Developing a Scottish Business Sentiment Index

Scottish Government
Riaghaltas na h-Alba

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Executive Summary

The Scottish Business Sentiment Index (BSI) provides a new comprehensive, real-time measure of business confidence in Scotland by analysing sentiment in news articles related to corporate and industrial developments. Constructed using data from Factiva (a global news database), the BSI systematically tracks sentiment shifts by applying machine learning and linguistic analysis techniques to a vast corpus of business news from national and regional newspapers.

The BSI serves as a valuable complement to traditional sentiment measures, such as survey-based consumer confidence indices. By leveraging real-time news coverage, the index offers a dynamic perspective on business sentiment, allowing for timely assessments of economic conditions. The index is validated through comparisons with macroeconomic indicators like GDP and employment levels, confirming its reliability as an economic barometer and as leading or early warning indicator. Additionally, its responsiveness to key economic events, including the Great Financial Crisis, Brexit, and the COVID-19 pandemic, highlights its effectiveness in capturing sentiment fluctuations in response to major shocks.

Future enhancements, including increased geographic coverage, higher-frequency updates, and expanded data sources, could further refine its predictive capabilities and establish the BSI's role as a key tool for policymakers, economic analysts, and business leaders in monitoring and forecasting economic trends in Scotland.

1 Introduction

Understanding business sentiment is crucial for policymakers, investors, and economic analysts seeking to gauge economic conditions and anticipate future trends. Traditional sentiment measures, such as consumer confidence indices, rely on sample surveys that can be limited in scope The Business Sentiment Index (BSI) offers a complementary approach by leveraging real-time textual analysis of business news articles to assess prevailing economic conditions in a cost-effective manner.

The increasing adoption of sentiment analysis in economic research reflects its growing recognition as a powerful tool for tracking business and market trends. Studies have shown that news-based sentiment indices can effectively capture economic fluctuations and provide early insights into business behaviour (Lee et al., 2020; Yang et al., 2022). In particular, machine learning-based approaches have enhanced the accuracy and scalability of sentiment analysis, allowing for more precise measurement of news sentiment (Shapiro, Sudhof, and Wilson, 2022). Additionally, Seki, Ikuta, and Matsubayashi (2022) highlight the importance of real-time sentiment tracking as a valuable indicator of business confidence, reinforcing the relevance of the BSI's methodology in economic analysis.

The new BSI for Scotland is constructed using Factiva, a global news database, which provides access to business-related articles from leading national and regional newspapers. Articles categorised under "Corporate/Industrial News" and tagged as relevant to Scotland are analysed by applying machine learning and linguistic analysis techniques to generate sentiment scores. These scores are aggregated into a monthly index that reflects fluctuations in business sentiment over time.

This document outlines the methodology used to construct the BSI along with the underlying data, including the application of sentiment analysis techniques and machine learning models to extract meaningful insights. The validation process compares the BSI with key economic indicators to assess its reliability and predictive power. Additionally, the report discusses how the BSI reacts to significant economic events and explores potential improvements that could enhance its utility.

By providing a real-time measure of business sentiment, the BSI offers a valuable tool for policymakers and business leaders to monitor economic trends, identify risks, and inform decision-making processes.

2 Data

To construct the underlying dataset used for the analysis below, articles are collected from Factiva, an online database that archives content from a broad range of news sources. The reliance on Factiva as a data source aligns with recent

advancements in sentiment research, where structured news data has been leveraged to create business sentiment indices (Seki, Ikuta, & Matsubayashi, 2022). The original selection focuses on retrieving articles from sixteen key leading British newspapers, including ten national newspapers—*The Times, The Sunday Times, The Daily Telegraph, The Daily Mail, The Daily Express, The Guardian, The Mirror, The Sun, The Northern Echo,* and *The Evening Standard*—alongside six major Scottish newspapers—*The Independent, The Scotsman, The Herald, The National, The Courier,* and *The Press and Journal.*

Specifically, to extract the articles from the newspapers of interest, the following query is used in Factiva to search for newspapers: *'gh|courir|sc|ind|ns|nrco|thesun|dmirr|grdn|theexp|mosm|daim|dt|st|t|fabp'*. This query yields twenty-one newspaper titles, including: *Aberdeen Press & Journal, Daily Mail, Evening Standard, London Evening Standard, Mail on Sunday, Mirror, The Courier, The Daily Express, The Daily Mirror, The Daily Telegraph, The Evening Standard, The Guardian, The Herald, The Independent, The Mail on Sunday, The Northern Echo, The Press and Journal, The Scotsman, The Sun, The Sunday Times, The Times.*

Some of these titles are used as alternative names for newspapers or refer to a sister publications, i.e. the *Evening Standard* and *London Evening Standard* are alternative titles for *The Evening Standard; the Aberdeen Press & Journal* is an alternative title for *The Press and Journal; The Daily Mirror* is an alternative name for the *Mirror;* and the *Daily Mail* is a sister newspaper with the *Mail on Sunday,* alternatively known as *The Mail on Sunday.* After consolidating these groupings, fifteen of the sixteen originally selected newspapers of interest are confirmed to be included in the dataset. *The National* is absent from the search results, possibly due to Factiva's classification criteria, which may not systematically categorize articles from this newspaper.

Next, using Factiva's classification system, all articles in the database categorised under "Corporate/Industrial News" and tagged as related to Scotland are identified and retrieved. This procedure yields a total corpus of 205,630 news articles covering the period from January 1, 2006, to September 30, 2024.[1]

Figure 1 illustrates the annual evolution of the total number of news articles by newspaper title. Notably, a significant decline in the total volume of articles is observed after 2010.This drop can be attributed to several potential factors, including changes in classification standards by Factiva, which likely resulted in a reduced volume of articles being accessed post-2010. Additionally, several key shifts in the media landscape, industry practices, and broader societal trends might have also played a role. For instance, the rise of digital platforms and the decline in print media have drastically reshaped news production and consumption. Traditional

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[1] Articles were retrieved from Factiva on October 12, 2024.

newspapers scaled back print articles as digital formats became dominant, with cost pressures and reduced advertising revenue driving a focus on fewer, more impactful stories. This shift, combined with click-driven online content, reduced long-form reporting and regional coverage.

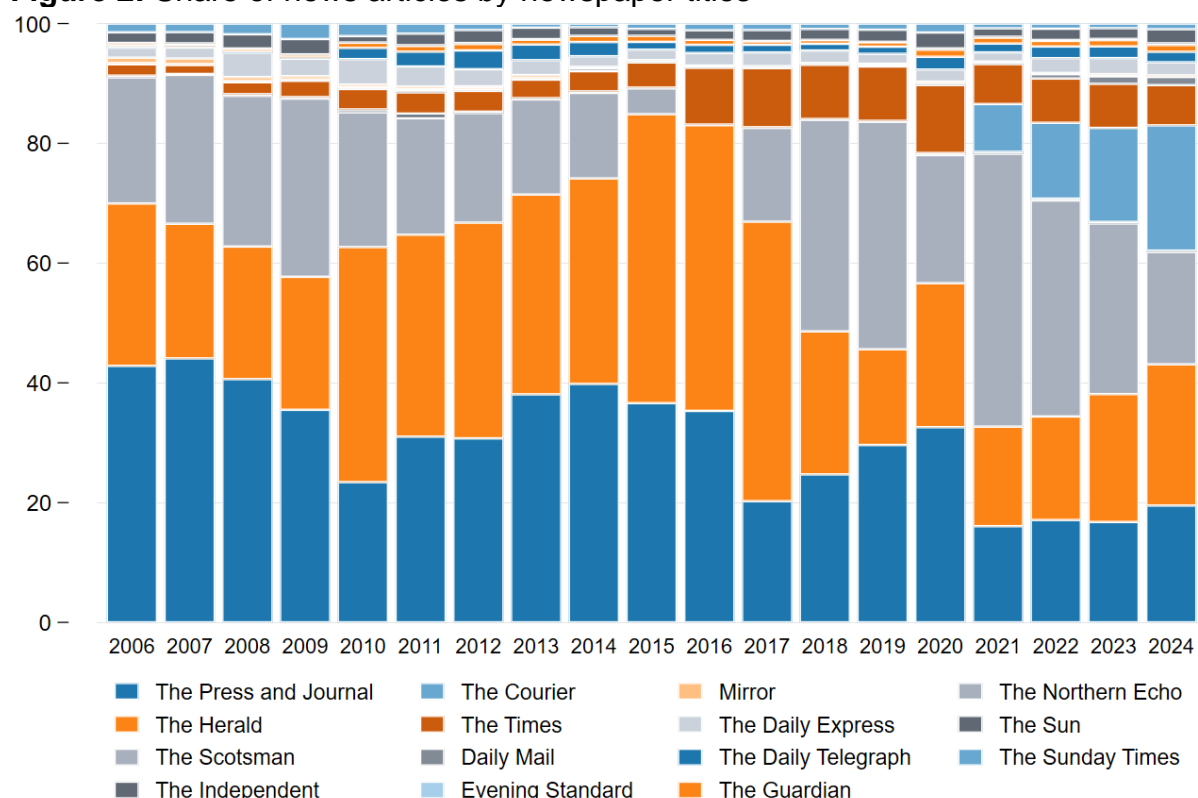**Figure 1:** Total number of news articles by newspaper titles
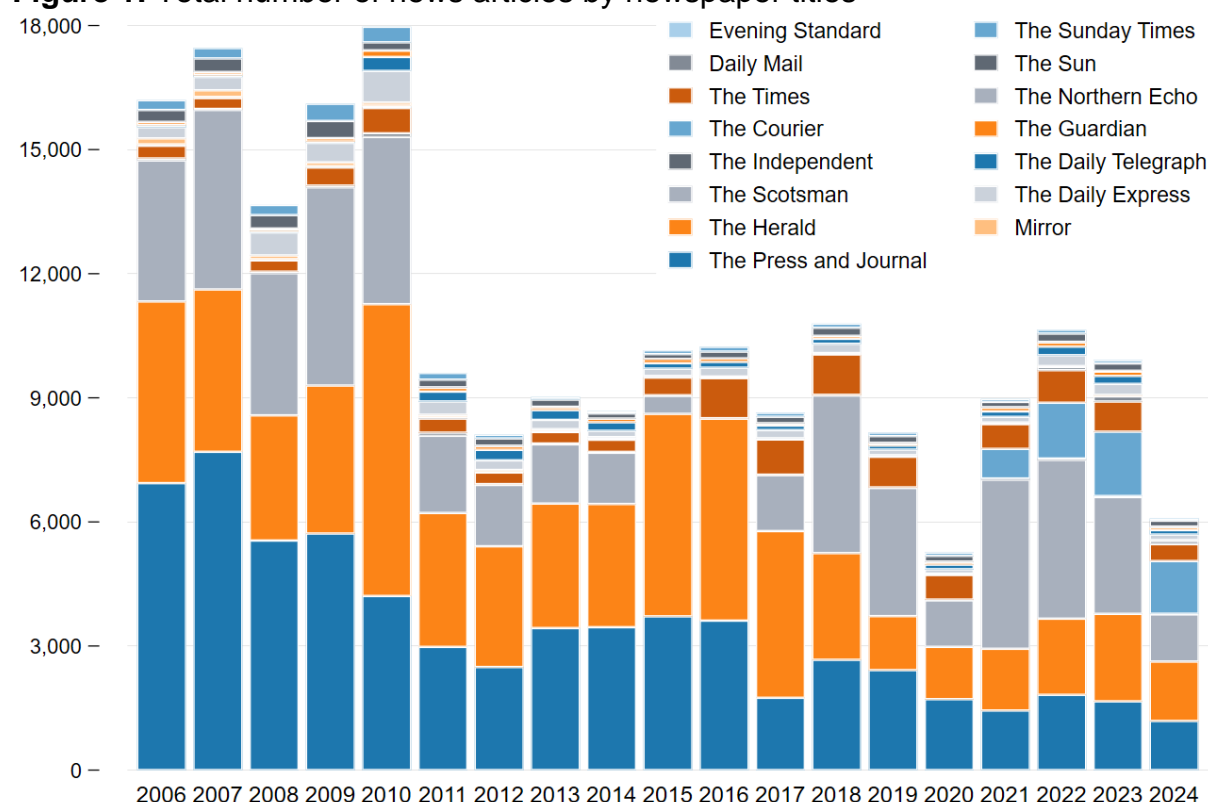
Notes: The figure plots the yearly number of news articles by newspaper title that the Factiva database classifies as related to Scotland and under the "Corporate/Industrial News" category when using the following search query:
'gh|courir|sc|ind|ns|nrco|thesun|dmirr|grdn|theexp|mosm|daim|dt|st|t|fabp'. The total corpus consists of 205,630 news articles covering the period from January 1, 2006, to September 30, 2024.

Additionally, content priorities shifted during the 2010s, with major political events like the Scottish Independence Referendum and Brexit dominating coverage at the expense of other topics. Global events, such as the 2008 financial crisis and the COVID-19 pandemic, disrupted reporting, with attention focused on public health and government responses.

In the same spirit, Figure 1 also highlights variations over time in the distribution of articles across newspapers, particularly among Scottish publications. However, as depicted in Figure 2, the overall share of articles from Scottish newspaper titles has remained relatively stable, averaging approximately 85% throughout the sample period. This share ranged from 90% at the beginning of the period to 82% at the end, while the remaining 15% of articles were contributed by the ten selected non-Scottish UK newspapers.

Figure 2: Share of news articles by newspaper titles

Notes: The figure plots the yearly share of news articles by newspaper title that the Factiva database classifies as related to Scotland and under the "Corporate/Industrial News" category when using the following search query: *'gh|courir|sc|ind|ns|nrco|thesun|dmirr|grdn|theexp|mosm|daim|dt|st|t|fabp'*. The total corpus consists of 205,630 news articles covering the period from January 1, 2006, to September 30, 2024.

3 Technical Details & Construction

This section details the methodology used to construct the Business Sentiment Index (BSI), covering both overall sentiment analysis and topic-specific sentiment extraction. It outlines the use of the Loughran and McDonald (2011) dictionary for measuring sentiment in business news and explains how the Latent Dirichlet Allocation (LDA) model is applied to identify relevant topics. Additionally, it describes how topic-specific BSIs are derived and discusses the rationale behind the selection of the optimal number of topics for analysis.

3.1 Overall Business Sentiment Analysis

The overall sentiment of business news is measured using the Loughran and McDonald (2011) (LM) dictionary, which is specifically designed to tailor word classifications for corporate and financial contexts. Unlike general-purpose sentiment dictionaries, the LM dictionary adjusts the classification of financial terms that might otherwise be misinterpreted as negative (e.g., "liability" and "capital") and refines positive and uncertain wording to better reflect the unique language used in regulatory filings, earnings announcements, and media coverage of firms.

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In practice, each article's sentiment score is calculated by taking the difference between its count of positive and negative words and dividing this difference by the total word count in the article. These article-level sentiment scores are then averaged for each month and multiplied by one hundred to produce the monthly Business Sentiment Index (BSI), expressed in percentage terms. This index is designed to capture fluctuations in the tone of business reporting over time.

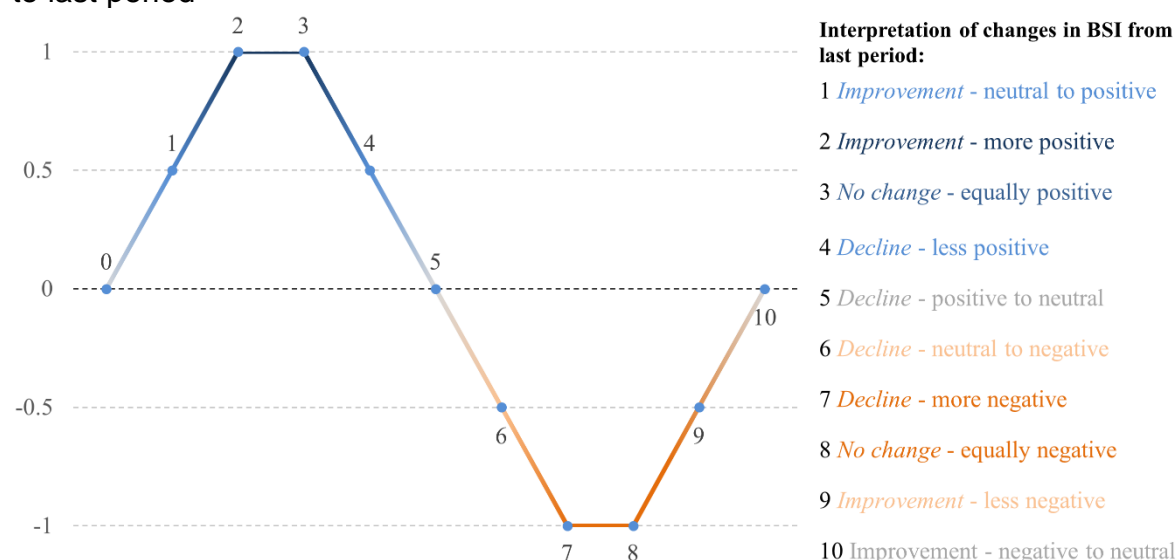**Figure 3a:** Overall Business Sentiment Index (monthly series)
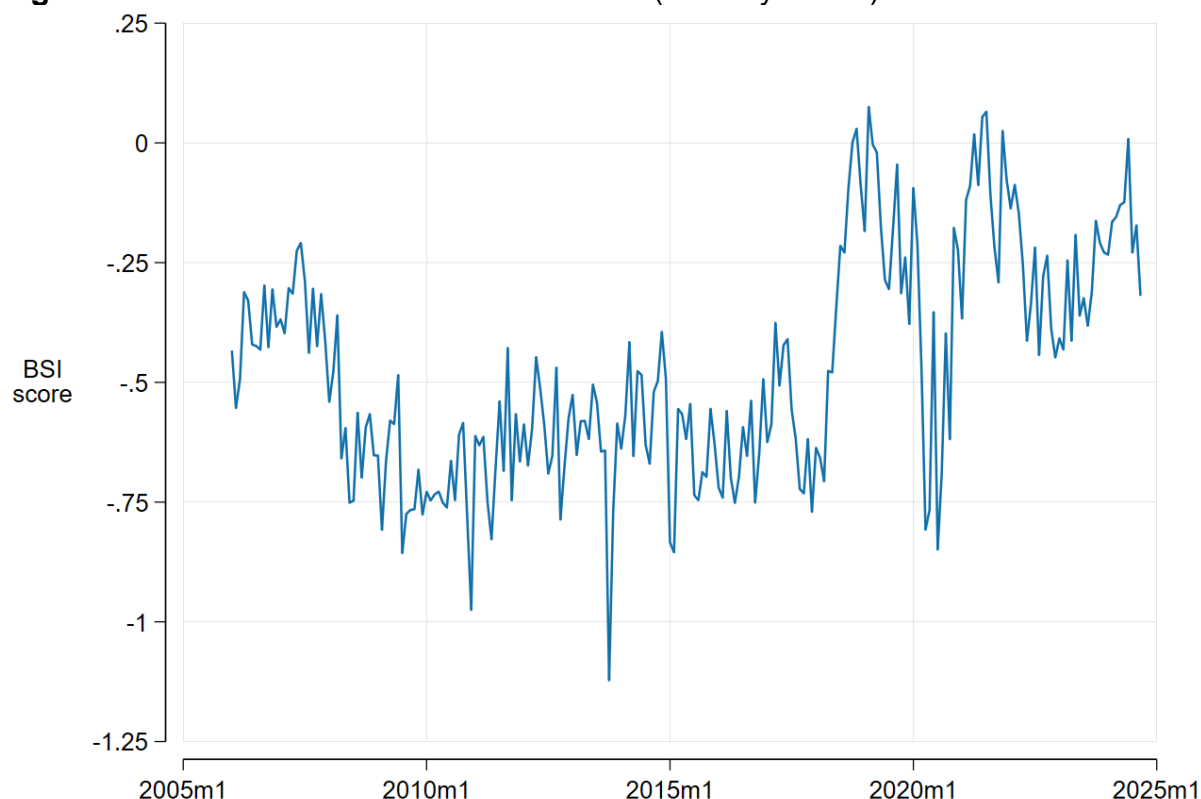
Notes: The figure plots the monthly series of the Overall Business Sentiment Index covering the period from January 1, 2006, to September 30, 2024, and constructed using Factiva data.

For example, as shown in Figure 3a, the BSI value of -1.12% in October 2013 (the lowest in our sample) indicates that the count of negative words exceeded positive words by a proportion equivalent to 1% of the total word count in the relevant articles of that month, reflecting an overall negative sentiment in business news. Compared to the previous month's BSI score of -0.64%, the sentiment in October 2013 was approximately twice as negative, declining by 0.5 percentage points. In numerical terms, this means that, relative to September 2013, the proportion of negative words exceeding positive words increased by an additional 0.5 percentage points of the total word count.

To assist policymakers and stakeholders in interpreting the BSI, it is important to understand how sentiment fluctuations translate into economic trends. A positive BSI reflects business optimism and may indicate economic expansion, while a negative BSI suggests deteriorating business sentiment. To enhance interpretability, Figure 3b provides a classification of sentiment trends, ranging from mild to strong

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improvements or declines compared to last period. Furthermore, for further insights on aggregation and normalization procedures affecting the BSI, see Section 4.6.

Figure 3b: Interpretation of changes in Overall Business Sentiment Index compared to last period

Interpretation of changes in BSI from last period:

1 *Improvement* - neutral to positive

2 *Improvement* - more positive

3 *No change* - equally positive

4 *Decline* - less positive

5 *Decline* - positive to neutral

6 *Decline* - neutral to negative

7 *Decline* - more negative

8 *No change* - equally negative

9 *Improvement* - less negative

10 Improvement - negative to neutral

Notes: This is a stylised figure on how to interpret changes in the Overall Business Sentiment Index compared to the previous period.

3.2 Topic-specific Business Sentiment Analysis

To construct topic-specific Business Sentiment Indices (BSIs), relevant topics must first be identified. This is achieved using the Latent Dirichlet Allocation (LDA) model, an unsupervised machine-learning method designed to uncover latent thematic structures in a corpus without requiring manually labelled training data, which can be highly labour-intensive (Blei, Ng, and Jordan 2003). The LDA model autonomously learns the structure of the data and detects latent patterns or thematic groupings. In this context, the model identifies underlying topics in the corpus and automatically associates news content with these topics.

A key advantage of the LDA model is its ability to be readily updated as new data become available, making it well-suited for tracking the evolution of topic-specific content over time in a cost-effective and near real-time manner, depending on the highest frequency at which data are available.[2]

Formally, the LDA characterizes each document as a probabilistic mixture of latent topics, with each topic modelled as a probability distribution over all words in the model's vocabulary. In simpler terms, a topic consists of a group of words, each contributing to varying degrees in the topic. The model estimation process involves

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[2] For more details and relevant references about the LDA model, see Section 2.3 in Chung et al. (2022) or the most up to date version of the working paper provided by the authors.

placing Bayesian priors on these distributions, enabling a principled inference of coherent themes.

The LDA model generates two primary outputs: (1) the probability distribution of words within each topic, which is used to identify the most significant words—those with the highest probabilities—for labelling each topic (see Appendix for details on topic modelling results); and (2) the probability distribution of topics within each document, which facilitates the construction of article-specific time-series shares of topic coverage.

Once topics have been identified, topic-specific BSIs are constructed at a monthly frequency as a weighted average of the article-specific Overall BSIs (computed earlier), weighted by the article-specific shares of topic coverage (as determined by the LDA model).

Operationalising the LDA model requires specifying the total number of topics, a key parameter in model selection. The primary consideration in topic selection is the extent to which topics of interest are meaningfully grouped. To assess this, the LDA model is applied to configurations with 30, 40, 50, 60, 70, and 80 topics,[3] revealing that 50 topics provide the most coherent and interpretable groupings.

In particular, a smaller number of topics tends to merge distinct themes, while an excessive number of topics results in topics that are difficult to interpret. For example, in a 30-topic model, the topic on taxes combines tax-related discussions with political themes, as indicated by the keywords in this topic, i.e. "*government uk minister snp labour tax party leader policy public scotland sturgeon country people eu secretary vote independence support political*" (see Topic 24). Conversely, in a 60-topic model, the keyword '*tax*' appears both in Topic 18—"*government business uk tax support small industry scheme economy sector minister rate eu economic scotland policy budget plan country change*"—and Topic 53—"*pay gbp cost tax pension bonus million scheme paid salary increase payment wage charge price benefit income executive annual rate*"—diluting its thematic clarity.

Upon manually reviewing the 50 topics generated by the model, Topic 24 is determined to be uninformative and irrelevant to the context of Scottish business. The words in this topic do not form a coherent or actionable theme within the business domain, making it difficult to label or utilise effectively for analysis.[4] Therefore, the final output includes 49 topic-specific BSIs suitable for further analysis.

As illustrated in Figure 4a, the shares of topic coverage (averaged across all periods), range from 4.7% for the topic "*Company Profits and Financial Results*" to

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[3] Please see a list of topics with results for 30, 40, 50, 60, 70, and 80 topics.
[4] The words identified for topic 24 are: "*time people dont make year back thing big long im problem world bit work point money life put find fac*". See Appendix for the words identified in all other topics.

0.5% for the topic "*Sports Championships and Competitions*". While some topics receive larger coverage than others, the dispersion is not substantial, with an average topic coverage of 2%, a standard deviation of 0.9% over all periods, and the top 10 topics collectively covering approximately 32% of the content.

Figure 4a: Shares of topic coverage for 50 topics, averaged across all periods (%)
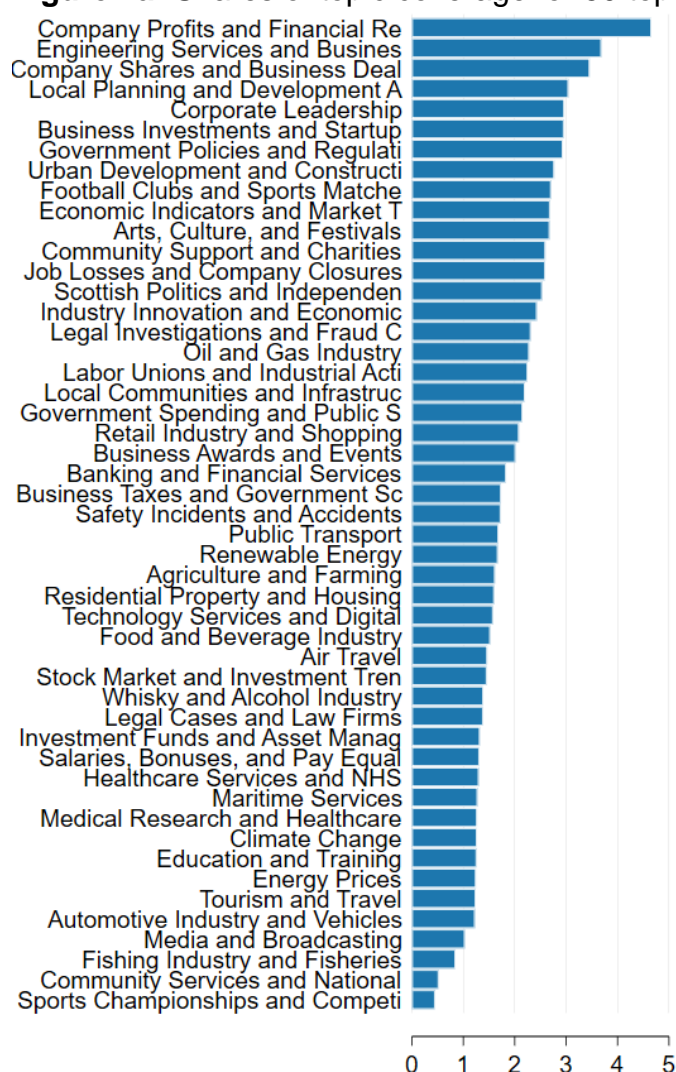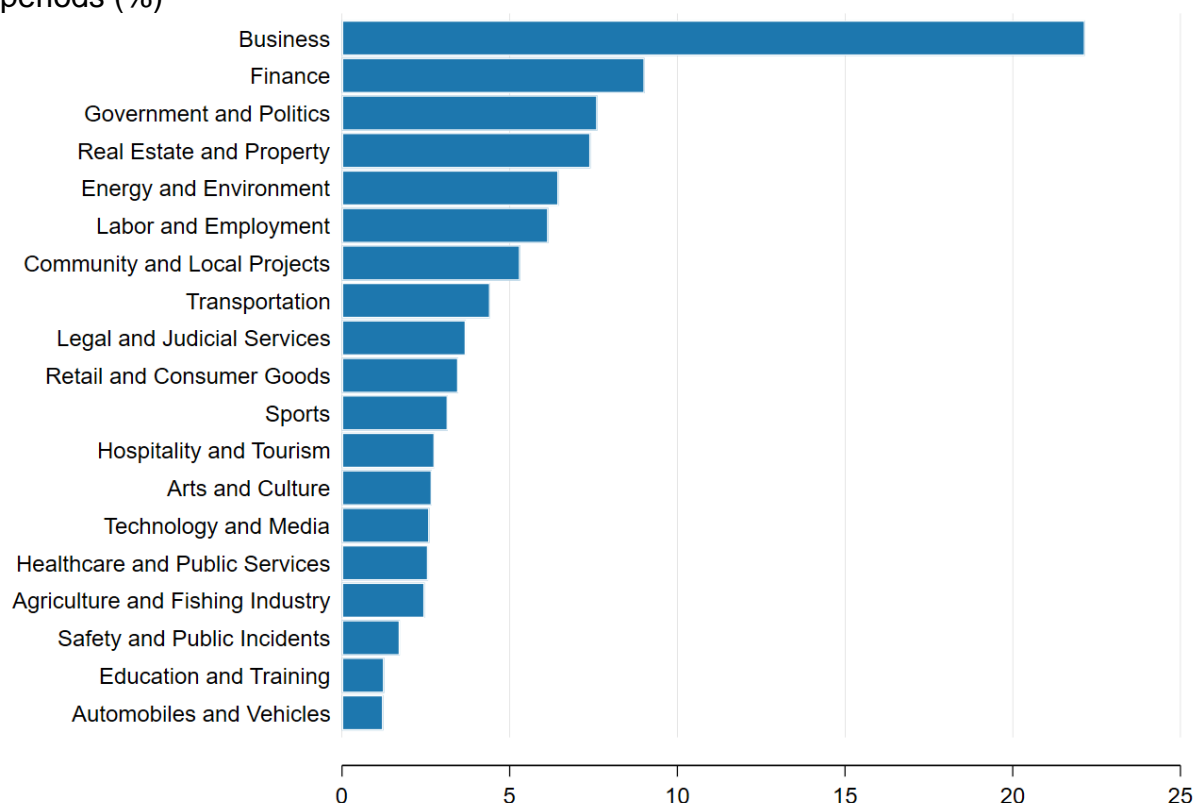

Notes: The figure plots the % share of topic coverage averaged across all periods for each of the 50 topics produced by the LDA topic modelling using Factiva data. Note, that the topic "Other" refers to topic 24 in the 50-topic model, which is meaningless and uninformative in the context of Scottish business news, and thus not relevant to use for topic-specific sentiment analysis.

To provide a broader analytical scope, results are also presented based on an aggregation of the 50 topics into 20 broader categories. This aggregation is performed manually, with a detailed mapping of the topics provided in the Appendix. Figure 4b displays the share of topic coverage averaged across all periods for the 20 broad topics. The most prominent topics are "*Business*" and "*Finance*" with coverage shares of 22% and 9%, respectively, while the least covered topics, "*Education and*

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Training" and "*Automobiles and Vehicles,*" each account for 1.2%. Overall, the top 10 topics represent approximately 75% of the content.[5]

Figure 4b: Shares of topic coverage for 20 aggregated topics, averaged across all periods (%)

Notes: The figure plots the % share of topic coverage averaged across all periods for each of the 20 aggregated topics produced by the LDA topic modelling using Factiva data. Note that the aggregation to 20 broad topics is done manually and a detailed list of the exact topics used from the 50-topic model is provided in the Appendix. Note, that the topic "Other" refers to topic 24 in the 50-topic model, which is meaningless and uninformative in the context of Scottish business news, and thus not relevant to use for topic-specific sentiment analysis.

It is important to highlight here that a topic-specific BSI at the monthly level is constructed as a topic-share weighted average of article-specific overall BSIs in each month. As such, the variation in topic-specific BSIs can be driven by both the overall BSI in each article and the shares of topic coverage in each article.

It is important to note that a topic-specific BSI at the monthly level is constructed as a topic-share-weighted average of article-specific overall BSIs. Also, recall that the Overall BSI is a direct outcome of the Loughran and McDonald (LM) general-purpose sentiment dictionary and is not explicitly linked to the extent to which a given topic is covered within an article. Consequently, variations in topic-specific BSIs can be influenced by both the overall BSI of individual articles and the shares of topic coverage within those articles. Figure 5 illustrates this point where there is no clear cut assortative ranking between the correlation coefficient of each of the 50 topic-

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[5] For both the 50 topics and the 20 aggregated topics the topic coverage allocations appear to be rather stable with only small differences over the years (see Figure A.1 and A.2 in the Appendix).

specific BSIs with the Overall BSI and the respective shares of topic coverage. For instance, for Topic 46 "Tourism and Travel" with low shares of topic coverage (1.24%) the respective topic-specific BSI exerts a high correlation with Overall BSI—with a correlation coefficient of 0.7.

Figure 5: Correlation of each of the 50 topic-specific Scottish Business Sentiment Index (BSI) with Scottish Overall BSI and shares of topic coverage for 50 topics, averaged across all periods (%)
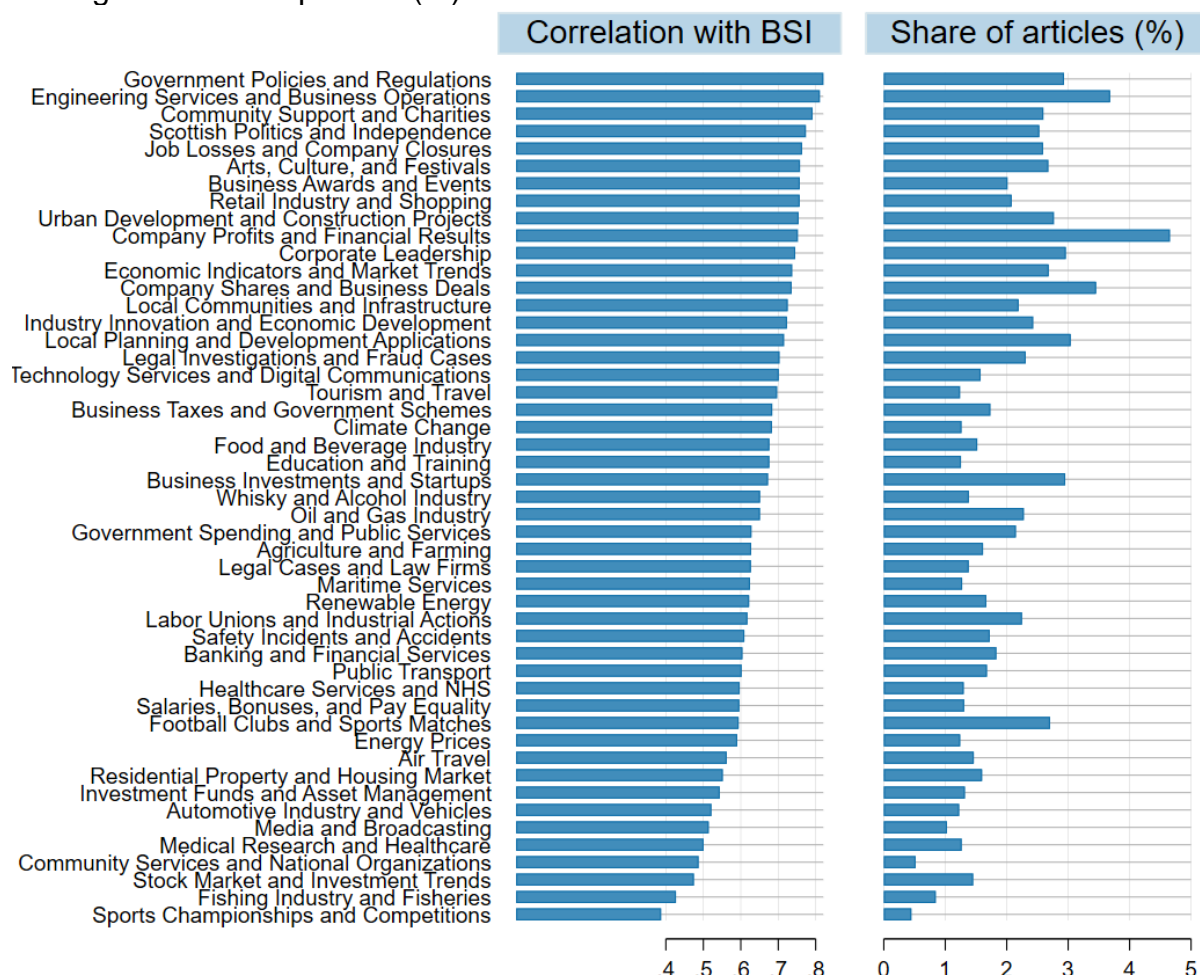
Notes: The figure plots the correlation coefficient for each of the 50 topic-specific Scottish Business Sentiment Index (BSI) with the Scottish Overall BSI (left panel) and the % share of topic coverage averaged across all periods for each of the 50 topics (right panel) produced by the LDA topic modelling using Factiva data. Note, that the topic "Other" refers to topic 24 in the 50-topic model, which is meaningless and uninformative in the context of Scottish business news, and thus not relevant to use for topic-specific sentiment analysis.

4 Validation

To assess the validity of the BSIs and their relationship with key aspects of the economy, this section examines correlations with alternative or closely related indicators, explores potential associations with significant events, and identifies underlying drivers that can enhance the effective use of these indicators.

In short, Table 1 provides a condensed summary of the key relationships found below between the BSI and other economic indicators. Overall, the evidence suggests that the BSI is a robust leading indicator of GDP and employment trends, while its relationship with uncertainty indices varies over time. These insights highlight the BSI's potential utility for forecasting economic conditions.

Table 1: Summary of BSI links with key economic indicators

Indicator	Correlation with BSI	Key Insight
CSI (Consumer Sentiment Index)	Positive (0.6)	Moves in sync with business sentiment, but **lags** behind during economic shifts.
Macroeconomic Indicators (GDP, Employment)	Positive (0.6 & 0.55)	BSI correlates and tends to **precede** GDP or employment, acting as a leading indicator for economic trends.
Economic Policy Uncertainty (EPU)	Near-zero (pre-2015), negative (post-2015)	Increased uncertainty **moves opposite to** BSI, especially after events like Brexit.
Sector Sentiments	Varies by sector	Certain sectors, e.g. **whisky and oil,** react more strongly to global events and market shifts.
Government Policy	Positive links	**Government decisions** (e.g. fiscal or regulatory) directly affect business sentiment.

Notes: This summary table condenses the key relationships between the BSI and other economic indicators discussed in detail in Section 4.

## 4.1 Correlation with Scottish Consumer Sentiment Index (CSI)

As an initial exercise, the Overall Business Sentiment Index (BSI) is compared with the Scottish Consumer Sentiment Index (CSI), which is derived from a survey measuring households' current sentiment and future expectations regarding economic performance, household finances, and attitudes toward spending. The CSI serves as a composite measure of consumer sentiment in Scotland, based on a face-to-face survey assessing households' views over the past 12 months and their expectations for the next 12 months in three key areas: Scottish economic performance, financial security, and spending behaviour. The original CSI series is available on a quarterly basis from Q2 2013, with a monthly series introduced in April 2019.[6]

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[6] Due to the coronavirus pandemic, data was not collected in the last two weeks of March 2020 and in April 2020 and May 2020. Find more information about the data and methodology at the Scottish Consumer Sentiment Indicator - 2024 Quarter 3 (Scottish Government).

Scottish CSI (monthly series - available from April 2019 onwards)

To align with the monthly frequency of the BSI, the analysis begins with the monthly series of consumer sentiment. The Scottish Overall BSI exhibits a strong positive correlation with the monthly composite Scottish CSI. Specifically, the correlation coefficients between the BSI and the composite CSI for current conditions, future expectations, and the overall index (average of the two) are 0.5, 0.3, and 0.6, respectively. Figure 6 illustrates that the composite CSI closely tracks the evolution of the overall BSI.

Figure 6: Scottish Business Sentiment Index (BSI) vs. Composite Consumer Sentiment Index (CSI)
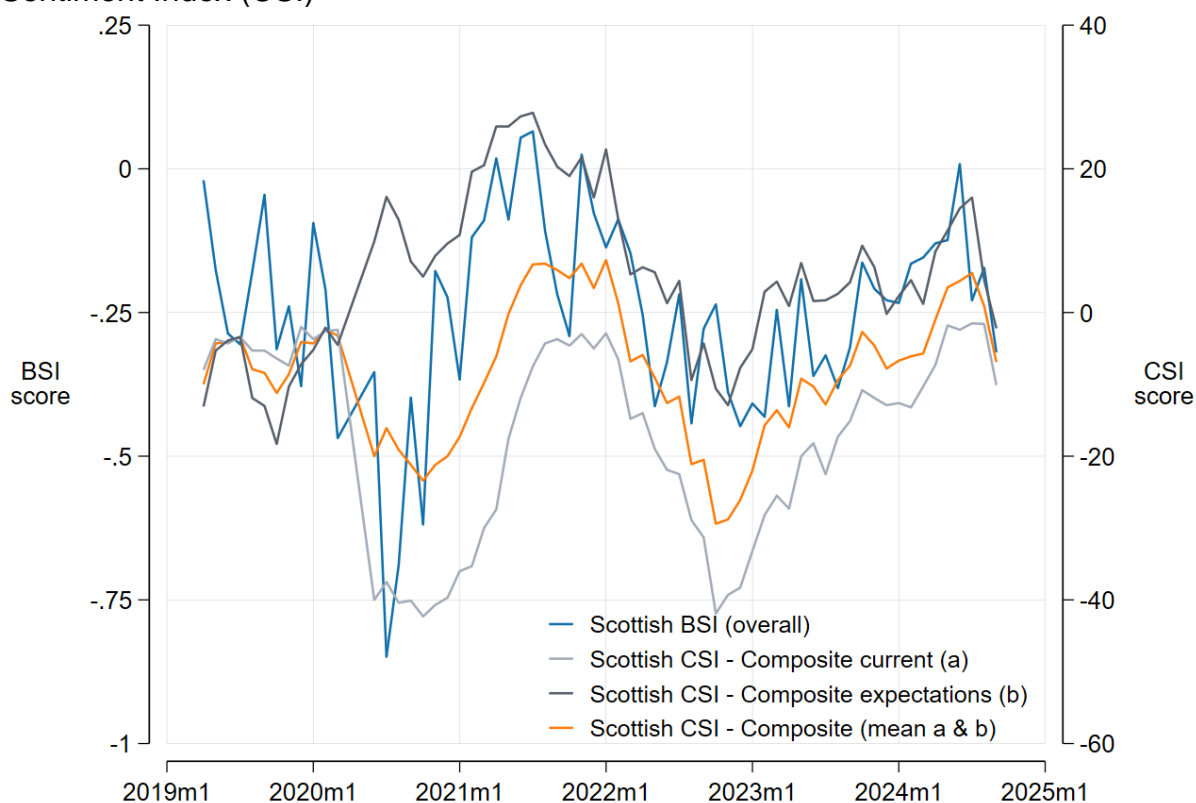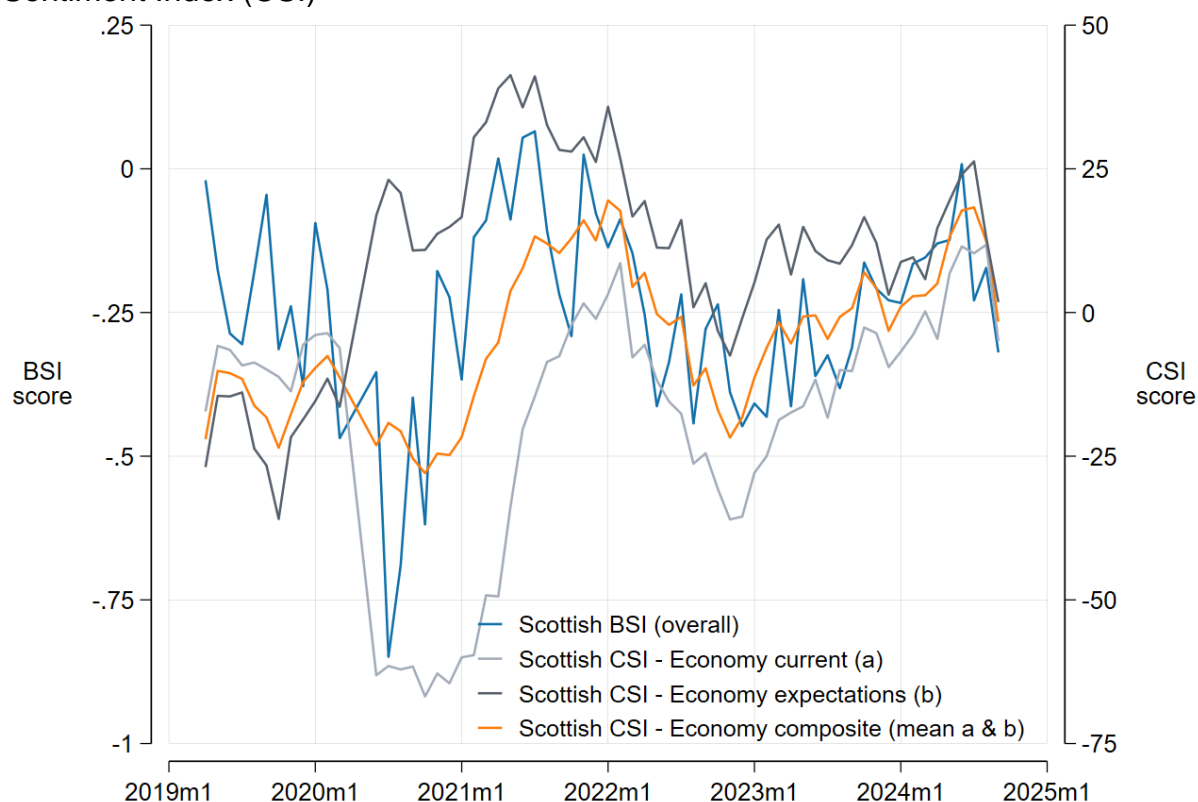

Notes: The figure plots the monthly frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the monthly series for the Composite Scottish Consumer Sentiment Index (CSI - right axis), which is available from April 2019 and can be found at the Scottish Consumer Sentiment Indicator - Monthly Data (Scottish Government). Due to the coronavirus pandemic, data was not collected in the last two weeks of March 2020, and in April 2020 and May 2020.

The composite CSI represents an average of consumer sentiment indices related to economic performance, household finances, and spending attitudes. To better align with the business-related focus of the BSI, an additional comparison is conducted using only the economy-specific CSI. The correlation between the BSI and the economy-specific CSI remains strong and positive, with coefficients of 0.4, 0.2, and 0.5 for current conditions, future expectations, and the overall index, respectively. Figure 7 further validates this relationship, showing a significant co-movement between the CSI time series and the BSI.

The correlation patterns vary over time. From 2020 onwards, the correlation strengthens, whereas prior to 2020, the relationship becomes negative, indicating that the two series moved in opposite directions during that period. To further investigate this pattern, the analysis is extended using the longer-term quarterly CSI series.

Figure 7: Scottish Business Sentiment Index (BSI) vs. Economy Consumer Sentiment Index (CSI)

Notes: The figure plots the monthly frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the monthly series for the Scottish Consumer Sentiment Index for the Economy (CSI - right axis), which is available from April 2019 and can be found at the Scottish Consumer Sentiment Indicator - Monthly Data (Scottish Government). Due to the coronavirus pandemic, data was not collected in the last two weeks of March 2020, and in April 2020 and May 2020.

Scottish CSI (quarterly series - available from Q2 2013)

To facilitate a longer-term comparison, the analysis incorporates the quarterly Scottish CSI series, available from Q2 2013. The quarterly BSI series is constructed by averaging the monthly BSI values, allowing for direct comparison with the quarterly CSI.

Consistent with findings from the monthly analysis, the quarterly BSI exhibits a strong positive correlation with the quarterly CSI for both the composite and economy-specific indices, particularly from Q2 2019 onwards. The correlation coefficients between the BSI and the composite CSI for current conditions, future expectations, and the overall index are 0.6, 0.4, and 0.7, respectively. Similarly, the

correlation coefficients for the economy-specific CSI are 0.5, 0.3, and 0.6. Figures 8 and 9 illustrate these relationships.

The positive correlation becomes even stronger post-2019, while prior to 2020, it turns negative, remaining negative throughout the earlier years of the series. This trend highlights that business and consumer sentiment can move in opposite directions at times.

A few general notes are in order. First, for both the composite and economy-specific CSIs, consumer sentiment regarding future expectations over the next 12 months exhibits the weakest correlation with the BSI. In contrast, consumer sentiment on past economic performance over the preceding 12 months shows a stronger relationship with the BSI. This suggests that business sentiment, which reflects a mix of current conditions, expectations, and other external factors, is not fully captured by consumer sentiment indices.

Figure 8: Scottish Business Sentiment Index (BSI) vs. Composite Consumer Sentiment Index (CSI)
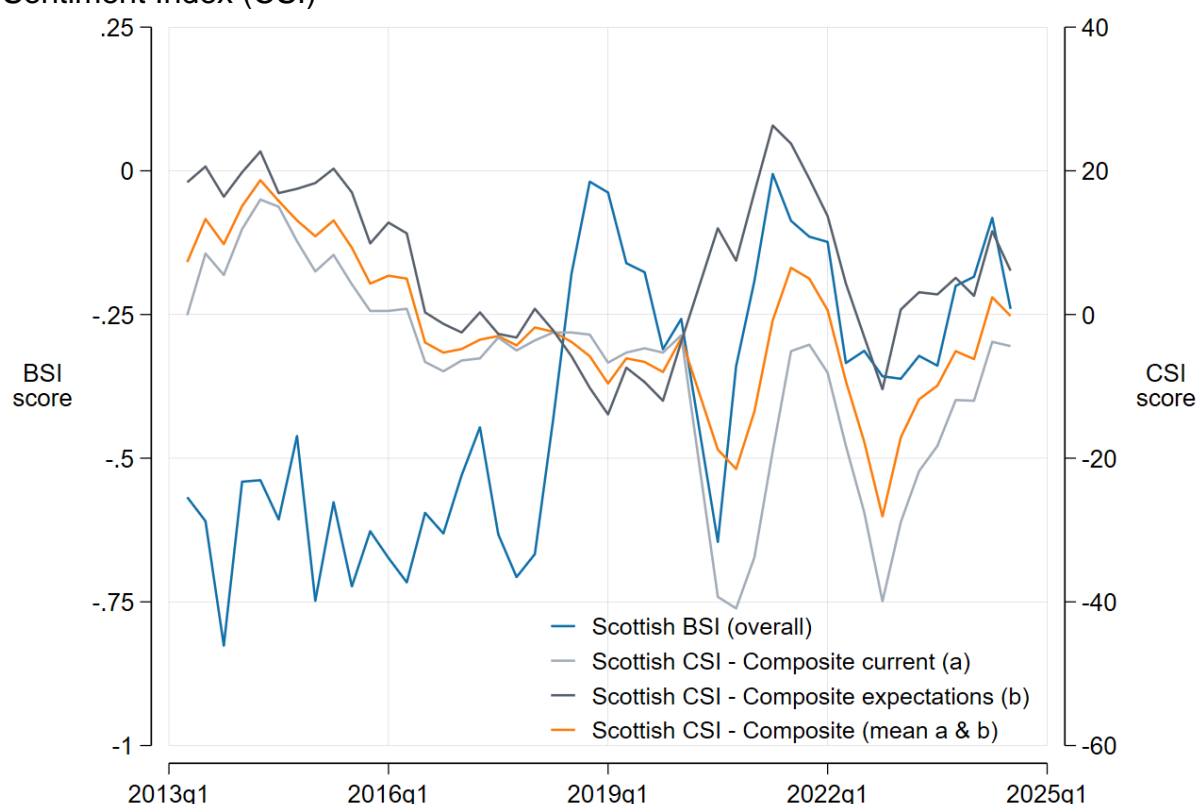
Notes: The figure plots the quarterly (average of monthly) frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Composite Scottish Consumer Sentiment Index (CSI - right axis), which is available from Q2 2013 and can be found at the Scottish Consumer Sentiment Indicator - 2024 Quarter 3 (Scottish Government). Due to the coronavirus pandemic, data was not collected in the last two weeks of March 2020, and in April 2020 and May 2020.

Second, the strong positive correlation observed from 2020 onwards contrasts with the negative correlation seen before 2020. This may indicate that consumer and

business sentiment can diverge over time or move with a time lag, possibly due to differences in how (potential) economic shocks or policy changes are perceived by businesses and households.

For example, in 2018, despite the mixed picture in the UK's economic landscape, i.e. positive domestic growth tempered by heightened uncertainties surrounding Brexit negotiations and rising global trade tensions, Scotland experienced robust GDP growth, a strong labour market and accelerated growth in manufacturing and exports. These positive developments are likely to have significantly boosted business sentiment across Scotland as shown in the previous figures by the large increase in BSI during 2018. In particular, the largely negative sentiment score of roughly -0.6 became zero (neutral) or even positive for the first time in the period available in the data. However, these large improvements in business sentiment were not mirror by consumers, as the CSI remained negative and rather stable with scores hovering around -0.4. Conversely, during significant economic shocks such as the COVID-19 lockdowns, business and consumer sentiment moved more closely together.

Figure 9: Scottish Business Sentiment Index (BSI) vs. Economy Consumer Sentiment Index (CSI)
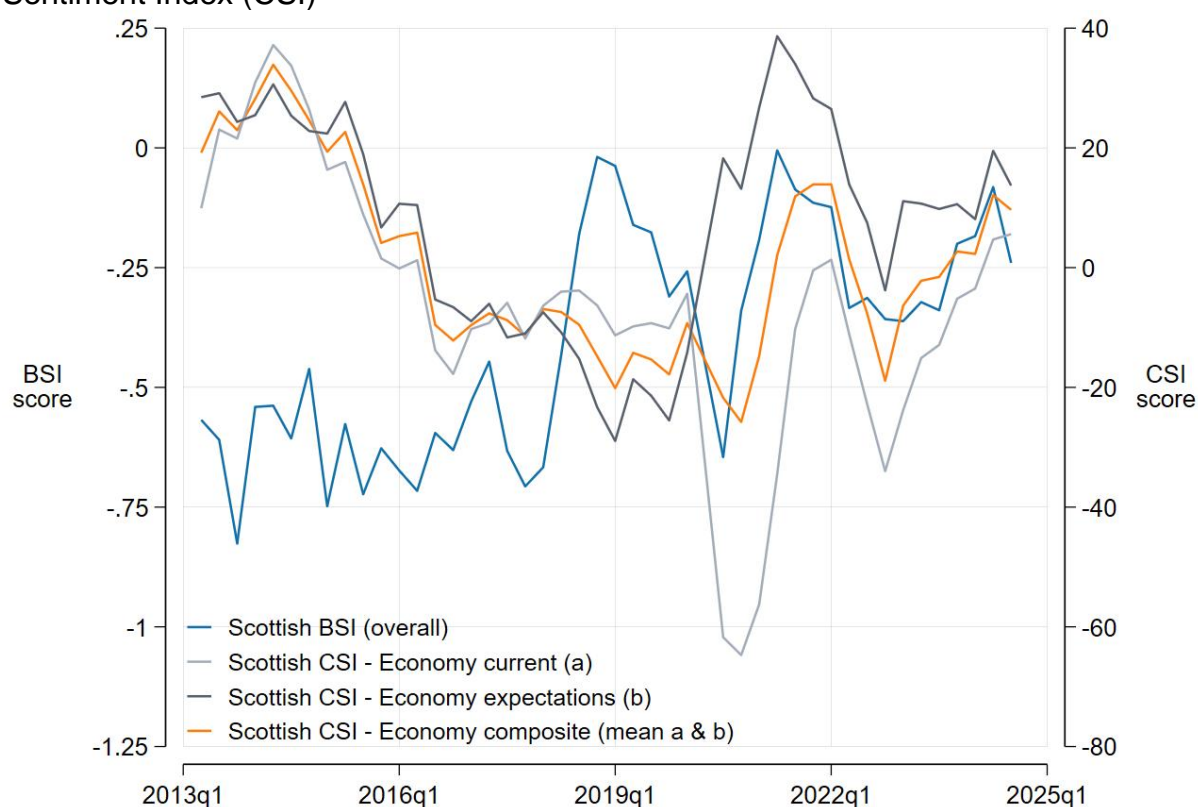
Notes: The figure plots the quarterly (average of monthly) frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Scottish Consumer Sentiment Index for the Economy (CSI - right axis), which is available from Q2 2013 and can be found at the Scottish Consumer Sentiment Indicator - 2024 Quarter 3 (Scottish Government). Due to the coronavirus pandemic, data was not collected in the last two weeks of March 2020, and in April 2020 and May 2020.

The BSI series exhibits greater volatility compared to the CSI, indicating that the business sector may be more sensitive to economic shocks and uncertainty. Businesses often adopt a more short-term, reactive outlook, leading to sharper fluctuations in sentiment in response to both positive and negative developments. This volatility may also be attributed to differences in the methodologies used to construct the BSI and CSI. The BSI, which captures sentiment in a more dynamic manner, may better reflect short-term changes in business sentiment. In contrast, the CSI, based on surveys conducted at a monthly or quarterly frequency, may smooth out short-term reactions to economic shocks over time. This is in line with Yang et al. (2022) who further highlight that consumer sentiment and business sentiment often exhibit differential responses to economic shocks.

Overall, a perfect correlation between consumer and business sentiment is not expected, as they reflect the perspectives of different economic agents—households and businesses—each with distinct considerations and time horizons. While consumer and business sentiment may align in certain periods, divergences are likely to occur, driven by differences in economic outlooks, policy impacts, and broader market conditions. The findings underscore the importance of analysing both indices to gain a comprehensive understanding of overall economic sentiment.

4.2 Correlation with key Scottish macroeconomic variables

This section examines the relationship between the Scottish Overall BSI and key macroeconomic indicators that reflect the performance of the Scottish economy, including Gross Domestic Product (GDP) and employment levels.

Scottish GDP (quarterly series)

The Scottish Overall BSI exhibits a strong positive correlation with nominal GDP (measured in current prices, seasonally adjusted, £ billion), with a correlation coefficient of 0.6.[7] This indicates that periods of high economic growth are generally associated with high business sentiment, while economic downturns correspond with lower sentiment levels. Figure 10 illustrates this relationship, showing how the quarterly BSI and nominal GDP series tend to co-move, particularly during major economic downturns such as the Global Financial Crisis and the COVID-19 pandemic lockdowns.[8] Furthermore, we find a correlation coefficient of roughly 0.5 between BSI and GDP (measured in constant prices 2019, seasonally adjusted, £ billion) that ensures that the link between GDP and BSI is not solely driven by
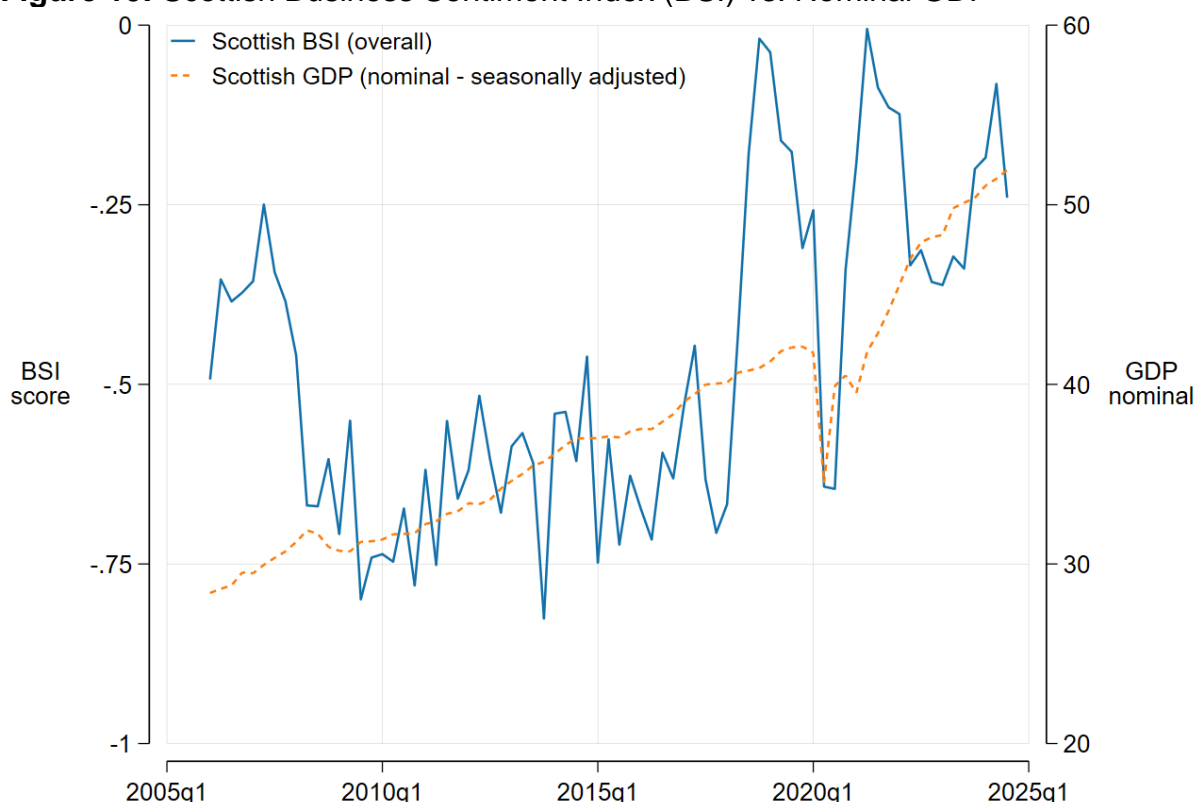
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[7] The quarterly series for the Scottish Nominal GDP in £ billion, current prices and seasonally adjusted can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).
[8] To better highlight the changes in those two indices, Figure A.3 in the Appendix plots the quarterly series of the percentage point (ppt.) changes from the previous quarter in the overall Scottish BSI and that of GDP growth. Overall, similar patterns arise as in the previous figure.

inflation and price changes (for an over time illustration of this relationship, see Figure A.4 in Appendix A.3).

Figure 10: Scottish Business Sentiment Index (BSI) vs. Nominal GDP

Notes: The figure plots the quarterly (average of monthly) frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Scottish Nominal GDP (£ billion, current prices, seasonally adjusted) which can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

Scottish employment levels (quarterly series)

The Scottish Overall BSI has a strong positive correlation with employment levels (individuals of age 16+ in employment) with a correlation coefficient of 0.55.[9]

As expected, periods of low employment coincide with reduced business sentiment, while periods of higher employment correspond with improved sentiment. Figure 11 highlights this trend, showing that the quarterly series for BSI and employment levels generally move in the same direction, particularly during major economic downturns, e.g. the Great Financial Crisis and the COVID-19 pandemic lockdowns, when employment levels decline or remain stagnant.

Notably, there is some evidence of a time lag between the BSI and these macroeconomic indicators, particularly during periods of economic downturns. In certain instances, fluctuations in BSI appear to precede changes in GDP and employment, suggesting that businesses may anticipate and react swiftly to negative

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[9] The quarterly series for the Scottish 16+ Employees in employment level (millions of individuals) can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

economic developments, such as financial crises or market contractions. This reflects a tendency for businesses to adopt a cautious and reactive stance in response to risks and uncertainties, potentially leading to reductions in investment and employment, which could further intensify economic downturns. While this pattern is evident during economic contractions, no clear trend is observed during periods of recovery.

Overall, these findings highlight the potential of the BSI as an early warning signal for changing economic conditions in Scotland. The sensitivity of business sentiment to economic shocks suggests that the predictive capabilities of the BSI may be enhanced when analysed at a more granular level, such as monthly, fortnightly, or daily frequencies.

Figure 11: Scottish Business Sentiment Index (BSI) vs. 16+ Employees in employment
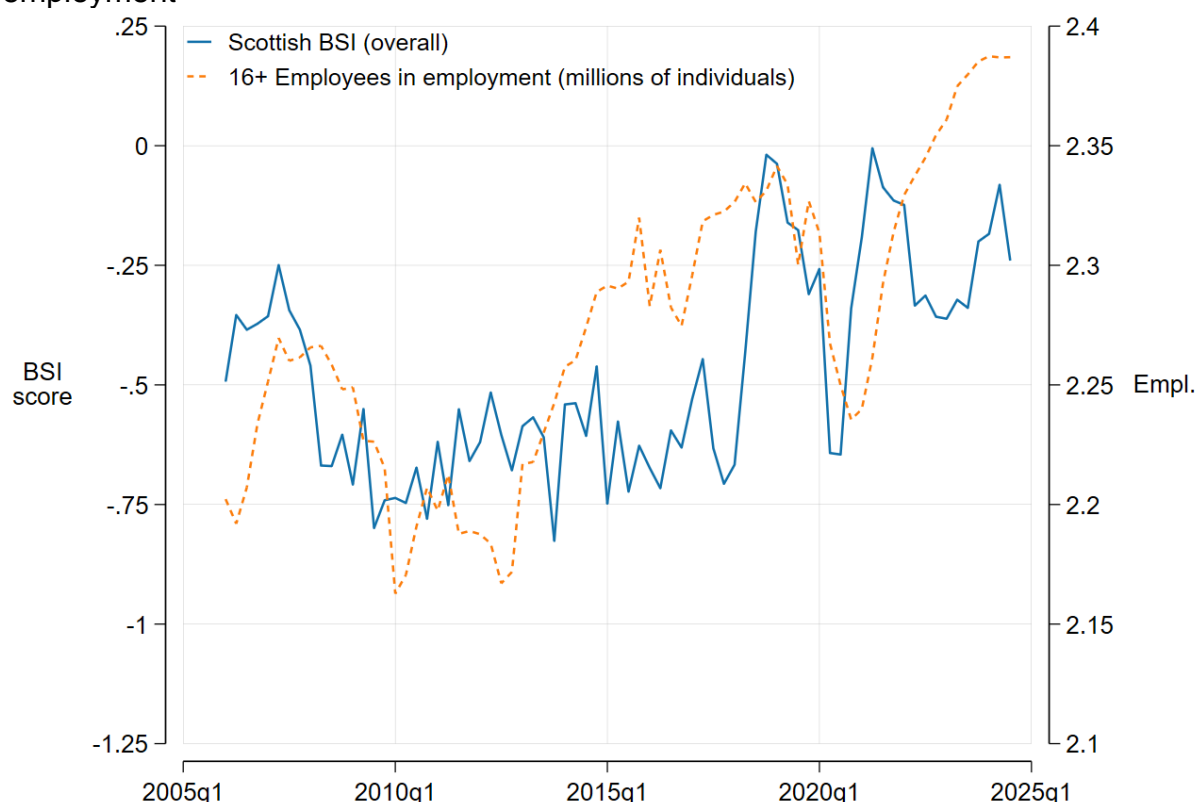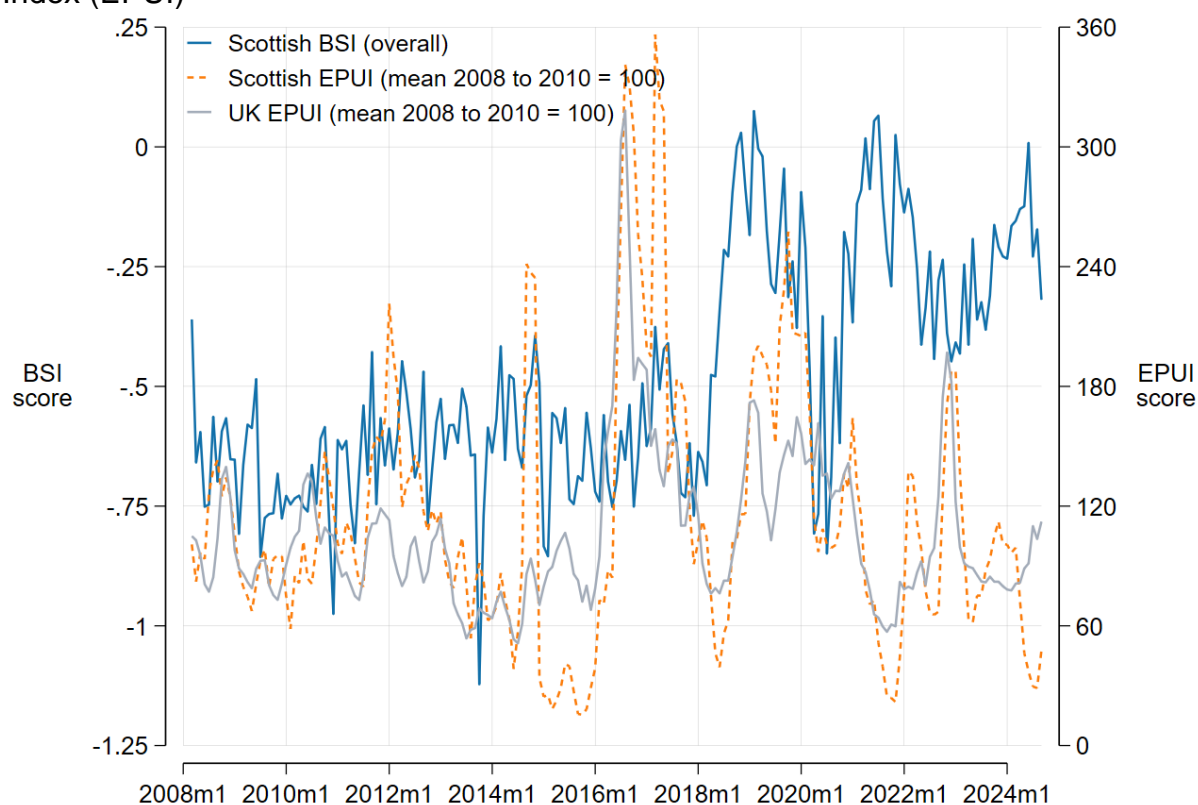

Notes: The figure plots the quarterly (average of monthly) frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Scottish 16+ Employees in employment level, in millions of individuals, (right axis) which can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

4.3 Correlation with Scottish and UK Economic Policy Uncertainty Index (monthly series)

As shown in Figure 12, the Scottish Overall BSI shows an almost zero correlation with the monthly Economic Policy Uncertainty Index for both Scotland and the UK.[10] This suggests that, in general, business sentiment and economic policy uncertainty have not moved in tandem. However, a shift is observed after 2015, when the correlation turns negative, aligning with expectations that heightened uncertainty can dampen business sentiment. In contrast, prior to 2015, the correlation remains weak and close to zero, indicating a less defined relationship during that time.

Figure 12: Scottish Business Sentiment Index (BSI) vs. Economic Policy Uncertainty Index (EPUI)

Notes: The figure plots the monthly frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the monthly series for the Scottish and UK Economic Policy Uncertainty Index (EPUI - right axis), which is standardized with a mean of 100 between March 2008 and 2010, and found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

Furthermore, when comparing the BSI to various other uncertainty indices,[11] a similar pattern emerges. This suggests that the BSI captures a broader range of

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[10] The monthly series for the Scottish and UK Economic Policy Uncertainty Index (EUI - right axis), which is standardized with a mean of 100 between March 2008 and 2010 can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).
[11] This includes a variety of uncertainty indicators, such as: Global Economic Policy, Trade Policy, Twitter Economic, Energy-Related and Oil Price, among others, available at the Economic Policy Uncertainty Platform.

economic and business dynamics beyond uncertainty alone. The multifaceted nature of the BSI may reflect its sensitivity to a diverse set of economic influences, reinforcing its value as a comprehensive economic indicator.
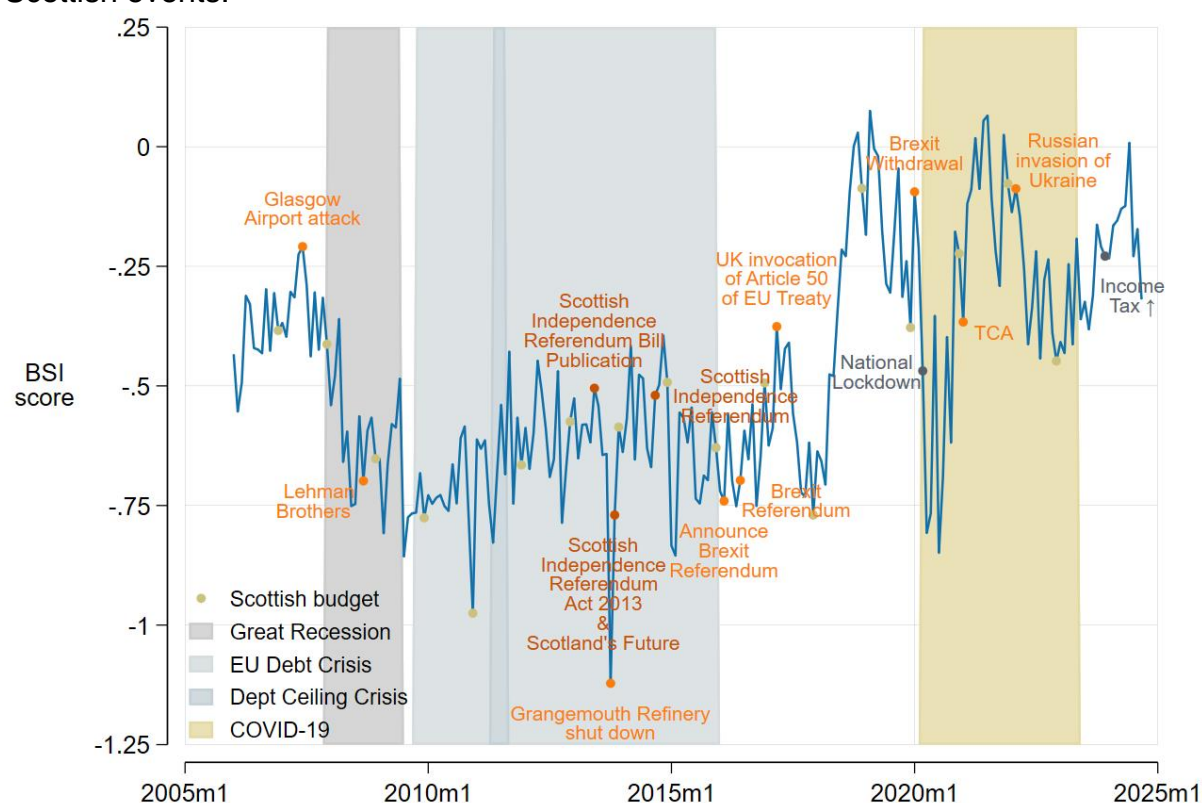
4.4 BSI and key global, UK, and Scottish events

This section discusses the extent to which the overall BSI reflects and captures key global, UK or Scottish events. Specifically, Figure 13 highlights how the Scottish BSI reacts to significant economic, political, and geopolitical events, demonstrating its sensitivity to broader societal changes. The index appears to closely mirror key developments, reflecting shifts in sentiment across the business landscape over time. Below is an overview of how various significant events shaped the Scottish BSI.

Global and national security

The BSI saw notable declines in the month following major incidents such as the Glasgow Airport attack in June 2007 and the Russian Invasion of Ukraine in February 2022. These decreases likely stem from heightened uncertainty, reduced confidence in economic stability, and concerns about national and global security.

Figure 13: Scottish Business Sentiment Index (BSI) and key global, UK, and Scottish events.

Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index constructed by the authors using Factiva data against various key global, UK and Scottish events.

Such events can disrupt business activity, strain consumer confidence, and introduce risks to both local and international markets, all of which are captured in the fluctuations of the index. The BSI's responsiveness underscores its value as a barometer for understanding how external shocks impact business sentiment in Scotland over time.

Fiscal matters - Scottish budget announcement (every December)

A recurring event of note is the annual Scottish budget announcement in December, during which details of taxes and other fiscal policies are revealed. Business sentiment in Scotland tends to dip in December, likely reflecting uncertainty and caution surrounding potential policy changes. In the following month, sentiment often rebounds, suggesting that once the budget details are digested, businesses recalibrate their expectations and adjust to the new fiscal landscape. However, there are exceptions when additional key events exacerbate uncertainty that keep sentiment low or boost sentiment. For example, the Brexit referendum announcement significantly dampened overall sentiment, countering the typical January recovery.

An especially relevant example is the December 2023 Scottish budget, which included announcements of higher income taxes. This policy change likely contributed to a slight reduction in business sentiment in January 2024, as businesses and consumers began to anticipate the broader economic impacts of the tax increase which washed away a month later. These patterns highlight how events like the budget announcement influence short-term fluctuations in sentiment as captured by the BSI.

The Great Financial Crisis (December 2007 - June 2009)

During the Great Financial Crisis, the BSI experienced a marked and sustained decline, reflecting the sharp downturn in global economic activity and heightened uncertainty. Key moments, such as the collapse of Lehman Brothers in September 2008, amplified this downward trend, as businesses faced tightening credit conditions, declining demand, and significant financial instability.

The European Sovereign Debt Crisis (October 2009 - End of 2015)

The European Sovereign Debt Crisis kept Scottish business sentiment rather negative and volatile for an extended period, reflecting ongoing concerns about the stability of the Eurozone. Notably, during the US Debt Ceiling Crisis (May – August 2011), sentiment was particularly low at the beginning of the crisis but rebounded sharply in August 2011 once a resolution was reached. The lingering uncertainty around Europe's fiscal health likely contributed to the prolonged dampened sentiment during this period.

Brexit and Related Events (2016 - 2020)

The announcement of the Brexit referendum in February 2016 coincided with a dip in business sentiment, reflecting growing uncertainty around the UK's future relationship with the EU. However, sentiment surprisingly increased after the Brexit vote in June 2016 and continued rising until the UK's invocation of Article 50 in March 2017. This rise may have been influenced by broader positive economic developments in Scotland, including the resolution of the EU fiscal crisis and robust UK-wide growth, which may have muted negative effects of the Brexit vote.

After Article 50 was triggered, sentiment declined sharply between March 2017 and early 2018, likely due to uncertainties surrounding the terms of Brexit. Nonetheless, business sentiment recovered strongly throughout 2018 and 2019, boosted by Scotland's robust GDP growth, a strong labour market, and accelerated manufacturing and export activity. By November 2018, the BSI turned positive for the first time in the data, and this positive trend largely persisted until late 2019, despite monthly fluctuations.

Post-Brexit Withdrawal (2020) & COVID-19 Pandemic (March 2020 - May 2023)

Following the UK's withdrawal from the EU in January 2020, the BSI dropped sharply, returning to pre-2018 negative levels. This coincided with the onset of the COVID-19 pandemic, which had a profound impact on business sentiment. Key events during this period include:

- **March 2020 National Lockdown**: Sentiment plummeted as restrictions were imposed, disrupting economic activity.

- **May 2020 Easing of Restrictions**: Sentiment rebounded significantly as businesses reopened and activity resumed.

- **Winter Lockdowns (Christmas 2020 – January 2021)**: Tightened restrictions during the second wave of the pandemic led to another sharp drop in sentiment.

- **January 2021 Trade and Cooperation Agreement (TCA)**: Signed between the UK and EU, it provided some stability, contributing to a rebound in sentiment alongside the rollout of Scotland's vaccination program.

- **Omicron Variant (Dec 2021 – Jan 2022)**: Restrictions associated with the Omicron wave led to another significant drop in sentiment.

- **Russian Invasion of Ukraine (Feb 2022)**: This introduced further economic and geopolitical uncertainty, particularly in energy markets, which likely affected sentiment as well.

Despite these challenges, the rollout of the vaccination program in early 2021 was associated with notable increases in business sentiment as businesses adapted to the evolving situation.

Local shocks - Grangemouth Refinery Shutdown (Oct 2013)

Another key event was the industrial action at the Grangemouth Refinery, a 48-hour strike that commenced on October 20, 2013. This action resulted in the temporary shutdown of the refinery and the Forties pipeline system, which is responsible for transporting a substantial portion of the UK's North Sea oil production. The disruption had widespread economic implications, affecting fuel supplies and contributing to a downturn in business confidence across Scotland. Overall, the shutdown of the refinery caused the BSI to reach its lowest recorded level, reflecting the severe disruption to one of Scotland's key industries.

Scottish Independence Referendum (2013 – 2014)

Following the publication of the Scottish Independence Referendum Bill in June 2013 there was a drop in sentiment, due in part to uncertainties surrounding the details of the form of the referendum. Sentiment remained low until the Scottish Independence Referendum Act 2013 provided details of the referendum. Sentiment increased during and after the referendum in September 2014, as uncertainties were resolved.

Overall, the Scottish BSI illustrates the sensitivity of business confidence to major economic, political, and geopolitical events. Periods of uncertainty and instability, such as financial crises, geopolitical conflicts, or disruptive policy decisions, tend to weigh heavily on sentiment. Conversely, clarity, economic recovery, and positive developments, such as robust growth or effective policy measures, contribute to improved business sentiment. This dynamic nature makes the BSI a valuable tool for understanding how external shocks and economic conditions influence Scotland's business environment.

It is important to highlight here that beyond economic conditions and sectoral developments, government policy emerges as a critical factor influencing business sentiment. Historical trends indicate that major fiscal and regulatory changes, such as the introduction of new tax regimes, public spending adjustments, and Brexit-related policy shifts, significantly impact business confidence. As seen in previous events like the Scottish budget announcements and Brexit negotiations, changes in government policies often coincide with sharp fluctuations in the BSI, reinforcing the importance of policy certainty in fostering stable business expectations.

4.5 Testing key sectoral events

To further confirm the reliability of the BSI, this section offers a collection of topic-specific BSIs linked to important industries within the Scottish economy, along with several key sector events anticipated to influence business sentiment in these fields.

Whisky and Alcohol Industry and US tariff on Single Malt Scotch

Figure 14 compares the monthly topic-specific BSI for the Whisky and Alcohol Industry with the overall Scottish BSI, highlighting their relationship against the backdrop of key global, UK, and Scottish events. The topic-specific BSI demonstrates a strong co-movement with the overall BSI, as evidenced by a correlation coefficient of 0.65. However, the Whisky and Alcohol Industry's BSI exhibits greater volatility, likely reflecting the unique characteristics and sensitivities of the sector (see Figure 14).

When focusing on a specific period, Figure 14 illustrates that the trend in Scottish business sentiment in the Whisky and Alcohol Industry since October 2019 is influenced by a combination of factors, tied to and unrelated to the US tariff on Single Malt Scotch Whisky. The observed fluctuations can be explained as follows.

In September 2019, the BSI stood at a relatively high level of 0.34%, reflecting stable business conditions and optimism across key sectors. However, sentiment began to decline in October 2019, dropping to 0.22% following the announcement and implementation of a 25% tariff on Single Malt Scotch Whisky by the United States as part of the long-running EU-US dispute over Airbus and Boeing subsidies. This tariff, which directly impacted one of Scotland's key export industries, raised concerns about reduced demand, revenue losses, and longer-term challenges in accessing the US market.

The downward trend continued into November and December 2019, with sentiment falling to 0.09% and 0.046%, respectively. This reflects the gradual realisation of the tariff's impact, coupled with ongoing uncertainty surrounding the UK's departure from the European Union. A slight recovery in January 2020 (0.053%) coincided with the finalisation of the Brexit Withdrawal Agreement, which provided businesses with much-needed clarity about the UK's exit from the EU on January 31, 2020.

In February 2020, the BSI experienced a sharp increase to 0.4%. This surge in sentiment may be attributed to the resolution of Brexit-related uncertainties and the perception of broader economic stability. Positive developments in sectors unrelated to whisky, such as manufacturing and domestic demand, likely contributed to this temporary optimism. The uptick suggests that businesses interpreted the clarity surrounding Brexit as a sign of reduced political risk, boosting confidence in the short term.

The onset of the COVID-19 pandemic led to a dramatic drop in sentiment, with the BSI in the Whisky and Alcohol industry plummeting to -0.355% in March 2020. The announcement of a nationwide lockdown in the UK on March 23, 2020, had an immediate and significant economic shock that disrupted nearly all sectors of the economy, particularly those reliant on exports, tourism, retail, and face-to-face interactions. While the Scotch Whisky US tariff along with Brexit might have

continued to weigh on the sector, the pandemic introduced a far larger source of uncertainty and pessimism, dominating sentiment across Scotland.

Overall, the initial decline in sentiment from October to December 2019 reflects the tariff's impact on the whisky industry and concerns about trade relations. The rebound in February 2020 likely signals temporary optimism tied to broader economic developments, such as Brexit clarity or sector-specific gains. However, the plunge in March 2020 demonstrates the overwhelming impact of the COVID-19 pandemic, which overshadowed earlier factors like the tariff and reshaped sentiment across all industries.

Figure 14: Scottish Business Sentiment Index (BSI), Overall and for Whiskey & Alcohol Industry, versus key global, UK, and Scottish events.
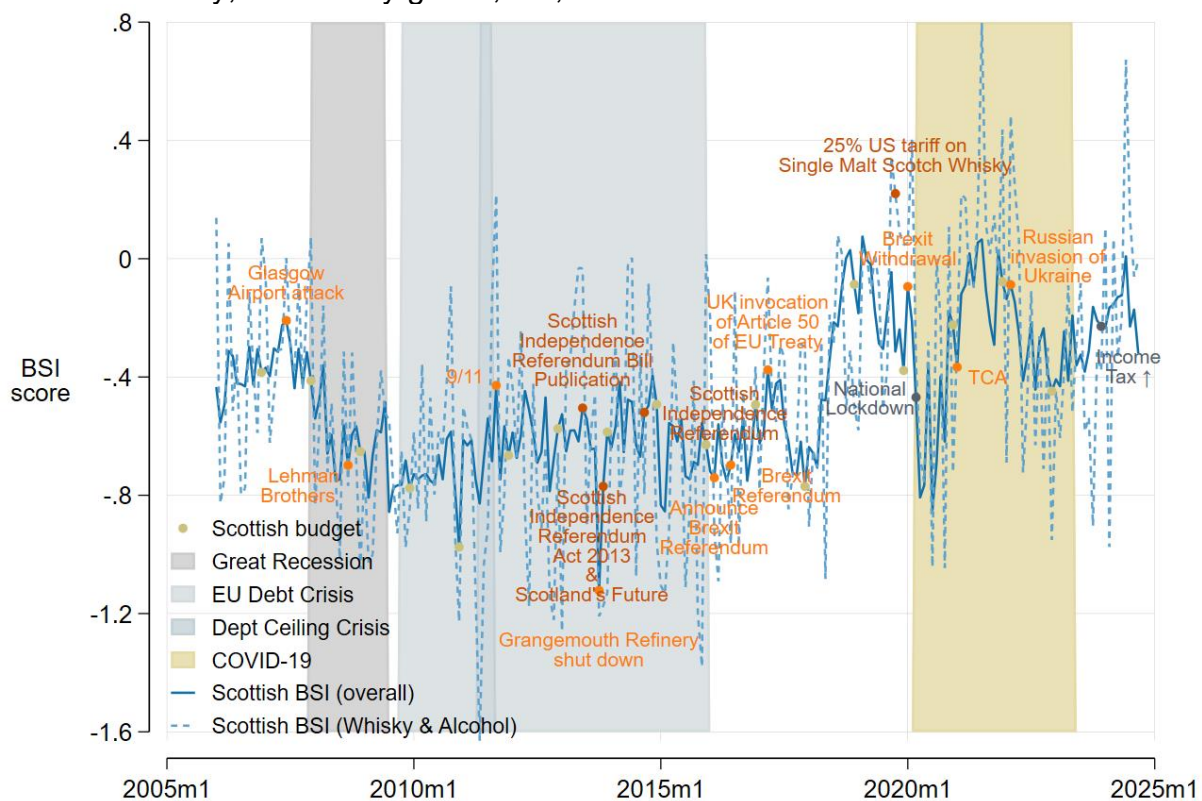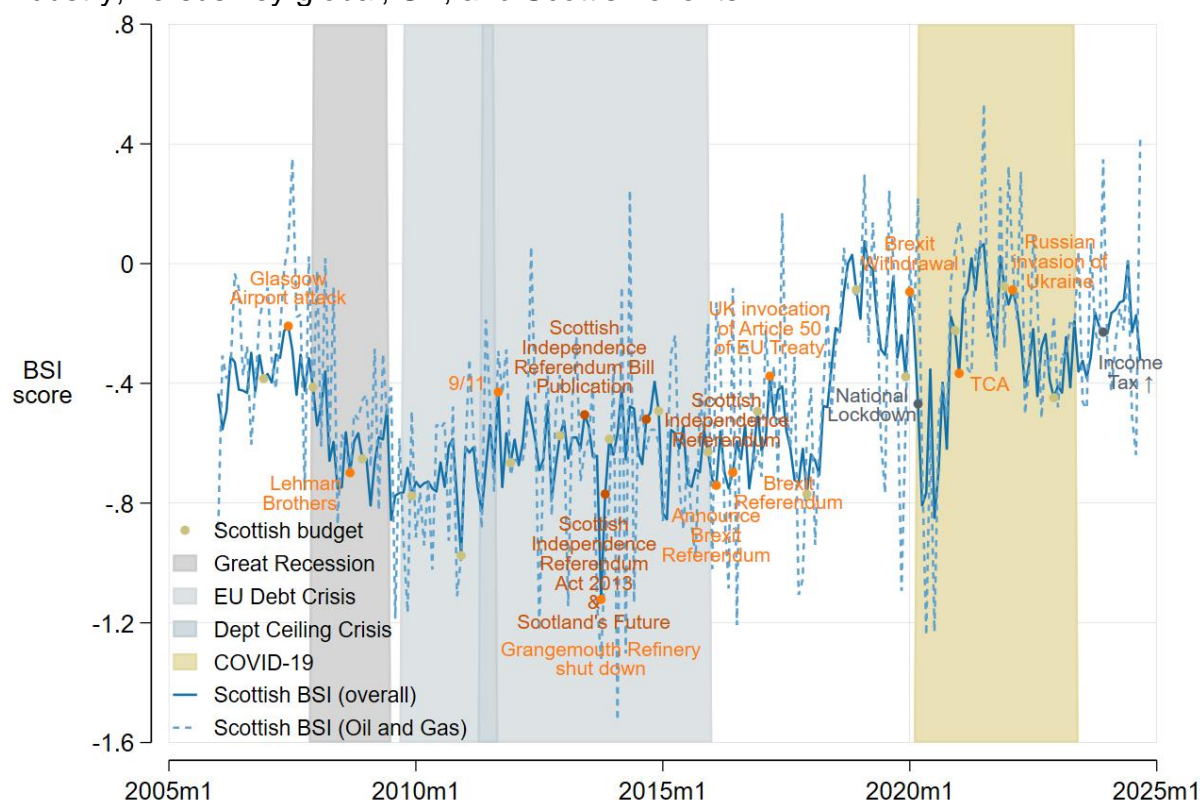

Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index (BSI) and the BSI for the Whisky and Alcohol Industry constructed by the authors using Factiva data against various key global, UK and Scottish events.

Oil and Gas Industry and the 2014–2016 oil price collapse

The topic-specific BSI for Scotland's Oil and Gas Industry provides a critical measure of sentiment and outlook within the industry. Although Scotland's GDP does not directly account for offshore North Sea production, fluctuations in global oil prices significantly impact GDP through the oil and gas supply chain. Comparing the provided BSI data in Figure 15 to key events in the industry's timeline offers valuable insights into whether the observed trends align with expectations. This analysis

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focuses on significant events such as the 2014–2016 oil price collapse, the global financial crisis, and the COVID-19 pandemic.

Figure 15: Scottish Business Sentiment Index (BSI), Overall and for Oil and Gas Industry, versus key global, UK, and Scottish events.

Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index (BSI) and the BSI for the Oil and Gas Industry constructed by the authors using Factiva data against various key global, UK and Scottish events.

2014–2016 Oil Price Collapse—The period from mid-2014 to early 2016 was marked by a dramatic fall in global oil prices, declining from over $100 per barrel to under $30 per barrel. This sharp downturn triggered widespread challenges for Scotland's oil and gas industry, as reflected in the significant decline in business sentiment during this time:

- **2014: Early Signs of Industry Stress.** The sentiment index displayed significant volatility in 2014, reflecting the initial impact of falling oil prices. For example, February 2014 saw a sharp decline (-1.53%), highlighting growing concerns about oversupply and weak global demand. While intermittent positive months (e.g., May 2014 at +0.25%) suggested optimism from specific developments, the index consistently pointed to a deteriorating outlook.

- **2015: Escalating Challenges.** By 2015, the industry was grappling with the sustained low price environment. Business sentiment remained negative throughout the year, with marked declines in January (-0.86%) and September (-0.98%). Investment in exploration projects slowed significantly, and firms faced mounting financial pressures.

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- **2016: Sentiment Reaches a Low Point.** The cumulative impact of prolonged low prices was evident in 2016, with sentiment bottoming out in July (-1.21%). While brief rebounds (e.g., February 2016 at -0.13%) reflected hopes of an OPEC-led production cut, these gains were short-lived. By mid-2016, widespread cost-cutting measures, including workforce reductions and project delays, dominated the industry.

Broader Trends in Business Sentiment—The 2014–2016 oil price collapse is part of a broader historical pattern in which external economic shocks and structural inefficiencies have influenced industry confidence:

- **2008–2009: Global Financial Crisis.** During the global financial crisis, the BSI fell sharply, reflecting plummeting demand for oil. For instance, the index reached a low of -1.19% in August 2009, mirroring the global economic slowdown.

- **2010–2013: Uneven Recovery.** Post-crisis recovery brought modest improvements, though volatility persisted. Declines in late 2013, such as October (-1.32%), signalled lingering structural challenges and emerging uncertainties about global economic stability.

- **2017–2020: Stabilisation and COVID-19 Disruptions.** After the 2014–2016 downturn, sentiment gradually improved, reflecting cautious recovery efforts. However, the COVID-19 pandemic in 2020 reignited pessimism, with sentiment dropping to -1.24% in May 2020 as global oil demand collapsed.

- **2021–2024: Recovery Amid Uncertainty.** Recent years show signs of recovery, with peaks in 2021 (e.g., July at +0.53%) driven by reopening economies and recovering demand. However, challenges such as energy market disruptions and geopolitical tensions in 2022 have prevented a sustained positive outlook, with sentiment dipping again in September 2022 (-0.52%).

From the above, the BSI for Scotland's oil and gas sector appears as a robust and effective measure of industry sentiment, with movements closely aligning to key global and industry-specific events. Its ability to reflect real-time confidence and economic pressures validates its relevance as a barometer of the sector's health. However, the index's high sensitivity to short-term fluctuations may obscure long-term trends. Therefore, to fully capture Scotland's evolving energy landscape, the BSI should be complemented with metrics that account for diversification and long-term sustainability.

Overall, the BSI appears to be a reliable measure of business sentiment in Scotland, effectively capturing the impact of key sectoral events. Analysis of the Whisky and Alcohol Industry shows strong co-movement with the overall BSI, with fluctuations

aligning closely with significant developments such as the US tariff on Single Malt Scotch and Brexit. Similarly, the Oil and Gas Industry's BSI reflects major events like the 2014-2016 oil price collapse, the global financial crisis, and the COVID-19 pandemic, demonstrating its responsiveness to external shocks. While the BSI effectively tracks short-term sentiment shifts, its high volatility suggests it should be used alongside other economic indicators for a more comprehensive understanding of Scotland's economic landscape.

4.6 Additional Checks

This section examines key methodological considerations, including seasonal adjustment, alternative aggregation method, and the implications of normalisation. These checks ensure that the BSI accurately reflects business sentiment without distortions from recurring seasonal patterns, outlier influences, or misleading transformations.

Seasonal adjustment

This section explores the extent to which seasonality might be driving the overall variation in the BSI by seasonally adjusting the BSI series. To seasonally adjust the data we use the [X-13ARIMA-SEATS seasonal adjustment method (U.S. Census Bureau)](), which removes seasonal patterns from time series data to reveal underlying trends and cycles. It combines ARIMA modelling, which handles trends, outliers, and irregular variations, with SEATS decomposition, which breaks the data into components like seasonal patterns, trends, and irregularities. This method adjusts for recurring effects, such as holidays or weather, producing seasonally adjusted data ideal for economic and business analysis.

Figure 16, plots the BSI along with its seasonally-adjusted series that eliminates misleading seasonal components at the monthly level. Seasonal adjustment in BSI helps to better understand the underlying base trends in the time series. The two series are very closely related with a correlation coefficient of 0.98. Overall, seasonal components in business sentiment appear to be negligible.

Figure 16: Scottish Business Sentiment Index (BSI) and seasonal adjustment.
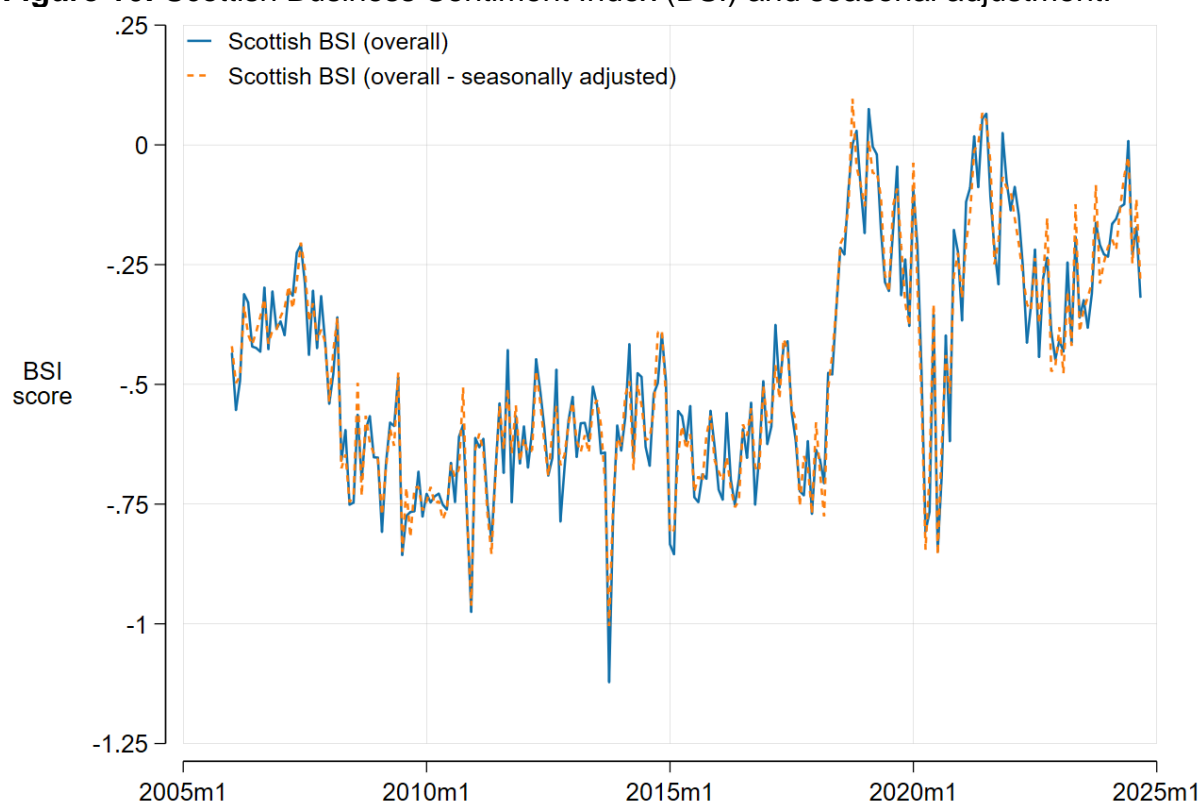
Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index constructed by the authors using Factiva data against its seasonally adjusted series using the X-13ARIMA-SEATS seasonal adjustment method (U.S. Census Bureau).

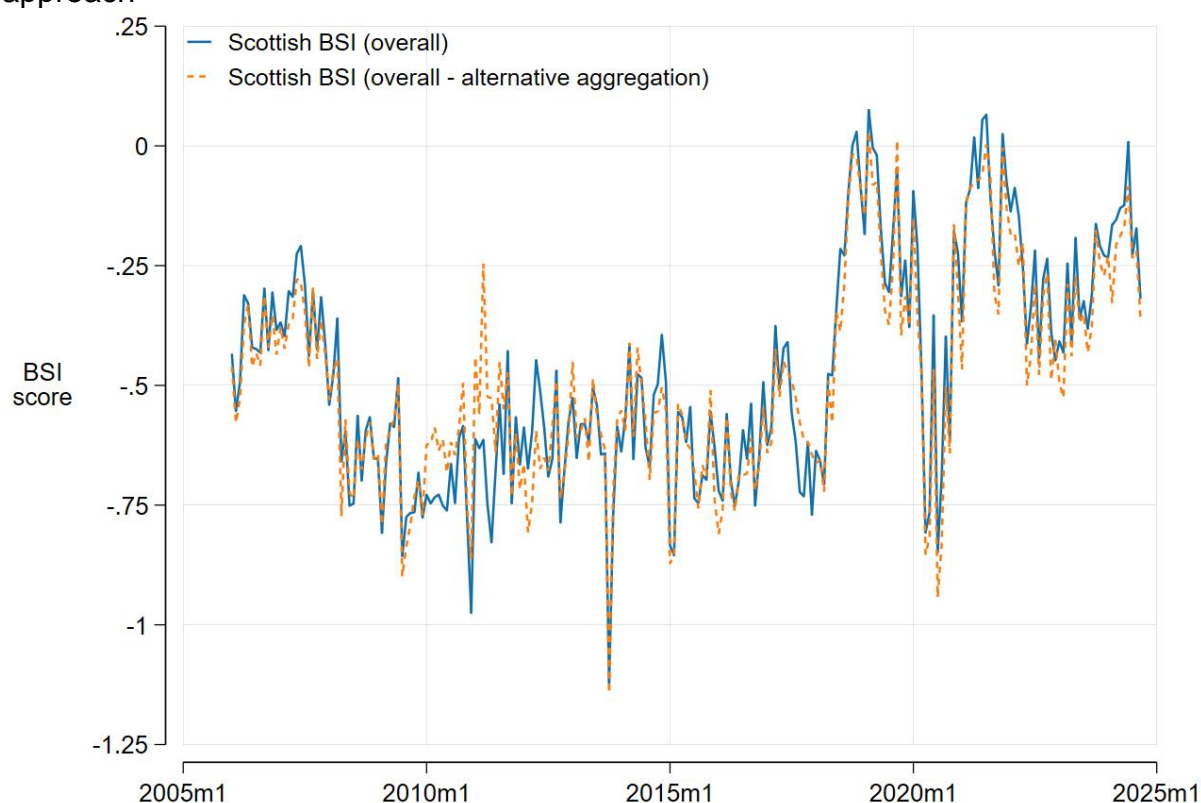**Alternative Aggregation**

The monthly overall BSI is calculated as a simple average of all article-level BSIs for each month, assigning equal weight to each article-level BSI in a month. To ensure the robustness of the index against alternative aggregation methods, an alternative approach is also explored. This method constructs the monthly overall BSI by calculating the difference between the total count of positive words and negative words (identified by the LM model) across all articles in a given month, then dividing this difference by the total word count of all articles in that month.

The overall correlation between the two series is close to perfect with a correlation coefficient of around 0.95. This also becomes clear from Figure 17, where the two plotted series follow each other closely. This highlights that the potential presence of outlier article-level BSI scores do not appear to be driving the monthly BSI series.

Figure 17: Scottish Business Sentiment Index (BSI) with an alternative aggregation approach

Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index constructed by the authors using Factiva data against a Scottish BSI aggregated at the monthly level with an alternative approach, i.e. by calculating the difference between the total count of positive words and negative words (identified by the LM model) across all articles in a given month, then dividing this difference by the total word count of all articles in that month.

Normalisation

Normalising the BSI relative to certain values may initially seem like a good idea, but this section highlights how it can complicate interpretation and increase the risk of confusion or misuse, as it transforms the index into a relative score.

The main issue arises from the fact that the BSI includes both positive and negative values. For instance, as presented in Figure 18 normalising the BSI relative to its overall average—which is negative (-0.47) in our case—would result in a normalised series that moves in the opposite direction of the original BSI, i.e. mirror image. This means the normalised index would need to be interpreted relative to the negative average, which could easily lead to misunderstandings, such as mistaking increases for decreases in sentiment. For example, in Figure 18, as presented in the original Overall BSI series (in blue), business sentiment increased vastly during 2018. However, this would not be clear from the normalised BSI series (in red). Overall, for better clarity and ease of interpretation such normalisations should be avoided.

Figure 18 Scottish Business Sentiment Index (BSI) versus normalised BSI
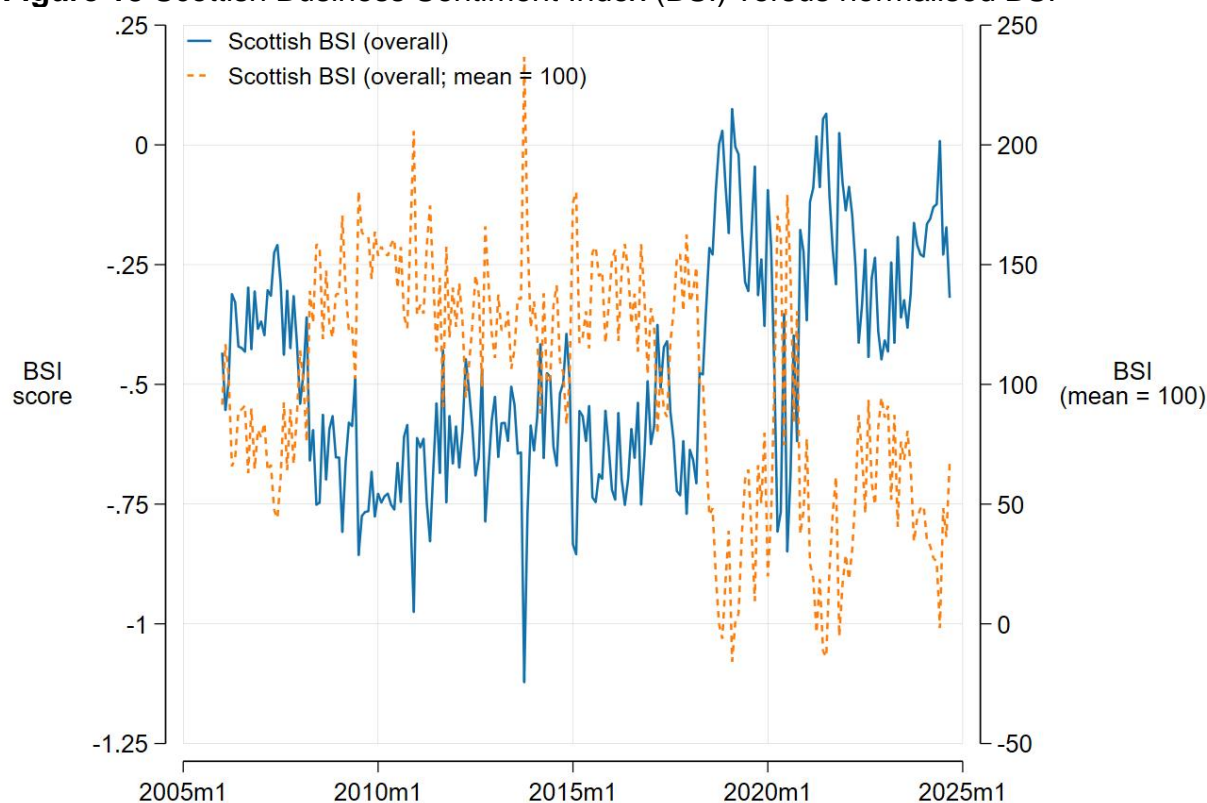
Notes: The figure plots the monthly frequency of the overall Scottish Business Sentiment Index (BSI) constructed by the authors using Factiva data against a BSI series normalised to have an overall average of 100.

4.7 Potential Enhancements and Further Applications

Expanding the scope of the BSI could provide additional validation, improve its robustness, and extend its applicability to a broader set of economic and policy-related analyses. This section outlines potential avenues for further development, some of which are contingent on expanded access to Factiva.

Expansion of BSI Coverage Across the UK and Devolved Governments

Currently, the BSI is constructed specifically for Scotland. Expanding its scope to include the UK as a whole and other devolved governments or regional economies would provide comparative insights into how business sentiment varies across different parts of the country. Such an approach would enable a more comprehensive assessment of regional business conditions, allowing for a better understanding of localised economic drivers and disparities.

Development of a Journal-Specific BSI

A journal-specific BSI could be constructed to analyse sentiment trends within specific newspapers or media outlets. This would help assess potential biases in coverage, examine how different publications portray business conditions, and

provide a more nuanced view of how sentiment is shaped by media narratives. This approach could also serve as a validation mechanism by comparing sentiment trends across different journalistic sources.

Construction of a Higher-Frequency BSI

Enhancing the temporal granularity of the BSI by increasing its frequency (e.g., from monthly to fortnightly, weekly, or even daily) could improve its responsiveness to real-time economic events. A higher-frequency index would allow for a more detailed analysis of how business sentiment reacts to short-term shocks, such as policy announcements, market fluctuations, or geopolitical events. This would further strengthen the BSI's role as a leading economic indicator for Scotland.

Inclusion of a broader and more diverge set of Newspapers

Expanding the range of newspapers included in the BSI calculation could enhance its accuracy and representativeness. This could involve adding more domestic newspapers to ensure a comprehensive reflection of Scottish business sentiment or incorporating select international newspapers that regularly feature Scotland-specific content, ensuring that international perspectives and reporting are considered when assessing business sentiment. By broadening the dataset, potential biases from reliance on a limited set of sources can be mitigated, thereby improving the robustness of the index.

Creation of a General Sentiment Index for Scotland

Beyond business sentiment, a general sentiment index for Scotland could be constructed to gauge overall societal sentiment, including public attitudes toward economic, political, and social developments.

Given data limitations in Factiva, the methodology used to construct the BSI may not be directly applicable. However, an alternative approach could involve using a proxy-based methodology, where a manually selected list of active (positive) versus passive (negative) words is analysed over a proxy for total word count (e.g., the frequency of neutral words such as "the"). In turn, this would allow to compare the BSI against the general sentiment index, examining whether business sentiment trends align with broader societal attitudes. Therefore, it would provide a reference point to contextualise BSI movements, particularly assessing whether shifts in business sentiment are reflective of general sentiment trends or driven by sector-specific factors.

This alternative measure would serve as both a validation exercise for the BSI and a broader tool for understanding sentiment fluctuations across different domains of Scottish society.

Overall, developing the BSI through these proposed enhancements would significantly increase its utility as an economic indicator. By expanding its geographical scope, refining its methodology, increasing its frequency, diversifying data sources, and introducing a general sentiment index, the BSI could provide deeper insights into business sentiment dynamics in Scotland and beyond. These advancements would enhance its role in economic forecasting, policymaking, and business strategy formulation.

5 Concluding Remarks

The introduction of the Scottish BSI marks a significant advancement in measuring economic sentiment using real-time news analysis. The index demonstrates strong correlations with key economic indicators, such as GDP and employment levels, confirming its relevance as a reliable measure of business sentiment. Moreover, its responsiveness to major economic and political events underscores its potential as an early warning indicator for economic downturns and recoveries. Overall, the BSI serves as a powerful tool for economic analysis, offering policymakers, businesses, and analysts a dynamic measure of business confidence for Scotland.

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Appendix A

A.1 Topic Modelling Results

Summary of Topic-Level Sentiment Index Calculation

1. **Identify relevant topics** from topic modelling (e.g., LDA).
2. **Multiply** each article's sentiment score by its relevance share for the topic.
3. **Aggregate** the weighted sentiments and topic shares monthly.
4. **Normalize** by dividing the total weighted sentiment by the total topic share to get the average sentiment index per month.

Model output (50 topics)

0   0.02033   island ferry highland service isle port vessel community inverness calmac shetland western ship route orkney ferguson transport marine yard hie

1   0.04959   director chief executive board chairman role year group appointed business appointment company member team senior head experience management time post

2   0.03372   police investigation claim case court complaint found crime officer allegation report company fraud month action firm claimed inquiry tribunal evidence

3   0.04336   city centre building site development project plan space office property street facility park million work area year construction council open

4   0.05198   government change issue industry policy uk rule report regulation system concern minister commission legislation scheme public proposal risk law review

5   0.02868   planning plan council development application site councillor local area proposal committee community land permission home trump highland decision scheme proposed

6   0.03003   award event business conference winner show year industry category exhibition annual prize international city entry competition held organiser place director

7   0.02033   energy wind power project offshore farm renewable turbine renewables uk electricity green sse government investment port development job nuclear grid

8   0.02366   school university student college education training teacher skill child young pupil apprenticeship apprentice parent career work learning programme graduate primary

9   0.02511   food restaurant pub product drink bar shop business customer local chef coffee brand chain open range produce cafe owner hospitality

10   0.01379   car vehicle engine model motor diesel electric wheel driver range litre mph road drive seat driving petrol bhp system speed

11   0.04661   uk month figure sector number market increase growth business rate level price report quarter survey demand average economy economic show

12   0.01699   whisky distillery brand drink scotch export market company beer spirit sale industry malt product diageo bottle world gin year alcohol

13   0.01716   bbc news medium advertising tv channel radio newspaper programme television stv itv press show broadcaster advert sky digital ad campaign

14   0.01654   cancer drug research treatment disease health patient trial people university study test cell vaccine dr life uk medical medicine product

15   0.05212   company business firm service group contract director million engineering market operation year deal growth industry construction uk management customer product

16   0.02044   investment fund asset trust life management standard investor financial company pension market manager insurance equity group income capital return year

17   0.03967   government snp minister labour party uk leader sturgeon vote independence tory election mp secretary salmond political conservative parliament westminster holyrood

18   0.03999   job company staff business loss closure firm worker cut redundancy plant close plan employee site factory administration future administrator union

19   0.01845   price energy cost customer bill fuel increase gas charge consumer company supplier gbp market pay average electricity cut power pound

20   0.02747   oil gas north sea production energy field offshore company bp industry shell uk drilling exploration barrel development million project asset

36

21   0.02256   home property house room housing garden bedroom area family price buyer kitchen sale estate offer building flat development market gbp

22   0.01451   share market stock ftse price index point group dollar bank investor rose fell biggest higher company page analyst lower trading

23   0.03358   government council public cost million contract service project funding minister budget money report authority local police year private cut snp

24   0.08475   time people dont make year back thing big long im problem world bit work point money life put find fact

25   0.03778   council local road community city town people area street councillor centre aberdeenshire service moray work northeast resident bridge park authority

26   0.01827   farmer farm kg farming beef cattle meat price dairy lamb milk agricultural sold food crop sheep production animal rural producer

27   0.02881   customer service company online technology mobile mail phone data system digital internet product royal user website information people software bt

28   0.02249   safety fire accident incident death police health worker road died injury work night family man risk investigation rescue people service

29   0.00922   fish fishing fishery fisherman salmon sea industry boat quota stock catch cod seafood marine vessel north european fleet eu mackerel

30   0.0214   union strike pay action worker member staff offer dispute industrial unite government deal council talk ballot service secretary trade increase

31   0.0161   airport flight passenger airline air service route travel aircraft baa aviation ba heathrow number airway ryanair million british plane uk

32   0.05312   company share deal group shareholder business bid million stake takeover offer gbp sale market firm investor price executive sell interest

33   0.05463   profit group company million sale gbp market revenue business growth share gbpm result month pretax cost trading strong loss chief

34   0.02576   club game ranger football player manager team season league celtic sport cup fan time rugby match back side win supporter

37

35   0.01937   rail train service bus transport passenger scotrail fare network railway line operator driver travel station route ticket journey franchise stagecoach

36   0.02347   pay gbp bonus woman pension salary staff worker paid employee wage scheme executive employer company annual payment work report benefit

37   0.00963   golf beat class championship woman open cup league men division st final world round tour bt england smith gb senior

38   0.03869   industry sector technology business economy world innovation support opportunity scotland future development uk investment economic project data global government change

39   0.03254   store sale retailer retail shop supermarket tesco street chain christmas customer high shopping brand shopper online centre food asda sainsburys

40   0.02251   court legal law case claim firm lawyer lord action appeal solicitor judge company decision ruling society justice session hearing tribunal

41   0.01555   service london community england ireland lab british royal john south west wale northern chief director mar executive central north east

42   0.04441   business people work support working charity community organisation staff team company opportunity make social time job employee service experience family

43   0.02659   bank banking rb lloyd financial customer royal branch loan business hbos credit group mortgage barclays lending money lender account gbp

44   0.03098   business tax government small rate scheme cost uk firm pay budget income support money cut increase economy million debt finance

45   0.04034   year art festival family music show world work life theatre time film book museum artist child royal home history event

46   0.02225   hotel offer holiday visitor travel park room night tourism visit loch castle including highland tour trip guest tourist booking resort

47   0.01942   water gas energy plant climate waste carbon emission fuel fracking green environmental government grangemouth ineos uk supply oil site coal

38

48   0.03707   firm business company investment partner client growth team market service office uk funding deal technology sector investor financial capital startup

49   0.01892   health nh care service hospital patient staff people nurse board doctor home medical social covid time work dr healthcare nursing

A.2 Manual aggregation of 50-topic model to 20 broad topics

1. **Business**

   1.1. **Topic 1:** Corporate Leadership

   Words: director, chief, executive, board, chairman, role, year, group, appointed, business, appointment, company, member, team, senior, head, experience, management, time, post

   1.2. **Topic 6:** Business Awards and Events

   Words: award, event, business, conference, winner, show, year, industry, category, exhibition, annual, prize, international, city, entry, competition, held, organiser, place, director

   1.3. **Topic 15:** Engineering Services and Business Operations

   Words: company, business, firm, service, group, contract, director, million, engineering, market, operation, year, deal, growth, industry, construction, uk, management, customer, product

   1.4. **Topic 44:** Business Taxes and Government Schemes

   Words: business, tax, government, small, rate, scheme, cost, uk, firm, pay, budget, income, support, money, cut, increase, economy, million, debt, finance

   1.5. **Topic 48:** Business Investments and Startups

   Words: firm, business, company, investment, partner, client, growth, team, market, service, office, uk, funding, deal, technology, sector, investor, financial, capital, startup

2. **Finance**

   2.1. **Topic 11:** Economic Indicators and Market Trends

   Words: uk, month, figure, sector, number, market, increase, growth, business, rate, level, price, report, quarter, survey, demand, average, economy, economic, show

   2.2. **Topic 16:** Investment Funds and Asset Management

   Words: investment, fund, asset, trust, life, management, standard, investor, financial, company, pension, market, manager, insurance, equity, group, income, capital, return, year

2.3.   **Topic 22:** Stock Market and Investment Trends

Words: share, market, stock, ftse, price, index, point, group, dollar, bank, investor, rose, fell, biggest, higher, company, page, analyst, lower, trading

2.4.   **Topic 32:** Company Shares and Business Deals

Words: company, share, deal, group, shareholder, business, bid, million, stake, takeover, offer, gbp, sale, market, firm, investor, price, executive, sell, interest

2.5.   **Topic 33:** Company Profits and Financial Results

Words: profit, group, company, million, sale, gbp, market, revenue, business, growth, share, gbpm, result, month, pretax, cost, trading, strong, loss, chief

2.6.   **Topic 38:** Industry Innovation and Economic Development

Words: industry, sector, technology, business, economy, world, innovation, support, opportunity, scotland, future, development, uk, investment, economic, project, data, global, government, change

2.7.   **Topic 43:** Banking and Financial Services

Words: bank, banking, rb, lloyd, financial, customer, royal, branch, loan, business, hbos, credit, group, mortgage, barclays, lending, money, lender, account, gbp

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3.   Government and Politics

3.1.   **Topic 4:** Government Policies and Regulations

Words: government, change, issue, industry, policy, uk, rule, report, regulation, system, concern, minister, commission, legislation, scheme, public, proposal, risk, law, review

3.2.   **Topic 17:** Scottish Politics and Independence

Words: government, snp, minister, labour, party, uk, leader, sturgeon, vote, independence, tory, election, mp, secretary, salmond, political, conservative, parliament, westminster, holyrood

3.3.   **Topic 23:** Government Spending and Public Services

Words: government, council, public, cost, million, contract, service, project, funding, minister, budget, money, report, authority, local, police, year, private, cut, snp

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4. Transportation

4.1. **Topic 0:** Maritime Services

Words: island, ferry, highland, service, isle, port, vessel, community, inverness, calmac, shetland, western, ship, route, orkney, ferguson, transport, marine, yard, hie

4.2. **Topic 31:** Air Travel

Words: airport, flight, passenger, airline, air, service, route, travel, aircraft, baa, aviation, ba, heathrow, number, airway, ryanair, million, british, plane, uk

4.3. **Topic 35:** Public Transport

Words: rail, train, service, bus, transport, passenger, scotrail, fare, network, railway, line, operator, driver, travel, station, route, ticket, journey, franchise, stagecoach

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5. Energy and Environment

5.1. **Topic 7:** Renewable Energy

Words: energy, wind, power, project, offshore, farm, renewable, turbine, renewables, uk, electricity, green, sse, government, investment, port, development, job, nuclear, grid

5.2. **Topic 19:** Energy Prices

Words: price, energy, cost, customer, bill, fuel, increase, gas, charge, consumer, company, supplier, gbp, market, pay, average, electricity, cut, power, pound

5.3. **Topic 20:** Oil and Gas Industry

Words: oil, gas, north, sea, production, energy, field, offshore, company, bp, industry, shell, uk, drilling, exploration, barrel, development, million, project, asset

5.4. **Topic 47** Climate Change

Words: water, gas, energy, plant, climate, waste, carbon, emission, fuel, fracking, green, environmental, government, grangemouth, ineos, uk, supply, oil, site, coal

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6. Healthcare and Public Services

6.1. **Topic 14:** Medical Research and Healthcare

Words: cancer, drug, research, treatment, disease, health, patient, trial, people, university, study, test, cell, vaccine, dr, life, uk, medical, medicine, product

6.2. **Topic 49:** Healthcare Services and NHS

Words: health, nh, care, service, hospital, patient, staff, nurse, board, doctor, home, medical, social, covid, time, work, dr, healthcare, nursing

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7. Hospitality and Tourism

7.1. **Topic 9:** Food and Beverage Industry

Words: food, restaurant, pub, product, drink, bar, shop, business, customer, local, chef, coffee, brand, chain, open, range, produce, cafe, owner, hospitality

7.2. **Topic 46:** Tourism and Travel

Words: hotel, offer, holiday, visitor, travel, park, room, night, tourism, visit, loch, castle, including, highland, tour, trip, guest, tourist, booking, resort

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8. Legal and Judicial Services

8.1. **Topic 2:** Legal Investigations and Fraud Cases

Words: police, investigation, claim, case, court, complaint, found, crime, officer, allegation, report, company, fraud, month, action, firm, claimed, inquiry, tribunal, evidence

8.2. **Topic 40:** Legal Cases and Law Firms

Words: court, legal, law, case, claim, firm, lawyer, lord, action, appeal, solicitor, judge, company, decision, ruling, society, justice, session, hearing, tribunal

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9. Real Estate and Property

9.1. Topic 3: Urban Development and Construction Projects

Words: city, centre, building, site, development, project, plan, space, office, property, street, facility, park, million, work, area, year, construction, council, open

9.2. Topic 5: Local Planning and Development Applications

Words: planning, plan, council, development, application, site, councillor, local, area, proposal, committee, community, land, permission, home, trump, highland, decision, scheme, proposed

9.3. Topic 21: Residential Property and Housing Market

Words: home, property, house, room, housing, garden, bedroom, area, family, price, buyer, kitchen, sale, estate, offer, building, flat, development, market, gbp

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10. Sports

10.1. Topic 34: Football Clubs and Sports Matches

Words: club, game, ranger, football, player, manager, team, season, league, celtic, sport, cup, fan, time, rugby, match, back, side, win, supporter

10.2. Topic 37: Sports Championships and Competitions

Words: golf, beat, class, championship, woman, open, cup, league, men, division, st, final, world, round, tour, bt, england, smith, gb, senior

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11. Technology and Media

11.1. Topic 13: Media and Broadcasting

Words: bbc, news, medium, advertising, tv, channel, radio, newspaper, programme, television, stv, itv, press, show, broadcaster, advert, sky, digital, ad, campaign

11.2. **Topic 27:** Technology Services and Digital Communications

Words: customer, service, company, online, technology, mobile, mail, phone, data, system, digital, internet, product, royal, user, website, information, people, software, bt

12. Retail and Consumer Goods

12.1. **Topic 12:** Whisky and Alcohol Industry

Words: whisky, distillery, brand, drink, scotch, export, market, company, beer, spirit, sale, industry, malt, product, diageo, bottle, world, gin, year, alcohol

12.2. **Topic 39:** Retail Industry and Shopping

Words: store, sale, retailer, retail, shop, supermarket, tesco, street, chain, christmas, customer, high, shopping, brand, shopper, online, centre, food, asda, sainsburys

13. Education and Training

13.1. **Topic 8:** Education and Training

Words: school, university, student, college, education, training, teacher, skill, child, young, pupil, apprenticeship, apprentice, parent, career, work, learning, programme, graduate, primary

14. Agriculture and Fishing Industry

14.1. **Topic 26:** Agriculture and Farming

Words: farmer, farm, kg, farming, beef, cattle, meat, price, dairy, lamb, milk, agricultural, sold, food, crop, sheep, production, animal, rural, producer

14.2. **Topic 29:** Fishing Industry and Fisheries

Words: fish, fishing, fishery, fisherman, salmon, sea, industry, boat, quota, stock, catch, cod, seafood, marine, vessel, north, european, fleet, eu, mackerel

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15. Labor and Employment

15.1. **Topic 18:** Job Losses and Company Closures

Words: job, company, staff, business, loss, closure, firm, worker, cut, redundancy, plant, close, plan, employee, site, factory, administration, future, administrator, union

15.2. **Topic 30:** Labor Unions and Industrial Actions

Words: union, strike, pay, action, worker, member, staff, offer, dispute, industrial, unite, government, deal, council, talk, ballot, service, secretary, trade, increase

15.3. **Topic 36:** Salaries, Bonuses, and Pay Equality

Words: pay, gbp, bonus, woman, pension, salary, staff, worker, paid, employee, wage, scheme, executive, employer, company, annual, payment, work, report, benefit

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16. Safety and Public Incidents

16.1. **Topic 28:** Safety Incidents and Accidents

Words: safety, fire, accident, incident, death, police, health, worker, road, died, injury, work, night, family, man, risk, investigation, rescue, people, service

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17. Community and Local Projects

17.1. **Topic 25:** Local Communities and Infrastructure

Words: council, local, road, community, city, town, people, area, street, councillor, centre, aberdeenshire, service, moray, work, northeast, resident, bridge, park, authority

17.2. **Topic 41:** Community Services and National Organizations

Words: service, london, community, england, ireland, lab, british, royal, john, south, west, wale, northern, chief, director, mar, executive, central, north, east

17.3. **Topic 42:** Community Support and Charities

Words: business, people, work, support, working, charity, community, organisation, staff, team, company, opportunity, make, social, time, job, employee, service, experience, family

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18. Automobiles and Vehicles

18.1. **Topic 10:** Automotive Industry and Vehicles

Words: car, vehicle, engine, model, motor, diesel, electric, wheel, driver, range, litre, mph, road, drive, seat, driving, petrol, bhp, system, speed

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19. Arts and Culture

19.1. **Topic 45:** Arts, Culture, and Festivals

Words: year, art, festival, family, music, show, world, work, life, theatre, time, film, book, museum, artist, child, royal, home, history, event

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20. Other

20.1. **Topic 24:** Other

Words: time, people, dont, make, year, back, thing, big, long, im, problem, world, bit, work, point, money, life, put, find, fac

A.3 Additional Figures

Figure A.1: Shares of topic coverage for 50 topics, yearly average (%)
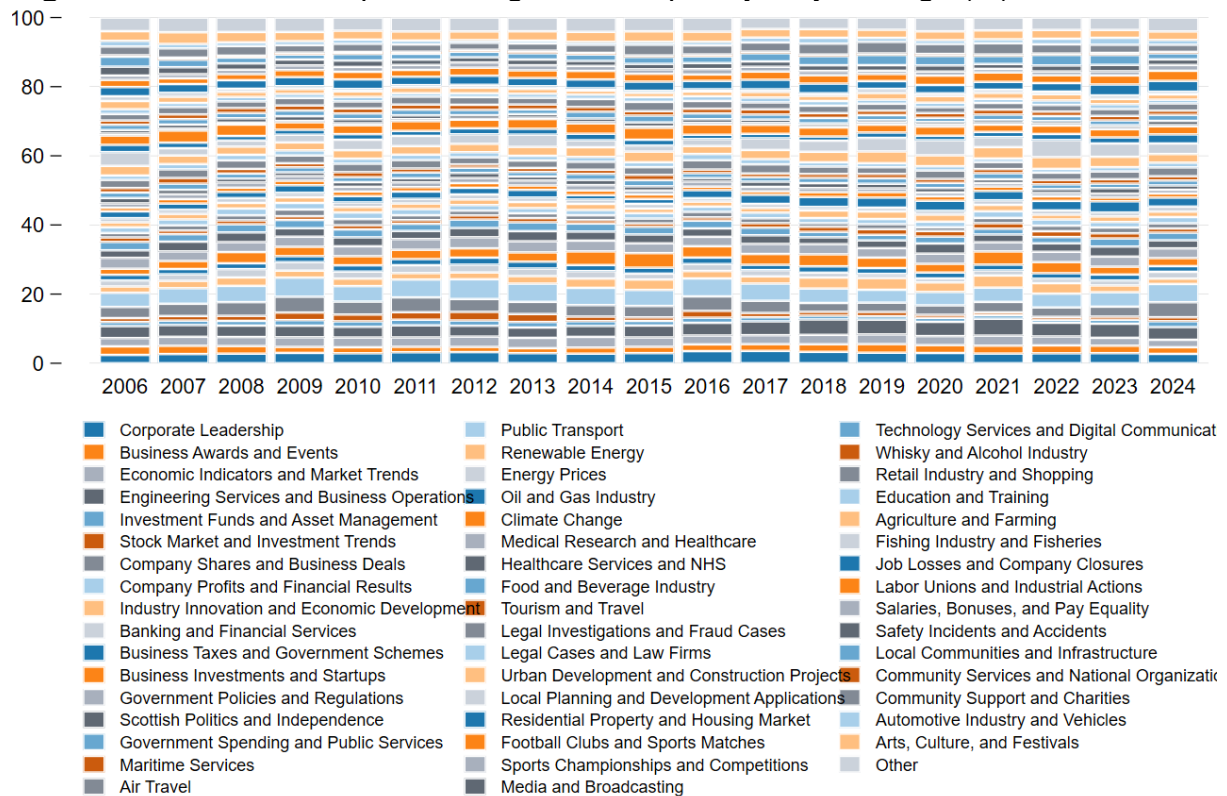

Notes: The figure plots the % share of topic coverage, yearly average, for each of the 50 topics produced by the LDA topic modelling using Factiva data. Note, that the topic "Other" refers to topic 24 in the 50-topic model, which is meaningless and uninformative in the context of Scottish business news, and thus not relevant to use for topic-specific sentiment analysis.

Figure A.2: Shares of topic coverage for 20 aggregated topics, yearly average (%)
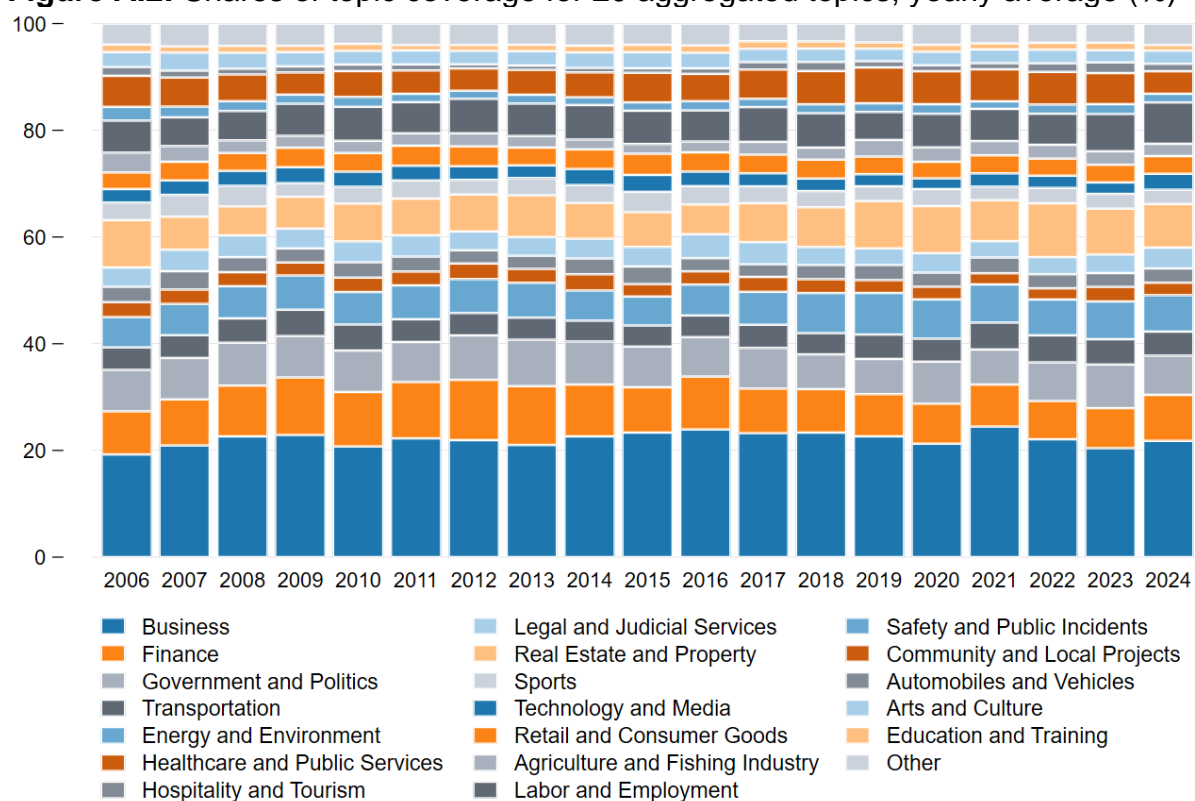
Notes: The figure plots the % share of topic coverage, yearly average, for each of the 20 aggregated topics produced by the LDA topic modelling using Factiva data. Note that the aggregation to 20 broad topics is done manually and a detailed list of the exact topics used from the 50-topic model is provided in the Appendix. Note, that the topic "Other" refers to topic 24 in the 50-topic model, which is meaningless and uninformative in the context of Scottish business news, and thus not relevant to use for topic-specific sentiment analysis.

Figure A.3: Scottish Business Sentiment Index (BSI) ppt changes from the previous quarter vs. Nominal GDP growth
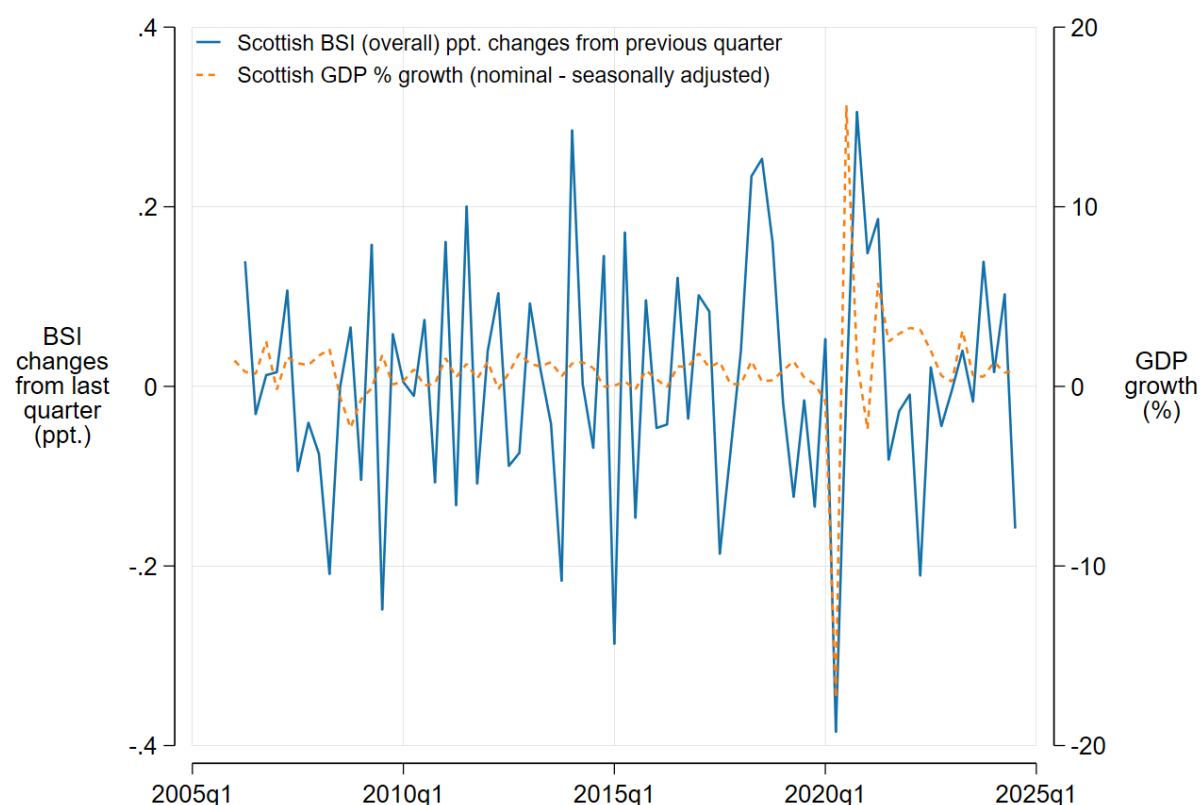
Notes: The figure plots the quarterly (average of monthly) frequency of the percentage point changes from the previous quarter in the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Scottish Nominal GDP (£ billion, current prices, seasonally adjusted) which can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

Figure A.4: Scottish Business Sentiment Index (BSI) vs. GDP in constant prices 2019
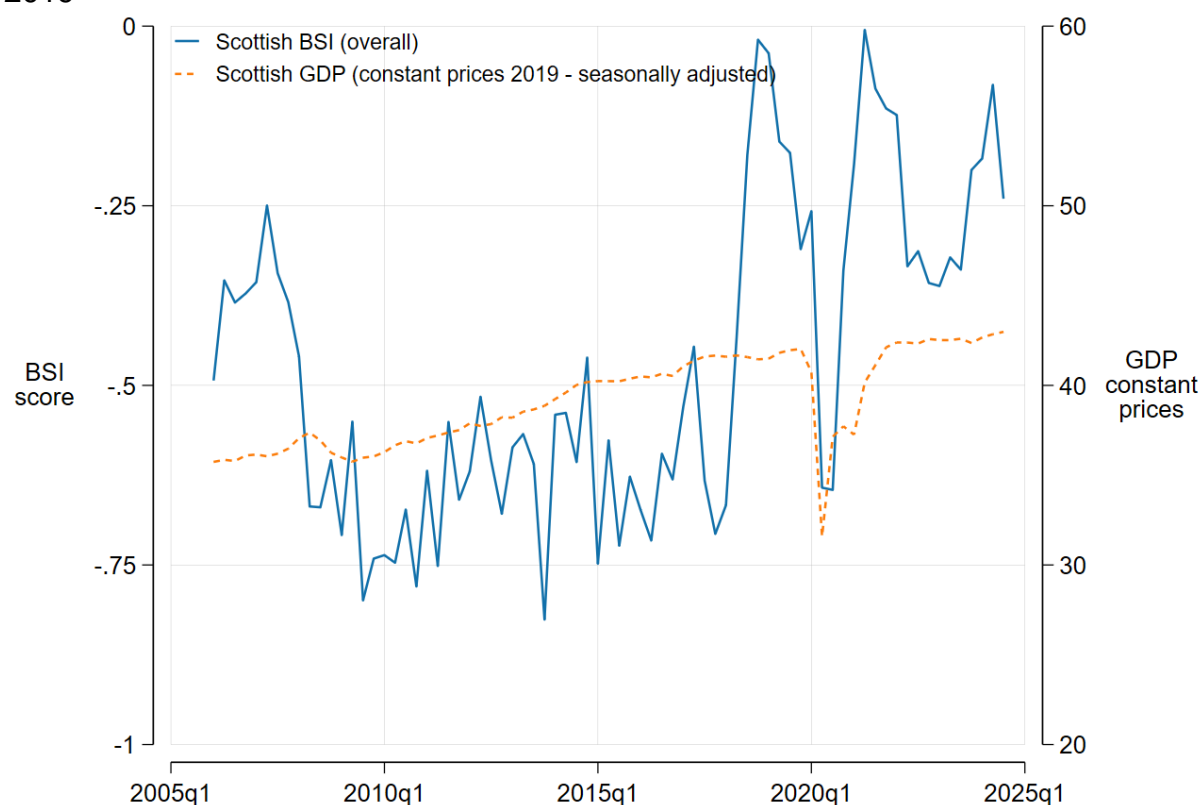
Notes: The figure plots the quarterly (average of monthly) frequency of the Scottish Business Sentiment Index (BSI - left axis) constructed by the authors using Factiva data and the quarterly series for the Scottish GDP (£ billion 2019, constant prices, seasonally adjusted) which can be found at the Scotland's Economic and Fiscal Forecasts (Scottish Fiscal Commission).

Scottish Government
Riaghaltas na h-Alba