Assessing economic sentiment with newspaper text indices: evidence from Switzerland

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Legal Issues

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Abstract

In this study, the signals of more than 530,000 news articles from 15 large Swiss newspapers are extracted to measure the economic sentiment in Switzerland. Economic sentiment includes consumer sentiment and sentiment about businesses as well. The research period for the text sentiment analysis ranges from 2016 until 2022 and, thus, the impact of the COVID-19 lockdown period is included in this analysis. I contribute two new indices: one concerns the measure of news sentiment in the German-speaking part of Switzerland, and the other concerns the measure of news sentiment in the French-speaking part of Switzerland. The two indices show strong comovement; however, the sentiment in these two language regions is not identical. The indices are available and updatable in real time. The news articles, in contrast to macroeconomic variables such as GDP estimates, are not revised, making these text-based indices an interesting source of information for economic forecasters, especially in times of market turmoil.

1 Introduction

Consumer sentiment is used by economists and policy-makers as a predictive indicator to forecast the development of aggregate consumption (see, e.g., Praet and Vuchelen, 1984; Pesaran and Weale, 2006). The movement of aggregate consumption is of utmost interest for policy-makers, as consumption is one of the largest components of gross domestic product (GDP). Consumption accounts for nearly half (Switzerland) to two-thirds (USA) of a country's GDP, as shown in Table A1 of the Appendix.

Some examples of surveys collecting aggregated data on consumer expectations are the University of Michigan Index of Consumer Sentiment (University of Michigan, 2023) conducted in the United States and the Consumer Confidence Survey conducted by the State Secretariat for Economic Affairs (SECO) (SECO, 2023) for Switzerland. However, these surveys are often published after a considerable time lag. Experience during the COVID-19 lockdown period showed that forecasts estimated from time series models that use a broad-based selection of diverse input indicators (i.e., survey results and many others) for estimating dependent variables such as GDP or consumption perform rather poorly in times of dramatic economic turmoil. In a situation of great economic instability, it is difficult to make accurate forecasts when the indicators are not all available in a timely manner due to time lags (e.g., surveys need to be conducted and need time to be evaluated and published). Therefore, a "snapshot" of the current state of the economy provided through a daily or weekly news sentiment indicator would be beneficial.

In this paper, it is examined how valuable signals for forecasting purposes are after being promptly extracted from newspaper texts. To perform this analysis, I extract the sentiment signals from 15 large Swiss newspapers. The investigated time frame is meant to cover the period of four years prior to the lockdown being imposed by the Federal Council on March 16, 2020, followed by the length of the lockdown and that of the rapid economic recovery that followed. The findings show how the sentiments extracted from French-speaking newspapers differ from those printed in German-speaking newspapers.

Data[1] shows that readers are primarily interested in local newspapers rather than in those of the other language regions. The newspapers pick up the sentiments of their own region. This study assumes that the decision-making of readers is influenced by this, which in turn exerts an influence on their consumption and business decisions.

The results show evidence that the concept of *rational inattention* (RI) may influence the significance of news-based sentiment indicators. Maćkowiak et al. (2023) describe RI as a theory stating that "agents cannot process all available information" since, on one hand, there is a limited ability to do so and, on the other hand, the agents have a choice of which news they want to give their attention.[2] Furthermore, agents pay more attention to relevant information when it entails a higher degree of uncertainty. The theory of RI is in line with the results of Kalamara et al. (2022), who emphasize their findings that the more stressful times are, the greater the degree to which text-based sentiment indicators improve the forecasting of macroeconomic variables. The same pattern applies to my results. Starting around the time of the lockdown period and during the recovery phase, the news-based indicator shows a higher degree of correlation with the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023b).

The first obstacle was finding a data pool for text mining to enable access to a legally secure machine-readable database that reflects the Swiss media landscape. To enable access to such a data pool, Swissdox@LiRI (2023) offers a special agreement for researchers. However, at the time of retaining the data, it was not possible to filter the dataset according to categories but rather only according to keywords. Within the scope of this paper, more than 900,000 newspaper articles have been processed. To facilitate the analysis, I split the news articles into six new main categories (business-related news, financial news, health-related news, international and national news, regional news, and other news) by reading each provided rubric in the corresponding newspaper

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[1]See Table A2 in the Appendix, which shows the reach of the newspapers in the different language regions.

[2]Further research could analyze whether there is a difference in the attention given to articles that appear in Sunday editions compared to that of daily newspapers, as people usually have more time to read newspapers over the weekend.

to manually assign each article to the respective category mentioned above. A further factor for consideration is that the provided rubrics differ across newspapers.[3]

The second obstacle was addressing the different languages used in the articles. The selected Swiss newspapers are printed in German and French. The techniques used and lexica, however, are generally developed in English. There are several possibilities for translating news texts. One is to translate all news texts to English and then evaluate them using English lexica software; another possibility, which is the option selected for this study, is not to translate the original newspaper articles (French or German) but rather to create a special lexicon following the approach described by Puschmann and Haim (2023). These newly created German and French lexica are translated from an English lexicon that reveals distinctive keywords. These keywords represent positive or negative sentiments. Two domain-specific English lexica are used. One is Henry's finance-specific dictionary (Henry, 2008) from the R-package SentimentAnalysis (Proellochs and Feuerriegel, 2021). The other is the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011). A third lexicon that combines the two abovementioned lexica is also applied. I specifically decided against an automated translation to enable the transparency and traceability of the keywords that better reflect the same sentiment in each language and thus improve the quality of the keywords utilized.

The main difference in this study to the approach taken in the related literature is that the chosen languages are German and French and the scope of this paper covers two different regions in Switzerland. Contrary to Kalamara et al. (2022), who looked at three popular UK newspapers over an extended period of time (1990-2019), as did Buckman et al. (2020), who considered 16 major newspapers in the USA covering the period of 1980-2020, I looked into 15 newspapers with high circulation (either available daily or only on weekends) published in the main two language regions of Switzerland. As already established in earlier studies, the technique of using news-based sentiment indicators

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[3]The term rubric is used synonymously to represent a category in a newspaper article that enables the mapping of an article to a specific topic, such as business news. Such rubrics are presented in a column provided in the database of Swissdox@LiRI (2023).

works better when analyzing times of crisis (e.g., Kalamara et al., 2022), this paper covers the COVID-19 crisis, as this crisis is especially well suited for analyzing whether the sentiments in these two Swiss regions differ. The French-speaking region of Switzerland had been affected earlier more heavily (at the beginning) by COVID-19 than the German-speaking region (FOPH, 2023). At the beginning of the crisis, the Swiss cantons dealt differently with the occurrence of COVID-19 and, thus, applied different rules to handle the effects of the coronavirus (SRF, 2020). This paper considers whether these varying developments in the regions are also reflected in regional sentiments.

Another difference in the approach relates to the chosen benchmark. Buckman et al. (2020) used the monthly University of Michigan Index of Consumer Sentiment (University of Michigan, 2023) as one of their benchmarks for their news-based sentiment index, which is a monthly survey-based index. In this paper, the monthly reported KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023b) for Switzerland is chosen as a benchmark since the results of the Consumer Confidence Survey conducted by the State Secretariat for Economic Affairs (SECO) (SECO, 2023) are published on a quarterly basis. However, the KOF Economic Sentiment Indicator is a much broader index since it is a weighted average of the results of the Consumer Confidence Survey conducted by the State Secretariat for Economic Affairs (SECO) and other survey-based indicators from the manufacturing, construction, retail, and other service sectors. The same broad approach used for the KOF Economic Sentiment Indicator can also be applied to news-based sentiment indices. Especially for a small open economy such as Switzerland, it is difficult to argue that only consumer sentiment can be extracted from newspaper text-based indices. Considering the possibility that news-based sentiment indices also reflect business sentiment, these news-based indices are referred to as economic sentiment indices throughout this paper. They therefore include consumer sentiment.

The three main results of this study are as follows: First, an important result is that the German- and the French-speaking parts of Switzerland exhibit different sentiments. This observation is also mirrored by the varying GDP data in the different Swiss regions (FSO, 2023). Therefore, I propose apply-

ing a sentiment indicator for each language region. To my knowledge, the presentation of this evidence represents a novel contribution to the literature.

Second, another important result is that some newspapers appear to reflect the KOF Economic Sentiment Indicator more accurately than others. The papers that tend toward greater accuracy are daily newspapers that cover a larger geographic area. Those newspapers that exhibit the highest correlation with the KOF Economic Sentiment Indicator are general newspapers or general newspapers with a focus on business, with the exception of tabloids.

Third, a surprising result is that the categories—business news, international and national news, regional news and other news—contribute almost evenly to the sentiment indices of German-speaking newspapers (depending on the lexicon), whereas sentiment is mainly driven by international and national news for the French-speaking newspapers.

Relating and comparing these text-based sentiment analyses for Switzerland to the existing evidence in the USA and the UK, it can be seen that not only are single newspapers analyzed on an individual level, but aggregated indices for the German- and French-speaking newspapers are also calculated on the basis of the sentiments of all articles in a given month published in a given language region. Similar to Buckman et al. (2020), my findings suggest that the aggregated sentiment indices reveal that the decrease that occurred during the COVID-19 crisis is not only the same size but also appears earlier than that reported in the survey-based consumer sentiment index, concluding that news articles contain valuable information for business cycle forecasters and, thus, can be used as leading indicators. Interestingly, these findings predominantly hold for the aggregate indices and do not apply to the signal extractions from all newspapers on an individual level.

This study makes the following contributions to the literature. First, it provides translations in German and French of the Loughran and McDonald 2016 version dictionary and Henry's 2008 dictionary.

Second, in line with RI theory, this paper provides further evidence for the finding of Carroll (2003), who reported stickiness in household inflation expectation via the news channel caused by agent's inattention. Carroll assumes

that households form inflation expectations based on news media that rely on the views and opinions of professional forecasters for their inflation reports. However, these signals are not passed through to all households in an economy, as not all the readers of newspapers or all the consumers of media pay close attention to news reports. This inattention causes stickiness in the aggregated inflation expectations. My findings suggest that this assumption is not only valid in a household inflation forecasting context but also applies to consumer sentiment or, more generally, economic sentiment.

Third, this paper sheds light on how expectations are formed by economic agents. In line with Lamla and Lein (2014) and the concept of RI, my results suggest that economic agents pay more attention to news reports in times of crisis. However, the results in this paper do not confirm compared to consumer inflation forecasting, in the case of consumer sentiment or economic sentiment, the amount of news[4] improves the positive correlation between the news-based sentiment index and the survey-based sentiment index (meaning that the forecasts performed by consumers are better aligned to the forecasts conducted by professionals). Lamla and Lein (2014) hint at the existence of possible bias in media reporting, resulting in more articles being based on bad than on good news. This bias is reflected in the Loughran and McDonald dictionary, which contains six times more negative than positive words. Interestingly, when using this "biased" dictionary, the results are more accurate than those produced using the balanced (almost equal number of positive and negative words) Henry 2008 lexicon, thus revealing biased reporting.

To conclude, the evidence presented indicates that signal extraction from newspaper texts improves the accuracy of business cycle forecasts in times of stress due to its timely availability and the tendency of households to pay close attention to news reports during such times.

The remainder of this paper is structured as follows: Section 2 describes how the world, particularly Switzerland, were hit by the COVID-19 pandemic and outlines its impact on daily life. Furthermore, the macroeconomic environment during the lockdown period is introduced. Section 3 presents the data. Section

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[4]Compare for example Panels (a) and (b) in Figure A1 of the Appendix which show the ratio of the number of positive versus negative articles.

4 is focused on presenting the empirical strategy with a special emphasis on the identified news articles and chosen dictionaries. Section 5 reports and discusses the main results. Section 6 concludes.

2 Macroeconomic Environment During the COVID-19 Lockdown Period

The COVID-19 pandemic dramatically changed people's lives. The coronavirus that caused the pandemic can be deadly and is easily transmitted among humans by aerosols. Social distancing and mask mandates were the only ways to protect humans prior to vaccination becoming available in Switzerland in December 2020 (FOPH, 2020). Therefore, lockdowns and video conferences determined a large part of public and professional life in 2020. Gita Gopinath (2020), the Chief Economist at the International Monetary Fund (IMF) at the time, even gave the economic situation the name of "The Great Lockdown."

The Great Lockdown led to a sharp drop in economic activity. This shrinkage was mainly driven by two simultaneous macroeconomic shocks. On the one hand, a supply shock occurred as firms struggled with disrupted supply chains, and in some industries (especially in the service sector), people were not allowed to go to work or were required to work from home. As a consequence, the aggregate output that could have been produced by firms was negatively affected. On the other hand, the economy was also largely affected by a demand shock, as consumers could spend their money in only limited ways since many shops, theaters, and other public institutions were forced to close and people were ordered to stay at home. The last such sharp decline in economic activity occurred during the financial crisis of 2007/08.

Figure 1 depicts the sharp drop in economic activity that occurred during the lockdown period. A comparable decline was last seen in the 1930s. However, in the 2020s, a quick recovery of economic growth took place as a result of large fiscal stimuli. Figure 1 illustrates the similarities in the fluctuations in economic growth between the USA and Switzerland during recent decades.
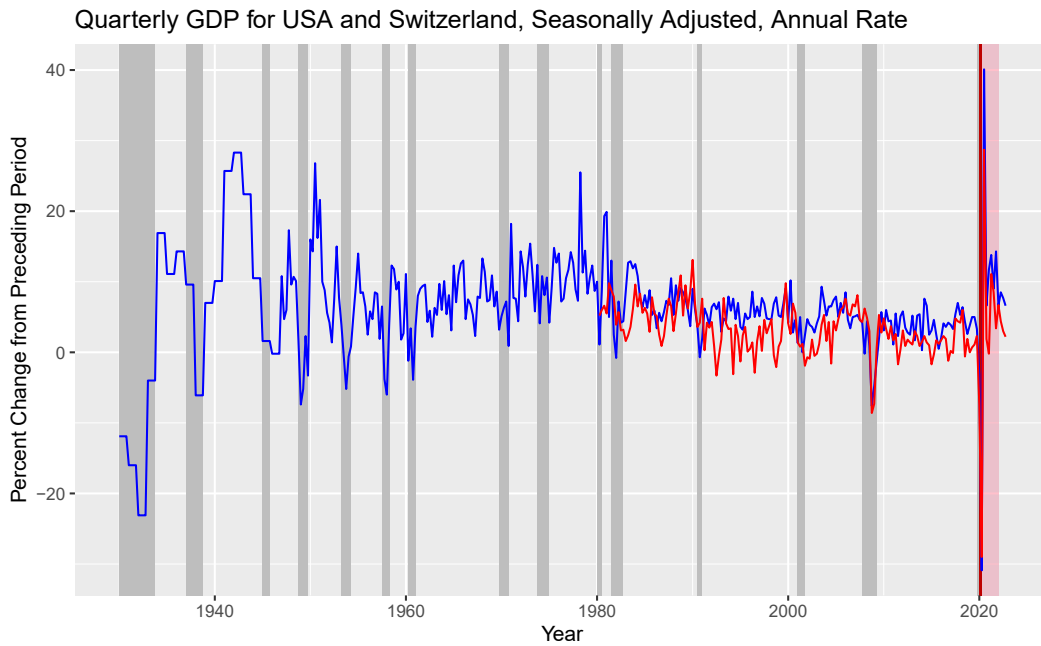
Figure 1: GDP Growth Rates for the USA (blue) and Switzerland (red) Since 1930 (FRED, 2023).

Notes: The gray shaded areas show recessions in the USA, according to NBER (2023). The red shaded area refers to the strict lockdown period in Switzerland, the 'extraordinary situation' that occurred from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022). For the USA, the time series *A191RP1Q027SBEA - Gross Domestic Product, Percent Change from Preceding Period, Quarterly, Seasonally Adjusted Annual Rate* is taken. Since the time series starts in 1947Q2, the time series *A191RP1A027NBEA - Gross Domestic Product, Percent Change from Preceding Period, Annual, Not Seasonally Adjusted*, which is produced on an annual basis, is taken for the time period 1930Q1-1947Q1. For Switzerland, the annualized growth rate of the time series *CPMNACSCAB1GQCH - Gross Domestic Product for Switzerland, Millions of National Currency, Quarterly, Seasonally Adjusted* is taken.

The following two subsections discuss economic development that occurred during the lockdown period in the French- and German-speaking parts of Switzerland in more detail. Since Italian-speaking newspapers are excluded from the analysis, no details for the Italian-speaking part of Switzerland are given. In summary, it can be said that the Ticino region (the Italian-speaking part of Switzerland) was hit first and hit hard by the COVID-19 crisis. After

that, the French-speaking part was affected, followed by the German-speaking part of Switzerland (FOPH, 2023).

2.1 French-Speaking Part of Switzerland

Figure 2 illustrates the 14-day incidence regarding laboratory-confirmed COVID-19 cases in Switzerland (black line). The German-speaking part of Switzerland is shown in red, and the French-speaking part is shown in blue. The red shaded area indicates the lockdown period, and the pink shaded area represents the time of the protective measures. According to the 14-day incidence, the French-speaking region was hit harder by COVID-19 than the German-speaking region. In this study it is determined whether this observation is also reflected in the news-based sentiment indices of the respective regions.

The French-speaking region of Switzerland became a hotspot that triggered a second wave of COVID-19 in October-November 2020. This tendency, however, began only after the first wave, somewhere around June 2020. Contrary to a common assumption, this hotspot was not the result of an epidemic during the autumn months but was caused by previously higher incidences in the summer. The higher number of incidences was followed by a more punctuated decrease in cases in November 2020 in the French-speaking region since stricter measures relative to the rest of Switzerland were imposed (Stadler, 2020).

A similar pattern with a sharp peak and a more punctuated decrease relative to the rest of Switzerland can be observed for the French-speaking region during the largest wave around early 2022, as shown in Figure 2.

Laboratory−confirmed COVID−19 cases in Switzerland
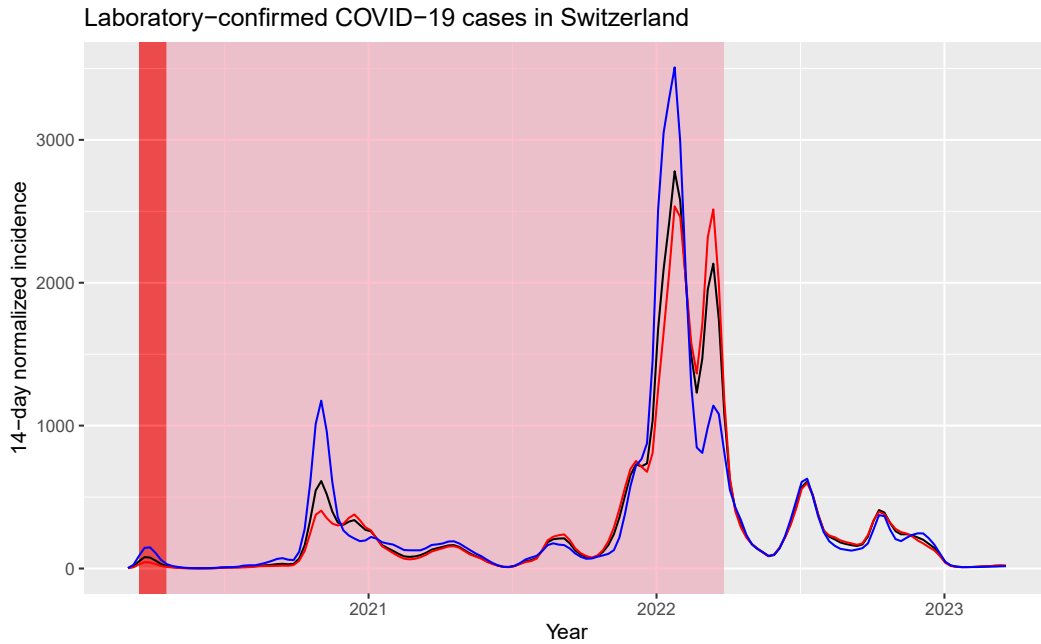
Figure 2: 14-day Incidence of Laboratory-Confirmed COVID-19 Cases in Switzerland (black), as Compared Between the French- (blue) and German-Speaking (red) Regions of Switzerland (FOPH, 2023).

Notes: The 14-day incidence is calculated by dividing the number of new laboratory-confirmed COVID-19 cases by the population of the respective cantons normalized per 100,000 inhabitants and then taking the two-week average. The following cantons are considered for the German-speaking region: AG, AI, AR, BE, BL, BS, GL, LU, NW, OW, SG, SH, SO, SZ, TG, UR, ZG and ZH. The French-speaking region is calculated by taking the two-week average of these cantons: FR, GE, JU, NE, VD and VS. The cantons TI and GR are not part of either region, since the language in these cantons is Italian and for GR also includes Romansh (apart from German). The red shaded area refers to the strict lockdown period in Switzerland, the 'extraordinary situation' that occurred from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022).

2.2 German-Speaking Part of Switzerland

Changes in the number of incidences after the first wave were noted for the German-speaking part of Switzerland compared to some regions in the French-speaking part, showing that the German-speaking part had been affected by the incidences much less than the French-speaking part (Stadler, 2020).

Contrary to what occurred in the French-speaking part, a peak in laboratory-confirmed COVID-19 cases in the German-speaking part that occurred toward the end of the protection measures period can be observed in Figure 2.

Figure 3 presents the growth rates of the Swiss GDP and the GDP of the German- and French-speaking parts of Switzerland. The German-speaking region accounts for roughly two-thirds of the Swiss GDP (FSO, 2023); therefore, the Swiss GDP more accurately matches the movements of the German-speaking part than those of the French-speaking part. This study investigates whether the differences in the GDP growth rates (available annually) in the French- versus the German-speaking parts are also reflected in the news-based sentiments by applying the monthly regional KOF Business Situation Indicator (KOF Swiss Economic Institute, 2023a) as a proxy for yearly regional activity.
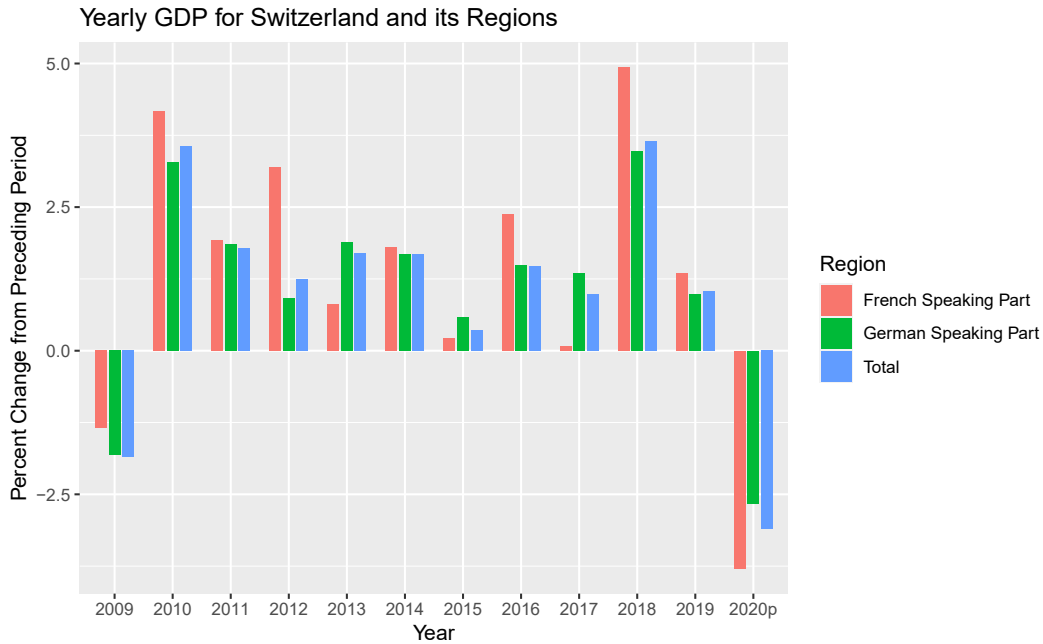
Figure 3: GDP of Switzerland and its Regions (FSO, 2023).

Notes: The GDP of the German-speaking part is calculated as the average of the following cantons: AG, AI, AR, BE, BL, BS, GL, LU, NW, OW, SG, SH, SO, SZ, TG, UR, ZG and ZH. The GDP of the French-speaking part is calculated by taking the average of these cantons: FR, GE, JU, NE, VD and VS. The cantons TI and GR are not part of either region, since the language in these cantons is Italian and for GR also includes Romansh (apart from German).

3 Data

In this paper, to create a news-based sentiment index, sentiment analysis is applied to process a large quantity of detailed information drawn from Swiss newspapers with large circulations. Due to data availability, this paper focuses on newspapers from the French- and German-speaking parts of Switzerland only, ignoring the Italian-speaking part. The characteristics of the Swiss newspapers printed in both French and German are described in more detail in the following subsections.

The articles from the chosen newspapers are retrieved from Swissdox@LiRI (2023). For this paper, the printed editions are selected rather than the online versions. The printed version is specifically chosen so that the external validity is given, which enables a comparison of my results with those of Kalamara et al. (2022) and Buckman et al. (2020).

Since there were no categories available from the data provider at the time, I had to generate my own list of keywords to retrieve the articles from Swissdox@LiRI. At least one of the keywords mentioned in Table 1 had to be contained in the retrieved article. The articles were then mapped to the six new main categories (business, financial, health, international and national, regional, and other news) using the rubrics. Table 1 lists the chosen keywords for the different languages.

Table 1: Keywords Used to Generate the Corpus.

English	German	French
economic/business	Wirtschaft	économie
news	News/Nachrichten	actu
Swiss	Schweiz	Suisse
world/foreign affairs	Ausland	monde
focus	Schwerpunkt	focus
opinion	Meinung	opinion
international	International	international
region	Region	régio
analysis	Analyse	analyse
politic	Politik	politique

Notes: The corpus is retrieved using string matching. The above list contains keywords, for example the keyword *opinion*, that retrieve all other words containing this string, for instance, "opinions". SWI swissinfo.ch (2023) offers news from Switzerland in various languages, German, French and English, among others, and was therefore chosen as a robustness check, as most of the sentiment analysis software was originally developed for the English language. Thus, the keywords are also translated into English.

3.1 Newspapers Published in French

For this paper, the top five newspapers from the French-speaking region were chosen, accounting for the highest circulation. The selected newspapers, which include daily papers, Sunday editions and free newspapers, cover the Swiss political spectrum. Table 2 shows the characteristics of the chosen newspapers used to determine the sentiment in the French-speaking part of Switzerland.

The number of raw articles that are shown in Table 2 are based on the keywords. The duplicates and reader letters to the editor[5] were then removed, which resulted in a revised dataset containing a reduced number of articles.[6]

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[5]Reader letters to the editor were removed to avoid reverse causality issues.

[6]Instead of removing single rubrics, the rubrics to keep are specified. To do so, the rubrics of each newspaper were manually checked since the defined terms differ across newspapers.

Furthermore, the time period covered by the newspapers is shown as well as their types (printed daily or only on weekends) and the newspaper's circulation.

Table 2: Chosen Newspapers for the Text-Based Sentiment Index of the French-Speaking Part of Switzerland.

	Newspaper (Abbr.)	Number of raw Articles	Number of Articles	Time Period	Daily Newspaper	Circu-lation
1	20 minutes (ZWAS)	42,489	24,002	31.01.2016–29.09.2022	Y	134,210
2	24 heures (HEU)	79,888	53,687	31.01.2016–30.09.2022	Y	45,807
3	Le Matin Dimanche (TLMD)	22,173	10,179	06.02.2016–24.09.2022	N	70,500
4	Le Temps (TPS)	77,118	45,984	31.01.2016–30.09.2022	Y	35,370
5	Tribune de Genève (TDG)	74,484	43,571	31.01.2016–30.09.2022	Y	30,629
	Total	296,152	177,423			

Notes: Articles are retrieved from Swissdox@LiRI (2023). Circulation is taken from Dow Jones Factiva (2023). Circulation for the newspaper 20 minutes is retrieved from WEMF (2023a). Eisenegger et al. (2013) count Le Matin Dimanche as a tabloid press.

3.2 Newspapers Published in German

In Table 3, the characteristics of the top ten listed newspapers in the German-speaking part of Switzerland, which are used to determine the sentiment, are shown. In addition to the newspapers printed in French, two tabloid newspapers are selected. The number of papers chosen is higher than that in Table 2 because the German-speaking part has a greater economic share of the national GDP. The processing of the data is the same as that for the data in Table 2.

The defined terms are chosen in such a way that they can be assigned to the main six categories. Another possibility for constructing the main six categories would be through the use of topic models; however, to place the focus on traceability, a manual approach was chosen.

Table 3: Chosen Newspapers for the Text-Based Sentiment Index of the German-Speaking Part of Switzerland.

	Newspaper (Abbr.)	Number of raw Articles	Number of Articles	Time Period	Daily Newspaper	Circu-lation
1	20 Minuten (ZWA)	52,599	35,057	31.01.2016–29.09.2022	Y	310,927
2	Aargauer Zeitung (AZM)	118,796	76,868	31.01.2016–30.09.2022	Y	59,785
3	Blick (BLI)	50,859	30,919	31.01.2016–30.09.2022	Y	91,263
4	Luzerner Zeitung (LUZ)	93,384	56,438	18.09.2016–30.09.2022	Y	59,266
5	Neue Zürcher Zeitung (NZZ)	111,069	54,078	31.01.2016–30.09.2022	Y	96,628
6	NZZ am Sonntag (NZZS)	25,436	11,536	06.02.2016–24.09.2022	N	106,633
7	Schweiz am Sonntag (SAS)/	5,723	3,455	06.02.2016–25.02.2017	N	
	Schweiz am Wochenende (SAW)*	22,475	16,159	03.03.2017–27.12.2019*	N	378,244
8	Sonntagsblick (SBLI)	19,974	9,150	06.02.2016–24.09.2022	N	107,963
9	SonntagsZeitung (TAS)	22,408	9,106	06.02.2016–24.09.2022	N	136,580
10	Tages-Anzeiger (TA)	90,234	50,351	31.01.2016–30.09.2022	Y	114,337
	Total	612,957	353,117			

Notes: *The newspaper Schweiz am Wochenende is the successor of the newspaper Schweiz am Sonntag. The newspaper Schweiz am Wochenende (SAW) has a data gap.
Articles are retrieved from Swissdox@LiRI (2023). Circulation is taken from Dow Jones Factiva (2023). Please note that there is a difference between circulation and readership. The circulation for the newspaper 20 Minuten is approximately 300,000, whereas the readership is estimated to be approximately 1,250,000 (Swissdox, 2023). Eisenegger et al. (2013) count the following newspapers as tabloids: Blick and Sonntagsblick.

4 Empirical Strategy

This section illustrates the data cleaning process, presents the preliminary data analysis, and describes the domain-specific lexica used for the sentiment analysis. The section closes with a subsection regarding the process of index creation.

4.1　Data Cleaning and Preliminary Data Analysis

Before a sentiment score could be extracted from the text of a newspaper, each text had to be cleaned. The correct handling of textual data is important to the data cleaning process.[7] The data cleaning process starts with the removal of English names. Then, lists of Swiss first and surnames are created. The Swiss first names had to occur at least 200 times. These Swiss names are then omitted from the corpus. Furthermore, numbers, punctuation, and stopwords[8] in German, French and English per the language of the relevant newspaper are removed. Lower case of all words is imposed, and only the word stems[9] are kept.

For a preliminary data analysis, Figure 4 illustrates the conditional density of the unique number of words (types) per news article in the newspaper *Aargauer Zeitung* per news category. Remarkably, the news category *Other* contains a broad variety of short and long articles of between zero and 1,000 types, whereas the rest of the categories contain approximately 250 types per article.

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[7]The following R (2022) packages are used for data processing: **data.table** (Dowle and Srinivasan, 2021), **dplyr** (Wickham, François, Henry, Müller and Vaughan, 2023), **FKF** (Luethi et al., 2022), **ggplot2** (Wickham, 2016), **lmtest** (Zeileis and Hothorn, 2002), **quanteda** (Benoit et al., 2018), **quanteda.textplots** (Benoit et al., 2018), **quanteda.textstats** (Benoit et al., 2018), **SentimentAnalysis** (Proellochs and Feuerriegel, 2021), **SnowballC** (Bouchet-Valat, 2020), **stringr** (Wickham, 2022), **textclean** (Rinker, 2018), **tidyr** (Wickham, Vaughan and Girlich, 2023), **tidyverse** (Wickham et al., 2019), and **tm** (Feinerer et al., 2008).

[8]Stopwords are not very informative words, for example "a", "the" or "to".

[9]In English, the expression for "best" translates as "meilleur", "meilleure", "meilleurs" or "meilleures" in the French language depending on the context used in a sentence. Through the use of word stems, such varieties can be omitted and only "meilleur" is considered.
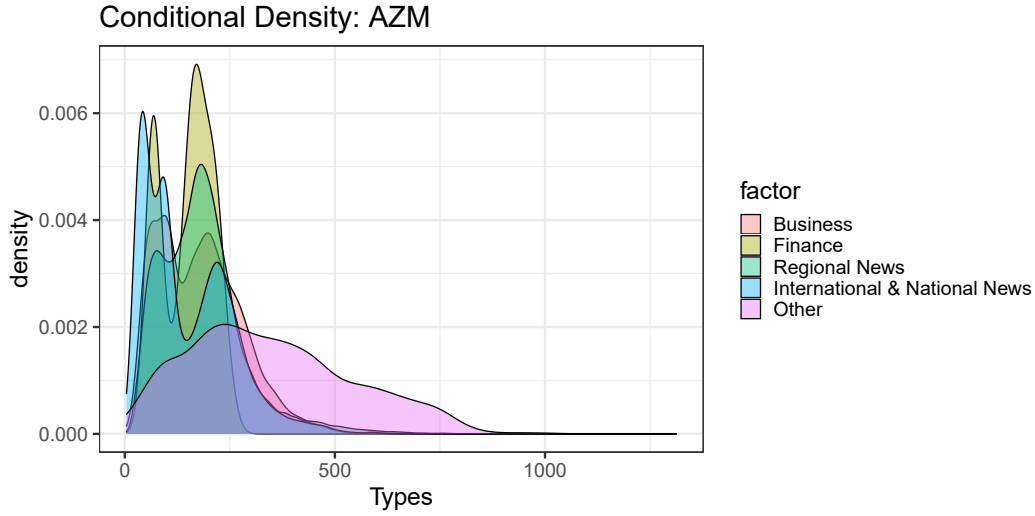
Figure 4: Conditional Density of the Number of Unique Words (Types) per Article per News Category for the Aargauer Zeitung (AZM).

Notes: Types refer to the unique number of words per article as calculated after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).

The preliminary data analyses of all the newspapers of the corpus are depicted in the Appendix in Figures A2-A4. In sum, it can be observed that, unsurprisingly, the German-speaking free newspaper and newspapers from the tabloid press have a smaller type count of approximately 100 compared to the rest of the German-speaking newspapers. The number of types of other German-speaking newspapers depends on the news category and centers around 250 types per article. The number of types for the daily newspapers and the Sunday editions do not differ greatly. French-speaking newspapers center also approximately around 250 types per article; however, French-speaking articles contain more outliers with a larger number of types. Surprisingly, the French-speaking free newspaper exhibits bimodal conditional densities with two peaks of 50 types and 150 types per article.

Figure 5 shows the word cloud for the most frequently used words in the articles of the *Aargauer Zeitung* per news category. Interestingly, the word stems *corona crisis (coronakris)* and *virus* are part of the financial news category. Other frequent words in the financial news category are *firms (unternehm)* and

turnover (umsatz). For the business category, the frequently used words are *Switzerland (schweiz)*, *strong (stark)* or *billion (milliard)*. Unsurprisingly, the regional news in the Aargauer Zeitung deals with *Aargau, canton (kanton)* or *communes (gemeind)*. The conditional word clouds of all the newspapers of the corpus are shown in the Appendix in Figures A5-A7.

Figure 5: Word Cloud With the Most Frequent Word Stems per News Category for the Aargauer Zeitung (AZM).

Notes: The conditional word cloud shows the most frequent word stems after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).

4.2 Domain-Specific Lexica

The sentiment of the news articles is extracted using domain-specific lexica. The domain-specific lexica used in this paper are focused on financial expressions or sentiments, since different expressions have different meanings and, therefore, different sentiments when used in everyday language than that of their financial meanings. For example, "default" has the meaning of "not being able to pay a debt" in the financial context and, hence, represents a negative

sentiment, whereas the same term used in computer science means a "standard setting in a program" and is considered neutral in regard to sentiment.

Two popular lexica are applied to the corpus: (i) Henry's finance-specific dictionary (Henry, 2008)[10] and (ii) the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011)[11]. A mix of both lexica (containing all the words of both lexica) is taken as a third lexicon.

To obtain more accurate results for the German- and French-speaking news-based sentiment indices, I decided to manually check each translated word in the newly created translated lexica. This enabled me to pay attention to the appropriate sentiment applicable to the financial world and gave me the choice of adding more synonyms to the Henry (2008) lexicon.

Table 4 shows the characteristics of the dictionaries used in the different languages. The ratio of positive versus negative words is different for each lexicon. To compare the results, the time series are later standardized with a mean of 0 and a standard deviation of 1.

Table 4: Lexica Used to Create the Text-Based Sentiment Indices.

	Lexicon	English		French		German	
		Positive	Negative	Positive	Negative	Positive	Negative
1	Henry (2008)	53	44	215	222	144	230
2	Loughran and McDonald (2016)	145	884	155	828	222	1,161
3	Combined Lexicon	173	906	321	935	328	1,298

Notes: The numbers of positive and negative word stems in each language are listed in the table. The lexica were originally created in English and translated into French and German by the author. For the translated version, synonyms are also included. Therefore, the number of word stems is generally larger for the translated versions. The combined version contains only the unique word stems of both lexica and excludes any duplicates.

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[10]Provided by the R package **SentimentAnalysis** (Proellochs and Feuerriegel, 2021).

[11]Provided by Shapiro et al. (2022) available online at `https://www.frbsf.org/economic-research/indicators-data/daily-news-sentiment-index/`

The reason why I chose to translate two English dictionaries into German and French rather than using existing German and French sentiment lexica is that the results are comparable within the Swiss context (internal validity) but also comparable to the results in the US economy, as reported in Shapiro et al. (2022) (external validity).

This study focuses on extracting the sentiment using the lexical approach since Shapiro et al. (2022) showed that machine learning techniques (including highly sophisticated methods such as GloVe[12] word embeddings or BERT[13] document embeddings) produce similar results for the sentiment analysis.[14]

4.3   Index Creation

To create the text-based sentiment indices, net positivity is used. The positive minus the negative terms per article represent the net positivity of a given article n at time t

$$NP_{t,n} = \#P_{t,n} - \#N_{t,n} \tag{1}$$

where $NP_{t,n}$ denotes net positivity and $\#P_{t,n}$ and $\#N_{t,n}$ represent the total number of positive or negative terms in an article, respectively.

Words that appear repeatedly in an article are counted multiple times inasmuch they are attributed to positive or negative sentiment. The benefit of this approach is that it is easily comprehensible and transparent. The words used in each article are traceable and can be attributed to a specific sentiment.

Preliminary analyses have shown that the text lengths of articles in all newspapers of a specific language region are within a similar range, thus enabling a summed total text-based sentiment index per language region.

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[12]Global Vectors for Word Representation (GloVe) by Pennington et al. (2014).

[13]Bidirectional Encoder Representations from Transformers (BERT) by Devlin et al. (2018).

[14]The recent development of large language models (LLMs), such as the GPT models, offers new possibilities for further research in the area of sentiment analysis. Zhang et al. (2023) investigate how well LLMs are suited for performing sentiment analysis tasks. However, this study focuses on a simple dictionary approach to facilitate traceability. The comparison of the dictionary approach with LLMs could be an avenue for future research.

The text-based sentiment indices can be calculated on a daily[15] SI_t, weekly[16] SI_w or monthly SI_m basis.

$$SI_t = \sum_{n=1}^{N} NP_{t,n} \qquad \text{where } t = \text{day, and } n = \text{article} \qquad (2)$$

$$SI_w = \sum_{wd=1}^{WD} SI_{t,wd} \qquad \text{where } wd = \text{weekday (1 [Monday] to 7 [Sunday])} \qquad (3)$$

$$SI_m = \sum_{md=1}^{MD} SI_{t,md} \qquad \text{where } md = \text{day of the month (1 to 28/29/30/31)} \qquad (4)$$

It is also possible to split the indices into subcategories, such as business- or finance-related news.

5 Results

This section presents and discusses the results in more detail and is followed by subsections reporting on the in-sample analysis, out-of-sample analysis, Granger causality tests and robustness checks.

Figure 6 depicts the sentiment indices for the aggregated indices in Panels (a) and (b). The aggregated indices are a simple sum of all individual newspaper indices in a given language region. Interestingly, the sharp drop in consumer sentiment caused by the COVID-19 pandemic can be observed earlier in the news-based indices than in the survey-based sentiment index. This is in line with the assumption that it requires time for a survey to be conducted and the results to be reported. During the lockdown period, a high correlation is observed, while in the pre-pandemic period, the correlation is less pronounced. The sentiment indices of the individual newspapers are shown in the Appendix in Figures A10-A18.

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[15]See, for example, the daily text-based index for Aargauer Zeitung in Figure A8 in the Appendix.

[16]See, for example, the aggregated text-based index for the French newspapers in Panel (b) of Figure A9 in the Appendix.
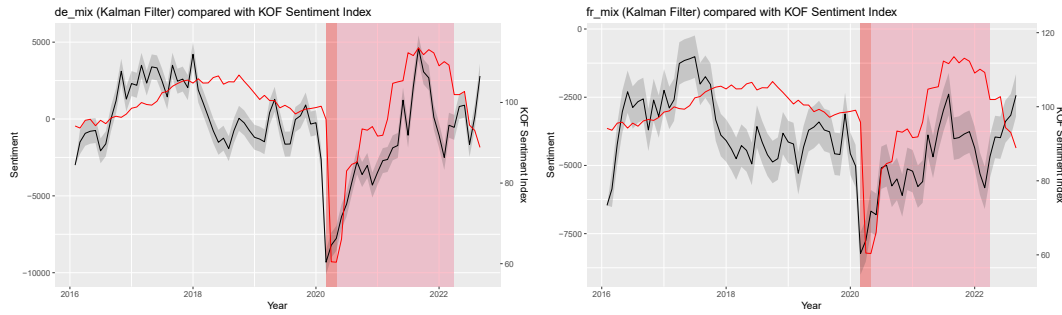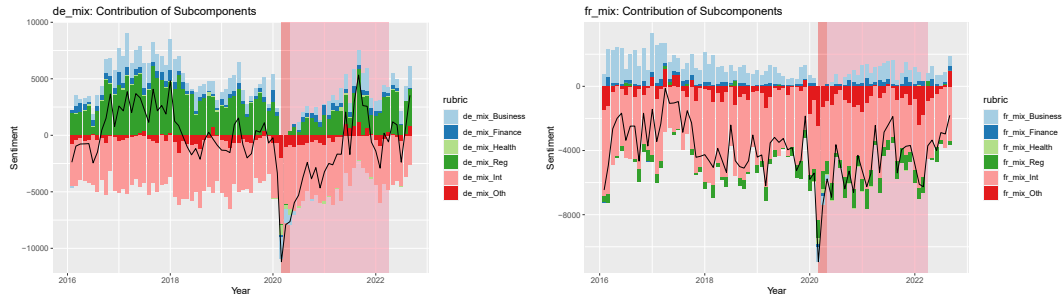
(a) German-Speaking News-Based Index. (b) French-Speaking News-Based Index.

Figure 6: Aggregated News-Based Sentiment Indices With Confidence Bands Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment indices use the combined lexica with stemmed data. The Kalman filter is applied to the sentiment indices to smooth the indices. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022). Due to a data gap, the aggregated index of the German-speaking part of the country contains the sentiments of the newspapers SAS and SAW only in the pre-pandemic period. Articles are retrieved from Swissdox@LiRI (2023).

Figure 7 shows the contribution of each rubric to the sentiment indices. Interestingly, the largest negative contribution is due to international and national news. The contribution of single newspapers is shown in the Appendix in Figures A19-A27. The contribution of rubrics in each newspaper depends on the focus of the newspaper on regional or business news, etc. Therefore, there is no clear contribution pattern to one specific rubric across newspapers. For German-speaking Sunday editions, international and national news are important. Interestingly, comparing the contribution of the sentiment of 20 Minuten (ZWA) with the French-speaking edition of 20 minutes (ZWAS), the focus is different. Regional news is important to 20 Minuten (ZWA), whereas for 20 minutes (ZWAS), a large part of the sentiment is driven by national and international news. In line with common assumptions, the Neue Zürcher Zeitung (NZZ) and its Sunday edition (NZZS) have a large share of business news and international and national news.

(a) German-Speaking News-Based Index. (b) French-Speaking News-Based Index.

Figure 7: Contribution of News Categories to News-Based Sentiment Indices for Aggregated Indices.

Notes: The sentiment indices use the combined lexica with stemmed data. No Kalman filter is applied to the data shown in the panels. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022). Due to a data gap, the aggregated index of the German-speaking part of Switzerland contains the sentiments of the newspapers SAS and SAW only in the pre-pandemic period. Articles are retrieved from Swissdox@LiRI (2023).

Comparing the share of contributions led to an interesting additional insight. In an additional analysis, I compared the aggregated index of the French-speaking part of the country with the University of Michigan Index of Consumer Sentiment (University of Michigan, 2023), since it seems that the index in the French-speaking part is more heavily affected by international news than the index of the German-speaking part of the country. When the University of Michigan Index of Consumer Sentiment is lagged by two months, a certain co-movement in the two time series can be detected during the pre-pandemic period of 2018-2020, as shown in Figure 8. This observation can potentially be explained by a certain lagged spreading of news from large economies, such as the USA, to small open economies. However, it seems that this spreading of news is not stable over time and might be influenced by international news cycles.
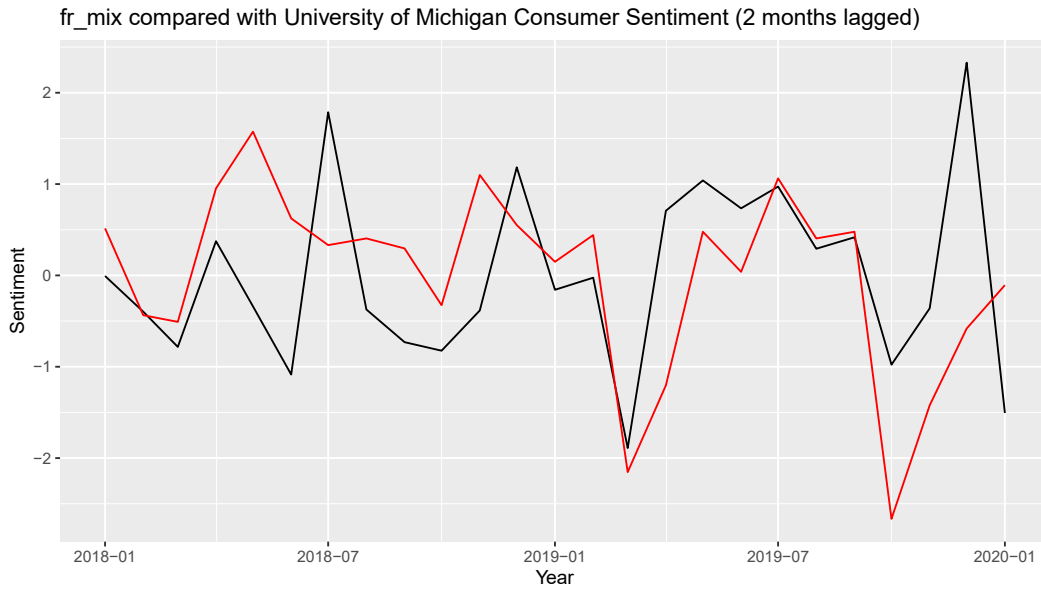
Figure 8: Comparison of the Aggregated French-Speaking News-Based Sentiment Index (black) With the Two-Months Lagged University of Michigan Index of Consumer Sentiment (red) (University of Michigan, 2023).

Notes: The two time series are standardized. Articles for the news-based sentiment index are retrieved from Swissdox@LiRI (2023).

Figure 9 depicts the two standardized sentiment indices for the German- and French-speaking parts of Switzerland compared with the standardized KOF Economic Sentiment Indicator. It is important to note that the size of the dip in the news-based indices almost exactly matches the dip in the consumer sentiment index. Therefore, a text-based sentiment index might serve as an interesting forecasting tool in a crisis. Another interesting result is that the sentiments in the French- and German-speaking parts of the country are quite different. Since the development in GDP growth rates also differ across the two regions, this would present the need to have different sentiment indices according to economic regions in Switzerland. Since the largest part of the Swiss GDP depends on the German-speaking region, it is not surprising that the comovement between the KOF Economic Sentiment Indicator and the German-speaking text-based index looks more similar than that with the French-speaking text-based index.
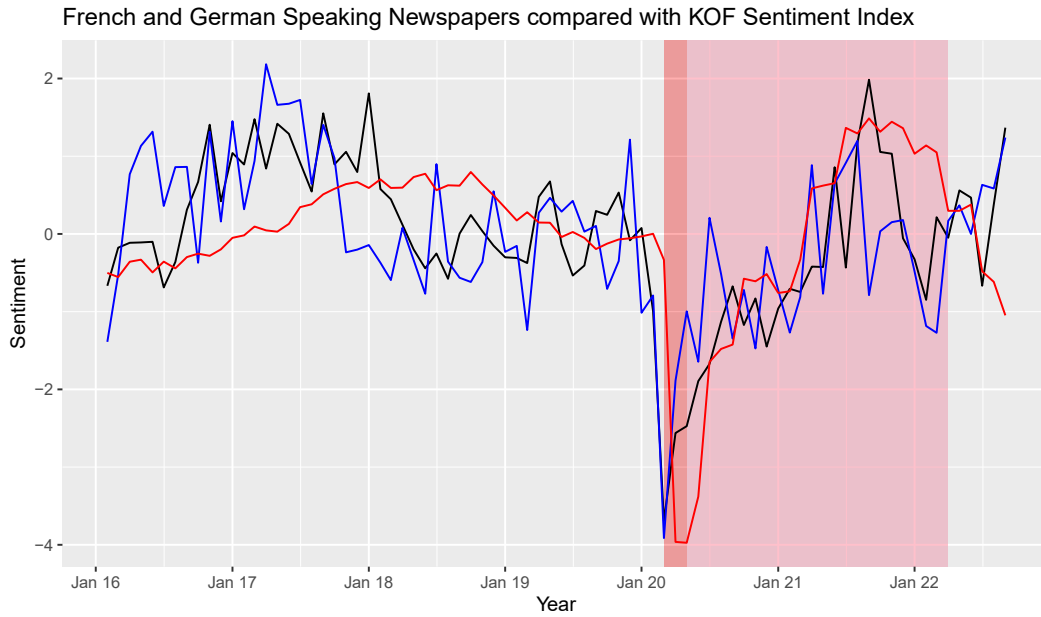
Figure 9: News-Based Sentiment Indices for the French (blue) and German (black) Speaking Newspapers Compared With the KOF Economic Sentiment Indicator (red) (KOF Swiss Economic Institute, 2023*b*).

Notes: The three time series (combined lexicon version for the news-based sentiment indices) are standardized with a mean of 0 and a standard deviation of 1. No Kalman filter is applied. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022). Articles for the news-based sentiment indices are retrieved from Swissdox@LiRI (2023).

Figure A28 in the Appendix shows the news-based sentiment in the different language regions in Switzerland during the strict lockdown period. Interestingly, the news-based sentiments were very close to each other in both language regions. However, a slightly lower sentiment is observed in the German-speaking part of the country. This pattern applies to all lexica used.

5.1 In-Sample Analysis
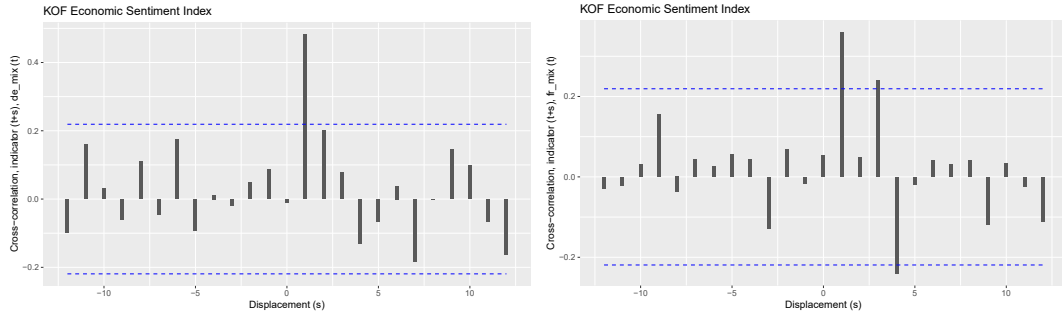
(a) German-Speaking Newspapers With Combined Lexicon and KOF Economic Sentiment.

(b) French-Speaking Newspapers With Combined Lexicon and KOF Economic Sentiment.
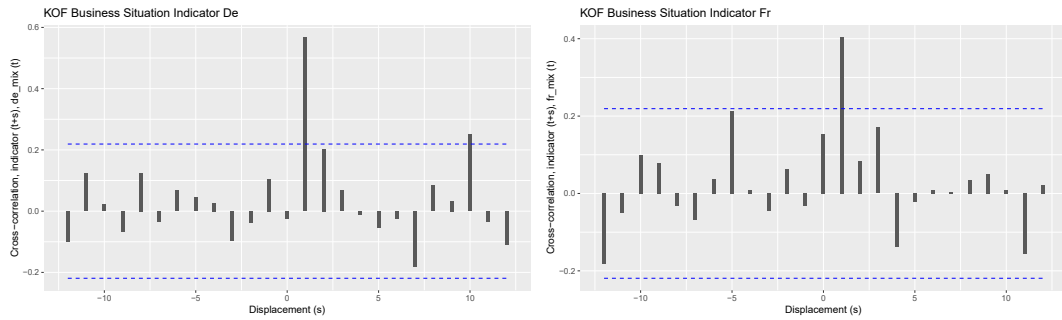
(c) German-Speaking Newspapers With Combined Lexicon and KOF Business Situation Indicator for the German-Speaking Part.

(d) French-Speaking Newspapers With Combined Lexicon and KOF Business Situation Indicator for the French-Speaking Part.

Figure 10: Cross-Correlation Tests for News-Based Sentiment Indices and the KOF Economic Sentiment Indicator as well as the Regional Subindices of the KOF Business Situation Indicator.

Notes: Following Burri and Kaufmann (2020), the tests use monthly data. The 95% confidence bands are indicated by the dashed lines. Values that are outside of the 95% confidence bands imply a statistically significant lead/lag relationship between the indicators of order s. Similar to Neusser (2016, Ch. 12.1), the series are prewhitened with an AR(p) model prior to the cross-correlations being calculated. The order p of the AR model is identified by applying the Bayesian information criteria. The KOF Business Situation Indicator (KOF Swiss Economic Institute, 2023a) is available from KOF on a major regional level. For the German-speaking region, an average of the following regions is taken: Espace Mittelland, Northwestern Switzerland, Zurich and Central Switzerland. For the French-speaking region, the following region is taken: the Lake Geneva Region.

Figure 10 presents the cross-correlation tests for the news-based sentiment indices and the KOF Economic Sentiment Indicator as well as the regional subindices of the KOF Business Situation Indicator (KOF Swiss Economic Institute, 2023a). The cross-correlation tests, following Burri and Kaufmann (2020) and Neusser (2016, Ch. 12.1), are used to measure whether the news-based sentiment indices are leading the KOF Economic Sentiment Indicator and the regional subindices of the KOF Business Situation Indicator.

The tests show a significant correlation between the news-based sentiment indices and the KOF indicators. The leading relationship between the German-speaking newspapers determined by using the combined lexica (de_mix) and the KOF Economic Sentiment Indicator as shown in Panel (a) of Figure 10 is particularly strong for the next quarter $h = 1$. The leading relationship determined by using the combined lexica (fr_mix) as shown in Panel (b) of Figure 10 is slightly less pronounced but still highly significant for the French-speaking newspapers. This observation is in line with the assumption that the German-speaking index better captures the movements of the KOF Economic Sentiment Indicator since the German-speaking region of Switzerland accounts for a larger part of the overall Swiss GDP and that the sentiment differs across the German-speaking and French-speaking parts of the country. The cross-correlation tests between the news-based sentiment indices and the regional KOF Business Situation Indicators support this assumption. Evidence is displayed in Panel (c) and (d) of Figure 10, indicating that the movement differences in the regions are substantial.

Similar results regarding the correlation with the KOF Economic Sentiment Indicator can be observed for the German- and French-speaking newspapers using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) (de_lm) and (fr_lm), as shown in Panel (a) and (b) of Figure A29 in the Appendix, respectively. On the other hand, there is no significant coincident or leading relationship using Henry's finance-specific dictionary (Henry, 2008) for the German- (de_he) or French-speaking newspapers (fr_he) in Panel (c) and (d) of Figure A29 in the Appendix, indicating the importance of using a negatively "biased" dictionary to conduct sentiment analysis.

The main benefit of the news-based sentiment indices, which can be broken

down into health, business, financial, regional, international and national, and other news, is its ready availability and that news texts are not subject to data revisions.

5.2   Pseudo Out-Of-Sample Analysis

The predictive power of the news-based sentiment indices in forecasting GDP growth is assessed using pseudo real-time forecasts, following Burri and Kaufmann (2020). Quarterly GDP vintages taken from ALFRED (2023) are used as real-time data.

To evaluate the out-of-sample performance, a direct forecasting model, as in Burri and Kaufmann (2020), is used as follows:

$$y_{\tau+h} = \alpha_h + \beta_{h,1} SI_{\tau|t} + \beta_{h,2} SI_{\tau-1} + v_{\tau+h} \qquad (5)$$

where y_τ stands for quarterly GDP growth, the forecast horizon is denoted by h, the time subscript for quarterly frequency is τ, and time in monthly frequency is represented by t. $SI_{\tau|t}$ is the news-based sentiment index of quarter τ given the information available in month t. $SI_{\tau|t}$ and SI_τ are the averages of the observations in a specific quarter, and $v_{\tau+h}$ denotes the error term.

The last news-based sentiment index observations are taken at $\tau = 2022Q3$ and $t =$ September 2022. Forecasts are performed based on the information set at the specific time t when a new GDP vintage is released. 19 nowcasts and 19 one-quarter ahead forecasts are computed.

The out-of-sample prediction of the forecasts is evaluated against four benchmarks. The first benchmark is the first available quarterly release of GDP growth and, thus, it ignores the data revisions of later GDP releases. The second benchmark is an AR(1) model[17] that takes the real-time vintage for GDP growth as input. The third benchmark are forecasts of GDP growth estimated on the KOF Economic Sentiment Indicator and on the regional KOF Business Situation Indicators. The identical forecasting model, which is

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[17]AR(1) stands for autoregressive model of order 1.

used for the news-based sentiment indices and adapted with the data of the KOF Economic Sentiment Indicator or the regional KOF Business Situation Indicator, is applied. The fourth benchmark are forecasts of GDP growth estimated by the SNB Business Cycle Index (Galli, 2018). The quarterly GDP release of February 2, 2023 is used for calculating the forecast errors.

Table 5 illustrates the out-of-sample evaluation for the combined lexica of the German-speaking newspapers index (de_mix) [and the French-speaking newspapers index (fr_mix) in brackets]. The root-mean-squared errors (RMSE) displayed in Panel (a) of Table 5 are lower for the first available GDP release, although the differences are not statistically significant at the 5% significance level (aside from fr_mix at h=0). In Panel (b), it can be observed that the news-based sentiment indices beat the AR(1) benchmark, but without a significant difference in forecast precision. The forecasts of the news-based sentiment indices, the KOF Economic Sentiment Indicator and the regional KOF Business Situation Indicators are comparable, as shown in Panel (c) of Table 5. The difference in forecast accuracy between the KOF Economic Sentiment Indicator and the regional KOF Business Situation Indicators is statistically significant at a 10% significance level for the next quarter ($h = 1$). In Panel (d) of Table 5, the forecasts of the news-based sentiment indices are compared with those of the SNB Business Cycle Index (Galli, 2018), a dynamic factor model (DFM) for the Swiss economy. As expected in the absence of economic turmoil, the text-based sentiment indices could not beat the DFM for the current quarter ($h = 0$) on average; however, for the next quarter ($h = 1$), the RMSE are lower for the text-based sentiment indices, although not being statistically significant at a 10% significance level.

The same analysis is performed for the German- and French-speaking newspapers indices, using Henry's lexicon de_he [and fr_he in brackets], in Table A3 of the Appendix and for the German- and French-speaking newspapers indices, using the Loughran and McDonald lexicon de_lm [and fr_lm in brackets], in Table A4 of the Appendix with similar results.

To conclude, there are two main benefits of the news-based indices: first, the forecast accuracy of the one-quarter ahead forecasts and second, the timely availability of the indices.

Table 5: Out-Of-Sample Evaluation of the German-Speaking Newspapers Index [and the French-Speaking Newspapers Index in Brackets] Using the Combined Lexicon.

(a) GDP growth: First release versus de_mix [fr_mix]

	RMSE First release	RMSE de_mix	Relative RMSE First release/de_mix	DMW test (p value) First release < de_mix
h=0	0.44	3.21 [2.95]	0.14 [0.15]	0.068 [0.047]
h=1	0.45	2.89 [2.80]	0.16 [0.16]	0.096 [0.098]

(b) GDP growth: de_mix [fr_mix] versus AR(1)

	RMSE de_mix	RMSE AR(1)	Relative RMSE de_mix/AR(1)	DMW test (p value) de_mix < AR(1)
h=0	3.21 [2.95]	3.72	0.86 [0.79]	0.110 [0.142]
h=1	2.89 [2.80]	3.00	0.96 [0.93]	0.307 [0.200]

(c) GDP growth: de_mix [fr_mix] versus the KOF Economic Sentiment Indicator (KOF ESI) and versus *the KOF Business Situation Indicator (KOF BSI)*

	RMSE de_mix	RMSE KOF ESI *KOF BSI*	Relative RMSE de_mix/KOF ESI *de_mix/KOF BSI*	DMW test (p value) de_mix < KOF ESI *de_mix < KOF BSI*
h=0	3.21 [2.95]	1.76	1.83 [1.68]	0.904 [0.918]
		2.81 [3.10]	*1.14 [0.95]*	*0.723 [0.120]*
h=1	2.89 [2.80]	3.82	0.76 [0.73]	0.085 [0.095]
		3.18 [3.06]	*0.91 [0.91]*	*0.065 [0.086]*

(d) GDP growth: de_mix [fr_mix] versus the SNB Business Cycle Index (SNB BCI)

	RMSE de_mix	RMSE SNB BCI	Relative RMSE de_mix/SNB BCI	DMW test (p value) de_mix < SNB BCI
h=0	3.21 [2.95]	1.53	2.10 [1.93]	0.906 [0.922]
h=1	2.89 [2.80]	6.98	0.41 [0.40]	0.143 [0.146]

Notes: The out-of-sample evaluation follows the approach presented in Burri and Kaufmann (2020). The root-mean-squared errors (RMSE) are calculated for forecasts in those months when a new quarterly GDP figure is released. Quarterly GDP data (CPMNACSAB1GQCH) are taken from ALFRED (2023). Lower predictive accuracy is given by a higher RMSE; $h = 0$ ($h = 1$) represents the forecast horizon, thus $h = 0$ stands for the current quarter and $h = 1$ for the next quarter. The following benchmarks are used: The first benchmark is the first available quarterly release of GDP growth (Panel a). The second benchmark is an AR(1) model (Panel b). The third benchmark is the KOF Economic Sentiment Indicator as well as the regional subindices of the KOF Business Situation Indicator [cf. Figure 10] (Panel c). The SNB Business Cycle Index (Galli, 2018) is used as a fourth benchmark (Panel d). For the Diebold-Mariano-West (DMW) test, a quadratic loss function is taken. The null hypothesis for the DMW test is that the two forecasts are equally accurate in prediction, whereas the alternative hypothesis is that one indicator (as given in the column header) is more accurate than the other (Diebold and Mariano, 2002 and West, 1996).

5.3 Granger Causality

Tables 6 and A5 in the Appendix show the Granger causality tests for the aggregated indices for the German-speaking and French-speaking parts of Switzerland. Table A6 in the Appendix illustrates the Granger causality tests on an individual newspaper level. For the most significant results, a breakdown of the newspapers into the different subcategories is performed in Table A7 in the Appendix. Newspaper articles should Granger-cause economic sentiment, as measured by the KOF Economic Sentiment Indicator. However, reverse causality cannot be excluded in all cases.

Table 6: Granger Causality Tests for the Aggregated Indices for German- and French-Speaking Newspapers Using the Combined Lexicon.

| | | Newspaper Granger-causes KOF sentiment | | | | KOF sentiment Granger-causes Newspaper | | | |
| | | 2016–2022 | | 15.3.20–1.4.22 | | 2016–2022 | | 15.3.20–1.4.22 | |
Index	lags	Wald test	p value	Wald test	p value	Wald test	p value	Wald test	p value
de_mix	1	0.0054	0.9416	1.5510	0.2267	**16.5540**	**0.0001*****	**23.1550**	**0.0000*****
	2	0.2075	0.8131	2.0578	0.1567	**15.7040**	**0.0000*****	2.0755	0.1545
	3	0.0714	0.9751	1.8718	0.1777	**10.8310**	**0.0000*****	1.0562	0.3968
	4	0.1375	0.9678	**4.2654**	**0.0224***	**8.5415**	**0.0000*****	2.2587	0.1233
fr_mix	1	0.6447	0.4245	0.0003	0.9871	**7.2970**	**0.0085****	**17.6100**	**0.0004*****
	2	0.2986	0.7427	0.1793	0.8374	**5.9806**	**0.0039****	0.8081	0.4612
	3	0.3249	0.8073	0.3377	0.7983	**3.8497**	**0.0131***	0.7512	0.5385
	4	0.8394	0.5050	0.3139	0.8632	**4.1848**	**0.0044****	1.1015	0.3999

Notes: The stemmed version using the domain-specific lexicon and the Kalman filter is applied. Significance codes: 0 '***' 0.001 '**' 0.01, '*' 0.05 '.' 0.1. Tests with a significant result on at least a 10% significance level are displayed in bold. The KOF Economic Sentiment Indicator is available from KOF (KOF Swiss Economic Institute, 2023b).

5.4 Robustness Checks

Figure 11 shows the sentiment in the language region using different lexica. The dip in the text-based indices caused by the COVID-19 pandemic occurs earlier than in the survey-based index and is comparable across lexica. The German text-based indices are slightly less volatile than the French versions.
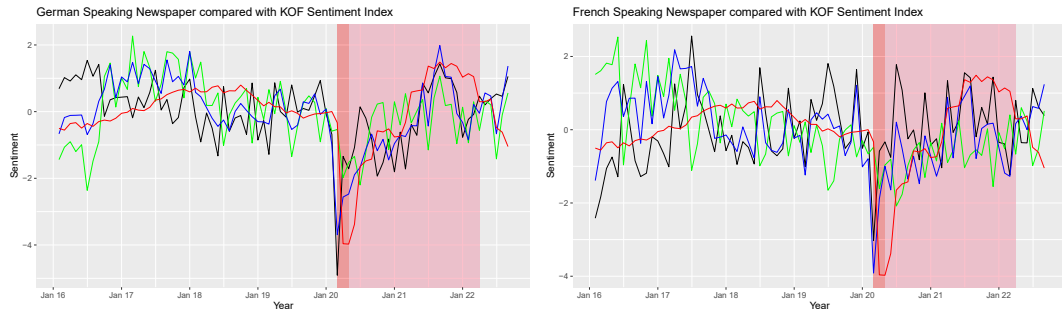
(a) German Text-Based Index.

(b) French Text-Based Index.

Figure 11: Comparison Lexica: Henry (2008) (green) compared with Loughran and McDonald (2016) (black) and the combined version (blue) with the KOF Economic Sentiment Indicator (red) (KOF Swiss Economic Institute, 2023b) for German- and French-Speaking News-Based Sentiment Indices.

Notes: The stemmed version is used. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020a and 2020b). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which ended on April 1, 2022 (Federal Council, 2022). Articles for the news-based sentiment indices are retrieved from Swissdox@LiRI (2023).

Table 7 shows the sentiment results of the same news-based text in the English, German and French versions taken from swissinfo.ch (2023). For robustness checks, the Henry (2008) dictionary is applied to the different language versions. The results show that the sentiments are comparable across language versions. A second article analysis with similar results is shown in the Appendix in Table A8.

Table 7: Comparison of Similar Articles in Different Languages from swissinfo.ch (2023).

Language	Publication Date	Rubric	Character Counts	Types	Tokens
Article: Where is Swiss chocolate most popular? (https://www.swissinfo.ch/eng/business/chocolate-money_where-is-swiss-chocolate-most-popular/42045736)					
English	28.03.2016	Business	3,232	163	259
Henry (2008)	Positive	Negative			
Percentage/Count	**71.43%**/5	**28.57%**/2			
Positive	**best, good, growth 2x,** strong				
Negative	drop, fall				
Article: Das sind die grössten Fans von Schweizer Schokolade! (https://www.swissinfo.ch/ger/wirtschaft/exportschlager_das-sind-die-groessten-fans-von-schweizer-schokolade/42046142)					
German	29.03.2016	Wirtschaft	3,019	152	198
Henry (2008)	Positive	Negative			
Percentage/Count	100.00%/9	0.00%/0			
Positive	**(best)** best, **(good)** gut, (greater) gross, **(growth)** wachstum, (most) meist 3x, (strength) gewicht, (strength) stark				
Article: Dans quels pays le chocolat suisse est-il le plus populaire? (https://www.swissinfo.ch/fre/economie/exportations-_dans-quels-pays-le-chocolat-suisse-est-il-le-plus-populaire/42054926)					
French	29.03.2016	Economie	2,621	137	198
Henry (2008)	Positive	Negative			
Percentage/Count	**75.00%**/12	**25.00%**/4			
Positive	**(best)** meilleur, (excel) extraordinair, (expans) hauss, (grow) développ **(growth)** croissanc, (increase) augment, (more) plus 5x, (solid) solid				
Negative	(decrease) baisse, (decrease) diminu, (down) bas, (under) dessous				

Notes: Although the content of the articles in each of the three different languages is the same, the content id, the id, and the publication times are not identical. Relative positivity and negativity are given as a percentage value. The respective words are given in the alphabetic order of the English words (not necessarily in the chronological order on which they appear in the text). The translation to the English dictionary is given in parentheses. Identical words across languages are written in bold. In the German version, there is a 100% positivity rate since the two negatively associated words "Umsatzrückgang" (decline in turnover) and "gingen zurück" (declining) are not part of the lexicon in the German version. Types are unique tokens. Tokens refers to word stems in this case. The articles can be accessed online at the URL given in parentheses.

6   Conclusion

Evidence on how the signals extracted from newspaper texts can add valuable information to business cycle forecasts is presented in this paper.

I evaluated ten German-speaking newspapers and five French-speaking newspapers in Switzerland during the time period of 2016-2022 by analyzing more than 900,000 articles. The sentiments were extracted using three domain-specific lexica. I show that the high number of news texts analyzed results in accurate indices on the aggregate level during times of stress. There are two possible explanations for why this works so well in times of economic turmoil. The first is that signals from newspaper texts can be extracted in a timely manner, and the next is the tendency of households to pay closer attention to news reports in times of crisis than in normal times.

I first find that the aggregated sentiments in the two language regions are different. I then show that the drop in text-based sentiment in the COVID-19 lockdown period is almost the same as that in the KOF Economic Sentiment Indicator, but it occurs earlier than that in the survey-based index. My findings therefore imply that text-based sentiment indices can be used as leading indicators to improve forecasts in times of great economic instability.

References

ALFRED (2023), *Gross domestic product for Switzerland (CPMNAC-SAB1GQCH)*, Archival Federal Reserve Economic Data, St. Louis, USA. Retrieved June 12, 2023, from `https://alfred.stlouisfed.org/series/downloaddata?seid=CPMNACSAB1GQCH`.

Benoit, K., Watanabe, K., Wang, H., Nulty, P., Obeng, A., Müller, S. and Matsuo, A. (2018), 'Quanteda: An R package for the quantitative analysis of textual data', *Journal of Open Source Software* **3**(30), 774. `https://doi.org/10.21105/joss.00774`.

Bouchet-Valat, M. (2020), *SnowballC: Snowball stemmers based on the C 'libstemmer' UTF-8 Library.* R package version 0.7.0. `https://CRAN.R-project.org/package=SnowballC`.

Buckman, S. R., Shapiro, A. H., Sudhof, M., Wilson, D. J. et al. (2020), 'News sentiment in the time of COVID-19', *FRBSF Economic Letter* **8**, 1–05.

Burri, M. and Kaufmann, D. (2020), 'A daily fever curve for the Swiss economy', *Swiss Journal of Economics and Statistics* **156**, 1–11. `https://doi.org/10.1186/s41937-020-00051-z`.

Carroll, C. D. (2003), 'Macroeconomic expectations of households and professional forecasters', *The Quarterly Journal of Economics* **118**(1), 269–298. `https://doi.org/10.1162/00335530360535207`.

Devlin, J., Chang, M.-W., Lee, K. and Toutanova, K. (2018), 'Bert: Pre-training of deep bidirectional transformers for language understanding', *arXiv preprint arXiv:1810.04805* .

Diebold, F. X. and Mariano, R. S. (2002), 'Comparing predictive accuracy', *Journal of Business & Economic Statistics* **20**(1), 134–144. `https://doi.org/10.1198/073500102753410444`.

Dow Jones Factiva (2023), *Dow Jones Factiva*, Dow Jones & Company, New York, USA. Retrieved April 14, 2023, from `https://global.factiva.com/`.

Dowle, M. and Srinivasan, A. (2021), *data.table: Extension of 'data.frame'*. R package version 1.14.2. `https://CRAN.R-project.org/package=data.table`.

Eisenegger, M. et al. (2013), 'Main findings. The quality of the media–Switzerland. Yearbook 2013', *Qualität der Medien. Schweiz-Suisse-Svizzera* . Retrieved September 24, 2023, from `https://www.foeg.uzh.ch/dam/jcr:a8cae318-1ea9-4b71-9f07-33f17ae21322/2013_main_findingsJQM.pdf`.

Federal Council (2020*a*), *Coronavirus: Federal Council declares 'extraordinary situation' and introduces more stringent measures*, Swiss Government, Bern, Switzerland. Retrieved April 2, 2023, from `https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-78454.html`.

Federal Council (2020*b*), *Coronavirus: Federal Council extends measures by a week and decides on gradual easing*, Swiss Government, Bern, Switzerland. Retrieved April 16, 2023, from `https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-78744.html`.

Federal Council (2022), *Coronavirus: Rückkehr in die normale Lage und Planung der Übergangsphase bis Frühling 2023*, Swiss Government, Bern, Switzerland. Retrieved April 16, 2023, from `https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-87801.html`.

Feinerer, I., Hornik, K. and Meyer, D. (2008), 'tm: Text mining infrastructure in R', *Journal of Statistical Software* **25**(5), 1–54. R package version 0.7-8. `https://doi.org/10.18637/jss.v025.i05`.

FOPH (2020), *COVID-19: Switzerland can start vaccinating vulnerable groups already in December*, Federal Office of Public Health, Bern, Switzerland. Retrieved April 2, 2023, from `https://www.bag.admin.ch/bag/en/home/das-bag/aktuell/medienmitteilungen.msg-id-81762.html`.

FOPH (2023), *COVID-19 Switzerland: Geographic distribution over time: Laboratory-confirmed cases, 14-day normalised incidence*, Federal Office of Public Health, Bern, Switzerland. Retrieved April 2,

2023, from `https://www.covid19.admin.ch/en/epidemiologic/case/d/geo-regions;geoLevel=districts?geoDate=2020-03-09`.

FRED (2023), *Federal Reserve Economic Data*, Federal Reserve Bank of St. Louis, St. Louis, USA. Retrieved April 15, 2023, from `https://fred.stlouisfed.org`.

FSO (2023), *Gross domestic product per canton and region*, Federal Statistical Office, Neuchâtel, Switzerland. Retrieved April 3, 2023, from `https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/national-accounts/gross-domestic-product-canton.html`.

Galli, A. (2018), 'Which indicators matter? Analyzing the Swiss business cycle using a large-scale mixed-frequency dynamic factor model', *Journal of Business Cycle Research* **14**, 179–218. `https://doi.org/10.1007/s41549-018-0030-4`.

Gopinath, G. (2020), 'The Great Lockdown: Worst economic downturn since the Great Depression', *IMF Blog* **14**, 2020.

Henry, E. (2008), 'Are investors influenced by how earnings press releases are written?', *The Journal of Business Communication (1973)* **45**(4), 363–407. `https://doi.org/10.1177/0021943608319388`.

Kalamara, E., Turrell, A., Redl, C., Kapetanios, G. and Kapadia, S. (2022), 'Making text count: Economic forecasting using newspaper text', *Journal of Applied Econometrics* **37**(5), 896–919. `https://doi.org/10.1002/jae.2907`.

KOF Swiss Economic Institute (2023*a*), *KOF Business Situation Indicator*, ETH Zürich - KOF, Zurich, Switzerland. Retrieved June 13, 2023, from `https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-business-situation-indicator.html`.

KOF Swiss Economic Institute (2023*b*), *KOF Economic Sentiment Indicator*, ETH Zürich - KOF, Zurich, Switzerland. Retrieved February 6, 2023, from `https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-economic-sentiment-indicator.html`.

Lamla, M. J. and Lein, S. M. (2014), 'The role of media for consumers' inflation expectation formation', *Journal of Economic Behavior & Organization* **106**, 62–77. `https://doi.org/10.1016/j.jebo.2014.05.004`.

Loughran, T. and McDonald, B. (2011), 'When is a liability not a liability? Textual analysis, dictionaries, and 10-ks', *The Journal of Finance* **66**(1), 35–65. `https://doi.org/10.1111/j.1540-6261.2010.01625.x`.

Luethi, D., Erb, P., Otziger, S., McDonald, D. and Smith, P. (2022), *FKF: Fast Kalman Filter*. R package version 0.2.4. `https://CRAN.R-project.org/package=FKF`.

Maćkowiak, B., Matějka, F. and Wiederholt, M. (2023), 'Rational inattention: A review', *Journal of Economic Literature* **61**(1), 226–273. `https://doi.org/10.1257/jel.20211524`.

NBER (2023), *US Business Cycle Expansions and Contractions*, National Bureau of Economic Research, Cambridge, USA. Retrieved April 15, 2023, from `https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions`.

Neusser, K. (2016), *Time series econometrics*, (pp. 207–214). Cham: Springer. `https://doi.org/10.1007/978-3-319-32862-1`.

OECD (2023), *National accounts - gross domestic product*, Organisation for Economic Co-operation and Development, Paris, France. Retrieved April 3, 2023, from `https://stats.oecd.org/index.aspx`.

Pennington, J., Socher, R. and Manning, C. D. (2014), Glove: Global vectors for word representation, *in* 'Proceedings of the 2014 conference on empirical methods in natural language processing (EMNLP)', pp. 1532–1543. `https://doi.org/10.3115/v1/d14-1162`.

Pesaran, M. H. and Weale, M. (2006), Chapter 14 survey expectations, *in* 'Handbook of Economic Forecasting', Elsevier, pp. 715–776. `https://doi.org/10.1016/s1574-0706(05)01014-1`.

Praet, P. and Vuchelen, J. (1984), 'The contribution of EC consumer surveys in forecasting consumer expenditures: An econometric analysis for four major

countries.', *Journal of Economic Psychology* (5), 101–124. `https://doi.org/10.1016/0167-4870(84)90001-1`.

Proellochs, N. and Feuerriegel, S. (2021), *SentimentAnalysis: Dictionary-based sentiment analysis*. R package version 1.3-4. `https://CRAN.R-project.org/package=SentimentAnalysis`.

Puschmann, C. and Haim, M. (2023), *Automated content analysis with R: Working with different languages*. Retrieved April 1, 2023, from `https://content-analysis-with-r.com/7-multiple_languages.html`.

R Core Team (2022), *R: A language and environment for statistical computing*, R Foundation for Statistical Computing, Vienna, Austria. `https://www.R-project.org/`.

Rinker, T. W. (2018), *textclean: text cleaning tools*, Buffalo, New York. R package version 0.9.3. `https://github.com/trinker/textclean`.

SECO (2023), *Consumer sentiment*, State Secretariat for Economic Affairs, Bern, Switzerland. Retrieved February 6, 2023, from `https://www.seco.admin.ch/seco/en/home/wirtschaftslage---wirtschaftspolitik/Wirtschaftslage/Konsumentenstimmung.html`.

Shapiro, A. H., Sudhof, M. and Wilson, D. J. (2022), 'Measuring news sentiment', *Journal of Econometrics* **228**(2), 221–243. `https://doi.org/10.1016/j.jeconom.2020.07.053`.

Signorell, A. (2022), *bfsMaps: Plot maps from Switzerland by Swiss Federal Statistical Office*. R package version 0.9.8. `https://CRAN.R-project.org/package=bfsMaps`.

SRF (2020), *Corona-Massnahmen: Diese Kantone gehen weiter als der Bund*, Swiss Radio and Television (SRF), Zurich, Switzerland. Retrieved April 2, 2023, from `https://www.srf.ch/news/schweiz/corona-massnahmen-diese-kantone-gehen-weiter-als-der-bund`.

Stadler, T. (2020), *Policy Brief: On regional differences in the second wave*, Swiss National COVID-19 Science Task Force, Zurich, Switzerland.

Retrieved April 2, 2023, from `https://sciencetaskforce.ch/wp-content/uploads/2020/12/On_regional_differences_in_the_second_wave08Dez20-EN-3.pdf`.

Swissdox (2023), *Swissdox: Medienbeobachtung*, Swissdox AG, Zurich, Switzerland. Retrieved April 14, 2023, from `https://essentials.swissdox.ch/View/log/index.jsp`.

Swissdox@LiRI (2023), *LiRI - Linguistic Research Infrastructure – Swissdox@LiRI*, University of Zurich, Zurich, Switzerland. Retrieved October 2, 2022, from `https://www.liri.uzh.ch/en/services/swissdox.html`.

swissinfo.ch (2023), *About SWI*, SWI swissinfo.ch - a branch of Swiss broadcasting corporation SRG SSR, Bern, Switzerland. Retrieved April 16, 2023, from `https://www.swissinfo.ch/eng/about-swi`.

University of Michigan (2023), *The Index of Consumer Sentiment*, Surveys of consumers - University of Michigan, Ann Arbor, Michigan, USA. Retrieved February 6, 2023, from `https://data.sca.isr.umich.edu/`.

WEMF (2023*a*), *Auflagen / Tirages 2022*, Werbemedienforschung, WEMF AG, Zurich, Switzerland. Retrieved April 14, 2023, from `https://www.nextlevel1.ch/m-cloud/index.html`.

WEMF (2023*b*), *WEMF Fact & Figures*, Werbemedienforschung, WEMF AG, Zurich, Switzerland. Retrieved September 18, 2023, from `https://wemf.ch/de/tools/wemf-facts-figures/`.

West, K. D. (1996), 'Asymptotic inference about predictive ability', *Econometrica* pp. 1067–1084. `https://doi.org/10.2307/2171956`.

Wickham, H. (2016), *ggplot2: Elegant graphics for data analysis*, Springer-Verlag New York. `https://doi.org/10.1007/978-3-319-24277-4`.

Wickham, H. (2022), *stringr: Simple, consistent wrappers for common string operations*. R package version 1.5.0. `https://CRAN.R-project.org/package=stringr`.

Wickham, H., Averick, M., Bryan, J., an Lucy D'Agostino McGowan an Romain François, W. C., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Bache, S. M., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., Takahashi, K., Vaughan, D., Wilke, C., Woo, K. and Yutani, H. (2019), 'Welcome to the tidyverse', *Journal of Open Source Software* **4**(43), 1686. `https://doi.org/10.21105/joss.01686`.

Wickham, H., François, R., Henry, L., Müller, K. and Vaughan, D. (2023), *dplyr: A grammar of data manipulation*. R package version 1.1.0. `https://CRAN.R-project.org/package=dplyr`.

Wickham, H., Vaughan, D. and Girlich, M. (2023), *tidyr: Tidy messy data*. R package version 1.3.0. `https://CRAN.R-project.org/package=tidyr`.

Zeileis, A. and Hothorn, T. (2002), 'Diagnostic checking in regression relationships', *R News* **2**(3), 7–10. `https://CRAN.R-project.org/doc/Rnews/`.

Zhang, W., Deng, Y., Liu, B., Pan, S. J. and Bing, L. (2023), 'Sentiment analysis in the era of large language models: A reality check', *arXiv preprint arXiv:2305.15005* .

A   Appendix

A.1   Shares of GDP Components

Table A1: Shares of GDP Components for 2019 and 2020: The Expenditure Approach (OECD, 2023).

	Switzerland		USA	
	2019	2020	2019	2020
Consumption C	52.40%	51.60%	67.32%	67.03%
Investment I	26.44%	29.80%	21.32%	21.05%
Government G	11.35%	12.14%	14.07%	14.90%
Exports X	66.97%	64.31%	11.87%	10.20%
Imports M	57.16%	57.86%	14.58%	13.18%
GDP Y (in bn LCU)	716.88	694.66	21,380.98	21,060.47

Notes: The expenditure approach is, apart from the output and income approach, one way to calculate GDP. GDP, denoted as Y, is calculated using the expenditure approach as follows: $Y = C + I + G + (X - M)$. The presented data are taken from the OECD database. Calculations for the respective shares are based on current prices and the local currency unit (LCU). The GDP in absolute terms is given as a reference for assessing the size of the two chosen economies. The share of imports and exports is large for Switzerland compared to those of the USA, which reveals one characteristic of a small open economy.

A.2 Reach of Newspapers

Table A2: Reach of the Newspapers in the Different Language Regions.

	Newspaper (Abbr.)	Language	French Speaking Part (SP)	German SP	Italian SP
1	20 minutes (ZWAS)	French	98%	2%	0%
2	24 heures (HEU)	French	100%	0%	0%
3	Le Matin Dimanche (TLMD)	French	99%	1%	0%
4	Le Temps (TPS)	French	97%	3%	0%
5	Tribune de Genève (TDG)	French	100%	0%	0%
1	20 Minuten (ZWA)	German	27%	68%	5%
2	Aargauer Zeitung (AZM)	German	0%	100%	0%
3	Blick (BLI)	German	2%	97%	1%
4	Luzerner Zeitung (LUZ)	German	0%	100%	0%
5	Neue Zürcher Zeitung (NZZ)	German	2%	98%	0%
6	NZZ am Sonntag (NZZS)	German	2%	98%	0%
7	Schweiz am Sonntag (SAS)/ Schweiz am Wochenende (SAW)	German	0%	100%	0%
8	Sonntagsblick (SBLI)	German	1%	98%	1%
9	SonntagsZeitung (TAS)	German	0%	100%	0%
10	Tages-Anzeiger (TA)	German	0%	100%	0%

Notes: Reach is retrieved from WEMF (2023*b*). The regions Berner Seeland, Bündner Oberland and Bündner Unterland are included in the German-speaking region of Switzerland.

A.3   Ratio of Positive to Negative Articles
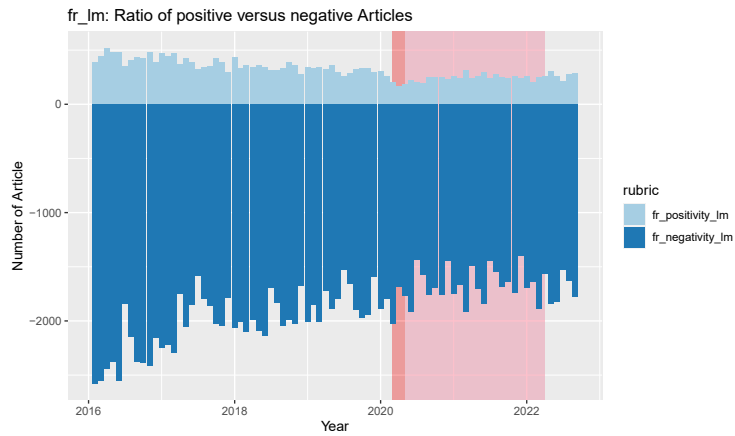
(a) Ratio for French-Speaking Newspapers.
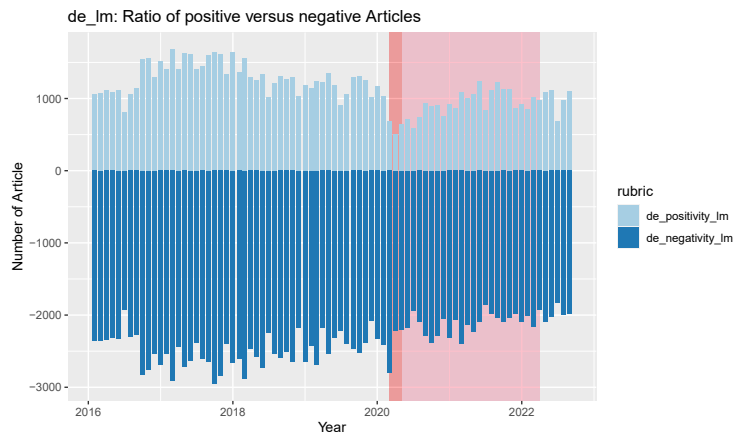
(b) Ratio for German-Speaking Newspapers.

Figure A1: Ratio of the Number of Positive to Negative Articles.

Notes: Articles that contain more positive than negative terms are counted as positive articles and vice versa. Sentiment is determined using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

A.4 Descriptive Statistics

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
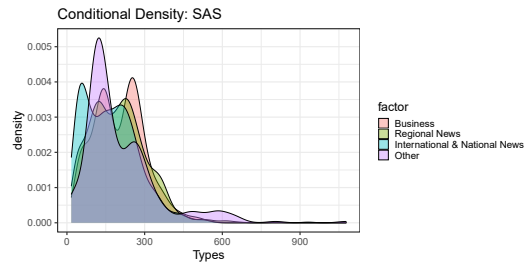
(e) Tages-Anzeiger

(f) 20 Minuten
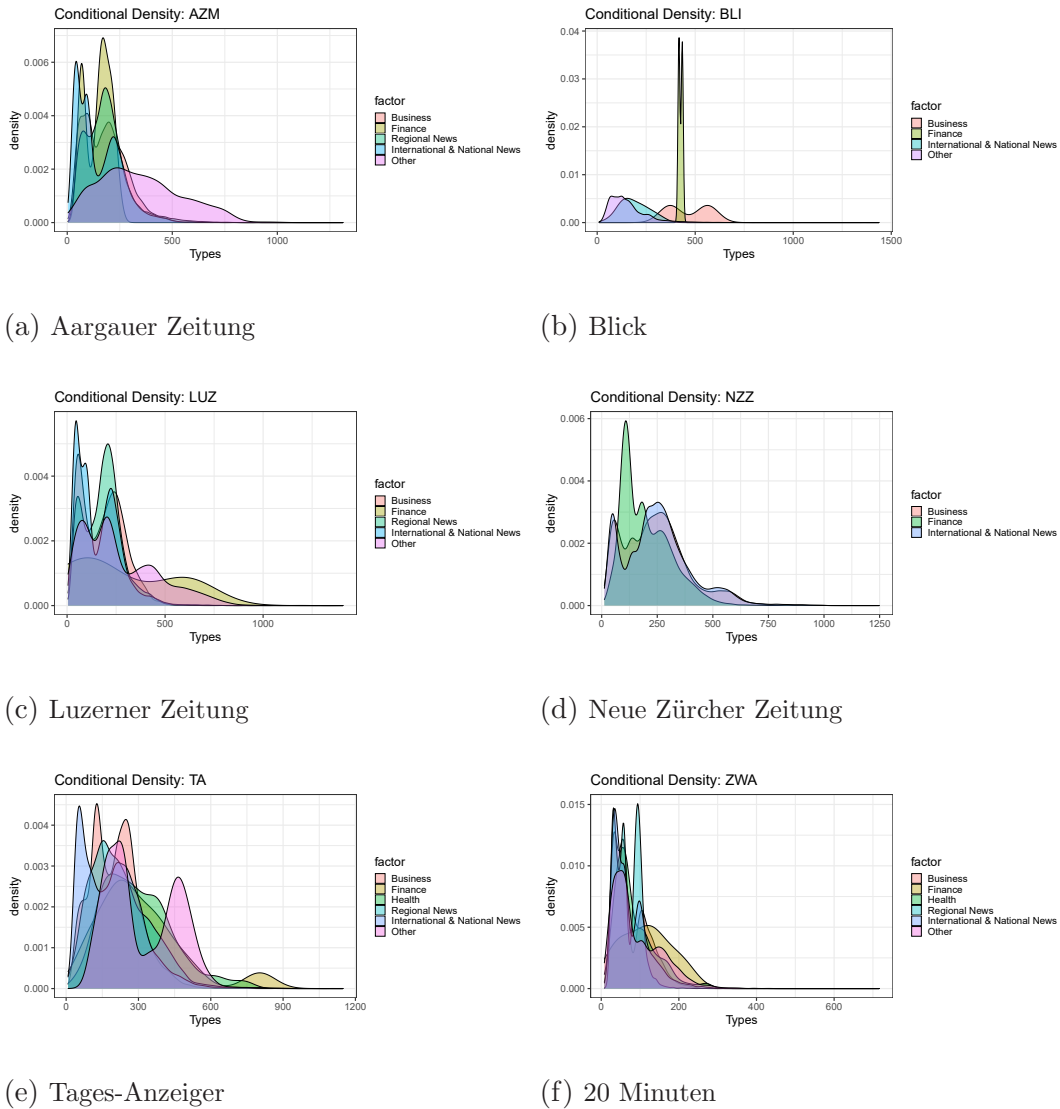
Figure A2: Conditional Density of the Number of Unique Words (Types) per Article per News Categories for German-Speaking Daily Newspapers.

Notes: Types refer to the unique number of words per article after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).
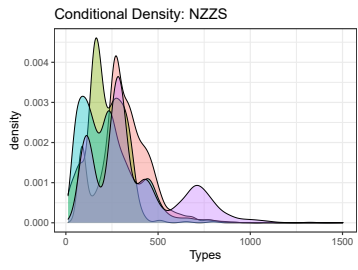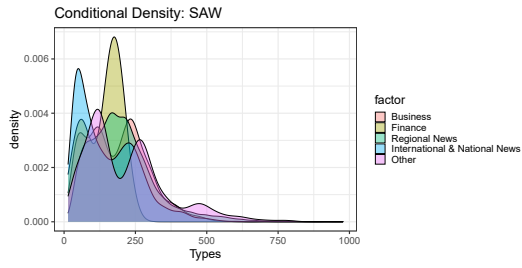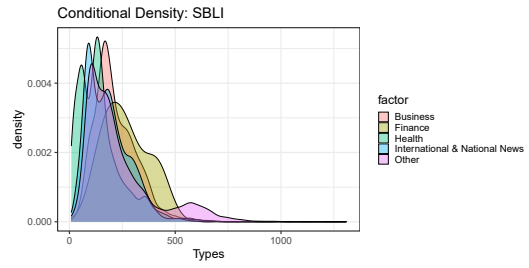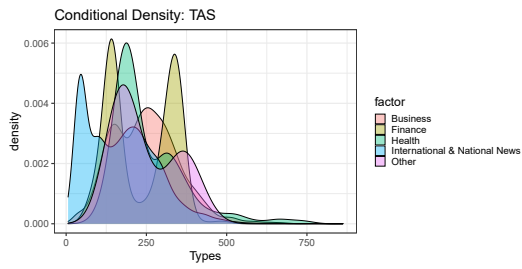
(a) NZZ am Sonntag

(b) Schweiz am Sonntag
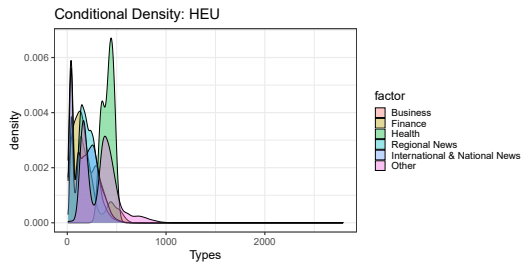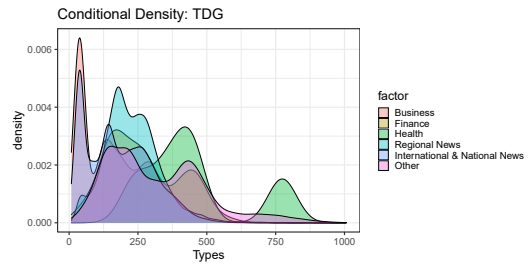
(c) Schweiz am Wochenende

(d) Sonntagsblick

(e) SonntagsZeitung

Figure A3: Conditional Density of the Number of Unique Words (Types) per Article per News Categories for German-Speaking Non-Daily Newspapers.
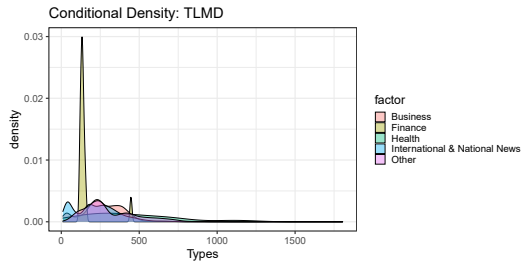
Notes: Types refer to the unique number of words per article after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).

Conditional Density: HEU

(a) 24 heures

Conditional Density: TDG

(b) Tribune de Genève

Conditional Density: TLMD

(c) Le Matin Dimanche

Conditional Density: TPS

(d) Le Temps

Conditional Density: ZWAS

(e) 20 minutes
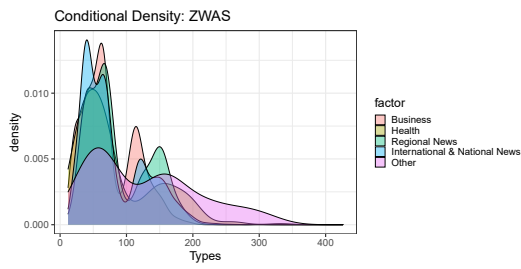
Conditional Density: SWII
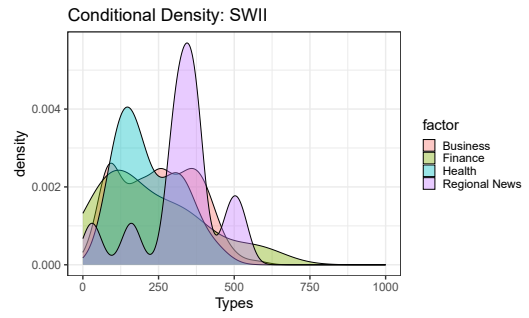
(f) Swissinfo

Figure A4: Conditional Density of the Number of Unique Words (Types) per Article per News Categories for French-Speaking Newspapers and Swissinfo.

Notes: Types refer to the unique number of words per article after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).
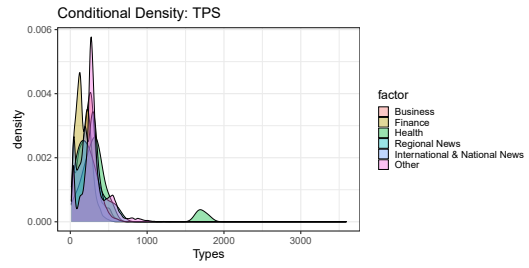
A.5 Conditional Word Clouds

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung

(e) Tages-Anzeiger

(f) 20 Minuten

Figure A5: Word Clouds Using the Most Frequent Word Stems per News Category for German-Speaking Daily Newspapers.

Notes: The conditional word clouds show the most frequent word stems after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick

(e) SonntagsZeitung

Figure A6: Word Clouds Using the Most Frequent Word Stems per News Category for German-Speaking Non-Daily Newspapers.

Notes: The conditional word clouds show the most frequent word stems after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).

Figure A7: Word Clouds Using the Most Frequent Word Stems per News Categories for French-Speaking Newspapers and Swissinfo.

Notes: The conditional word clouds show the most frequent word stems after the data cleaning process. Articles are retrieved from Swissdox@LiRI (2023).
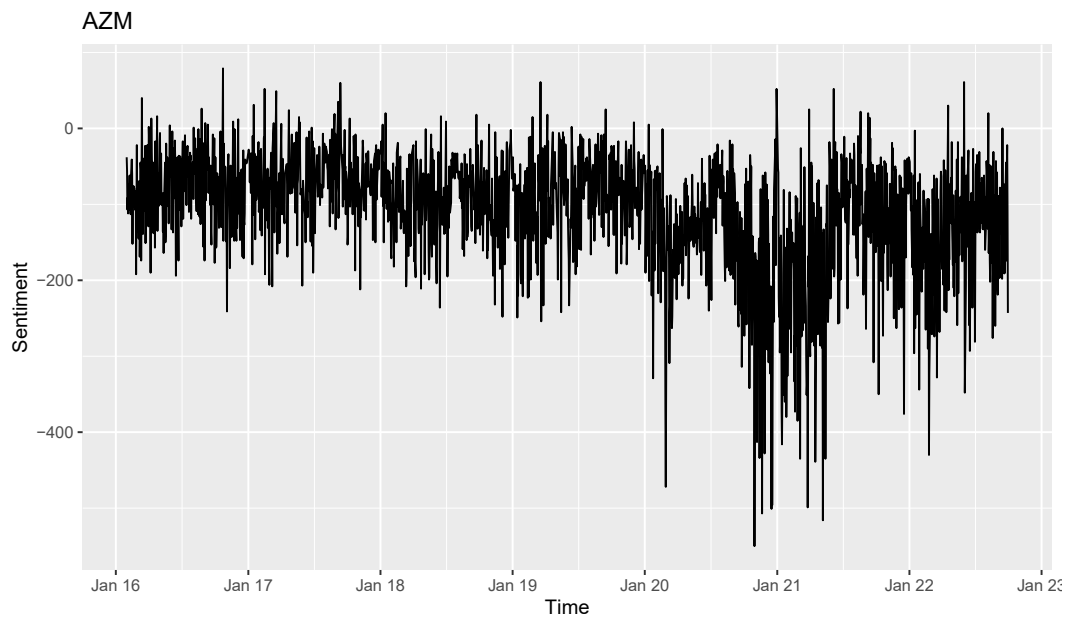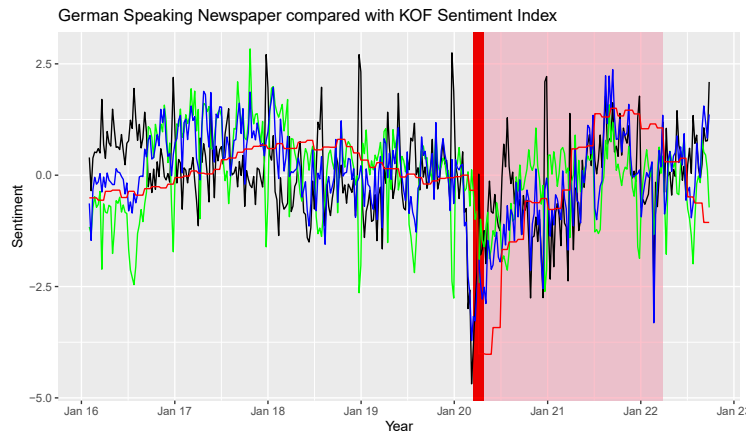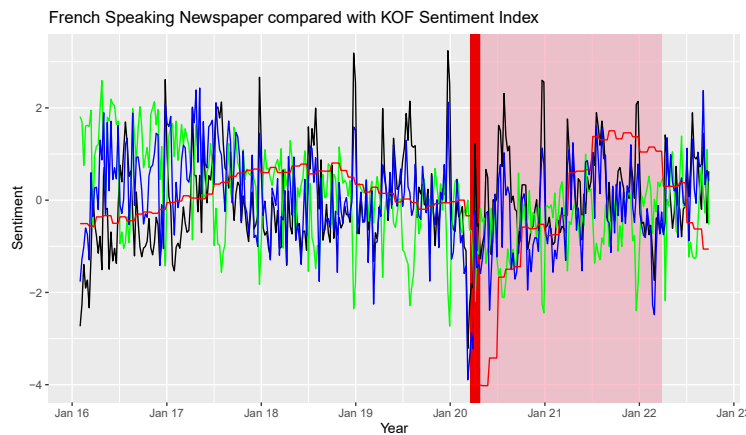
A.6 Daily Sentiment Index

AZM

Figure A8: Daily Text-Based Sentiment for the Aargauer Zeitung.

Notes: The sentiment is calculated by using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. Articles are retrieved from Swissdox@LiRI (2023).

A.7 Weekly Sentiment Index

(a) German Text-Based Index.

(b) French Text-Based Index.

Figure A9: Comparison Lexica: Henry (2008) (green) compared with Loughran and McDonald (2016) (black) and the combined version (blue) with the KOF Economic Sentiment Indicator (red) (KOF Swiss Economic Institute, 2023*b*) (KOF Swiss Economic Institute, 2023*b*) for German- and French-Speaking News-Based Sentiment Indices.

Notes: The stemmed version is used. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles for the news-based sentiment indices are retrieved from Swissdox@LiRI (2023).

A.8 Sentiment Indices per Newspaper

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
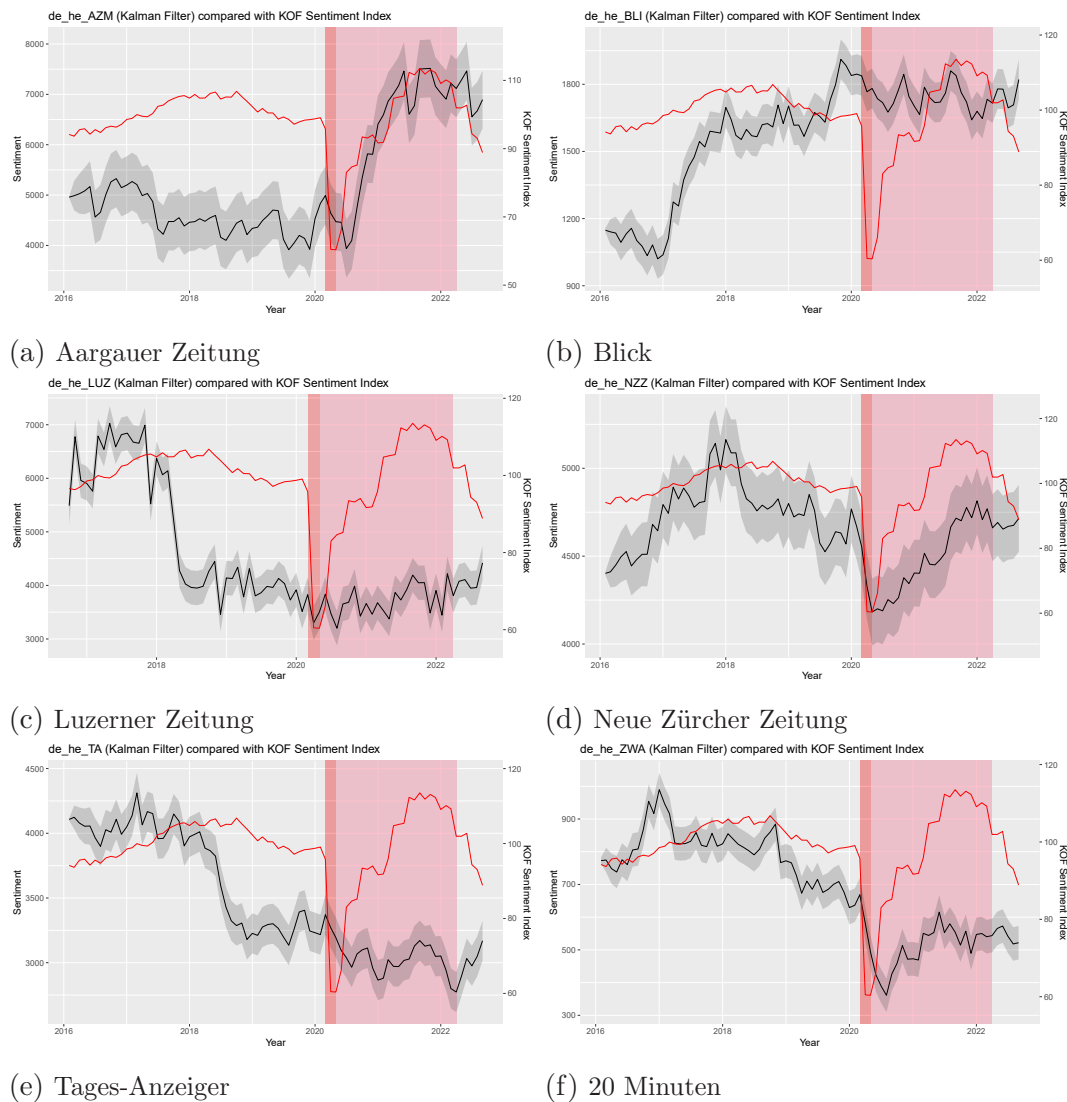
(e) Tages-Anzeiger

(f) 20 Minuten

Figure A10: News-Based Sentiment Index (Henry 2008 Dictionary) With a Confidence Band for German-Speaking Daily Newspapers Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
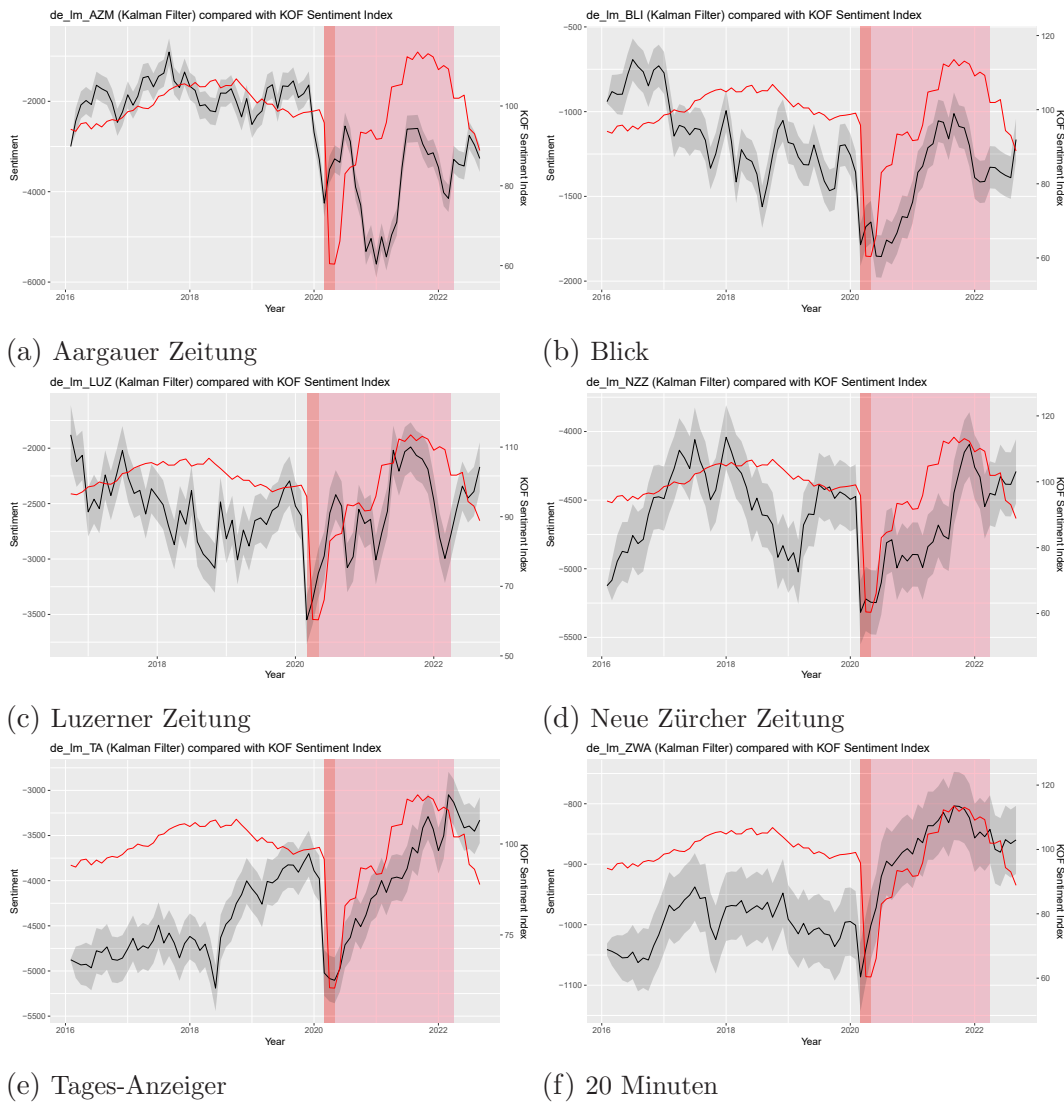
(e) Tages-Anzeiger

(f) 20 Minuten

Figure A11: News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) With a Confidence Band for German-Speaking Daily Newspapers Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
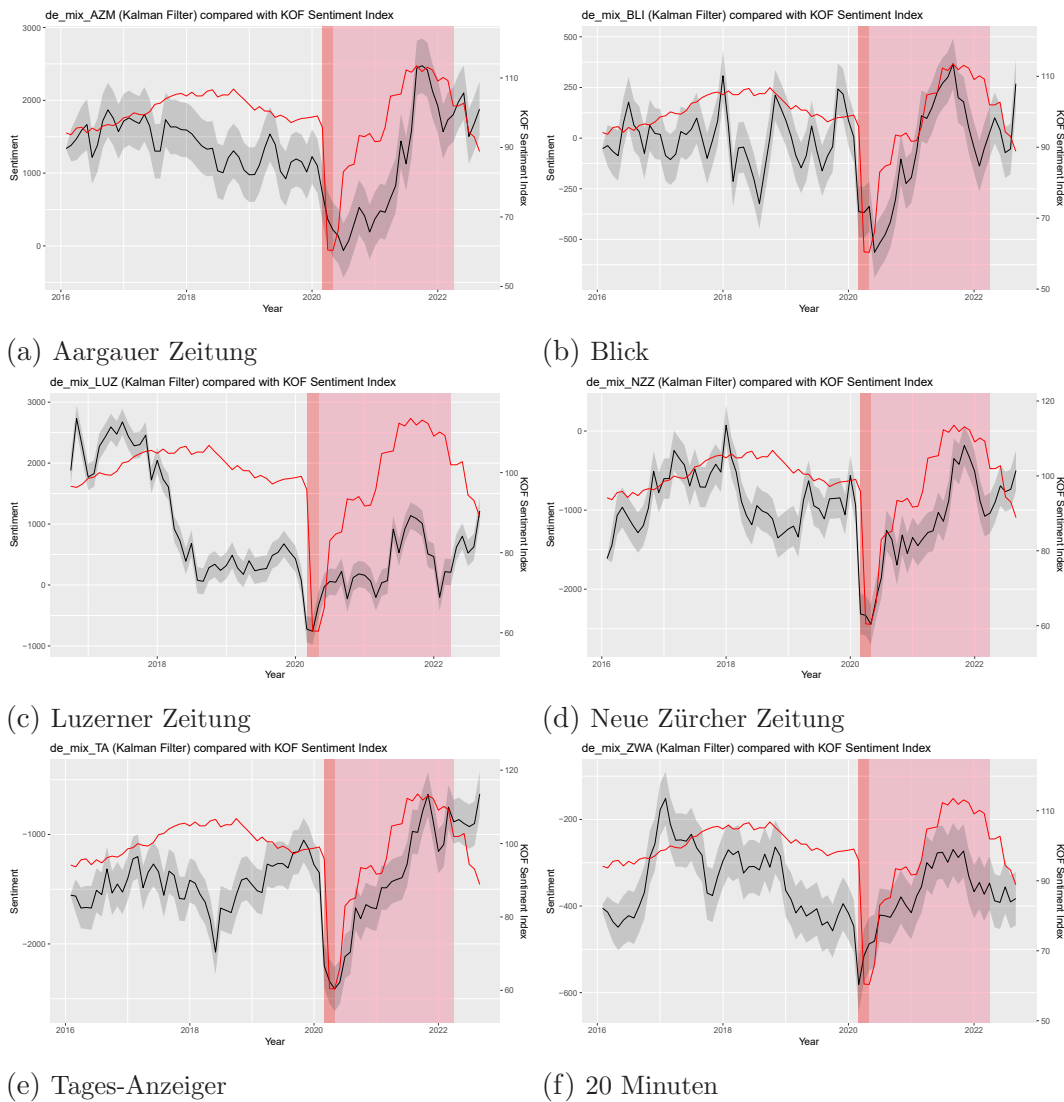
(e) Tages-Anzeiger

(f) 20 Minuten

Figure A12: News-Based Sentiment Index (Combined Version) With a Confidence Band for German-Speaking Daily Newspapers Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023b).

Notes: The sentiment index of the above newspapers is calculated using the combined lexicon with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020a and 2020b). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick

(e) SonntagsZeitung
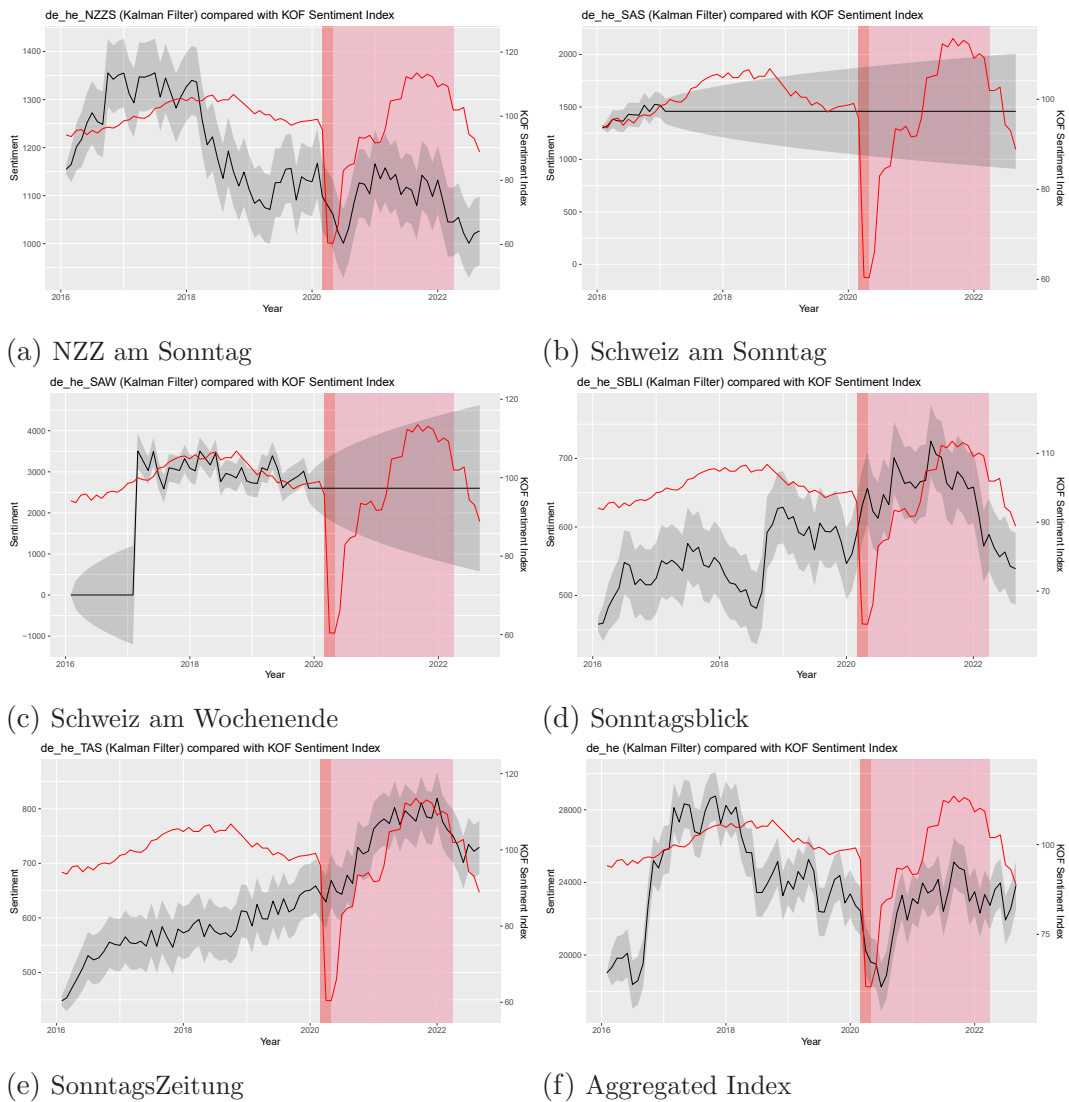
(f) Aggregated Index

Figure A13: News-Based Sentiment Index (Henry 2008 Dictionary) With a Confidence Band for German-Speaking Non-Daily Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

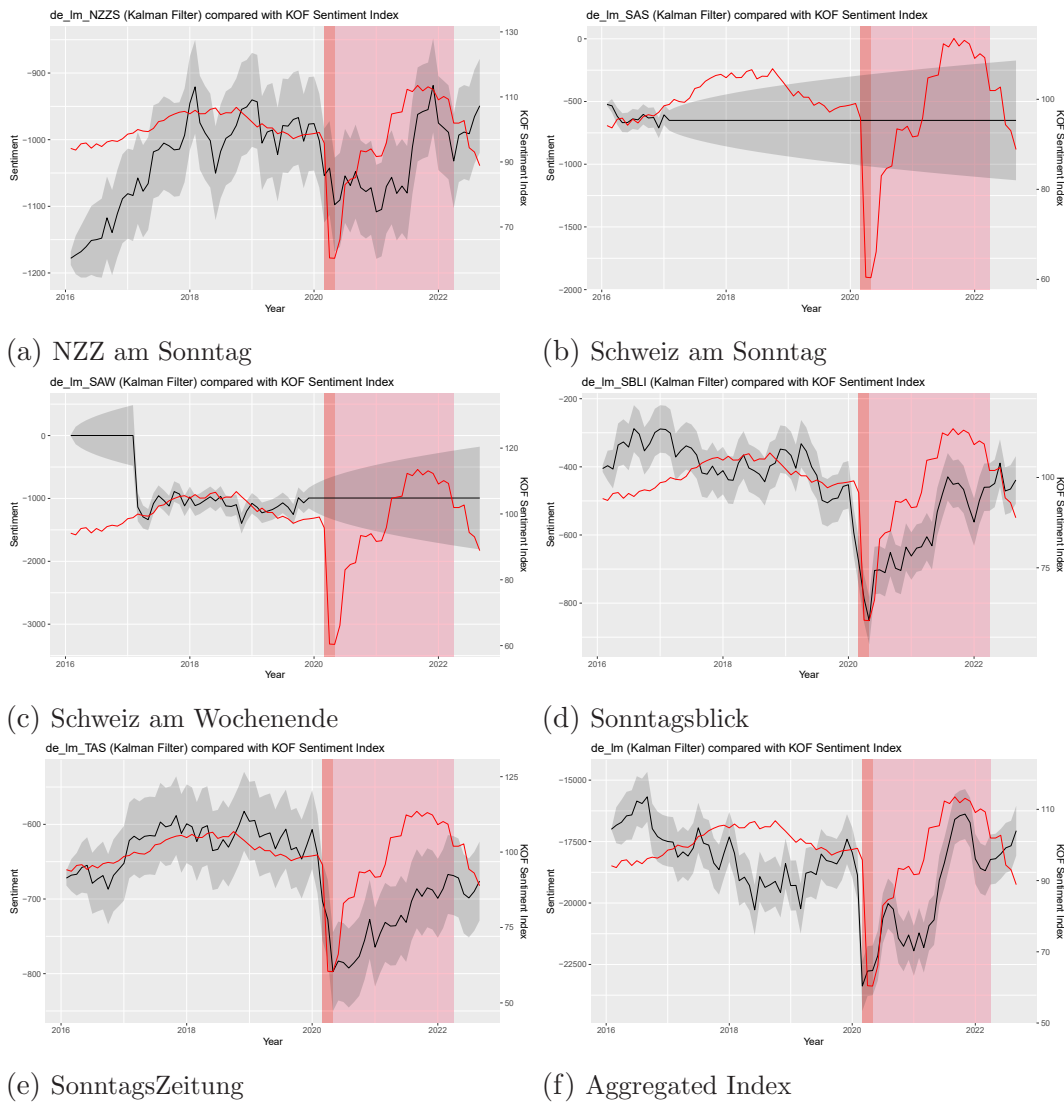(d) Sonntagsblick

(e) SonntagsZeitung

(f) Aggregated Index

Figure A14: News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) With a Confidence Band for German-Speaking Non-Daily Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick

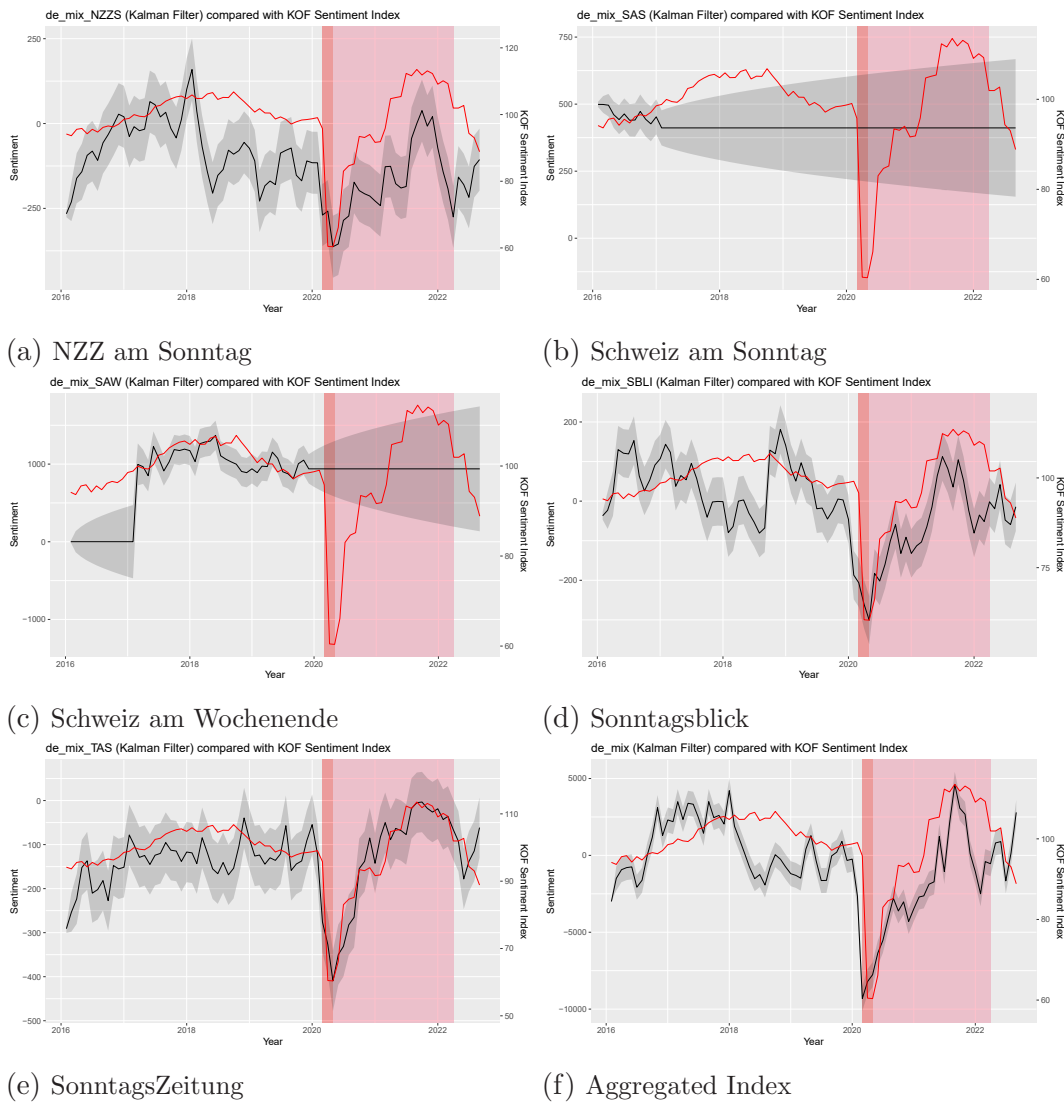(e) SonntagsZeitung

(f) Aggregated Index

Figure A15: News-Based Sentiment Index (Combined Version) With a Confidence Band for German-Speaking Non-Daily Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using the combined lexicon with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche

(d) Le Temps

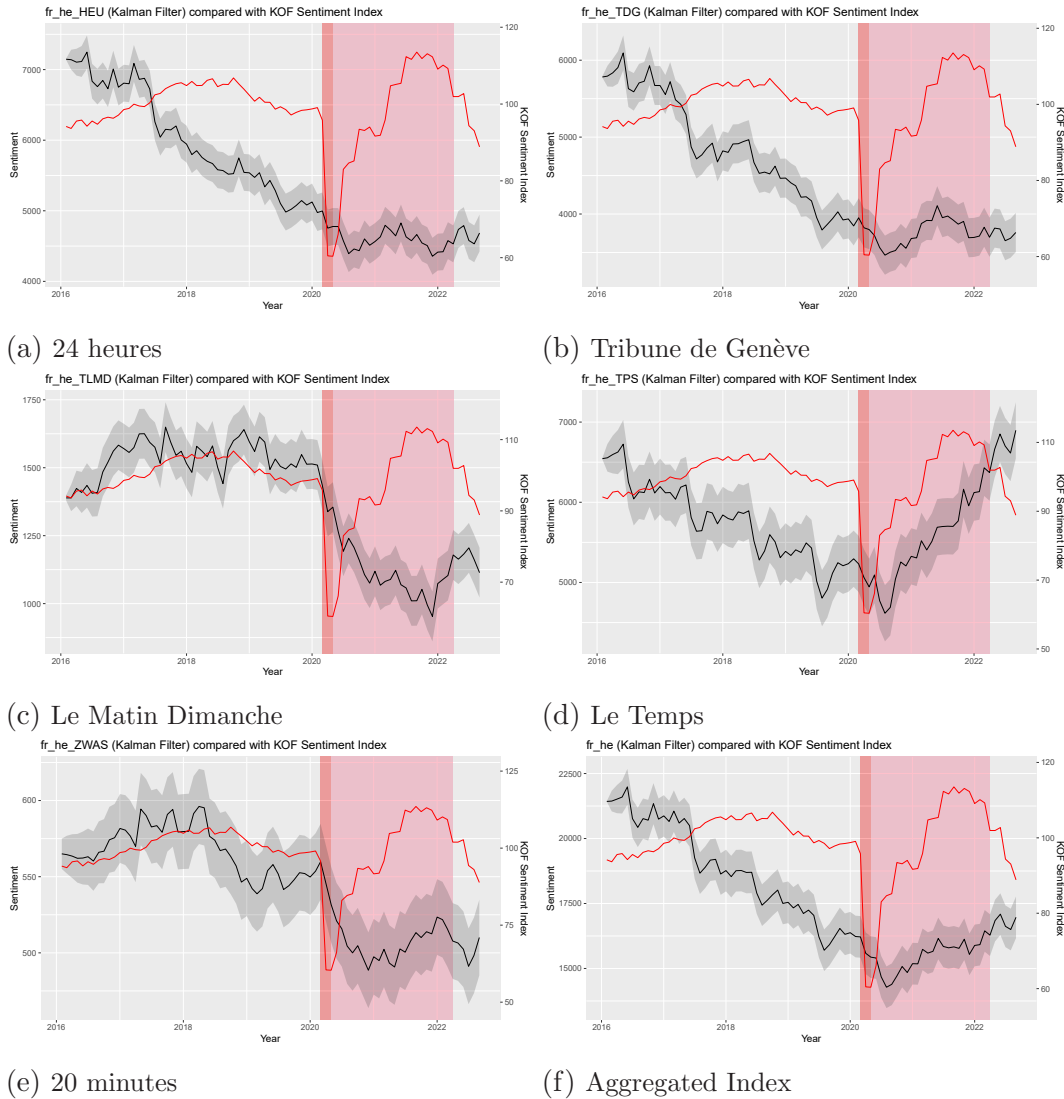(e) 20 minutes

(f) Aggregated Index

Figure A16: News-Based Sentiment Index (Henry 2008 Dictionary) With a Confidence Band for French-Speaking Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023b).

Notes: The sentiment index of the above newspapers is calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020a and 2020b). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche
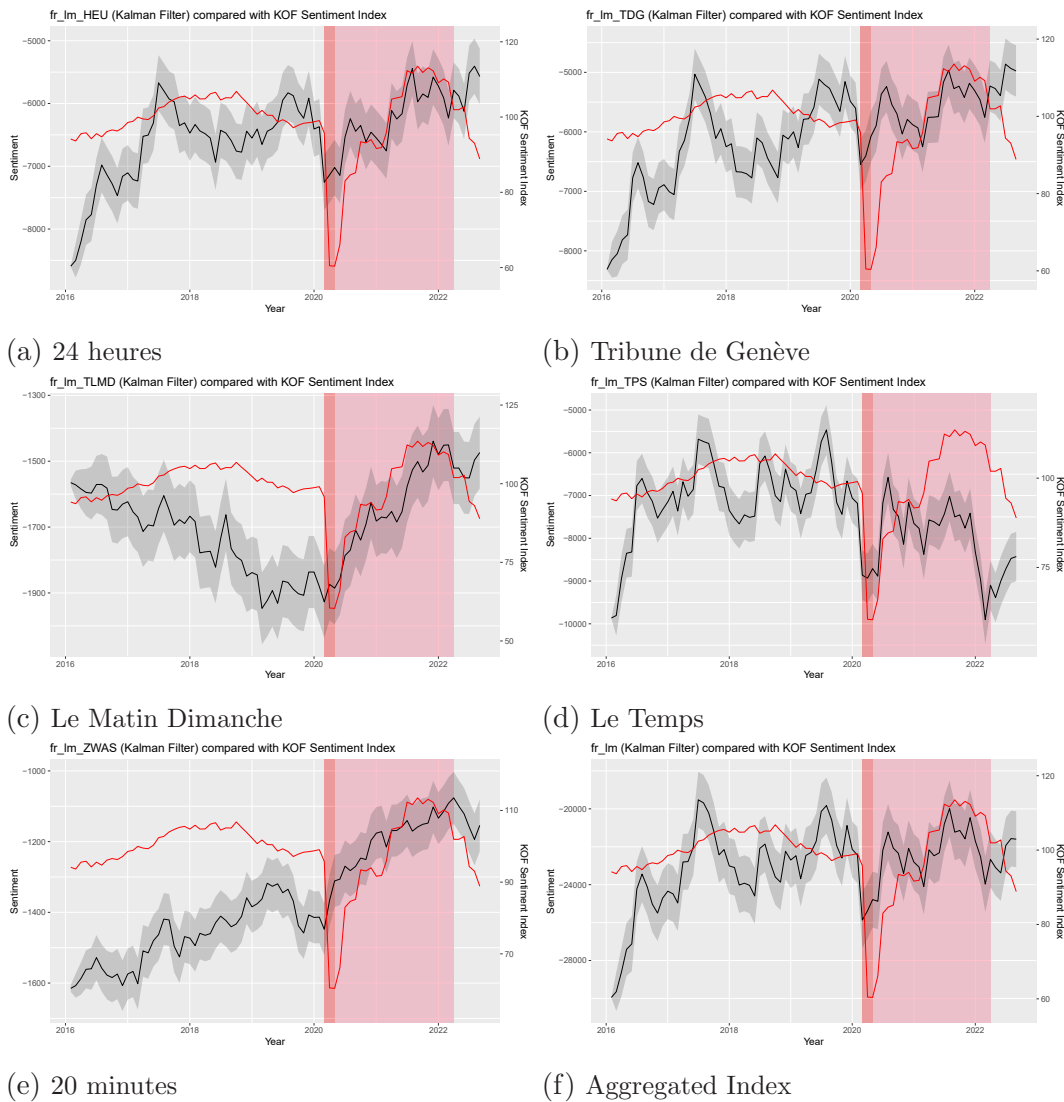
(d) Le Temps

(e) 20 minutes

(f) Aggregated Index

Figure A17: News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) With a Confidence Band for French-Speaking Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023*b*).

Notes: The sentiment index of the above newspapers is calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche

(d) Le Temps
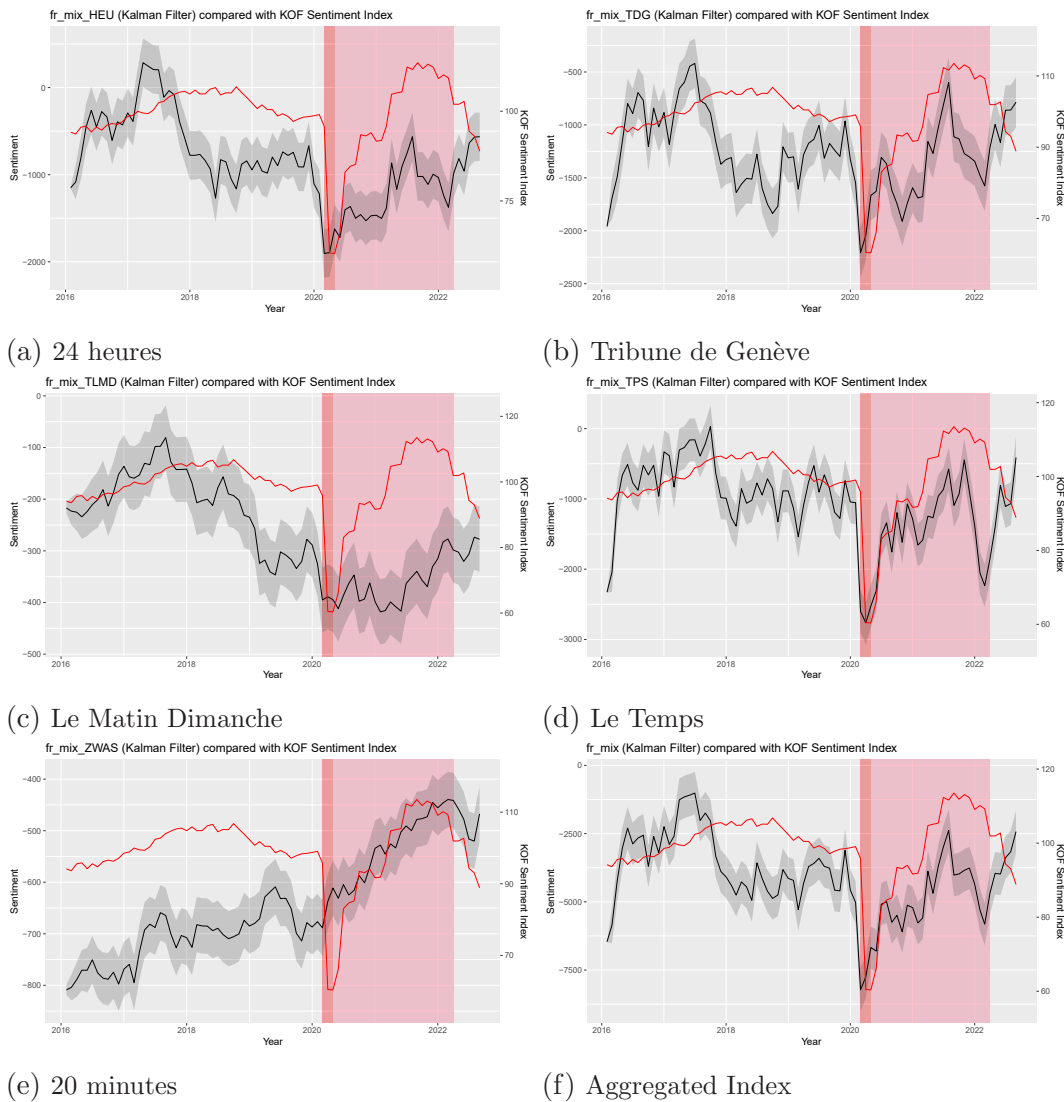
(e) 20 minutes

(f) Aggregated Index

Figure A18: News-Based Sentiment Index (Combined Version) With a Confidence Band for French-Speaking Newspapers and for the Aggregate Compared With the KOF Economic Sentiment Indicator (KOF Swiss Economic Institute, 2023b).

Notes: The sentiment index of the above newspapers is calculated using the combined lexicon with stemmed data. The Kalman filter is applied to the sentiment index to smooth the index. The shaded gray area includes the 67% confidence interval. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020a and 2020b). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

A.9 Contribution of News Categories to the News-Based Sentiment Index

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
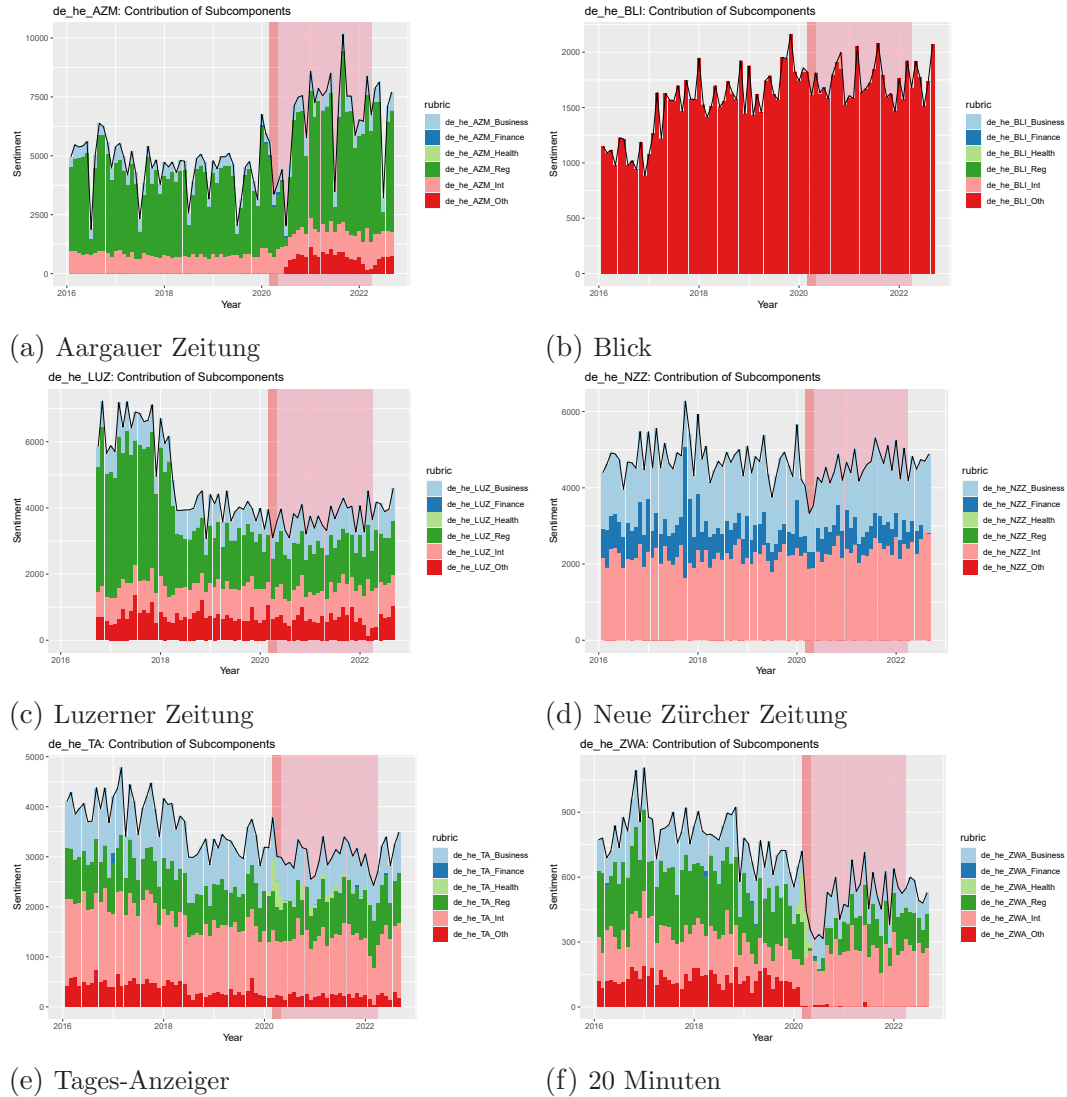
(e) Tages-Anzeiger

(f) 20 Minuten

Figure A19: Contribution of News Categories to the News-Based Sentiment Index (Henry 2008 Dictionary) for German-Speaking Daily Newspapers.

Notes: The sentiment indices of the above newspapers are calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

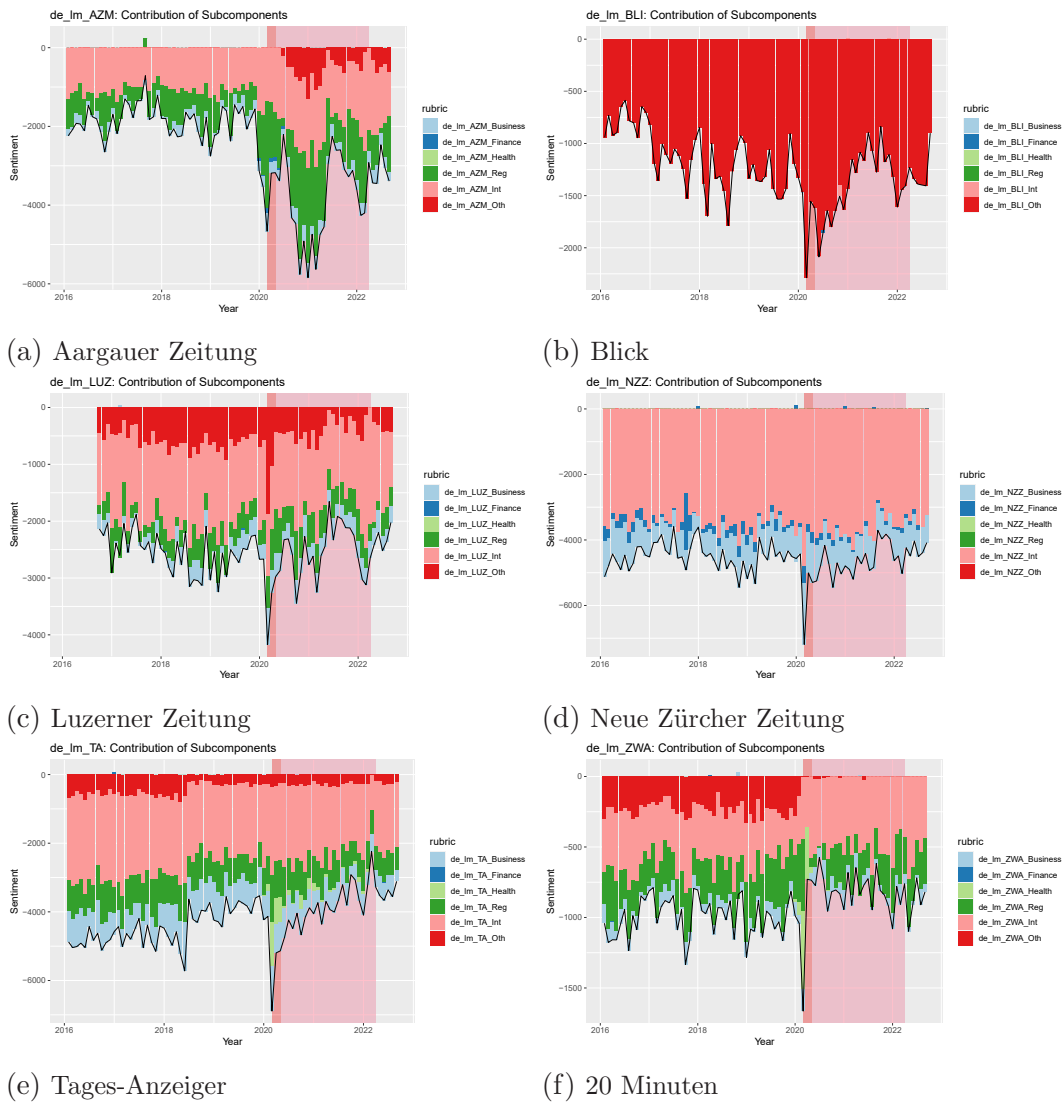(d) Neue Zürcher Zeitung

(e) Tages-Anzeiger

(f) 20 Minuten

Figure A20: Contribution of News Categories to the News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) for German-Speaking Daily Newspapers.

Notes: The sentiment indices of the above newspapers are calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) Aargauer Zeitung

(b) Blick

(c) Luzerner Zeitung

(d) Neue Zürcher Zeitung
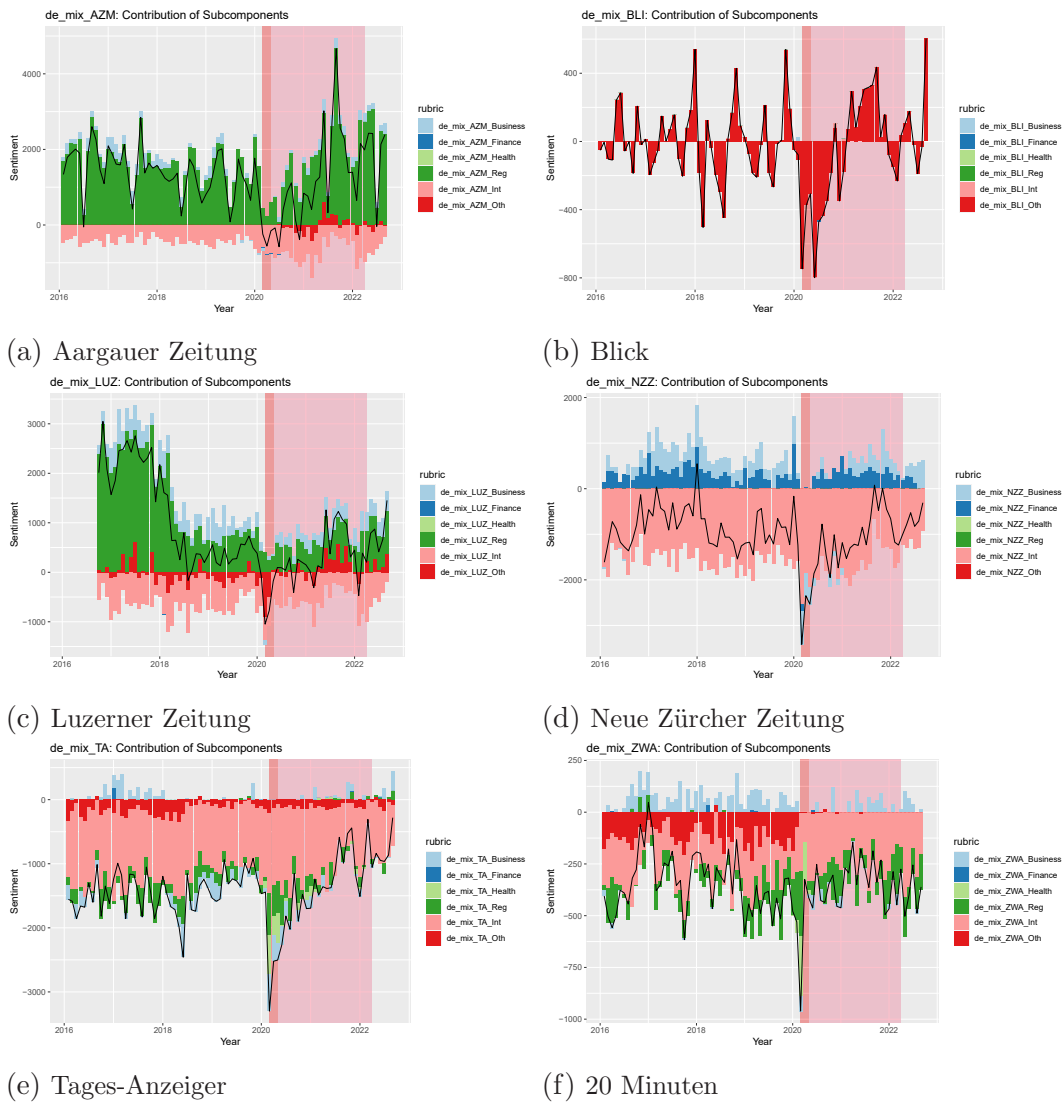
(e) Tages-Anzeiger

(f) 20 Minuten

Figure A21: Contribution of News Categories to the News-Based Sentiment Index (Combined Version) for German-Speaking Daily Newspapers.

Notes: The sentiment indices of the above newspapers are calculated using the combined lexicon with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick
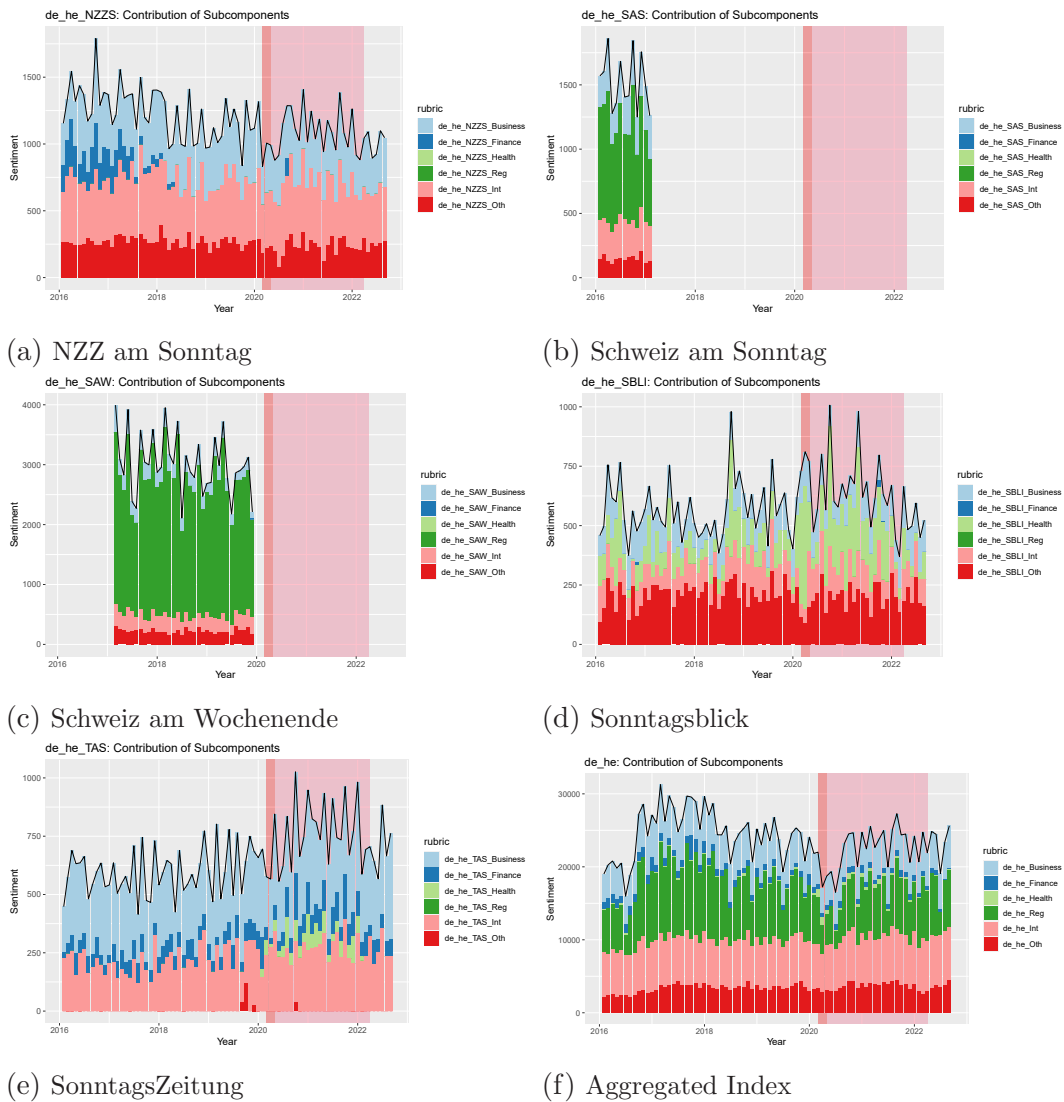
(e) SonntagsZeitung

(f) Aggregated Index

Figure A22: Contribution of News Categories to the News-Based Sentiment Index (Henry 2008 Dictionary) for German-Speaking Non-Daily Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick

(e) SonntagsZeitung
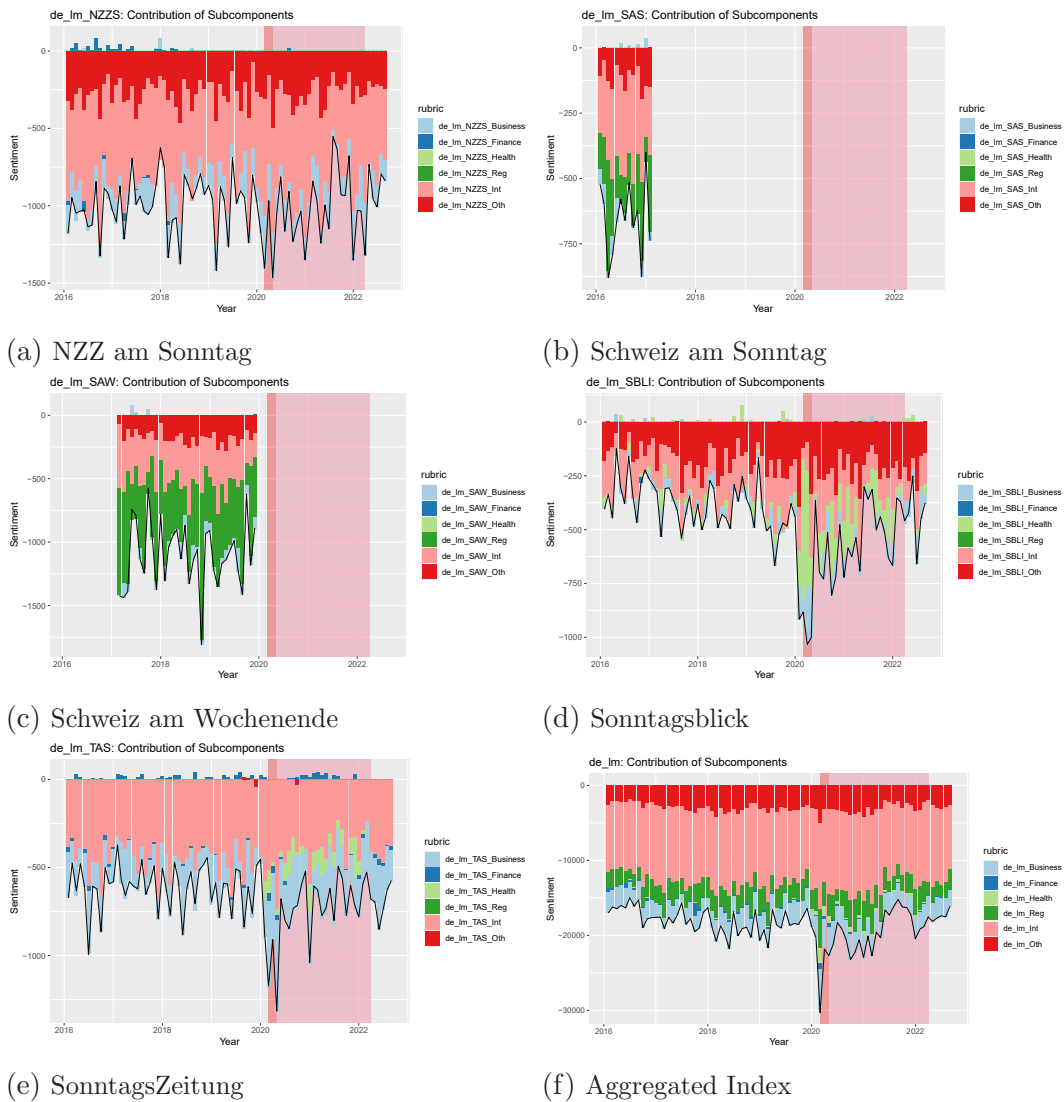
(f) Aggregated Index

Figure A23: Contribution of News Categories to the News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) for German-Speaking Non-Daily Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) NZZ am Sonntag

(b) Schweiz am Sonntag

(c) Schweiz am Wochenende

(d) Sonntagsblick
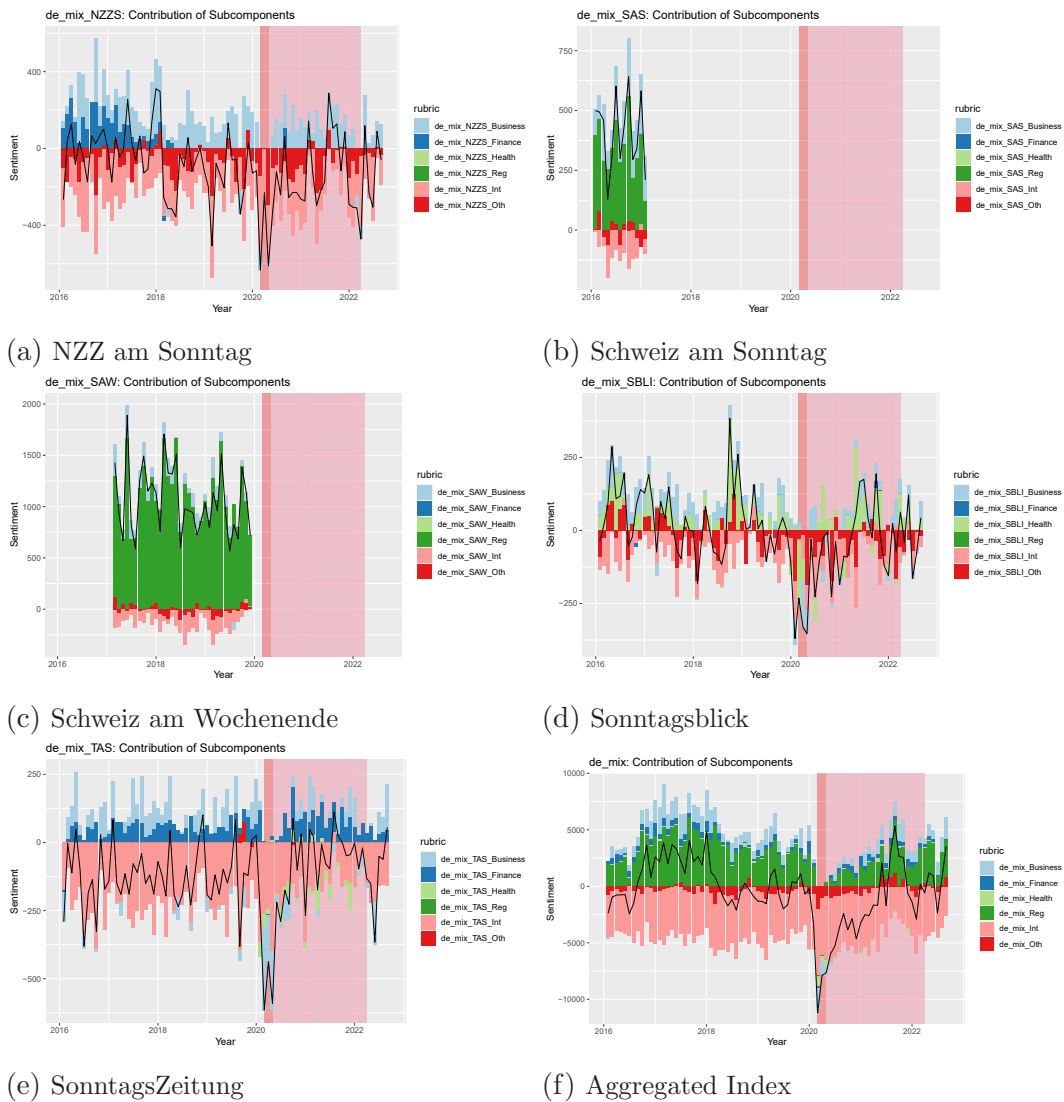

(e) SonntagsZeitung

(f) Aggregated Index

Figure A24: Contribution of News Categories to the News-Based Sentiment Index (Combined Version) for German-Speaking Non-Daily Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using the combined lexicon with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche

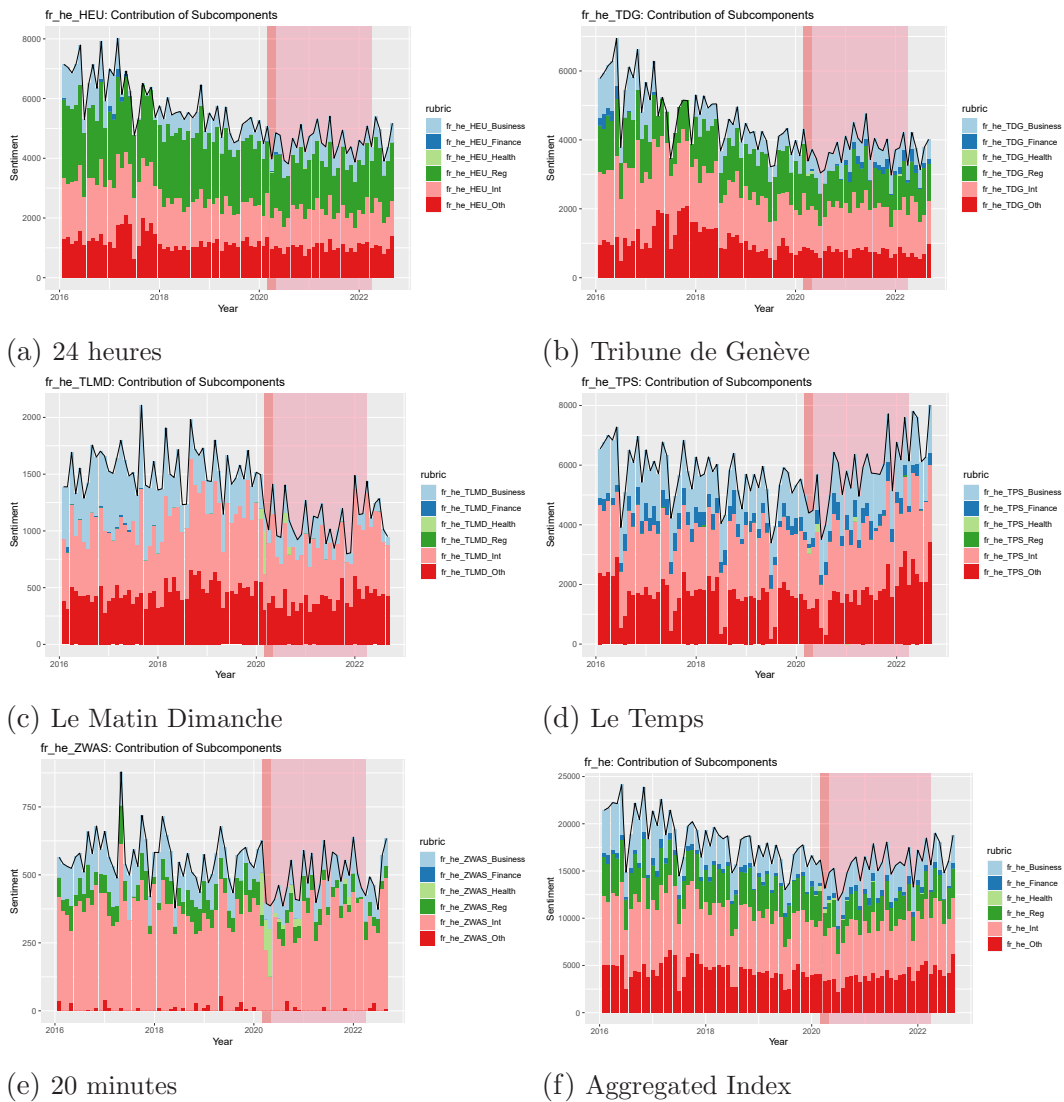(d) Le Temps

(e) 20 minutes

(f) Aggregated Index

Figure A25: Contribution of News Categories to the News-Based Sentiment Index (Henry 2008 Dictionary) for French-Speaking Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using Henry's finance-specific dictionary (Henry, 2008) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche

(d) Le Temps
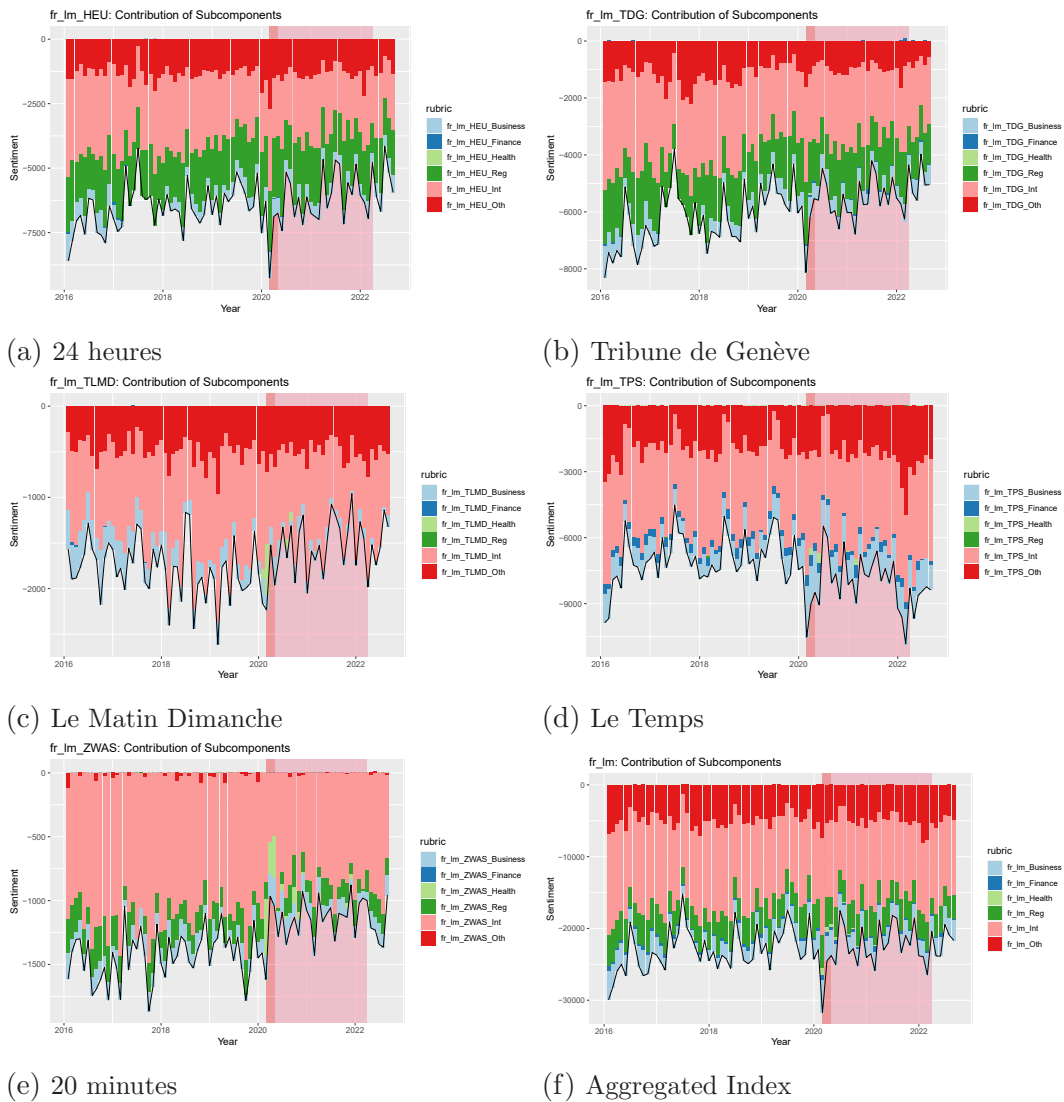
(e) 20 minutes

(f) Aggregated Index

Figure A26: Contribution of News Categories to the News-Based Sentiment Index (Loughran and McDonald 2016 Dictionary) for French-Speaking Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using the Loughran and McDonald 2016 version of the finance-oriented dictionary (Loughran and McDonald, 2011) with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

(a) 24 heures

(b) Tribune de Genève

(c) Le Matin Dimanche
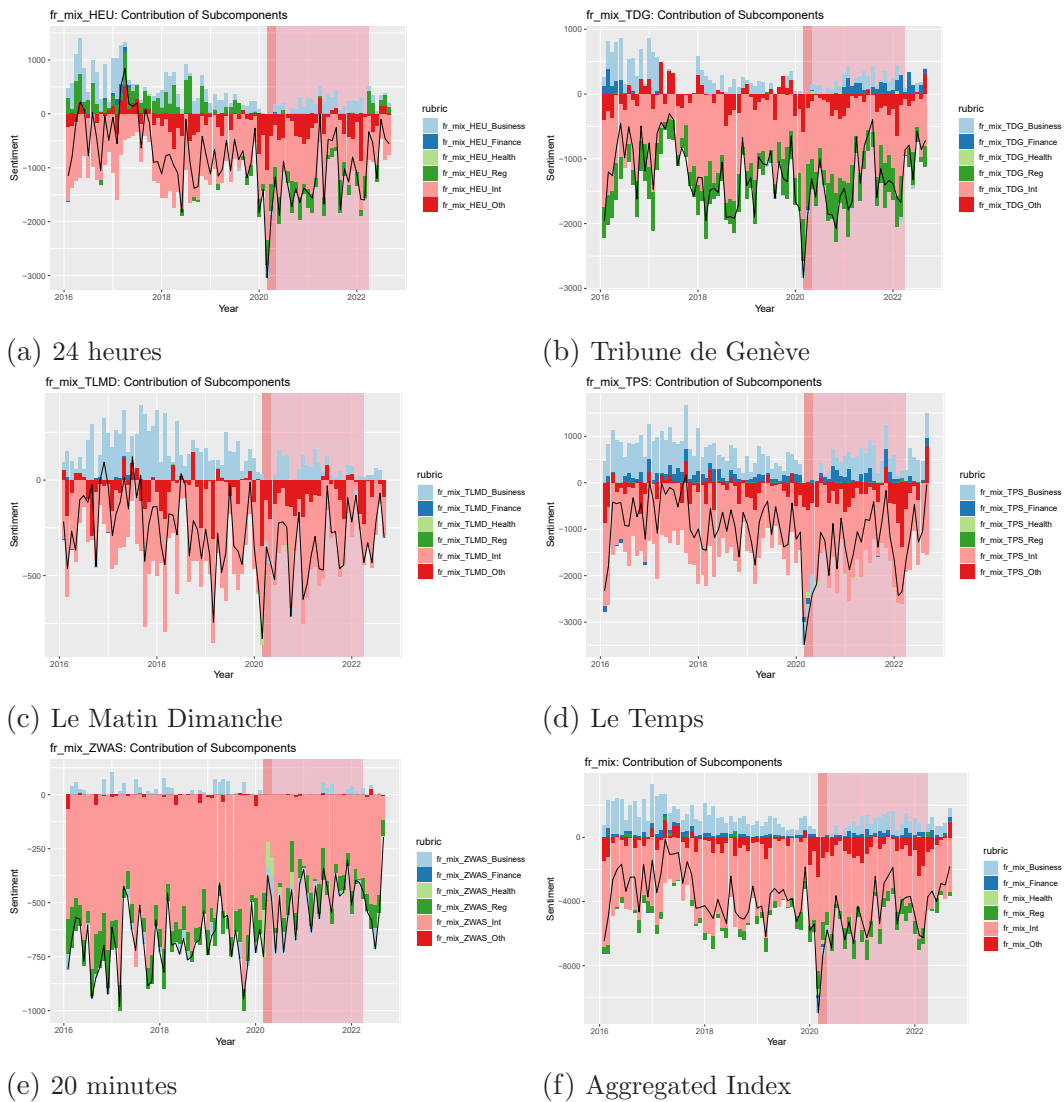
(d) Le Temps

(e) 20 minutes

(f) Aggregated Index

Figure A27: Contribution of News Categories to the News-Based Sentiment Index (Combined Version) for French-Speaking Newspapers and for the Aggregate.

Notes: The sentiment indices of the above newspapers are calculated using the combined lexicon with stemmed data. No Kalman filter is applied to the data shown in this figure. The red shaded area refers to the strict lockdown period in Switzerland, or the 'extraordinary situation' from March 15, 2020, to April 26, 2020 (Federal Council, 2020*a* and 2020*b*). The pink shaded area shows the period when the last COVID-19-related protection measures were still in place, which lasted until April 1, 2022 (Federal Council, 2022). Articles are retrieved from Swissdox@LiRI (2023).

A.10 Differences in Sentiment between the German- and French-Speaking Parts of Switzerland During the Strict Lockdown Period

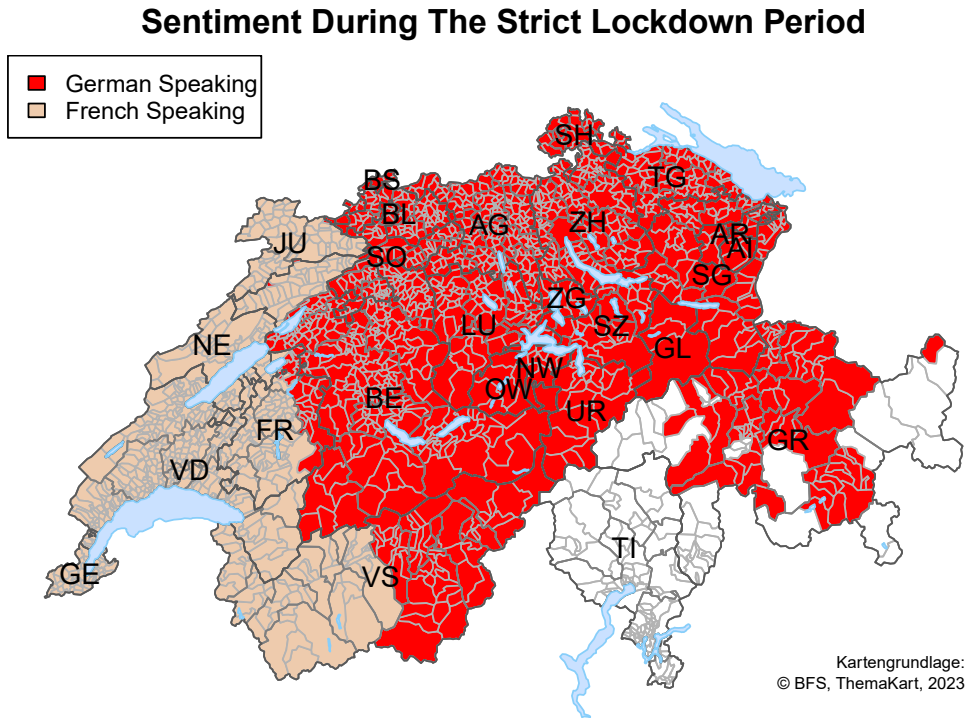**Sentiment During The Strict Lockdown Period**

Figure A28: Differences in Sentiment between the German- and French-Speaking Parts of Switzerland During the COVID-19 Lockdown Period.

Notes: During the strict lockdown period from March 15, 2020, until April 26, 2020, the German-speaking part of Switzerland had slightly lower mean sentiment scores than the French-speaking part. This is consistent across all chosen lexica. Henry (2008): -1.24 vs. -1.05; Loughran and McDonald (2016): -1.94 vs. -1.01; Combined version: -2.66 vs. -2.03. The R package **bfsMaps** (Signorell, 2022) is used for drawing the map and for determining in which areas of Switzerland French or German is spoken.

A.11 Cross-Correlation Tests for the News-Based Sentiment Indices and the KOF Economic Sentiment Indicator
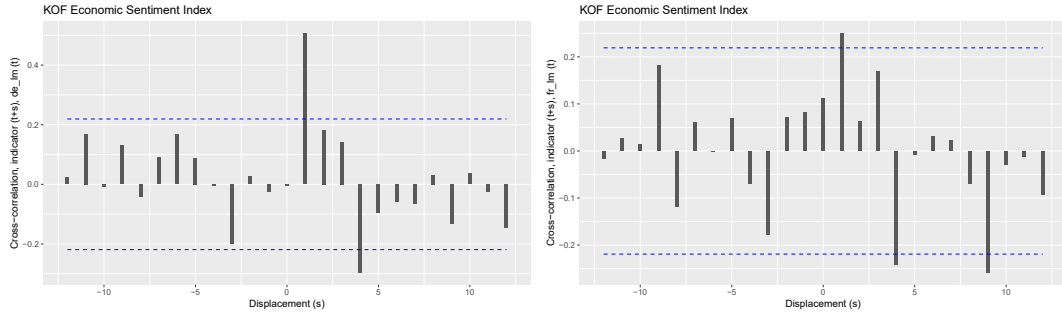
(a) German-Speaking Newspapers With the Loughran and McDonald Lexicon and the KOF Economic Sentiment.

(b) French-Speaking Newspapers With the Loughran and McDonald Lexicon and the KOF Economic Sentiment.
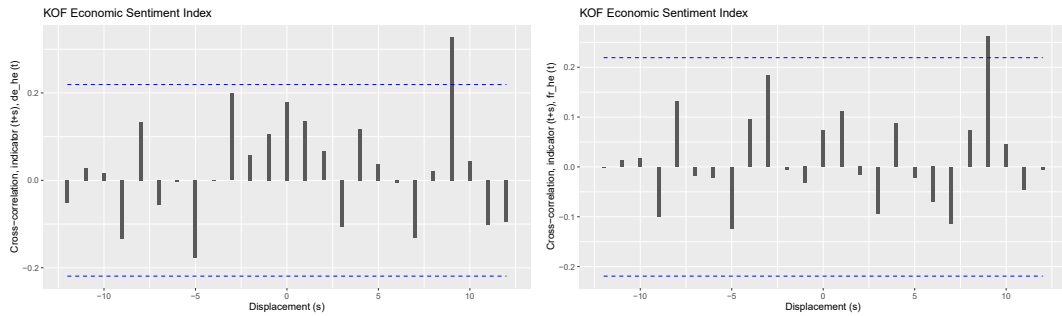
(c) German-Speaking Newspapers With Henry's Lexicon and the KOF Economic Sentiment.

(d) French-Speaking Newspapers With Henry's Lexicon and the KOF Economic Sentiment.

Figure A29: Cross-Correlation Tests for the News-Based Sentiment Indices and the KOF Economic Sentiment Indicator.

Notes: Following Burri and Kaufmann (2020), the tests use monthly data. The 95% confidence bands are indicated by the dashed lines. Values that are outside of the 95% confidence bands imply a statistically significant lead/lag relationship between the indicators of order s. Similar to Neusser (2016, Ch. 12.1), the series are prewhitened with an AR(p) model before the cross-correlations are calculated. The order p of the AR model is identified by applying the Bayesian information criteria.

A.12 Pseudo Out-Of-Sample Performance

Table A3: Out-Of-Sample Evaluation for the German-Speaking Newspapers Index [and the French-Speaking Newspapers Index in Brackets] Using Henry's Lexicon.

(a) GDP growth: First release versus de_he [fr_he]

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	First release	de_he	First release/de_he	First release < de_he
h=0	0.44	3.01 [3.05]	0.14 [0.14]	0.045 [0.055]
h=1	0.45	2.75 [2.78]	0.16 [0.16]	0.096 [0.088]

(b) GDP growth: de_he [fr_he] versus AR(1)

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	de_he	AR(1)	de_he/AR(1)	de_he < AR(1)
h=0	3.01 [3.05]	3.72	0.81 [0.82]	0.154 [0.133]
h=1	2.75 [2.78]	3.00	0.92 [0.93]	0.114 [0.209]

(c) GDP growth: de_he [fr_he] versus KOF Economic Sentiment Indicator (KOF ESI)

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	de_he	KOF ESI	de_he/KOF ESI	de_he < KOF ESI
h=0	3.01 [3.05]	1.76	1.71 [1.74]	0.923 [0.911]
h=1	2.875 [2.78]	3.82	0.72 [0.73]	0.087 [0.096]

Notes: The out-of-sample evaluation follows the approach in Burri and Kaufmann (2020). The root-mean-squared errors (RMSE) are calculated for forecasts in those months when a new quarterly GDP figure is released. Quarterly GDP data (CPMNACSAB1GQCH) are taken from ALFRED (2023). Lower predictive accuracy is given by a higher RMSE; $h = 0$ ($h = 1$) represents the forecast horizon, thus $h = 0$ stands for the current quarter and $h = 1$ for the next quarter. The following benchmarks are used: The first benchmark is the first available quarterly release of GDP growth (Panel a). The second benchmark is an AR(1) model (Panel b). The third benchmark is the KOF Economic Sentiment Indicator (Panel c). For the Diebold-Mariano-West (DMW) test, a quadratic loss function is taken. The null hypothesis for the DMW test is that the two forecasts are equally accurate in prediction, whereas the alternative hypothesis is that one indicator (given in the column header) is more accurate than the other (Diebold and Mariano, 2002 and West, 1996).

Table A4: Out-Of-Sample Evaluation for the German-Speaking Newspapers Index [and the French-Speaking Newspapers Index in Brackets] Using the Loughran and McDonald Lexicon.

(a) GDP growth: First release versus de_lm [fr_lm]

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	First release	de_lm	First release/de_lm	First release < de_lm
h=0	0.44	3.09 [2.58]	0.14 [0.17]	0.043 [0.045]
h=1	0.45	2.67 [2.76]	0.17 [0.16]	0.087 [0.085]

(b) GDP growth: de_lm [fr_lm] versus AR(1)

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	de_lm	AR(1)	de_lm/AR(1)	de_lm < AR(1)
h=0	3.09 [2.58]	3.72	0.83 [0.69]	0.167 [0.146]
h=1	2.67 [2.76]	3.00	0.89 [0.92]	0.193 [0.222]

(c) GDP growth: de_lm [fr_lm] versus KOF Economic Sentiment Indicator (KOF ESI)

	RMSE	RMSE	Relative RMSE	DMW test (p value)
	de_lm	KOF ESI	de_lm/KOF ESI	de_lm < KOF ESI
h=0	3.09 [2.58]	1.76	1.76 [1.76]	0.930 [0.866]
h=1	2.67 [2.76]	3.82	0.70 [0.72]	0.109 [0.106]

Notes: The out-of-sample evaluation follows the approach in Burri and Kaufmann (2020). The root-mean-squared errors (RMSE) are calculated for forecasts in those months when a new quarterly GDP figure is released. Quarterly GDP data (CPMNACSAB1GQCH) are taken from ALFRED (2023). Lower predictive accuracy is given by a higher RMSE; $h = 0$ ($h = 1$) represents the forecast horizon, thus $h = 0$ stands for the current quarter and $h = 1$ for the next quarter. The following benchmarks are used: The first benchmark is the first available quarterly release of GDP growth (Panel a). The second benchmark is an AR(1) model (Panel b). The third benchmark is the KOF Economic Sentiment Indicator (Panel c). For the Diebold-Mariano-West (DMW) test, a quadratic loss function is taken. The null hypothesis for the DMW test is that the two forecasts are equally accurate in prediction, whereas the alternative hypothesis is that one indicator (given in the column header) is more accurate than the other (Diebold and Mariano, 2002 and West, 1996).

A.13 Granger Causality of the Aggregated Newspapers Indices

Table A5: Granger Causality Tests for the Aggregated Indices for German- and French-Speaking Newspapers Using Henry's lexicon and the Loughran and McDonald lexicon.

| | | Newspaper Granger-causes KOF sentiment | | | | KOF sentiment Granger-causes Newspaper | | | |
| | | 2016–2022 | | 15.3.20–1.4.22 | | 2016–2022 | | 15.3.20–1.4.22 | |
Index	lags	Wald test	p value	Wald test	p value	Wald test	p value	Wald test	p value
de_he	1	0.7824	0.3792	**6.1777**	**0.0214***	0.8390	0.3626	0.1053	0.7488
	2	0.7175	0.4914	**3.8817**	**0.0397***	0.7605	0.4711	2.0409	0.1589
	3	0.4549	0.7147	2.3197	0.1168	0.5648	0.6400	0.9942	0.4223
	4	1.6735	0.1664	1.6583	0.2237	0.7501	0.5614	1.3352	0.3128
de_lm	1	0.0326	0.8571	0.4634	0.5035	**3.0999**	**0.0823 .**	**5.2462**	**0.0324***
	2	0.2081	0.8126	0.6559	0.5310	**17.0850**	**0.0000***	0.0640	0.9382
	3	0.1062	0.9562	0.5094	0.6818	**11.3930**	**0.0000***	0.1563	0.9240
	4	1.6597	0.1697	**4.1063**	**0.0253***	**9.5663**	**0.0000***	2.0653	0.1488
fr_he	1	0.7479	0.3899	**5.8434**	**0.0248***	0.0433	0.8358	0.8244	0.3742
	2	0.5460	0.5816	**4.1786**	**0.0323***	0.2295	0.7955	**5.8615**	**0.0110***
	3	0.5293	0.6637	**5.0976**	**0.0125***	0.1857	0.9058	**5.4770**	**0.0096****
	4	1.3244	0.2699	**3.0236**	**0.0612 .**	0.03375	0.8517	**4.7104**	**0.0162***
fr_lm	1	0.1001	0.7526	0.0882	0.7694	2.1635	0.1455	**6.7101**	**0.0171***
	2	0.3318	0.7187	1.3919	0.2741	**2.4231**	**0.0956 .**	2.6009	0.1018
	3	0.3603	0.7819	1.8121	0.1882	1.7712	0.1606	1.2160	0.3381
	4	0.9823	0.4232	0.6319	0.6492	**2.2741**	**0.0703 .**	**2.7485**	**0.0782 .**

Notes: The stemmed version using the domain-specific lexica and the Kalman filter is applied. Significance codes: 0 '***' 0.001 '**' 0.01, '*' 0.05 '.' 0.1. Tests with a significant result on at least a 10% significance level are written in bold. The KOF Economic Sentiment Indicator is available from KOF (KOF Swiss Economic Institute, 2023*b*).

Table A6: Granger Causality Tests.

| | | Newspaper Granger-causes KOF sentiment | | | | KOF sentiment Granger-causes Newspaper | | | |
| | | 2016–2022 | | 15.3.20–1.4.22 | | 2016–2022 | | 15.3.20–1.4.22 | |
Index	lags	Wald test	p value	Wald test	p value	Wald test	p value	Wald test	p value
AZM	1	0.0026	0.9596	**3.1506**	**0.0904 .**	0.0586	0.8093	**4.3278**	**0.0499***
	2	0.4267	0.6543	**3.9286**	**0.0384***	0.1000	0.9050	2.4935	0.1107
	3	0.9470	0.4228	2.0482	0.1503	0.3492	0.7898	2.1814	0.1327
	4	**3.7346**	**0.0084****	1.3882	0.2959	1.2178	0.3116	1.1625	0.3750
BLI	1	0.0522	0.8198	0.0002	0.9886	0.4717	0.4943	1.6919	0.2074
	2	0.0802	0.9231	1.4583	0.2588	0.3918	0.6772	1.2240	0.3174
	3	0.0510	0.9847	**4.0929**	**0.0262***	0.2375	0.8699	0.6151	0.6158
	4	0.3479	0.8446	0.1152	0.9746	0.2104	0.9318	1.1163	0.3937
LUZ	1	0.0905	0.7645	**4.1516**	**0.0544 .**	0.6762	0.4138	0.1161	0.7367
	2	0.0967	0.9080	1.4583	0.2588	0.3961	0.6745	**6.0488**	**0.0098****
	3	0.2297	0.8754	**4.0929**	**0.0262***	0.3161	0.8137	**3.6043**	**0.0385***
	4	0.5242	0.7183	**3.9685**	**0.0281***	0.2995	0.8771	**2.8450**	**0.0717 .**
NZZ	1	**6.6432**	**0.0119***	**12.1410**	**0.0022****	0.0046	0.9459	0.5556	0.4643
	2	**5.0342**	**0.0090****	**11.5100**	**0.0006*****	1.3398	0.2682	1.9997	0.1643
	3	**2.5494**	**0.0627 .**	2.0409	0.1513	1.2115	0.3120	0.8013	0.5123
	4	1.9846	0.1069	2.3220	0.1161	**2.3003**	**0.0677 .**	0.7931	0.5518
NZZS	1	0.1491	0.7004	1.5451	0.2276	1.4016	0.2401	0.0069	0.9346
	2	0.8084	0.4495	0.7492	0.4869	1.4176	0.2489	0.1893	0.8292
	3	1.4987	0.2225	0.6096	0.6190	1.2352	0.3035	0.2112	0.8871
	4	**3.7175**	**0.0086****	**2.5667**	**0.0923 .**	0.9962	0.4158	0.3771	0.8207
SAS	1	0.3514	0.5679	NA	NA	2.8970	0.1230	NA	NA
	2	1.0892	0.3949	NA	NA	0.5013	0.6290	NA	NA
	3	1.6083	0.3529	NA	NA	0.3071	0.8209	NA	NA
	4	NA	NA	NA	NA	NA	NA	NA	NA
SAW	1	1.2178	0.2786	NA	NA	0.0000	0.9781	NA	NA
	2	0.7836	0.4669	NA	NA	1.0080	0.3783	NA	NA

Continued on the next page

| | | Newspaper Granger-causes KOF sentiment | | | | KOF sentiment Granger-causes Newspaper | | | |
| | | 2016–2022 | | 15.3.20–1.4.22 | | 2016–2022 | | 15.3.20–1.4.22 | |
Index	lags	Wald test	p value	Wald test	p value	Wald test	p value	Wald test	p value
	3	0.3604	0.7821	NA	NA	0.7818	0.5157	NA	NA
	4	0.8292	0.5215	NA	NA	1.3595	0.2815	NA	NA
SBLI	1	0.7528	0.3883	0.0026	0.9596	0.7188	0.3992	**5.1772**	**0.0335***
	2	0.5323	0.5895	0.0206	0.9797	1.7472	0.1815	2.1442	0.1461
	3	1.1659	0.3290	0.9466	0.4430	1.4406	0.2383	1.1972	0.3445
	4	1.8687	0.1262	1.7398	0.2059	1.0574	0.3845	1.1575	0.3770
TA	1	0.0177	0.8946	0.1086	0.7450	0.0835	0.7734	**8.3441**	**0.0088****
	2	0.0108	0.9892	0.1902	0.8284	0.6658	0.5170	**3.2117**	**0.0642 .**
	3	0.2184	0.8833	0.1235	0.9448	0.5117	0.6755	1.8450	0.1823
	4	0.2429	0.9130	0.5040	0.7337	0.4563	0.7675	**3.6166**	**0.0372***
TAS	1	1.0975	0.2981	1.1021	0.3057	0.1277	0.7218	**11.8210**	**0.0025****
	2	1.5457	0.2201	1.4381	0.2634	0.0629	0.9391	**5.2873**	**0.0156***
	3	**2.2891**	**0.0859 .**	0.4337	0.7320	1.1147	0.3491	**3.5300**	**0.0409***
	4	**4.2550**	**0.0040****	2.1591	0.1357	0.8660	0.4890	1.7917	0.1953
ZWA	1	**2.9778**	**0.0885 .**	**12.6080**	**0.0019****	0.0080	0.9289	**4.8366**	**0.0392***
	2	**2.8196**	**0.0661 .**	**5.5463**	**0.0133***	0.0349	0.9658	**2.7733**	**0.0892 .**
	3	**2.4196**	**0.0733 .**	1.9888	0.1590	0.3194	0.8113	**3.1567**	**0.0558 .**
	4	1.9846	0.1068	0.6804	0.6187	0.2239	0.9241	**4.9110**	**0.0141***
HEU	1	0.0040	0.9496	0.3526	0.5590	0.1382	0.7111	2.4086	0.1356
	2	0.3439	0.7102	0.9893	0.3912	0.1255	0.8823	**5.4180**	**0.0144***
	3	0.2350	0.8717	0.9576	0.4381	0.0924	0.9640	**3.2622**	**0.0511 .**
	4	0.4116	0.7997	0.4281	0.7857	0.3896	0.8154	**5.0762**	**0.0125***
TDG	1	0.0421	0.8380	2.2422	0.1492	0.2863	0.5941	0.1472	0.7050
	2	0.0460	0.9551	1.4127	0.2692	0.1866	0.8301	**4.3740**	**0.0283***
	3	0.1076	0.9554	1.3769	0.2880	0.1162	0.9503	**3.5477**	**0.0403***
	4	0.4442	0.7762	1.0370	0.4280	0.0901	0.9852	**6.1298**	**0.0063****

| | | Newspaper Granger-causes KOF sentiment | | | | KOF sentiment Granger-causes Newspaper | | | |
| | | 2016–2022 | | 15.3.20–1.4.22 | | 2016–2022 | | 15.3.20–1.4.22 | |
Index	lags	Wald test	*p* value	Wald test	*p* value	Wald test	*p* value	Wald test	*p* value
TLMD	1	**3.1995**	**0.0776 .**	1.4302	0.2451	0.3900	0.5342	**35.2850**	**0.0000*****
	2	1.9655	0.1474	0.9504	0.4051	0.6541	0.5229	0.1119	0.8947
	3	2.1070	0.1071	1.4347	0.2720	0.6383	0.5929	1.4522	0.2673
	4	0.7766	0.5443	1.4380	0.2809	0.7341	0.5719	0.5204	0.7227
TPS	1	1.2483	0.2674	**3.0908**	**0.0933 .**	0.0917	0.7628	0.6049	0.4454
	2	0.6397	0.5304	2.3476	0.1242	0.4959	0.6110	**2.9014**	**0.0809 .**
	3	1.2542	0.2968	**5.1990**	**0.0116***	0.7043	0.5527	2.1611	0.1352
	4	**2.3899**	**0.0594 .**	**4.7620**	**0.0156***	0.5963	0.6665	1.4263	0.2844
ZWAS	1	**3.5022**	**0.0651 .**	**4.4098**	**0.0480***	0.1695	0.6817	**13.2760**	**0.0015****
	2	1.4682	0.2371	**3.7756**	**0.0427***	0.0258	0.9746	1.4330	0.2645
	3	1.3323	0.2709	**4.2679**	**0.0229***	0.1118	0.9529	0.8575	0.4843
	4	1.2708	0.2902	2.4517	0.1027	0.1053	0.9803	0.6022	0.6684

Notes: The stemmed version using the Henry (2008) dictionary and Kalman filter. Significance codes: 0 '***' 0.001 '**' 0.01, '*' 0.05 '.' 0.1. Tests with a significant result on at least a 10% significance level are displayed in bold. Articles for SAS are only available from Feb 2016 to Feb 2017, and articles for SAW are only available from Feb 2017 to Dec 2019. The KOF Economic Sentiment Indicator is available from KOF (KOF Swiss Economic Institute, 2023*b*).

A.15 Granger Causality of News Categories

Table A7: Granger Causality Tests.

		Newspaper Granger-causes KOF sentiment 15.3.20–1.4.22		KOF sentiment Granger-causes Newspaper 15.3.20–1.4.22	
Newspaper	lags	Wald test	p value	Wald test	p value
AZM					
Business	1	**4.4265**	**0.0476***	0.9255	0.3470
	2	**2.9807**	**0.0762 .**	0.1100	0.8965
Finance	1	**4.4660**	**0.0467***	**10.1930**	**0.0044****
	2	**41.9770**	**0.0000*****	0.0934	0.9113
International and	1	2.3955	0.1366	**6.1735**	**0.0215***
National News	2	1.6821	0.2139	1.9272	0.1744
Regional News	1	**4.7878**	**0.0401***	0.3429	0.5644
	2	**3.4516**	**0.0539 .**	11.2721	0.3043
Other News	1	0.2928	0.5941	**5.8427**	**0.0248***
	2	1.8682	0.2183	0.3126	0.7354
NZZ					
Business	1	2.8233	0.1077	**5.8641**	**0.0246***
	2	0.7127	0.5037	2.4570	0.1139
Finance	1	0.0495	0.8261	2.1373	0.1586
	2	1.1953	0.3255	0.1794	0.8373
International and	1	**5.5909**	**0.0278***	0.4777	0.4970
National News	2	**3.0762**	**0.0709 .**	1.9385	0.1728
TPS					
Business	1	**10.9250**	**0.0034****	**4.0607**	**0.0569 .**
	2	**3.7577**	**0.0433***	2.5200	0.1084
Finance	1	0.0537	0.8189	0.8813	0.3585
	2	0.1208	0.8869	0.0308	0.9697
Health News	1	**10.1000**	**0.0045****	2.2369	0.1496

Newspaper	lags	Newspaper Granger-causes KOF sentiment 15.3.20–1.4.22		KOF sentiment Granger-causes Newspaper 15.3.20–1.4.22	
		Wald test	*p* value	Wald test	*p* value
	2	**3.4905**	**0.0524 .**	**6.6384**	**0.0069****
International and	1	**6.3060**	**0.0203***	1.1004	0.3061
National News	2	2.5439	0.1064	1.5283	0.2438
Other News	1	**4.1739**	**0.0538 .**	0.5650	0.4606
	2	**4.2809**	**0.0301***	2.5842	0.1031
ZWAS					
Business	1	1.6206	0.2169	1.7296	0.2026
	2	0.7966	0.4661	0.0808	0.9227
Health News	1	0.3835	0.5424	**29.7160**	**0.0000*****
	2	**11.5510**	**0.0006*****	**3.9241**	**0.0385***
International and	1	**8.9190**	**0.0070****	2.3504	0.1402
National News	2	**6.3998**	**0.0079****	**5.4950**	**0.0137***
Regional News	1	0.0202	0.8882	0.0164	0.8992
	2	2.3262	0.1263	0.6853	0.5166
Other News	1	0.0923	0.7642	0.9279	0.3464
	2	0.0991	0.9062	2.4591	0.1137

Notes: The stemmed version using the Henry (2008) dictionary and no Kalman filter. Significance codes: 0 '***' 0.001 '**' 0.01, '*' 0.05 '.' 0.1. Tests with a significant result on at least a 10% significance level are displayed in bold. The KOF Economic Sentiment Indicator is available from KOF (KOF Swiss Economic Institute, 2023*b*).

A.16 Robustness Check

Table A8: Comparison of Similar Articles in Different Languages from swissinfo.ch (2023).

Language	Publication Date	Rubric	Character Counts	Types	Tokens
Article: The new Gotthard Tunnel: in numbers (https://www.swissinfo.ch/eng/business/railway-across-the-alps_the-new-gotthard-tunnel-in-numbers/42124876)					
English	30.04.2016	Business	1,304	70	100
Henry (2008)	Positive	Negative			
Percentage/Count	**100.00%**/1	**0.00%**/0			
	record				
Article: Eindrückliche Zahlen des neuen Gotthard-Tunnels (https://www.swissinfo.ch/ger/zuglinie-durch-die-alpen_eindrueckliche-zahlen-des-neuen-gotthard-tunnels/42122570)					
German	29.03.2016	Wirtschaft	1,459	76	95
Henry (2008)	Positive	Negative			
Percentage/Count	**100.00%**/2	**0.00%**/0			
Positive	(opportun) anlass, **(record)** rekord				
Article: Les chiffres impressionnants du nouveau tunnel du Gothard (https://www.swissinfo.ch/fre/transversale-ferroviaire-alpine_les-chiffres-impressionnants-du-nouveau-tunnel-du-gothard/42122042)					
French	29.03.2016	Economie	1,541	94	120
Henry (2008)	Positive	Negative			
Percentage/Count	63.64%/7	36.36%/4			
Positive	(excel) extraordinaire, (definit) final, (definit) prec, (more) plus 3x, **(record)** record				
Negative	(down) bas 2x, (drop) tomb, (worse) empir				

Notes: Although the content of the articles in each of the three different languages is the same, the content id, the id, and the publication times are not identical. Relative positivity and negativity are given as a percentage value. The respective words are given in the alphabetic order of English words (not necessarily in chronological order appearing in the text). The translation to the English dictionary is given in parentheses. Identical words across languages are written in bold. In the French version, there is a 64% positivity rate since there are 4 negatively associated words, whereas three occurrences are misclassified. There are two occurrences of "bas" (low) referring to "tunnel de base", one occurrence of "empir" (worse) generally referring to the French term "empirer" but in this case to the "Empire State Building". The articles can be accessed online at the URL given in parentheses.

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