. In contrast, in mid-2019 the EPU reacts more sensitively to the escalating trade conflicts, particularly between the US and China. Finally, in early 2020 the UPI seems to indicate the economic impact of the Corona pandemic slightly earlier; whether this is really the case and, if so, where in the corpus traces might be found will be inquired further below.

*Fig. 2 Comparing UPI and EPU**

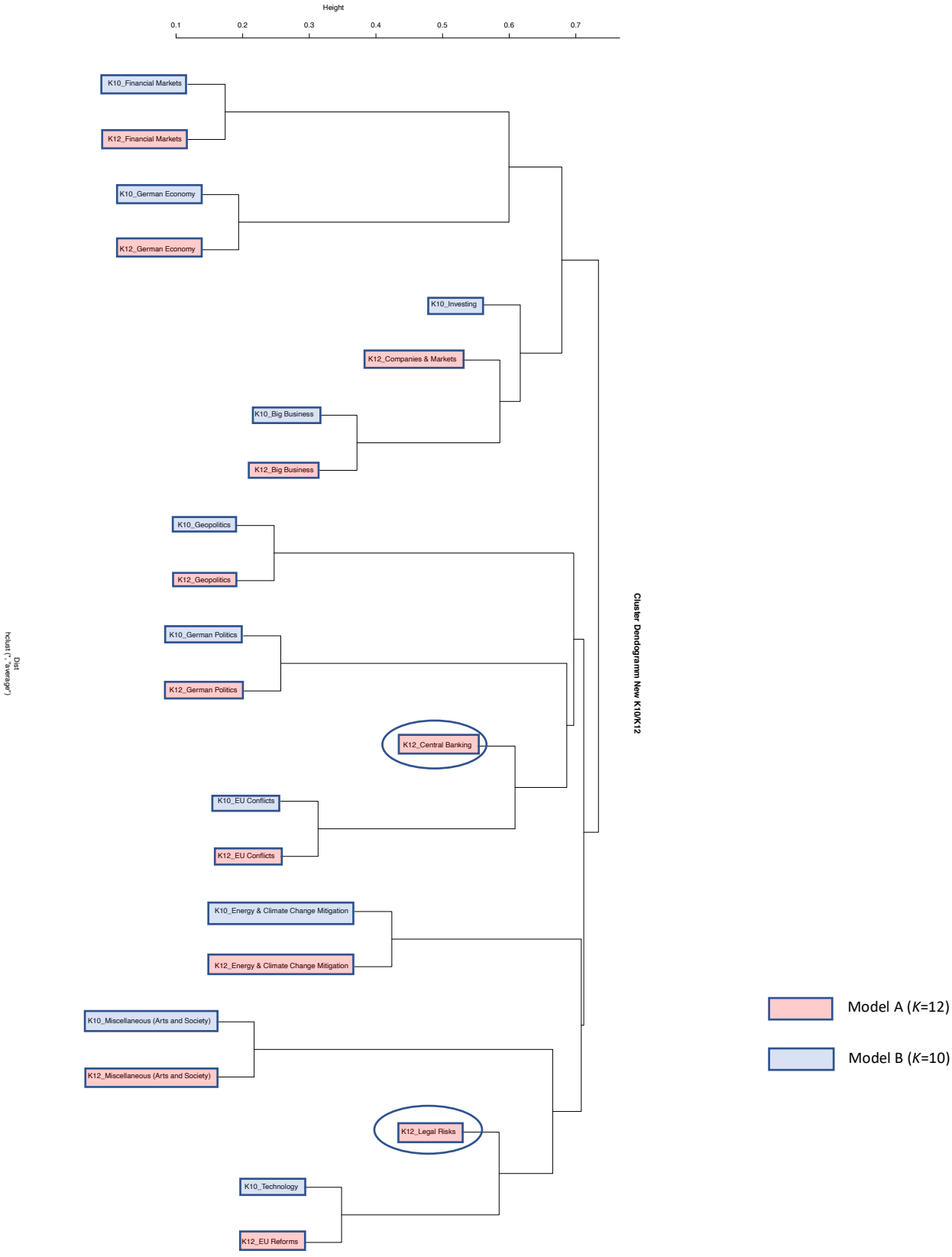


*montly data; left axis: percentage of UPI analysis corpora relative to overall corpus, right axis: EPU index points
Sources: Baker et al. (2016), www.policyuncertainty.com, authors' calculations

Measuring overall uncertainty has its merits, but for practical applications, like the forecasting of economic variables, the actual sources of uncertainty are more important. As already mentioned, we ran LDAs for different *K*-values.

The dendrogram (fig. 3) shows the statistical proximity (Hellinger distance) of the topics in LDA models A and B (*K*=12 and *K*=10, respectively). Topics that are depicted on the same branch are closely related, those on the same twig even more so. Each model yields only one topic of rather incoherent miscellaneous content. Most of the topics have a representation in both models. This is a remarkable result, underlining the model's robustness irrespective of parameter variations.

Fig. 3: Comparing topic structures for K-values of 10 and 12 (hellinger distance)



Source: authors' calculations

However, there are a couple of notable differences that need to be explained: legal issues emanating economic uncertainty (mostly labor, product, and financial market regulation as well as court rulings) can be found in a distinct topic of model A, while they are present in various topics in model B, especially in "Big Business" and "Investing". Moreover, model A sports a "Central Banks" topic for which there is no direct equivalent in model B. Central Banking issues in model B are found in the "Financial Markets" topic (mostly related to the Federal Reserve) as well as in the "EU Conflicts" topic (mostly related to the ECB). Technology issues, that form a distinct topic in model B, are located in "EU Reforms" of model A that also deals with technological challenges, R&D and investment strategies from an EU perspective.

The differences compared to the Baker et al. (2016) approach are striking. In Müller (2020a) we mimicked the EPU query which yielded several actor-focused topics, including a central banking topic. Several aspects of uncertainty did not show up in the topic structure. There were no newspaper articles dealing with energy, climate change, legal issues, or technology, since they were deliberately excluded from the query; consequently, there were no such topics. The broader search term used in this paper is open to all kinds of uncertainty as long as they are mentioned in an economic context. After all, if the UPI is meant to detect unexpected sources of uncertainty, a more open query is warranted. But this sensitivity comes at a cost: some topics in this analysis are not quite as clearly defined as the ones found in Müller (2020a), while certain issues can be found in several topics. We try to mitigate this weakness by combining topics that are closely related and partly overlap. In model A we combine "Big Business" and "Companies and Markets", "German Politics" and "Legal Risks", and the two EU topics ("EU Conflicts" and "EU Reforms") respectively; in model B "Financial Markets" and "Investing" are merged.

We consider model A better suited for measuring uncertainty: its finer granulation should present a more detailed picture of uncertainty-related developments. Table 1 provides an overview of its topics (a similar table for model B can be found in the appendix). Each topic can be described in a simple phrase and related to one of the three types of economic uncertainty we identified earlier. Even though the wider query allows for all kinds of sources of uncertainty to show up in the results in principle, only one of the topics ("Energy & Climate Change Mitigation") contains aspects of *truly exogeneous uncertainty*. This result reflects the strong focus of newspaper reporting on politics, institutions, their leaders, and the quarrels between them.

For analytical purposes topics are grouped in clusters that we call *Uncertainty Factors* (table 1, right column). These categories were formed according to the predominant actors mentioned in each topic.

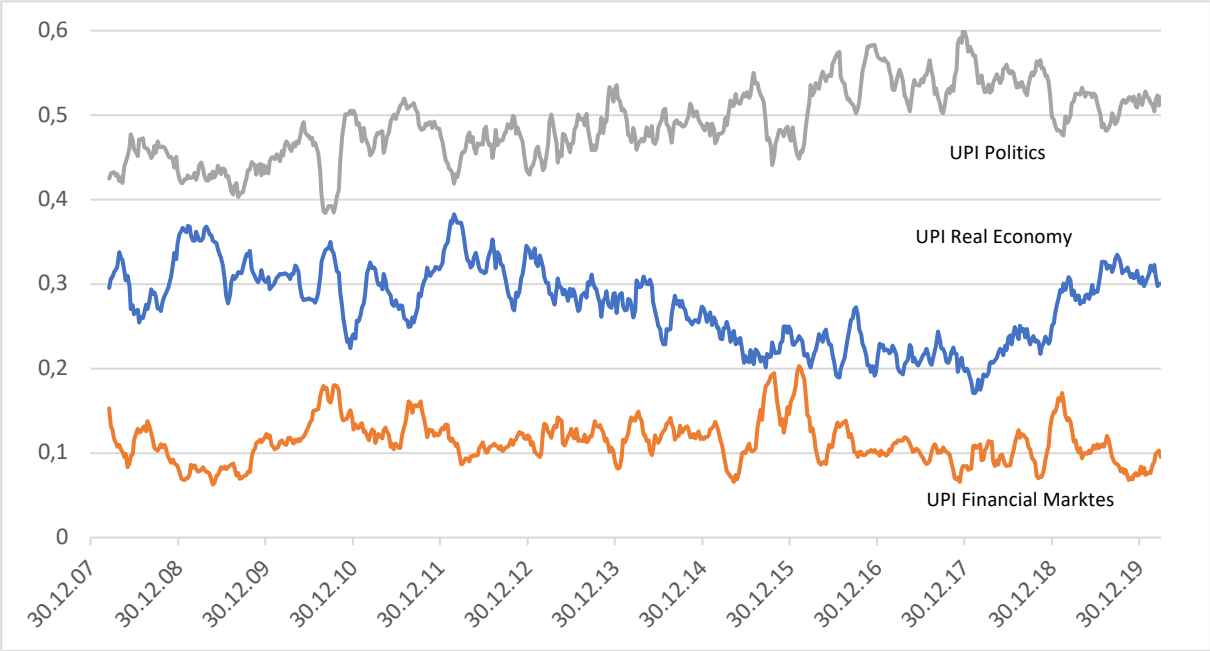
Table 1: Overview of Topics and Labels (model A, K=12)

Topic No.	Label	Share of analysis corpus (per cent)	Content	Type of uncertainty (as in Fig 1)	Part of Uncertainty Factor…
1	Big Business	8,66	Corporates in Germany and other EU countries in trouble	Market-based	UPI Real Economy
2	Central Banks	8,2	ECB, Fed etc. actions against crises	Economic policy	UPI Politics
3	Companies & Markets	5,56	Manufacturing, Real Estate sectors ups and downs	Market-based	UPI Real Economy
4	German Politics	7,26	Political developments in Germany (national level)	Economic Policy	UPI Politics
5	German Economy	9,02	Business cycle developments, forecasts, surveys	Market-based	UPI Real Economy
6	Legal Risks	8,25	Regulations and court rulings affecting businesses	Economic policy	UPI Politics
7	Energy & Climate Change Mitigation	4,15	Energy market developments, transition to sustainables etc.	Economic policy/market-based/truly exogenous	UPI Real Economy
8	Miscellaneous (Arts and Society)	12,07	Diverse	–	–
9	Geopolitics	7,54	Conflicts involving US, China, Russia, Turkey, Middle East…	Economic policy	UPI Politics
10	Financial Markets	11,07	Up and down at the bourses	Market-based	UPI Financial Markets
11	EU Conflicts	7,27	Brexit, Greece debt etc.	Economic policy	UPI Politics
12	EU Reforms	10,93	Debates about enhancing EMU, Investment, R&D etc.	Economic policy	UPI Politics

We combine 1 and 3, 4 and 6, 11 and 12 due to their proximity

Figure 4 shows the UPI decomposed into *Uncertainty Factors*. One striking feature of these results is the dominance of political uncertainty. As noted above, the strong role politics plays in the indicator could be exaggerated due to media reporting patterns that tend to focus on political actors; five out eleven topics are related to politics. However, this result seems to be justified by increasing government and central bank intervention over the period. After the financial crisis hit in 2008, rescuing financial markets and the real economy became a major task of state actors. Additionally, tension within the EU and in geopolitics increased, as is made visible in the rising trend over time, jumping particularly in the summer of 2016 with populist politics coming to prominence (Brexit referendum, Trump etc.).

Fig. 4: Decomposition of the UPI by Uncertainty Factors

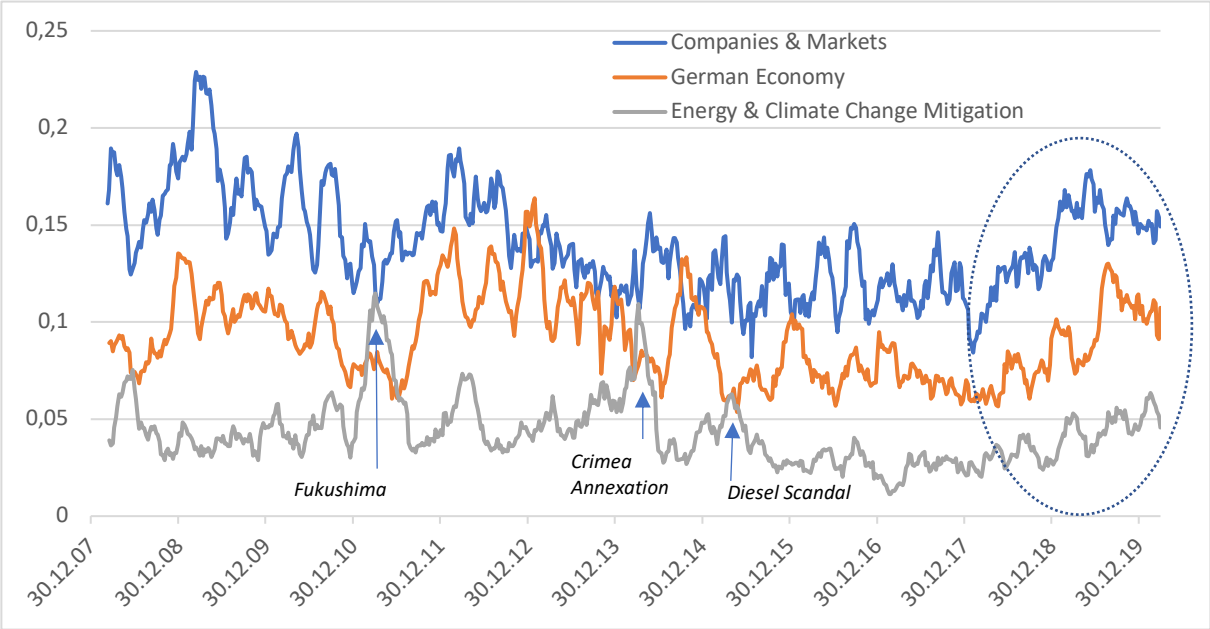


*shares in analysis corpus; three-month moving averages; source: authors' calculations

Referring to our reasoning about the three types of economic uncertainty (section 2.), which holds that *market-based uncertainty* may be driven by *economic policy uncertainty*, and vice versa, the graphs in fig. 4 suggest that the increase in market-based uncertainty from 2018 is a *result,* rather than a cause, of rising political uncertainty. This is in line with earlier findings in economics (Bloom et al., 2007). With a time-lag the real economy seems to be adversely affected by rising political uncertainty, which in turn is represented in the newspaper reporting captured in the UPI. LDA allows to zoom into the corpus, starting from a bird's eye view down to individual newspaper articles. Fig. 5 sheds some light on the nature of the rise in *market-based uncertainty* in 2018 and 2019.

UPI Real Economy consists of four topics; "Companies & Markets", as depicted in figure 5, is a combination of two closely related topics dealing with individual companies and developments in different markets. "German Economy" captures reporting on the business cycle, particularly on forecasts on declining economic growth in Germany and the Eurozone. "Energy & Climate Change Mitigation" (ECCM) encompasses issues related to energy prices and energy policies as well as their effects on companies and sectors. Since the query stresses uncertainty, a negative or skeptical framing is prevalent in these topics: clearly, the focus is on problems and conflicts.

*Fig. 5: UPI Real Economy, individual topics**



*shares in analysis corpus; three month moving averages; source: authors' calculations

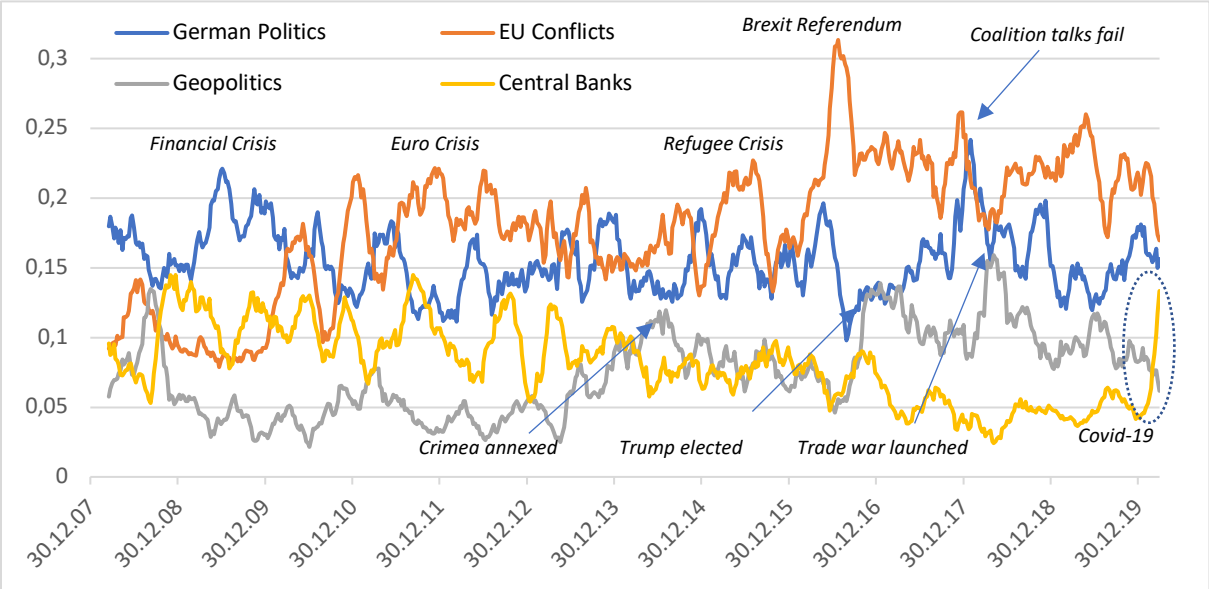
Figure 5 shows that the rise of the UPI Real Economy (fig. 4) is driven by all of the three topics: all the graphs trend upwards from 2018, as highlighted. Earlier, ECCM was driven by events such as the Fukushima disaster, tensions between Germany and its major gas and oil supplier Russia after the annexation of Crimea, and the Diesel scandal involving Germany's biggest car company Volkswagen. From 2018 the graph rises again as the public increasingly focusses on climate change and the economic implications of mitigation policies. However, the most pronounced increase is in "Companies & Markets": individual companies and sectors report disappointing results and/or prospects. With a time-lag, this increase is followed by an increase in "German Economy", i.e. the aggregate view on the economy. This is a pretty interesting result since it suggests that "Companies & Market" could serve as a leading indicator for economic growth; disaggregate reports on individual companies may serve as an early indicator for the economy as a whole. Earlier episodes show a similar pattern, e.g. in 2011 and 2013, with an apparent time-lag of about two quarters. Exploring the properties of these co-movements and their relation to economic indicators would be a worthwhile aim of future studies.

What has driven the rise in *market-based uncertainty* in the real economy? Fig. 4 suggested a connection with increasing policy uncertainty. LDA allows us to decompose this effect to uncover its drivers. Fig. 6 displays the individual topics of the UPI Politics. "German Politics" is a composition of two topics, covering political tensions in Germany and uncertainty surrounding legal issues. The graph shows a pattern driven largely by the election cycle, peaking in late 2017 when talks between Conservatives, Greens, and Liberal Democrats about the formation of a coalition government broke down. Over that period, the international landscape, i.e. the world order ("Geopolitics"), shows signs of instability, too. Starting with the election of Donald Trump in late 2016, uncertainty surrounding international affairs increases considerably, in particular with the start of the trade war, triggered by the US, in 2018. "EU Conflicts" consists of two topics that were labeled "EU Conflicts" and "EU Reforms"; while the former is driven by specific events the latter captures the ongoing debate about the future of Europe (see appendix). The uncertainty surrounding the European project since the Euro crisis

is the single most important source of uncertainty, with the Brexit referendum being the most important political event by far.

In sum, the rise in policy uncertainty starting 2018 is mainly driven by deteriorating international and European landscapes, and (relative to German standards) turbulent domestic politics. Central Banking played a soothing role over most of this period.

*Fig. 6: UPI Politics, individual topics**



*shares in analysis corpus; three month moving averages; source: authors' calculations

In earlier versions of the indicator (Müller, 2020a; Müller et al., 2018) international issues, including EU and Eurozone matters, were grouped into one single topic. This time, both issues are separated. This model's higher *K*-value combined with a broader query further illuminates the nature and sources of political uncertainty in an economic context.

Furthermore, in our earlier models, part of the Euro Crisis coverage as well as financial market developments ended up in the central banking topic. This model's "Central Banks" topic is rather clear-cut. Its characteristic articles reveal a skeptical if not critical framing. Typical headlines read "Daring Monetary Policy", "Misguided Draghi", "Is Bernanke part of the problem?", or "The ECB needs an exit plan" (see appendix). The topic peaks during the financial and the Euro crisis when a host of new central banking measures are adopted and the presidency of the ECB is handed over to Mario Draghi; new instruments and new decision makers cause considerable initial uncertainty that subsides over time.

At the very end of the period analyzed a distinct spike is visible (highlighted in fig. 6). This peak can be attributed to the Covid-19 pandemic. "Central Banks" is the only topic in which the term "Coronavirus" appears among the 100 top words (rank 95), which is remarkable given the length of the period analyzed and the size of the corpus. The interpretation of this result is straight forward: in fighting the economic fallout from the Corona crisis central banks were the first line of defense, acting swiftly and decisively. That's why, in this case, the "Central Banks" topic behaves like an early-warning indicator. At other times, different topics may perform this task.

5. Recent developments: Covid-19, the UPI and uncertainty spillovers

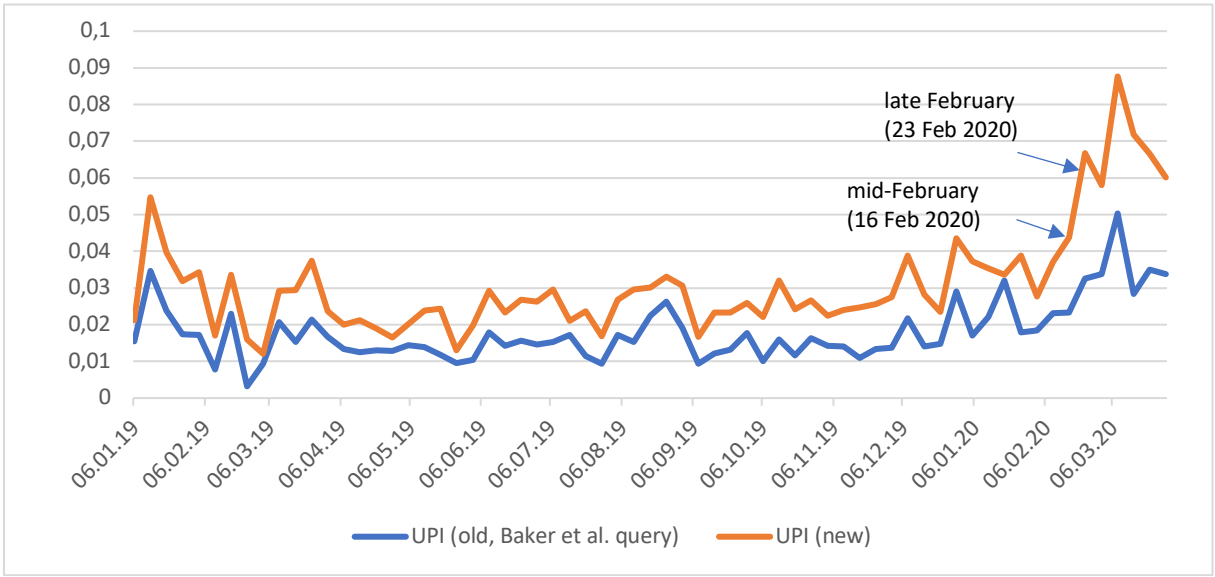
This paper started with the question whether we were able to build a better indicator than the ones available so far, in the sense that it reacts in a timelier fashion to hitherto unknown sources of uncertainty. In the previous section we have shown that LDA facilitates a decomposition of content which, combined with a broader query, offers a promising path for uncertainty analysis. However, we look at the past with a hindsight bias. The real test for an indicator comes when we look at the immediate past and try to make predictions for the future.

For instance, would we have been able to see the enormity of the Corona shock coming by, say, mid-February, if the UPI had been available then? In this section we propose a quantitative-qualitative routine for the analysis of the most recent past. In order not to miss developments, we use weekly (rather than monthly) data; and we look at actual shares of individual topics and their most recent movements (rather smoothed compositions of topics that are useful to show patterns over the longer term, but bound to hide specific developments in the most recent past).

We suggest a two-step procedure:
a) How has the overall indicator behaved in recent months (weekly data)?
b) Which topics are on the rise, which ones are in decline?

Fig. 7 shows weekly data; we compare the narrower EPU query with the broader one described above. The latter shows a steeper rise by mid-February 2020, i.e. when parts of China were already under lock-down and Covid-19 had arrived in Europe. But the severe size of the uncertainty shock in the making was not yet present in our data. A week later, however, the indicator had shot upwards, with a count of more than double that of the EPU-style one. Thus, by the third week of February, i.e. five weeks before the EPU jumped to historic highs, we could have been be pretty sure that a major economic uncertainty shock was in the making.

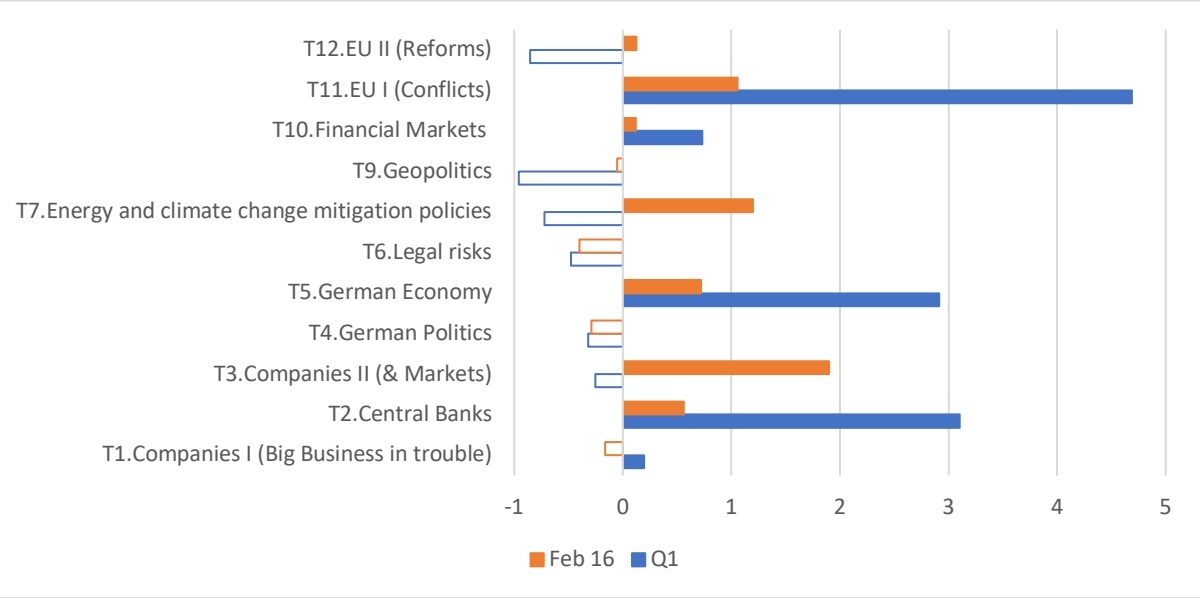
Fig. 7: UPI, different queries, Jan 2019 – March 2020, weekly data



Source: authors' calculations

What is driving this shock according to our model? Looking at individual topics we find that six out of eleven have risen over the first quarter (fig. 8, blue bars) relative to their levels at the end of December 2019, with "EU Conflicts", "Central Banks", and "German Economy" showing the steepest increases. As early as February 16 we see changes in these three topics with the correct sign, i.e. a considerable *rise* of associated uncertainty (fig. 8, orange bars). Thus, less than six weeks after the Corona virus was first officially acknowledged, traces of its fallout can already be found in the corpus' content structure. What is more, LDA allows us to go all the way down to the level of individual newspaper stories: recent articles that fit the model well provide insights into particular developments and dominant framings. This feature is an advantage of our approach since it gives researchers a tool that opens up an economical way to analyze the characteristics of increasing uncertainty, even in public spheres of which they have little knowledge. It is thus conceivable to build a family of UPIs covering a host of countries.

Fig. 8: Changes of topics' prevalence in 2020 Q1 (relative to end-2019)



Source: authors' calculations

Individual topics and Uncertainty Factors may indicate rising uncertainty, without showing up in the overall UPI. Still, these individual factors may give early warning signs that are masked by the broad indicator. The interactions between different topics with economic variables need to be examined in more detail in future research.

6. Conclusions: Shocking Sizes

This paper started out with the question whether we could build indicators that better prepare us for an age of uncertainty shocks. At the end, our cautious answer is: yes, but…

The work presented in this paper is based on our idea that economic uncertainty comes in three types, two of which, *market-based* and *economic policy uncertainty*, may reinforce one another, while the third type is *truly exogeneous*. Uncertainty indicators should be able to distinguish between the three. Our approach, the Uncertainty Perception Indicator (UPI),

enables us to shed light on the relationships between the three categories of uncertainty. To be sure, truly exogeneous phenomena that may eventually result in increased economic uncertainty are virtually impossible to detect at very early stages. There is a vast array of potential dangers an economy might face in the future, but most of them will never materialize. Therefore, an indicator that captures all the risks of the world would be of little use, since it would be prone to false alarms. On the other hand, an indicator that only looks for sources of uncertainty that have materialized in the past is bound to miss the new and surprising stuff. Any uncertainty gauge needs to strike a balance: it must detect the *known unknowns* (e.g. fiscal and monetary policy, trade policy, regulation) while being open to *surprising unknowns* (e.g. technological, ecological, social changes with some already apparent economic impact).

The UPI combines an open query, that filters for newspaper articles containing words related to the economy and to uncertainty, with the unsupervised topic modelling method Latent Dirichlet Allocation (LDA), thereby sorting aspects irrelevant to our analysis in distinct clusters of articles ("topics") that can henceforth be ignored. LDA yields topics that we combine in Uncertainty Factors, i.e. thematic subsets of the UPI, each associated with different parts of the economy and different types of uncertainty.

Our findings can be summarized as follows:

The UPI shows patterns broadly similar to the Economic Policy Uncertainty Indicator (EPU) of Baker et al. (2016). However, the UPI appears to be more sensitive to truly exogeneous uncertainty, like the Corona pandemic, that the EPU tends to exclude until they affect traditional policy areas.

It is not only of interest to gauge the *timing* of increases in uncertainty levels, but also to compare the *size* of the shock with earlier episodes. While a minor shock may be virtually unnoticeable in the real economy, a massive one represents a severe blow. The quicker an indicator is able gauge the severity of uncertainty shocks the more valuable it is to policy makers, business executives, investors, or individual households. The UPI seems to do quite well as an early warning indicator, as its performance during the Corona pandemic demonstrates. By 23 Feb 2020, five weeks before the EPU reacted, weekly UPI data shot up considerably (fig. 7).

LDA, calibrated as described above, produces interpretable, plausible and distinguishable uncertainty topics broadly in line with our theoretical framework. Disentangling the UPI yields topics that offer new insights into the nature of overall uncertainty and interactions between different types of uncertainty. For instance, policy uncertainty apparently drives uncertainty in the real economy. The associated time-lags may be considerable (fig. 4).

The developments captured in some Uncertainty Factors, or even some individual topics, may be more detrimental to the economy than others. Spotting these changes at the disaggregated level may enhance forecasts of specific variables. Our observation that market-based uncertainty at the level of individual firms and sectors seems to be a precursor of rising uncertainty in the economy as a whole (fig. 5) could become a promising tool for business-cycle forecasts. These effects need to be verified thoroughly in future research, e.g. by

performing Granger causality tests. The data we have produced offer considerable opportunities for econometric analyses.

Some caution is warranted. Our main caveat concerns the topic modelling method itself. LDA, being an inherently static approach, is highly suitable to analyze the content of large text corpora *in hindsight*. At each point in time, though, a new model needs to be calculated. To what extend LDA lends itself to produce reliable, ongoing time-series is an open question. For instance, changes in the topic structure may lead to a break-down of the time series. Statistical approaches to recurrently evaluate the models' compatibility over time need to be developed. Using "prototype" LDA models, as proposed by Rieger et al. (2020), may pave a way to achieve this objective.

To put the UPI to work, we plan to publish frequent updates of the indicator for Germany, at first on a quarterly basis, possibly on a monthly basis later on. Furthermore, we consider extending the analytical framework to other media and countries.

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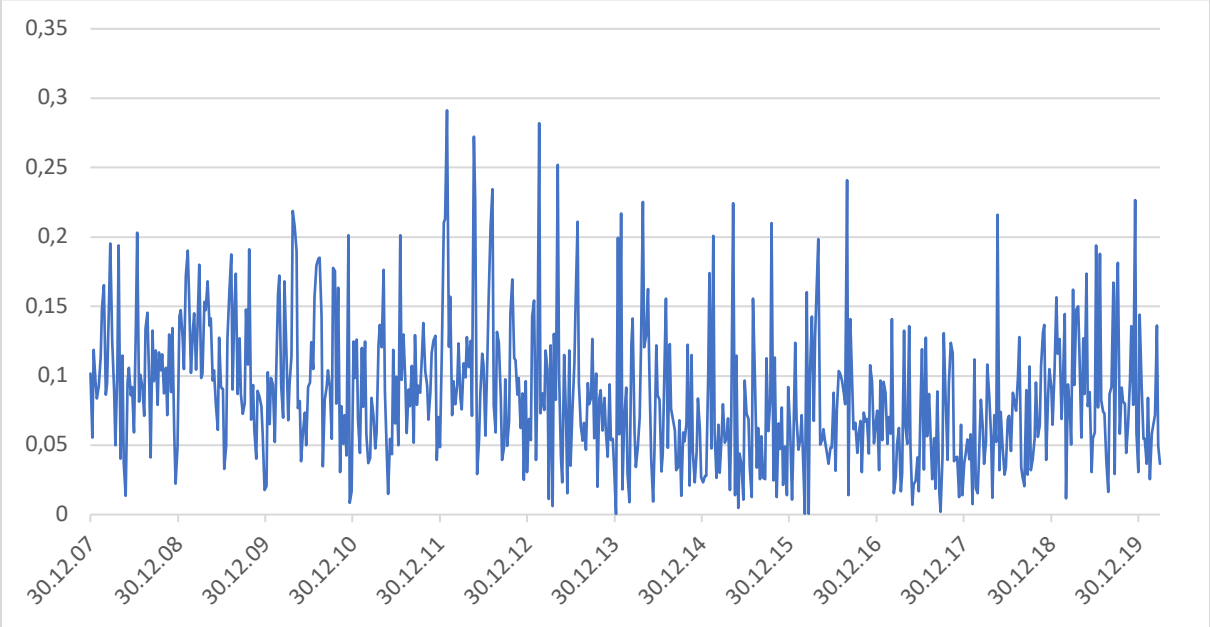
8. Appendix

The appendix presents the characteristics of individual topics of model A (K=12). For each topic a brief description is provided concerning its content and its relationship to our taxonomy of different kinds of economic uncertainty and the UPI. "Top Words" and "Top Texts" are mentioned, i.e. the ones with the best statistical fit to the model as provided by the algorithm. In addition, the appendix gives an overview of model B (K=10), its Uncertainty Factors and individual topics.

8.1 Model A, K=12

Topic 1: "Big Business"
Content: Corporates in Germany and other EU countries in trouble
Share of corpus: 8,66 per cent
Type of uncertainty: Market-based
Part of Uncertainty Factor: UPI Real Economy

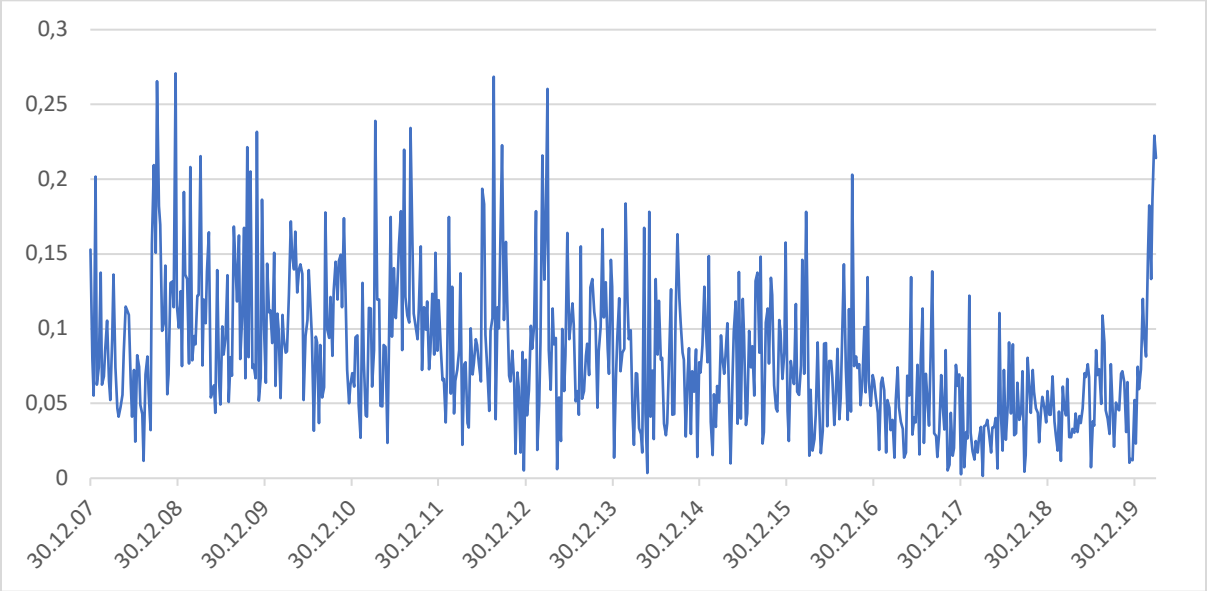
Fig. A.1 and Table A.1: Topic Big Business



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Euro	HB	2009-11-18	Nortel verbucht Verlust - Insolvenzverfahren verunsichert Kunden
Bank	HB	2010-02-24	Aareal Bank löst sich von Staatshilfen
Konzern	HB	2008-02-29	Gewinn von ABN Amro sinkt
Milliarden	HB	2010-04-28	Deutsche Bank hängt am Investmentbanking
Mrd	HB	2008-05-15	Gewinn der Post bleibt unter Druck
Dollar	SZ	2009-11-10	Allianz kann ohne Dresdner Bank glänzen; Finanzkonzern überrascht mit Milliardengewinn - Starke Lebensversicherungssparte - Aber weiter keine Prognose
Unternehmen	HB	2012-10-26	Baumarktkette Praktiker verliert Umsatz und macht Verlust
Umsatz	HB	2012-07-31	TNT Express kappt einen Teil seiner Kapazitäten in Europa
Mio	HB	2013-05-08	Sparrunden bei Pariser Banken
Quartal	HB	2011-07-19	Philips-Chef erzwingt Verlust

Topic 2: Central Banks
Content: ECB, Fed etc. actions against crises
Share of corpus: 8,2 per cent
Type of uncertainty: economic policy
Part of Uncertainty Factor: UPI Politics

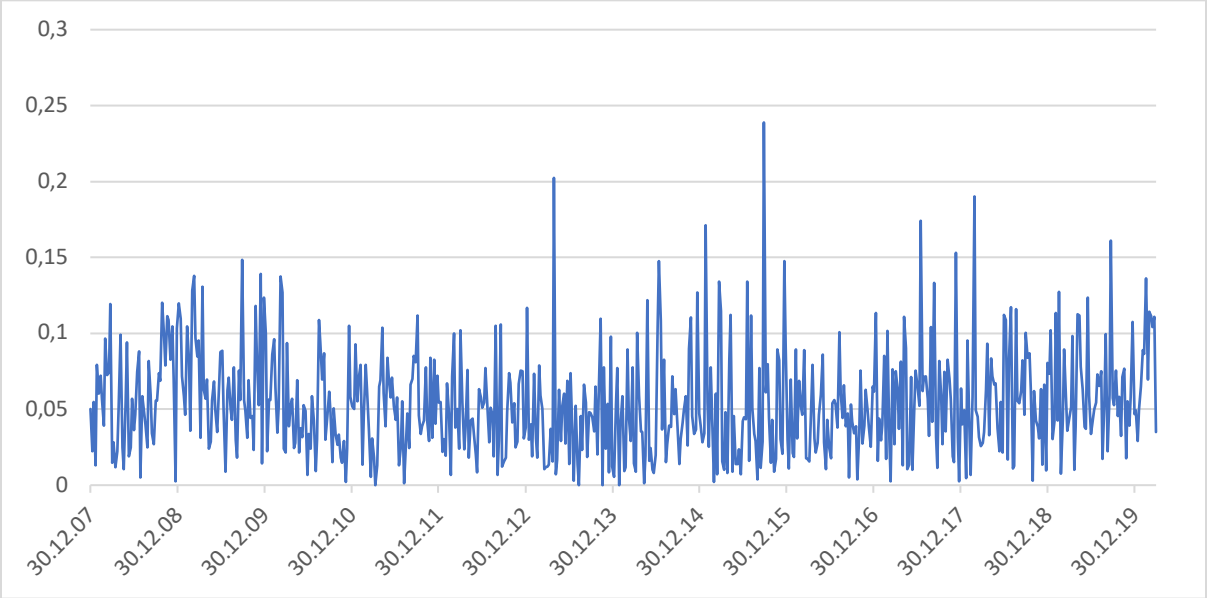
Fig. A.2 and Table A.2: Topic Central Banks



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Banken	HB	2012-11-07	Tollkühne Geldpolitik
EZB	HB	2014-07-14	Wegducken gilt nicht
Krise	HB	2011-04-28	D. Snower: Bernanke hat seine Munition verschossen
Zinsen	HB	2010-08-06	Die Denkfehler der Krise sind noch nicht ausgemerzt
Finanzkrise	HB	2014-10-06	Draghis Irrweg
Geldpolitik	HB	2009-01-26	Finanzkrise - ist Bernanke Teil des Problems?
Geld	HB	2009-02-03	Gefährliche Versteckspiele
Bank	HB	2017-06-09	"Die EZB braucht einen Ausstiegsplan"
Kredite	SZ	2009-05-11	Die Pläne zur Bad Bank sind halbherzig; Konzepte des Bundes könnten den Steuerzahler viel kosten
Inflation	HB	2012-07-10	... die EZB mit ihrer Zinssenkung die Wirtschaft ankurbelt? (Teil 2) .

Topic 3: Companies & Markets
Content: Manufacturing, Real Estate sectors ups and downs
Share of corpus: 5,56 per cent
Type of uncertainty: market-based
Part of Uncertainty Factor: UPI Real Economy

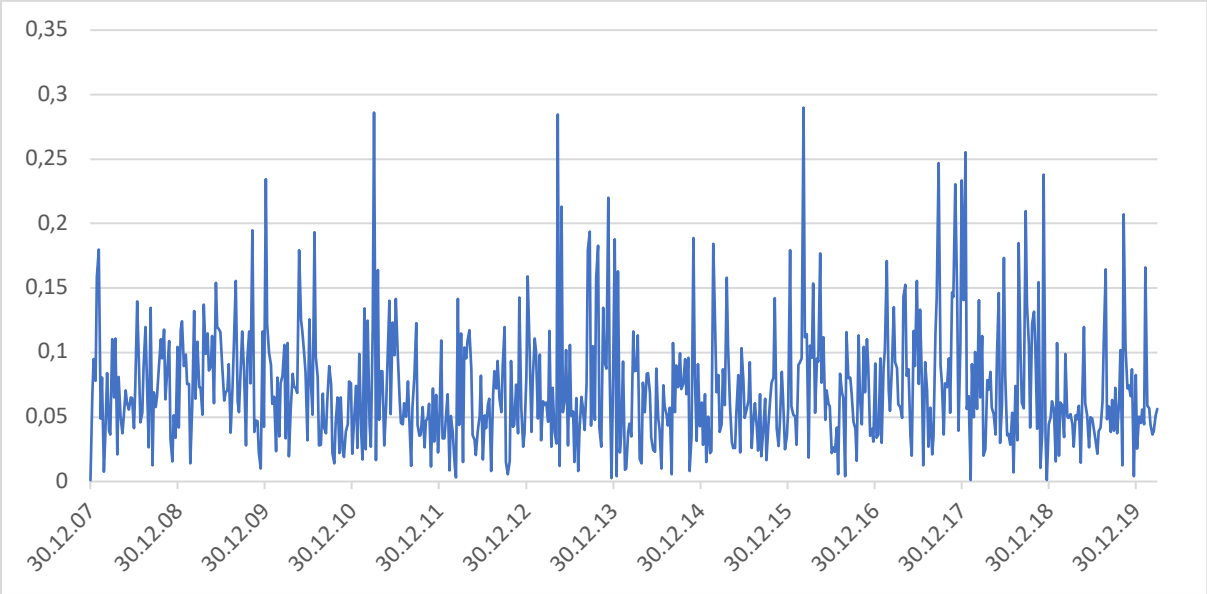
Fig. A.3 and Table A.3: Topic Companies & Markets



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Euro	SZ	2008-10-16	Airbus nimmt Tempo raus; Flugzeugbauer stoppt geplanten Ausbau der A320-Fertigung
Millionen	SZ	2016-12-17	Warum Air Berlin nicht mehr nach Mallorca fliegt; Zwei deutsche Airlines verabschieden sich aus der Ferienfliegerei. Das Geschäft machen nun Niki Air, Eurowings, Ryanair und Easyjet
Autos	SZ	2009-12-30	Preise für Eigenheime geben nach; Makler-Analyse: Bundesweit leichter Rückgang - Nur in Großstädten sind Wohnungen und Häuser teurer geworden
VW	SZ	2009-12-30	Immobilien; Wohnungen und Häuser werden billiger
Volkswagen	HB	2012-07-13	In Frankreich lohnt es sich für Käufer zu warten
BMW	SZ	2009-12-30	Immobilien; Wohnungen und Häuser werden billiger
Daimler	SZ	2010-05-07	Air Berlin stockt Langstrecke auf; Hauptstadt bekommt neue Fernverbindungen - Aschewolke belastet
Kunden	SZ	2009-12-30	Häuser und Wohnungen werden billiger; Makler-Analyse: Bundesweit leichter Rückgang - Nur in Großstädten sind Eigenheime teurer geworden
Hersteller	SZ	2008-11-10	Die neue Lust am kleinen Glück; Je größer, desto besser - das war einmal. Das Statussymbol Auto hat ausgedient, die Zukunft gehört den Kleinwagen. Wie sich Hersteller auf einen Trend einstellen, der ihre Geschäftsgrundlage umkrempelt
Jahr	SZ	2020-03-14	Rabatt-Saison für E-Autos

Topic 4: German Politics
Content: Political developments in Germany (national level)
Share of corpus: 7,26 per cent
Type of uncertainty: economic policy
Part of Uncertainty Factor: economic policy

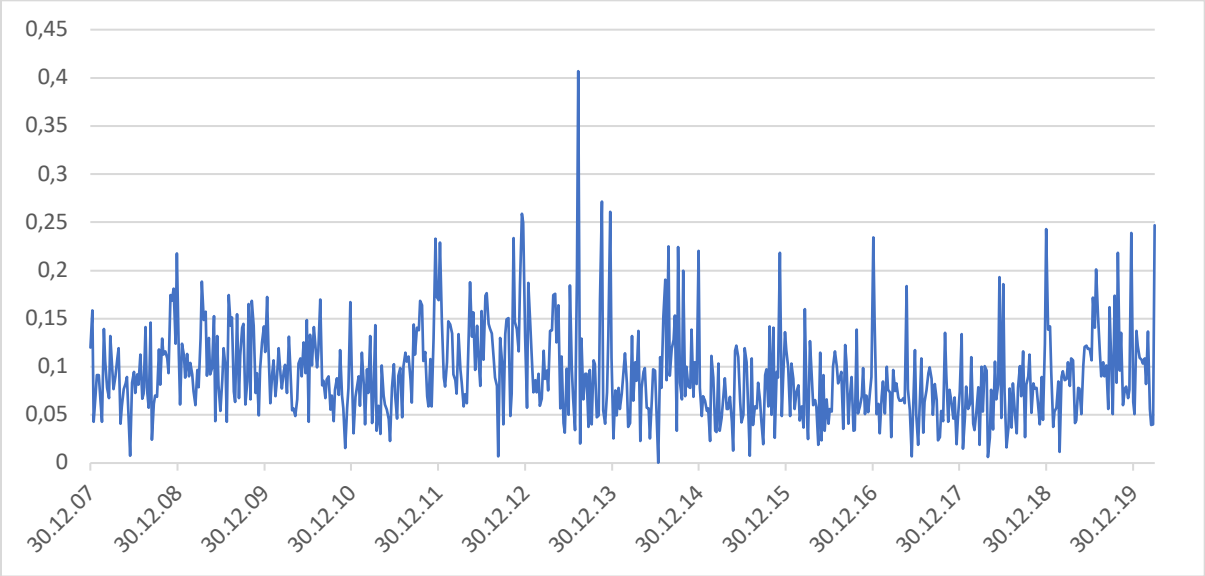
Fig. A.4 and Table A.4: Topic German Politics



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
SPD	HB	2017-03-21	Der Weckruf
Merkel	SZ	2018-06-05	Liberale halten die AfD auf Abstand; BAMF-Skandal: Die FDP geht mit ihrem Antrag zu einem Untersuchungsausschuss nicht so weit wie die rechte Partei. Die Union kritisiert beide Pläne als "politische Show"
CDU	SZ	2018-06-05	Liberale halten die AfD auf Abstand
Partei	HB	2009-09-22	Merkel schwört Partei auf Endspurt ein
Koalition	HB	2010-11-15	Grüne wollen Volkspartei werden
FDP	HB	2018-01-15	Die Genossen fordern Nachschlag
Union	SZ	2010-07-15	Fünf Jahre Zittern in Nordrhein-Westfalen; Kraft zur Chefin der Minderheitsregierung gewählt - Merkel: „Einer solchen Regierung kann man nicht trauen"
Grünen	HB	2018-10-29	Absturz der Volksparteien
Kanzlerin	HB	2017-11-21	SPD diskutiert Absage an Große Koalition
Angela	HB	2008-01-31	Merkel holt Koch nicht nach Berlin

Topic 5. German economy
Content: Business cycle developments, forecasts, surveys
Share of corpus: 9,02 per cent
Type of uncertainty: market-based
Part of Uncertainty Factor: UPI Real Economy

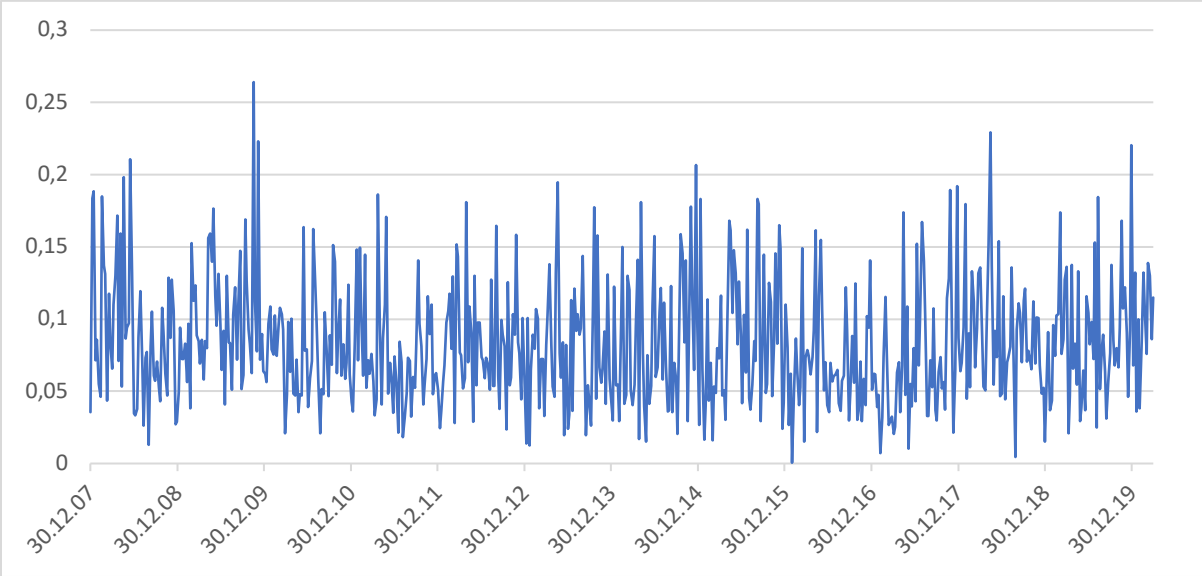
Fig. A.5 and Table A.5: Topic German economy



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Jahr	HB	2008-02-28	IWF fürchtet um deutsche Konjunktur
Unternehmen	HB	2011-09-20	Prognose: Wirtschaftswachstum lässt nach - Rezession bleibt aus
Wachstum	HB	2011-10-10	Im vierten Quartal geht's abwärts
Wirtschaft	HB	2019-11-27	Firmen suchen wieder mehr Personal
Quartal	HB	2013-06-04	IWF zufrieden mit Wirtschaftspolitik in Deutschland
Deutschland	SZ	2012-01-09	Ökonomen: Wirtschaft lahmt bereits; Umfrage: Rückgang verstärkt sich noch
Konjunktur	SZ	2012-05-31	Zuversicht bei deutschen Unternehmen
Deutsche	SZ	2012-11-16	Nächstes Jahr wird es besser
Deutschen	SZ	2013-01-02	Deutsche mit Zuversicht ins neue Jahr; 41 Prozent zufrieden mit finanzieller Lage
Rezession	SZ	2013-06-06	Schwächelnde Euro-Wirtschaft

Topic 6: Legal Risks
Content: Regulations and court rulings affecting businesses
Share of Corpus: 8,25 per cent
Type of uncertainty: economic policy
Part of uncertainty factor: UPI Politics

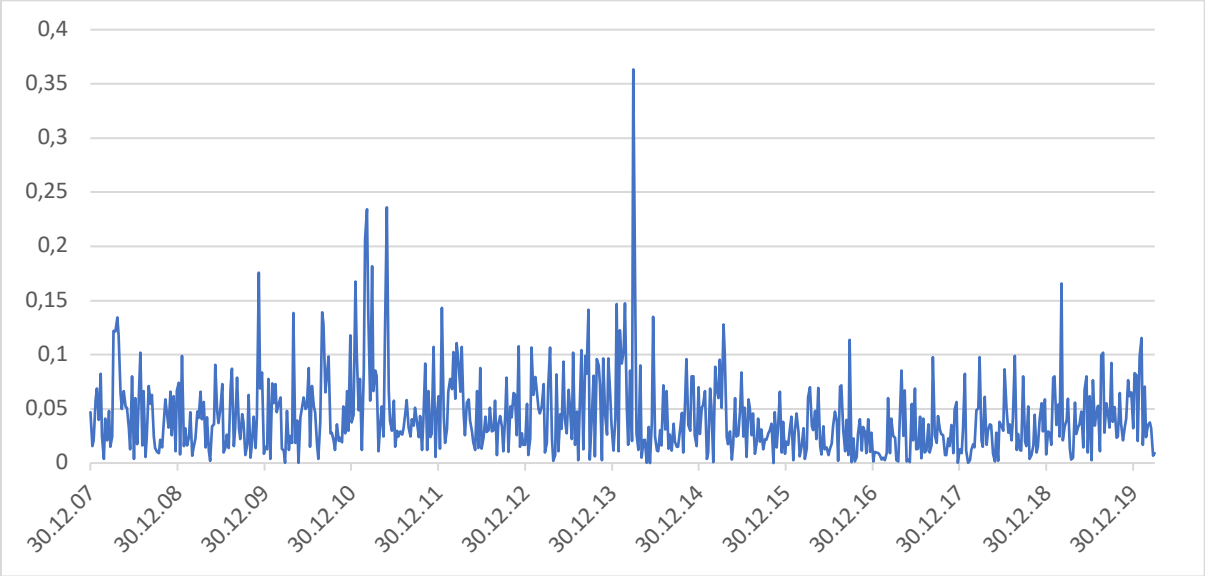
Fig. A.6 and Table A.6: Topic Legal Risks



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Unternehmen	HB	2008-03-14	Wirtschaft unterstützt Schüler bei der Studienwahl
Mitarbeiter	SZ	2015-04-11	Studium: Neuer Bachelor Angewandte Informatik ++ Berufswahl: Pläne nach der Schule durch Ausprobieren konkretisieren
Kunden	SZ	2009-09-26	Arbeitnehmer und Student zugleich; Studieren oder im Betrieb lernen? Duale Studiengänge vereinen beides
Daten	SZ	2018-06-07	EuGH: Facebook ist nicht allein verantwortlich
Firmen	HB	2012-07-27	Furcht vor Abmahnwelle bei Buttonlösung
Euro	HB	2018-06-29	Die neue Transparenz
Internet	SZ	2013-05-17	Zoff um Lebensversicherungen und kein Ende; Versicherer weigern sich, Kunden Stornokosten auszuzahlen - höchstrichterlicher Urteile zum Trotz
Studie	HB	2015-02-18	Mindestlohn-Haftung verunsichert Firmen
Arbeitgeber	HB	2008-04-22	Gesetzeslücke gefährdet Betriebsrenten
laut	SZ	2015-05-18	So lassen sich die Kosten für den Steuerprofi absetzen; Das Finanzamt denkt mit, wenn es um Rechnungen vom Steuerberater, die Software-Kosten oder den Beitrag für den Lohnsteuerhilfeverein geht. Aber es gibt auch klare Grenzen

Topic 7: Energy & Climate Change Mitigation Policies
Content: Energy market developments, transition to renewables, etc.
Share of Corpus: 4,15 per cent
Type of uncertainty: Economic policy/market-based/truly exogenous
Part of Uncertainty Factor: UPI Real Economy

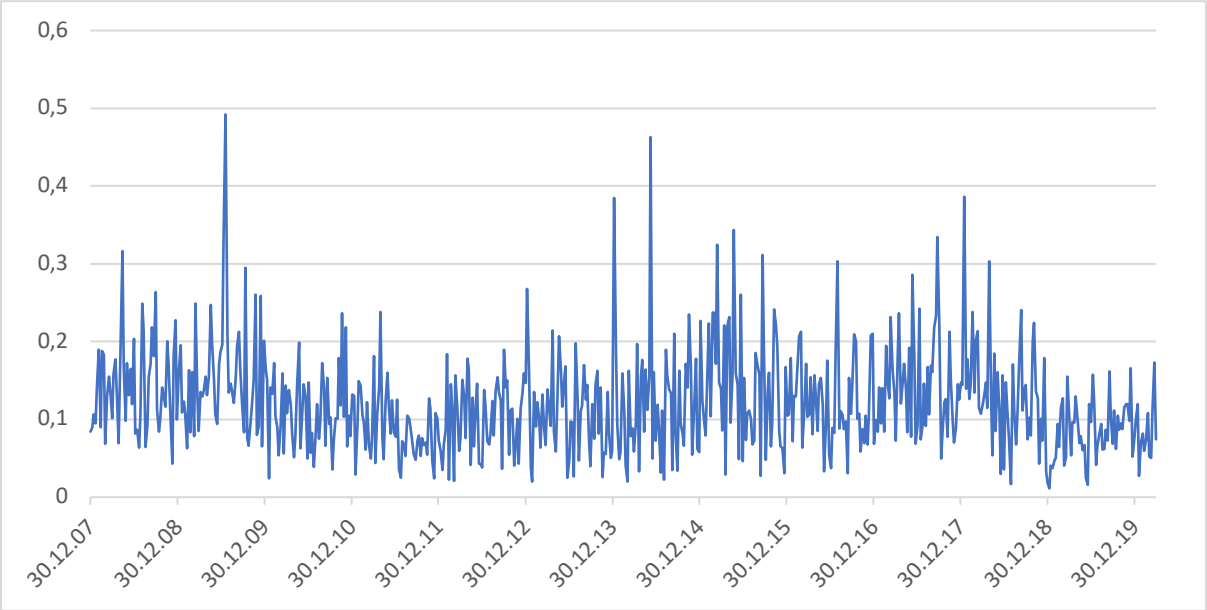
Fig. A.7 and Table A.7: Topic Energy & Climate Change Mitigation Policies



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Energiewende	HB	2011-03-03	Engpass an den Tankstellen
Energien	SZ	2019-05-04	Jetzt braucht es die Rekord-Reserve
Strom	SZ	2011-03-04	E10-Chaos: Benzin-Gipfel bei Brüderle; Kaum ein Autofahrer will Biosprit tanken
EON	HB	2011-04-01	Studie: Rascher Kernkraftausstieg erfordert Investitionen von 55 Milliarden Euro
Bundesregierung	HB	2012-11-07	Ministerien streiten über Entlastung für die Industrie
erneuerbaren	HB	2010-02-04	Kraftwerksprojekte fallen wie die Dominosteine
Industrie	SZ	2013-09-28	Die Energiebranche will den Strommarkt spalten; Radikaler Plan für den Umbau der deutschen Öko-Förderung
RWE	HB	2013-04-09	Unmut der Industrie über Strompreis
Öl	HB	2011-08-17	Förderung neuer Kraftwerke lässt auf sich warten
Energie	SZ	2008-08-12	Regierung erwartet mittelfristig keine Stromlücke; Monitoring-Bericht: Genügend Kraftwerke im Bau - Neue Verzögerungen würden Strom aber verteuern

T 8: Miscellaneous (Arts and Society)
Content: Unclear
Excluded from analysis

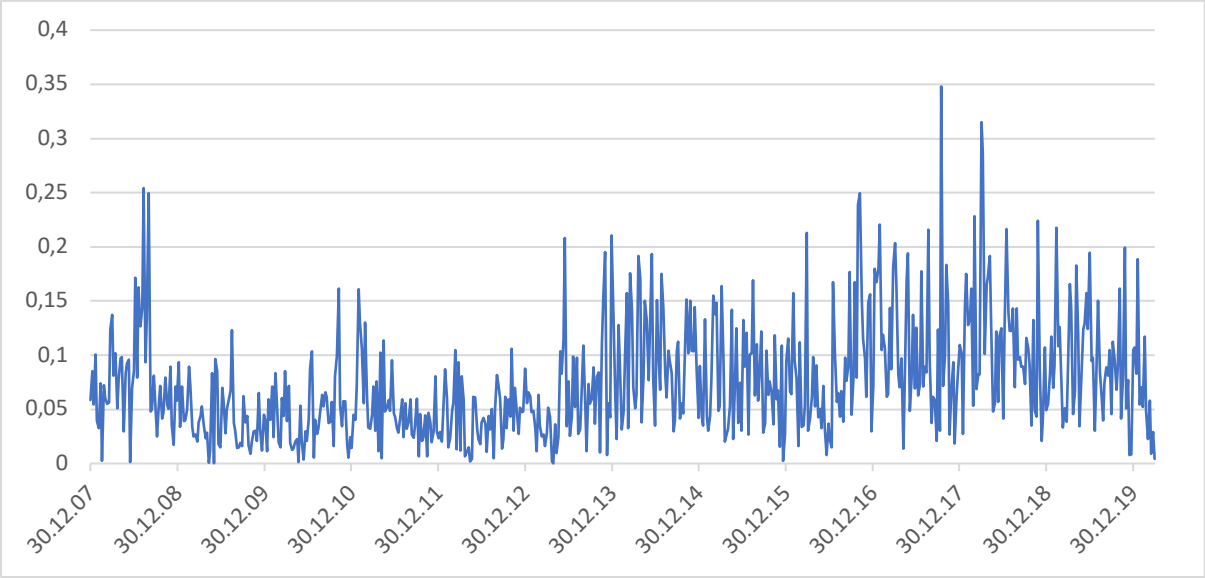
Fig. A.8 and Table A.8:Topic Miscellaneous (Arts and Society)



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Menschen	SZ	2018-01-20	"Wer die Hose runterlässt, darf die Scham nicht verdecken"; Heute eröffnet seine Retrospektive in der Fondation Beyeler, am Dienstag feiert Georg Baselitz seinen 80. Geburtstag. Ein Auszug aus der Sonderausgabe von BLAU, die heute für Abonnenten dieser Zeitung beiliegt
leben	SZ	2018-01-20	Wer die Hose runterlässt, darf die Scham nicht verdecken
heute	SZ	2009-11-07	Auf der Mauer stehen: ein Statement; Die Nacht der Nächte zwischen West und Ost
mann	SZ	2009-07-22	Kino
frauen	SZ	2009-11-22	DDR-Fernsehen; Happy Birthday - Das Sandmännchen wird 50 Jahre alt
kinder	SZ	2018-09-08	Abbau Ost
frau	SZ	2009-11-23	DDR-Fernsehen; Das Sandmännchen wird 50 Jahre alt
geschichte	SZ	2009-07-17	Kino
familie	SZ	2009-07-21	Kino
buch	SZ	2018-09-08	Abbau Ost; Aufstand und Lethargie in der sächsischen Provinz: Der Debütant Lukas Rietzschel hat das Buch zur Stunde geschrieben

Topic 9: Geopolitics
Content: Conflicts involving US, China, Russia, Turkey, Middle East…
Share of Corpus: 7,54 per cent
Type of uncertainty: Economic policy
Part of Uncertainty Factor: UPI Politics

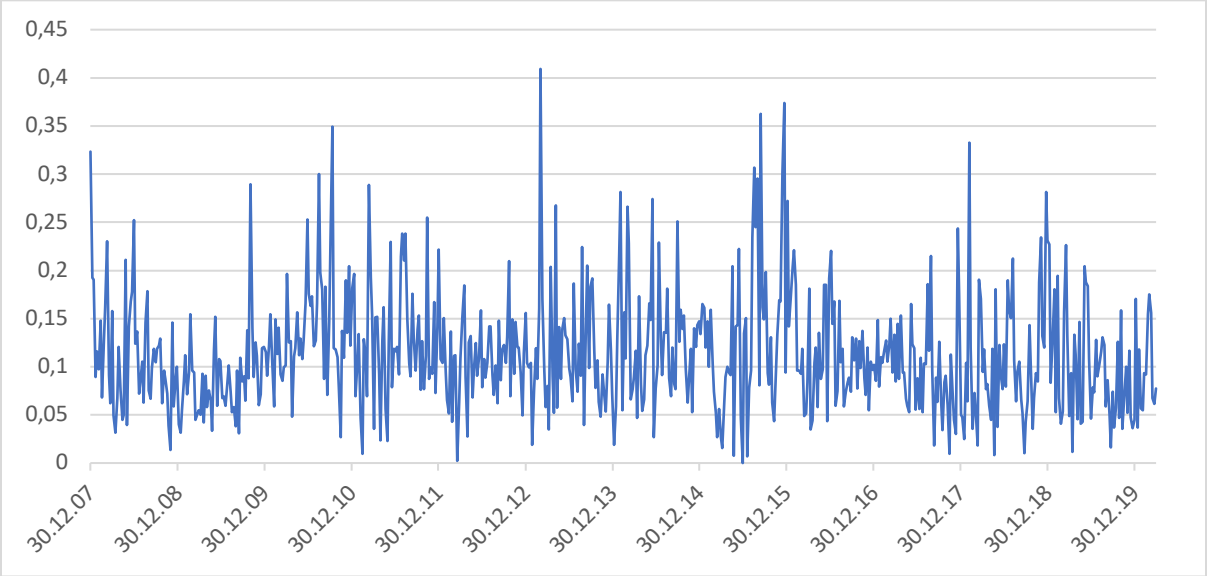
Fig. A.9 and Table A.9. Topic Geopolitics



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
China	SZ	2018-09-20	China gibt sich im Zollstreit wortkarg
Trump	SZ	2018-03-16	Chinesen rüsten gegen neue Zölle
USA	SZ	2018-11-30	Amerikas Abschied als Weltpolizist
Russland	SZ	2018-09-20	China gibt sich im Zollstreit wortkarg; Peking taktiert zu Trumps neuen Manövern
Türkei	SZ	2018-11-30	Amerikas Abschied als Weltpolizist; Beim G-20-Gipfel in Argentinien sehen sich die Führer der Welt mit einer neuen Herausforderung konfrontiert
Regierung	SZ	2018-03-16	Chinesen rüsten gegen neue Zölle; Nach der Entlassung des Außenministers Rex Tillerson schließt US-Präsident Donald Trump seine Reihen im Handelskonflikt
Peking	SZ	2018-08-13	Erdogan droht mit Abwendung vom Westen; Der türkische Präsident spricht nach den jüngsten US-Strafmaßnahmen erneut von Wirtschaftskrieg. Sein Land habe Alternativen
Land	SZ	2018-08-13	Erdogan droht mit Abwendung vom Westen
Obama	HB	2011-08-01	Erdogan verunsichert Finanzmärkte
Chinas	HB	2018-07-24	Wortgefechte schüren Spannungen am Golf

Topic 10: Financial Markets
Content: Up and down at the bourses
Share of corpus: 11,07 per cent
Type of uncertainty: market-based
Part of Uncertainty Factor: UPI Financial Markets

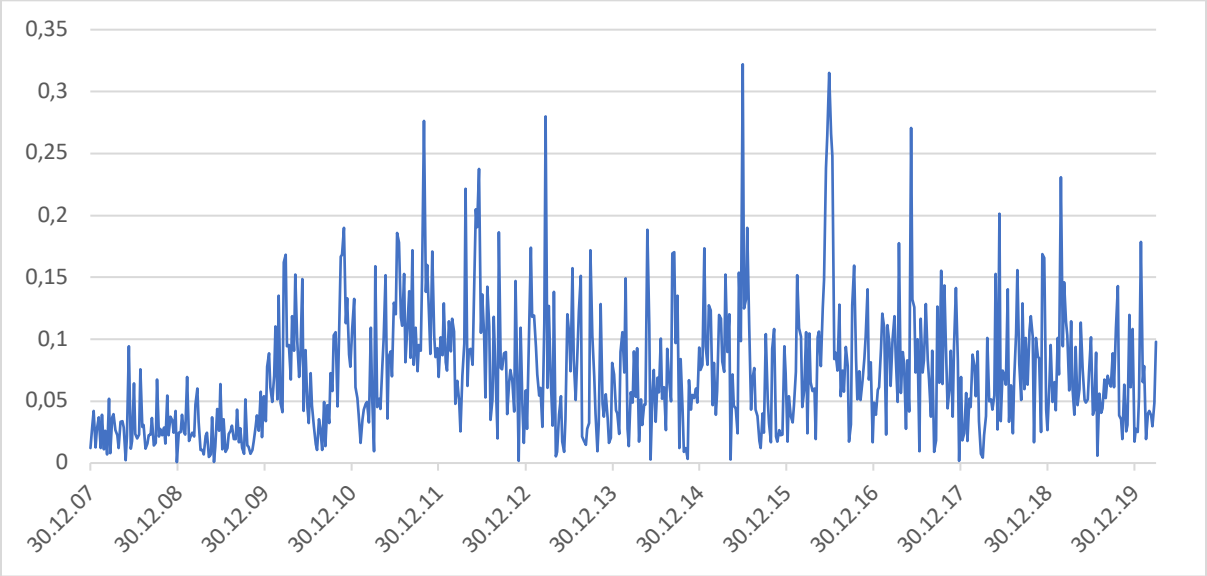
Fig. A.10 and Table A.10: Topic Financial Markets



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Anleger	HB	2010-06-16	Die Anleger setzen verstärkt auf Öl und Gold
Aktien	HB	2011-06-09	Bernankes Aussagen wirken nach
Dollar	HB	2016-01-08	Was Anleger jetzt wissen sollten
DAX	SZ	2008-10-28	Euro fällt Zeitweise unter 1,24 Dollar
Investoren	SZ	2009-11-16	Aktienexperten machen auf Optimismus; Anderthalb Monate vor Jahresende sagen die Auguren weitere Kursgewinne bis 2010 voraus - Aber am Horizont zeichnet sich Gefahren fürs Geld ab
Anleihen	SZ	2008-11-03	Hamburger Börse
Gold	HB	2016-04-06	Kurse auf Talfahrt
Euro	SZ	2009-11-16	Börsen-Vorschau; Experten sagen Aktien-Gewinne bis 2010 voraus
Kurse	HB	2015-02-26	Schwere Zeiten für Renteninvestoren
Börsen	SZ	2016-02-11	Sicherer Hafen: Gold feiert ein Comeback; Doch viele Experten rechnen nicht mit einem Höhenflug

Topic 11: EU Conflicts
Content: Brexit, Greece etc.
Share of Corpus: 7,27 per cent
Type of uncertainty: economic policy
Part of Uncertainty Factor: UPI Politics

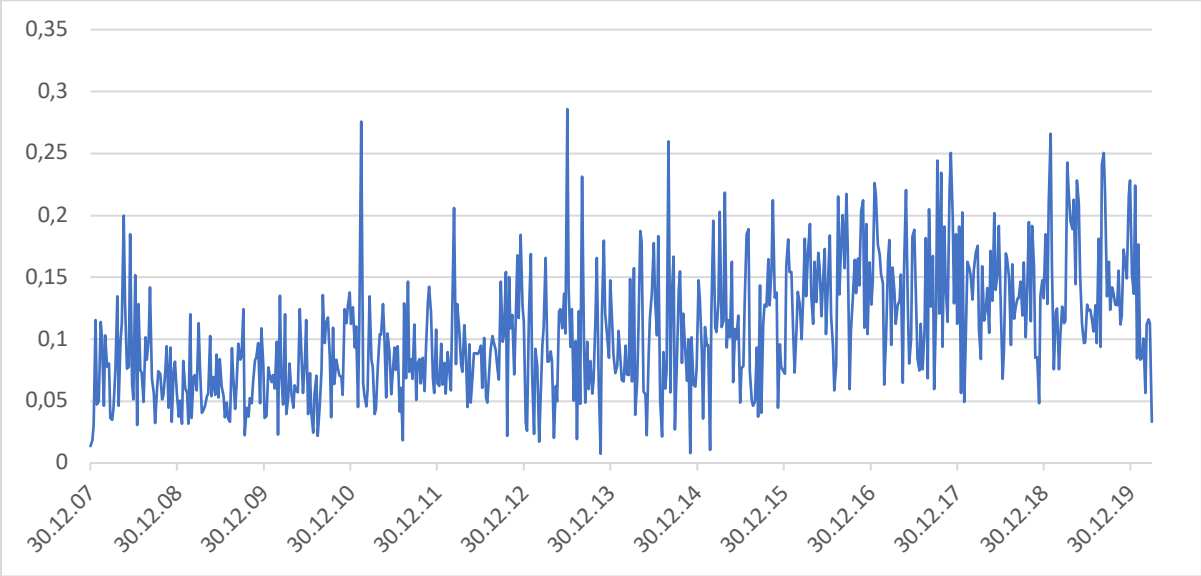
Fig. A.11 and Table A.11: Topic EU Conflicts



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
EU	HB	2019-02-27	May macht Weg für Brexit-Aufschub frei
Griechenland	SZ	2019-04-06	EU und London feilschen um die nächste Brexit-Verschiebung
Brexit	SZ	2019-03-26	May sieht keine Chance auf Abstimmungserfolg
Großbritannien	HB	2011-02-22	Isländer stimmen erneut über Rückzahlung von Schulden ab
Europäischen	HB	2019-03-25	Unterschätztes Risiko für das Pfund
Italien	HB	2014-12-17	Griechische Linkspopulisten beunruhigen die Euro-Zone
Regierung	HB	2016-10-12	EU-Austritt wird teuer
Eurozone	SZ	2016-08-08	Ratingagentur setzt Italien unter Duck; Regierung sperrt sich gegen Staatshilfen für Banken
Euro	HB	2012-01-24	Hair-Cut für Athen steht kurz bevor
Europa	HB	2010-02-16	Griechenland wehrt sich gegen Sparauflagen

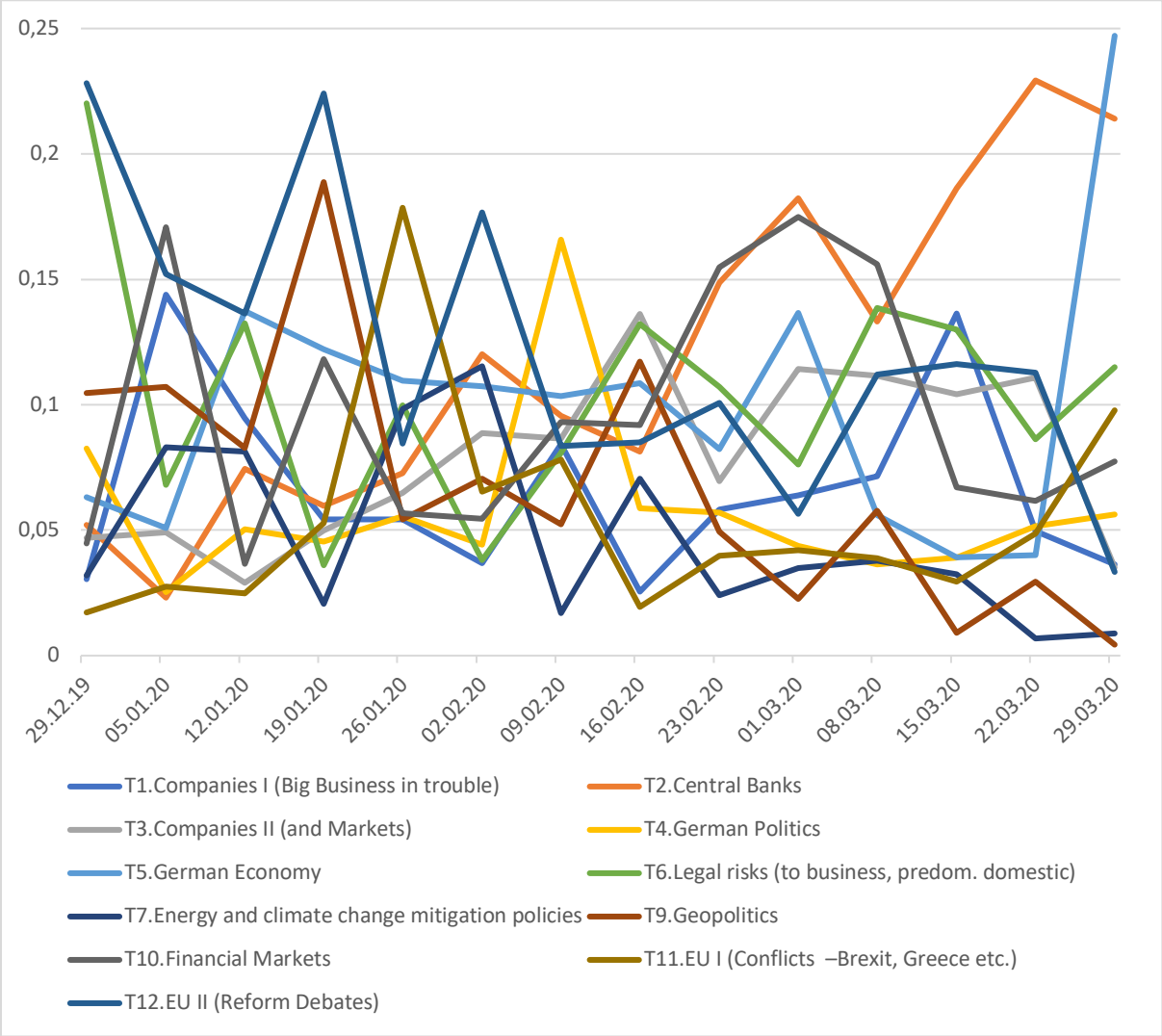
Topic 12: EU Reforms
Content: Debates about enhancing EMU, Investment, R&D etc.
Share of corpus: 10,93 per cent
Type of Uncertainty: Economic policy
Part of Uncertainty Factor: UPI Politics

Fig. A.12 and Table A.12: Topic EU Reforms



Top Words	*Top Texts*		
	Medium	*Publishing Date*	*Headline*
Europa	HB	2016-08-19	"Globalisierung als Sündenbock"
Deutschland	HB	2019-05-10	Fahrplan für einen digitalen Binnenmarkt
Menschen	SZ	2018-08-02	Der Ruck fehlt in Europa
unternehmen	SZ	2018-08-02	Der Ruck fehlt in Europa
Politik	HB	2013-02-21	Kreativität in der Amtsstube
Digitalisierung	HB	2010-09-27	Das Unbegreifbare
Herr	SZ	2010-06-10	Klare Positionierung; Engagement der Belegschaft nicht verlieren; Der DGFP-Vorstandsvorsitzende Stefan Lauer betont die prägende Rolle des Personalmanagements
natürlich	HB	2016-09-29	Wachstumstreiber Big Data
gibt	SZ	2011-05-25	Deutsche Unternehmen müssen international denken und neue Geschäftsmodelle entwickeln; Sicher durch eine Welt voller Unsicherheit
heute	HB	2018-01-24	Free and Fair Trade first!

Fig. A.13: UPI (K=12) Topics in Q1 2020



8.2 Model B (K=10)

Table B.1: Topic Structure

Topic No.	Label	Share of analysis corpus (per cent)	Content	Part of Uncertainty Factor…
1	Investing	6,97	Where and how to invest your personal savings in uncertain times	UPI Financial Markets
2	Financial Markets	11,67	Up and down at the bourses	UPI Financial Markets
3	German Politics	8,32	Political developments in Germany (predominantly national level)	UPI Politics
4	EU Conflicts	10,49	Brexit, Greece, EMU reforms etc.	UPI Politics
5	Energy & Climate Change Mitigation	7,84	Energy market developments, transition to sustainables etc.	UPI Real Economy
6	German Economy	9,91	Business cycle developments, forecasts, surveys	UPI Real Economy
7	Big Business	9,47	Corporates in Germany and other EU countries in trouble	UPI Real Economy
8	Miscellaneous (Arts and Society)	13,67	Diverse	–
9	Geopolitics	9,02	Conflicts involving US, China, Russia, Turkey, Middle East…	UPI Politics
10	Technology, Digitalization, R&D	12,62	(Digital) Innovation and the threat of falling behind	UPI Financial Markets

Fig. B.1: Model B, Uncertainty Factors (Three-months moving average)

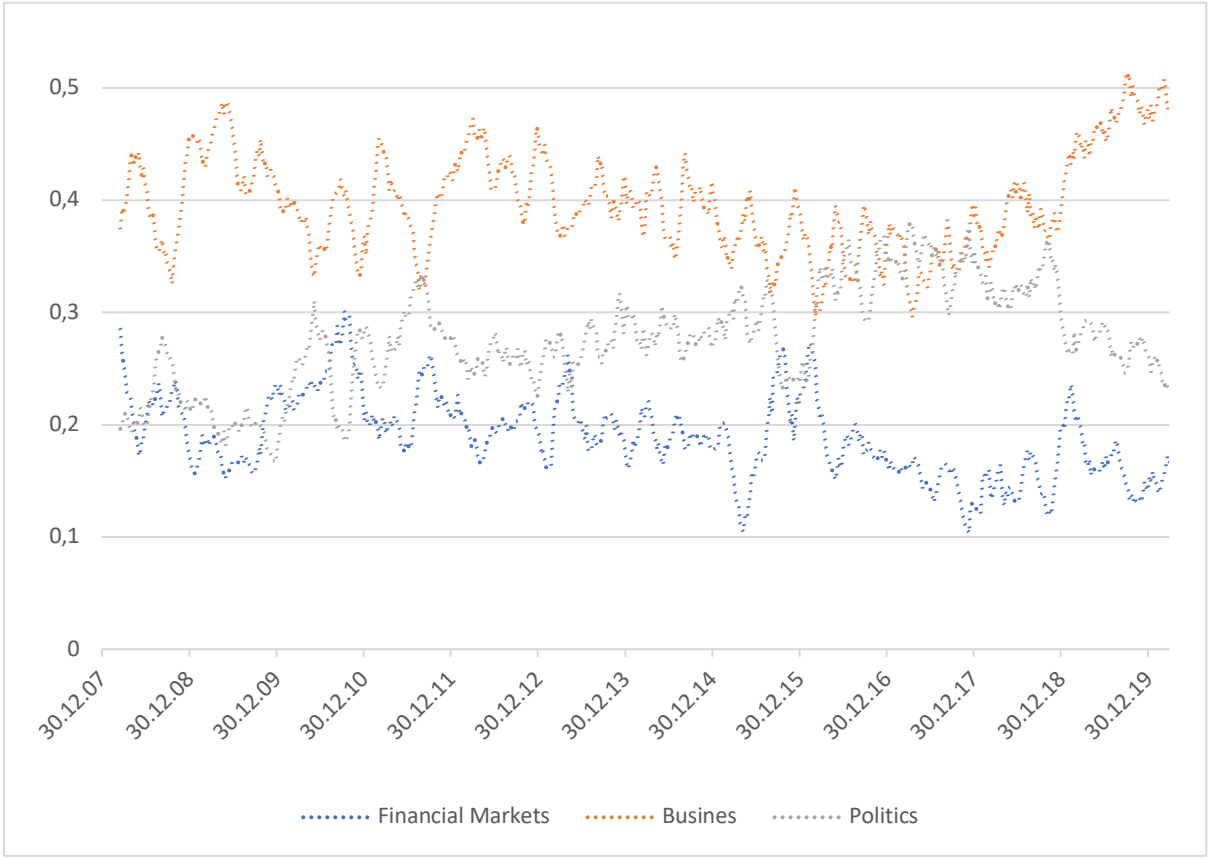


Fig. B.2: Model B, UPI Politics (Three-months moving average)

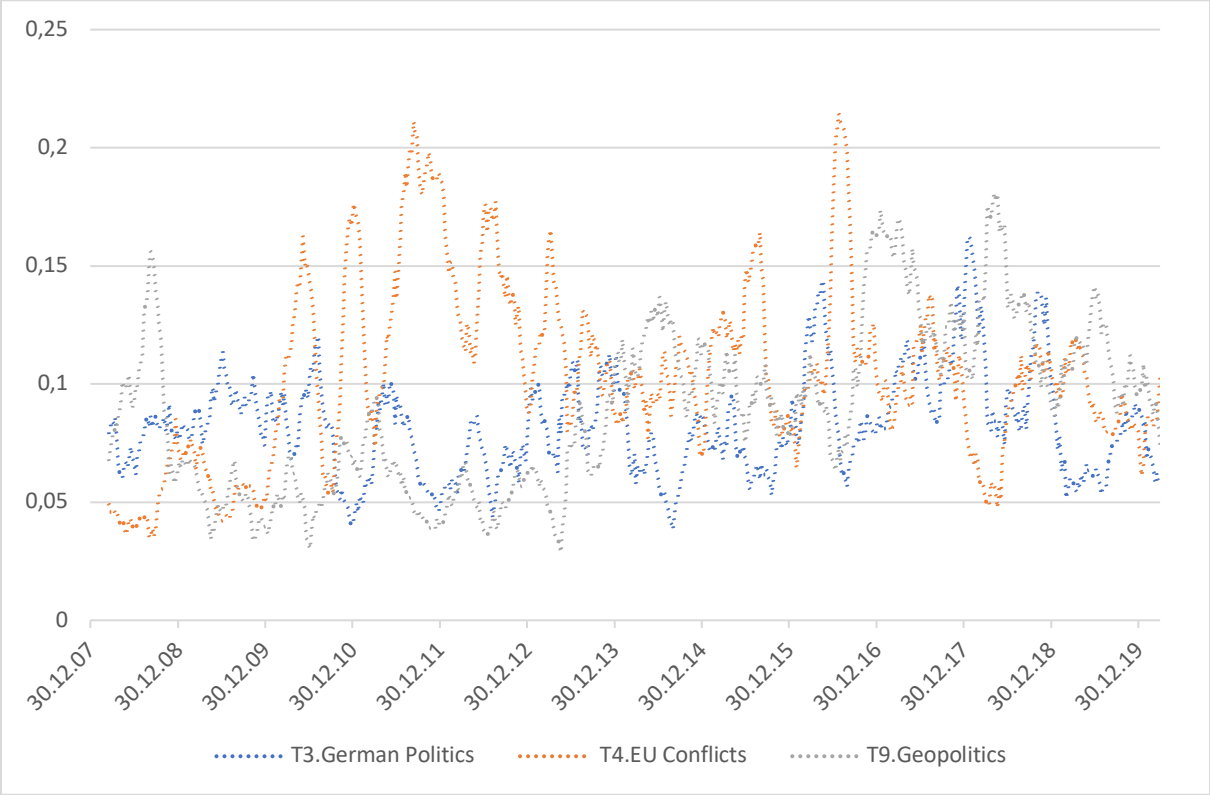


Fig. B.3: Model B, UPI Real Economy, individual topics (three-months moving averages)

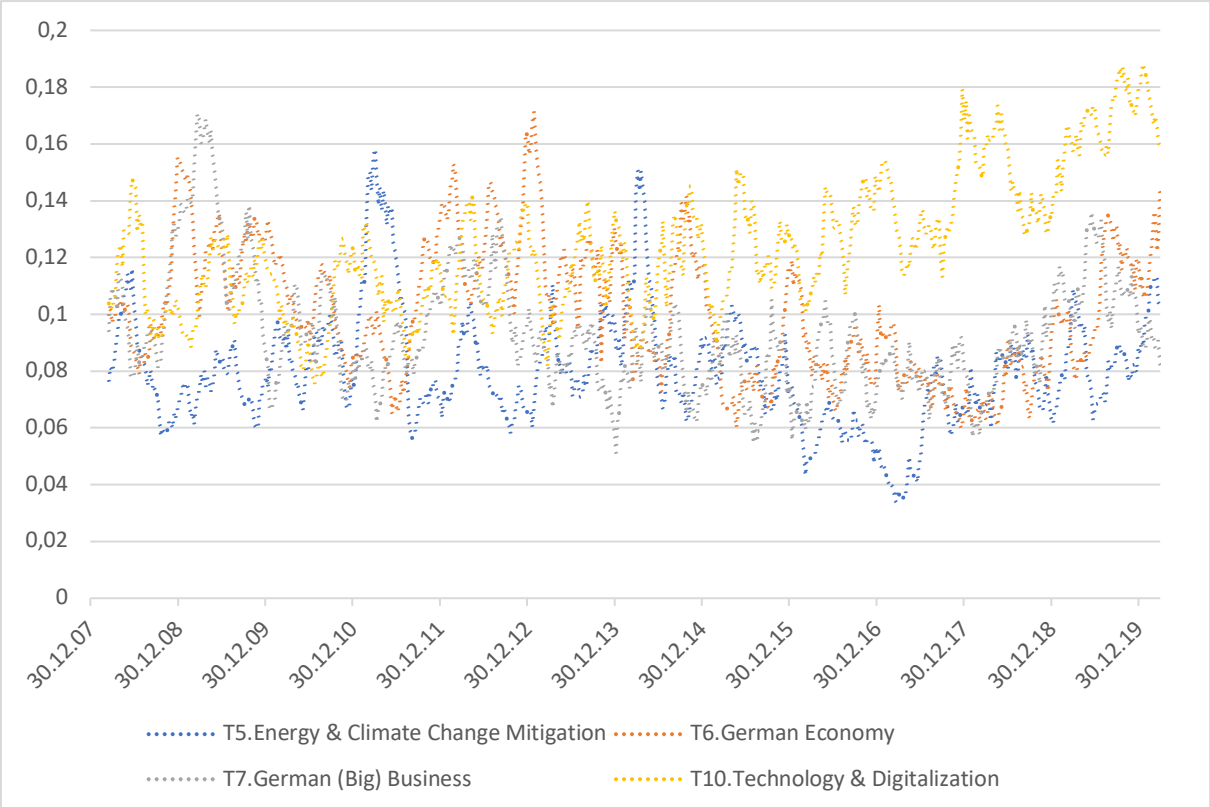


*Fig. B.3: Model B, UPI Financial Markets (*three-months moving averages*)*

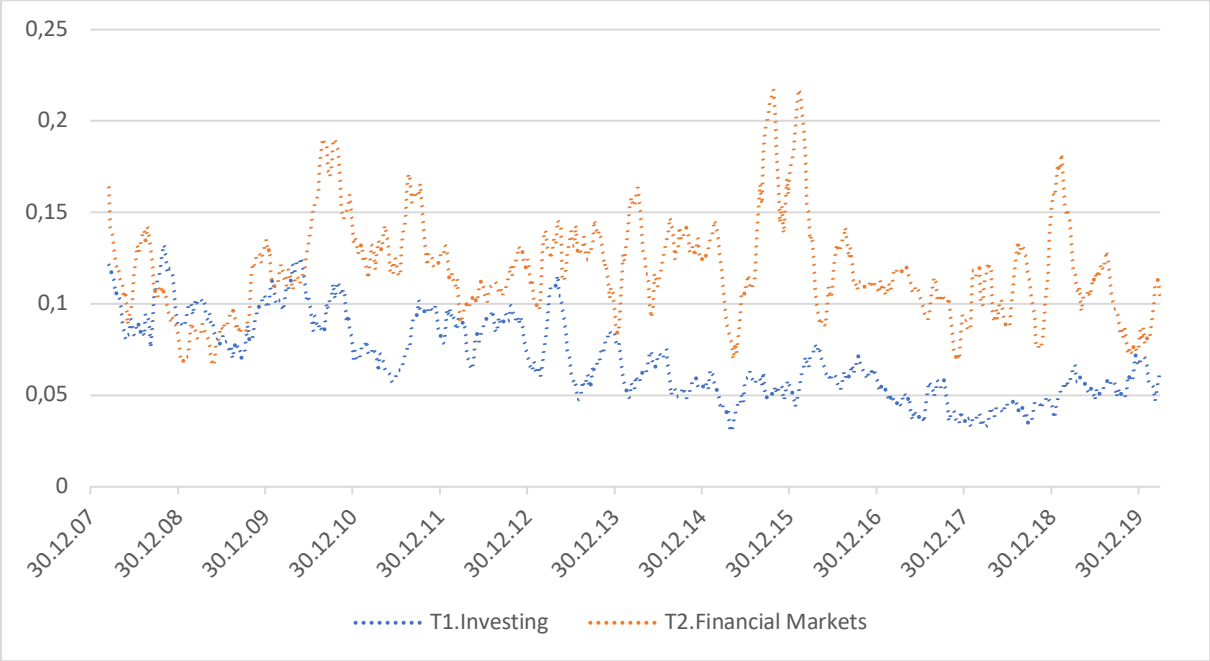


Fig. B.4: Model B, UPI (K=10), Q1 2020, weekly data