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RESEARCH ARTICLE

The nexus between national and regional reporting of economic news: Evidence from the United Kingdom and Scotland

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Abstract

Broadsheet newspapers are an important source of economic news. Using a unique dataset of more than 489,000 articles over the last 20 years, this article asks the question whether newspapers published in Scotland communicate similar economic sentiments as UK-wide newspapers. The findings show that although Scottish and UK newspapers share a positive correlation, this relationship varies over time. There is evidence of causality running mostly from the United Kingdom to Scotland. The Scottish Referendum 2014 has had an impact on newspaper reporting when there was more uncertainty in the communication. Individual newspapers respond differently during the referendum periods where some newspapers, The Daily Telegraph and Daily Record for instance reacted to the uncertainty rather strongly, whereas local newspapers represented news in a rather surprising positive note.

KEYWORDS

economic sentiment, newspapers, regional, Scotland, textual analysis, United Kingdom

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1 | INTRODUCTION

Newspapers are a perennial vector of communication of current economic news, and their roles become pivotal in the wake of economic and political instabilities. They inform agents of current happenings by relaying economic facts and data, and by doing so shape expectations of agents. This role is especially put in focus when there is economic and financial uncertainty, where agents may benefit from informed communications. In the United Kingdom, a recent example was the important role played by newspapers in influencing opinions during the EU Referendum and around events of future importance such as Brexit negotiations. Communication of and around economic events are likely to echo in the actions of agents which in turn impact on financial markets and show up in economic indicators, or more importantly on electoral outcomes. With the new dataset constructed in this article, a study of interest is to examine media-based sentiments between Scotland and the United Kingdom as a whole. Scotland and the rest of the United Kingdom (especially England) have a long political and economic history rooted in medieval times, which, in the 21st century, has imparted a strong sense of nationalism in Scotland, becoming apparent in the latter's urge to distance itself from the rest of the United Kingdom. Is the coverage of economic news, including its tonality, substantially different between Scotland and the United Kingdom as a whole? The importance of this question is nontrivial in the current political climate as a second Scottish Referendum is on the agenda of the current Scottish incumbent party.¹

Economic news from newspaper communication has a ripple effect on economic activity. There is substantial evidence that central bank communications affect financial markets and asset prices, and newspapers are no different. They are the "signaling channel" through which communication and appending commentaries of policy changes happen. Moreover, the analyses that feed in this channel may stand in line with the readership of the newspaper. In general, sentiments are bound to affect economic activity (Benhabib & Spiegel, 2019). One of the interesting questions which this article, to an extent, seeks to answer is whether there is evidence of causality in economic sentiments (or even a common factor) between the United Kingdom and Scotland generally. Certain rules, such as access to EU and international markets or migration policy, affect both countries.² Those policies, however, are not devolved to the region. Sentiments from one region to another can be subject to causal links through domestic trading and labor migration.

The aim of this article is to examine the relationship between tonality of economic news communicated in newspapers from Scotland and United Kingdom. We attempt to quantify the propagation of economic sentiments between both regions. To achieve this aim, sentiment indices are constructed from economic news which newspapers communicate. The sentiment measures are developed on a scale of positive to negative values and can be described as illustrating both the current and outlook of the economy. Articles communicating economic and financial news are sub selected from newspapers in Scotland and UK wide. The UK newspapers focus on all four states of Great Britain: England, Scotland, Wales and Northern Ireland, and therefore, news is mostly aggregated for all the regions. Scottish newspapers on the other hand lean predominantly toward news mostly relevant to the Scottish economy with less attention to global news. What constitutes economic news? Our broad sample includes reports about economic fundamentals, expert

¹ Scottish National Party.

² Causality will show up in both UK and Scottish data if there is a UK wide shock but the reverse is not true—an economic specific Scotland may have limited impact on the United Kingdom as Scotland is smaller in economic share. This is simply because of the economic size of both regions.

opinions and monetary policy communications. They are chosen according to a set of keywords, with a set of filters.

Although the focus of this article is built around the relationship between UK and Scottish implied sentiments, newspaper bias is a theme which is worth considering in the background. Economic communication has been shown to be subject to partisan bias, as argued in many studies such as Gentzkow et al. (2015) and D'Alessio and Allen (2000). In the United Kingdom, newspapers could be leaning either toward conservatives, labor or liberal democrats. There have been instances when newspapers changed their political closeness with parties who are in power (Latham, 2015). Other dynamics which have been evidenced in newspapers especially in the area of advertising (Anderson et al., 2018; Ellman & Germano, 2009) show that newspapers may have a defined model in terms of the allocation of its space for different news types.

There may be biases across newspapers at various levels. However, this article simply takes a stand that newspapers in Scotland and United Kingdom may diverge with respect to local and regional opinions. Whether this divergence can be substantiated as bias is not addressed in this article. Prior to the Scottish Referendum (2014) in Scotland, the Scottish National Party rhetoric was that independence would have been economically beneficial. We can surmise that such rhetoric will have most likely affected the communication of economic news. Therefore, a communication of economic news may be noisy especially in the presence of good economic data and the current political party announcing a counter measure. The Scottish Referendum (2014) is therefore a significant event to investigate in this article, given the sense of nationalism (Pattie et al., 1999; Soule et al., 2012).

As the United Kingdom and Scotland are close economically, with one unifying central bank implementing monetary policy, having a regional economic sentiment index may be counter-intuitive. However, Scotland structurally differs from the United Kingdom with devolved fiscal arrangements. The Scottish Independence debate has benefitted from a host of important economic arguments in applied practice regarding its potential macroeconomic framework. These arguments have considered political arrangements, implementation of fiscal rules, financial regulation, and currency options. We are interested in testing and measuring the extent sentiment from one country could drive another. We are also interested in the stability of these relationships around important debates such as the Scottish Independence Referendum.

To conduct the empirical analysis, this article constructs a unique and novel database on newspaper articles for Scotland comprising of more than 89,000 observations, which are collected based on keywords. These include reporting real-time information on general economic wide events such as industrial production, sectoral growth and inflation, interviews and speeches from experts, and central bank communications from February 1998 to December 2017. To understand the influence of newspapers after conditioning on economic news, we apply textual analysis on the economic news. The sample of newspapers for Scotland contains regional newspapers, and Scottish editions of some UK wide newspapers such as The Daily Telegraph and The Sun. The sentiments are extracted with Linear Support Vector Machines. For each newspaper article, the sentiments are assigned using the procedure, and all articles are averaged over the month to create a time series of economic news sentiment.

The article shows that economic sentiment inferred from Scottish and UK newspapers are positively correlated over time and react to economy fundamentals. UK economic media sentiments seem to be driving Scottish sentiments, and Scottish economic sentiments do not matter for the United Kingdom overall. However, in one of the most important historic events in the union of Scotland with United Kingdom, Scottish newspapers perceive the potential independence as a negative outcome for the Scottish Economy. Further findings indicate that there is indeed a

positive relationship between UK and Scottish sentiment in the time series as lags of Scottish sentiments precede UK sentiments. During the period 2007–08 (the global financial crash), there is an increase in the correlation between both United Kingdom and Scotland.

2 | RELATED LITERATURE AND THEORETICAL FRAMEWORK

This article connects two separate strands of literature: textual analysis of economic information and local-regional linkages in economic activity. With respect to the former, textual analysis can be used to measure sentiments across different types of texts. There are two main approaches to measure sentiments: (i) intensity (the number of times keywords are cited) and (ii) tonality (the emotional context of the word). Well-known applications of these techniques include the Economic Policy Uncertainty index (Baker et al., 2016) which is used to capture country and global economic uncertainty. Moreover, these techniques have been used to analyze Monetary Policy Communications. These include Picault and Renault (2017) and Stekler and Symington (2016). Moreover, in line with the current article, textual techniques have been applied to social media in order to measure the value of information in moving markets (Brown et al., 2017). In terms of applying textual techniques to newspapers, Bowden et al. (2019) applied textual techniques to UK newspapers to derive UK sentiment indices. Similarly, Rambaccussing and Kwiatkowski (2020) showed that some UK newspapers may help toward improving point forecasts of output growth and unemployment in the United Kingdom.

Closely related to our study is whether there are partisan biases in economic news reporting. Larcinese et al. (2011) used the intensity of economic news coverage to show that prodemocratic newspapers give considerable weight to high unemployment when the incumbent is republican. Similar patterns are noted with trade deficit and budget deficit. The use of textual analytics in establishing conflicting or different discourses has also been used in the literature, see for instance Pollak et al. (2011) for the case of Western newspapers coverage of Kenyan elections. One of the aspects which this article does not cover is the link between communication sentiments and economic activity. However, there are many studies which have addressed the link, in particular inflation expectations (Lamla & Lein, 2015; Lamla et al., 2019).

There are mechanisms which can help the propagation of economic sentiments, for instance information dissemination can happen through a variety of channels such as social media and news. Another factor could be traced to economic fundamentals where there is stronger interconnectedness through trade, foreign direct investment, and financial flows. Finally, sentiments can spill from one region (country) to another simply through network and psychological contagion. In theory, the expectations are that economic sentiments from the United Kingdom will impact the Scottish sentiment through the economic fundamentals. For instance, events such as Brexit would affect the United Kingdom globally rather than Scotland solely. Moreover, as monetary policy is implemented for the whole United Kingdom by the Bank of England, Scotland has little influence on issues around inflation and interest rates. In that respect, sentiments associated with these common variables are most likely to affect the United Kingdom first which may then be picked up by the local newspapers in Scotland. However, as Scotland has a devolved fiscal framework, actions pertaining to taxation, spending, borrowing, and welfare will generally impact economic sentiments in Scotland, but evidence is relative scant on the direction of causality.

This article also contributes to the literature on sentiment movements between regions and nations. Economic linkages across countries and regions benefit from a vast literature, which can be traced to global business cycles (Kose et al., 2003; Kose, Otrok, & Whiteman, 2008; Kose, Otrok,

& Prasad, 2008; Stock & Watson, 2005a, 2005b). Sentiment propagation has been investigated in Baker et al. (2012). The interaction between economic sentiments and economic activity in Europe has been investigated by Gelper and Croux (2010) and Ghonghadze and Lux (2011).

3 | METHODOLOGY

In this section, we describe our methodology. We use a similar methodology as in Bowden et al. (2019), from whom we use the data for the United Kingdom. To summarize the procedure, a dataset of economic articles for the United Kingdom is collected based on keywords selection using LexisNexis database. The keywords are as follows:

A: “Economy” or “Economic”

B: “Policy” or “Taxes” or “Budget” or “Bank of England”

C: “UK” or “Britain” or “British”

The words associated with category B are common words which relate to economic articles. Robustness checks have been performed to assess the reliability of the keywords.³ In selecting the economic articles for Scotland, “Bank of England” is omitted from category B, and the new category C is used as “Scotland” or “Scottish.” The number of articles collected is 109,818 for Scotland. After the sample of articles are collected, another sub selection is performed using the procedure of King et al. (2017), which ensures that only articles depicting the Scottish economy remain in the final corpus, which leaves the Scottish sample to 89,545. For the United Kingdom, the number of articles went down from 505,150 to 399,650.

Figures 1–3 show the time series of the logarithm of the number articles for some selected newspapers in the sample. The time series have issues related to missing monthly observations⁴ for consecutive months for individual newspapers. Therefore, working with the national mean from Scottish newspapers subsequently is a good compromise. The number of articles appears rather episodic—for instance there is an increase in the coverage of economic news in newspapers in 2007/08 which corresponds to the financial crash. There is a rather mild increase in the number of articles reporting on the Scottish economy prior to the Independence Referendum of 2014, followed by a sharp downward spike. The early 2015 oil crash coincides again with more newspapers articles reporting on the Scottish Economy. For the United Kingdom, the numbers of articles are less responsive to Scotland specific events but do respond to events such as the EU Referendum, the global financial crash of 2008–09, and European Sovereign debt crisis (2010–12).

3.1 | Analysis of keywords for Scottish newspapers

We also investigate the keywords used in the article. We find that common words appearing in the newspapers are “said” which suggests that the articles mostly consist of extracts of information provided by analysts and experts. A common word is also “will” an element which is futuristic

³ The objective is to include words which actually harvest most economic news by not missing out on relevant articles and at the same time not including irrelevant articles which may bias the measure and forthcoming estimates. Other words, following the robustness checks which may also be relevant in addition to the current queries are “oil,” “inflation,” “Chancellor,” and “Treasury.”

⁴ The missing observations arise from LexisNexis not including the articles in the database.

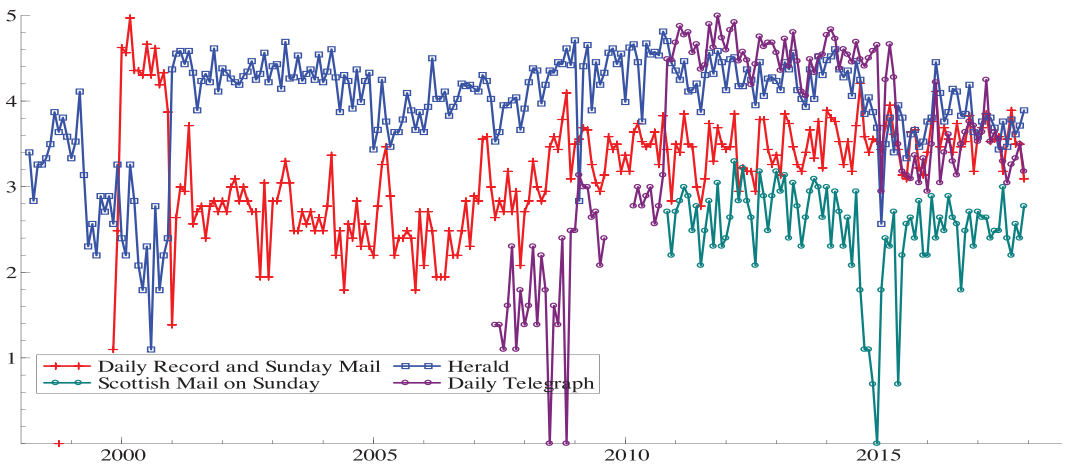


FIGURE 1 Plot of the logarithm of the number of newspaper articles for The Daily Record and Sunday Mail, The Scottish Mail on Sunday, The Scottish Herald, and The Scottish Daily Telegraph. [Colour figure can be viewed at wileyonlinelibrary.com]

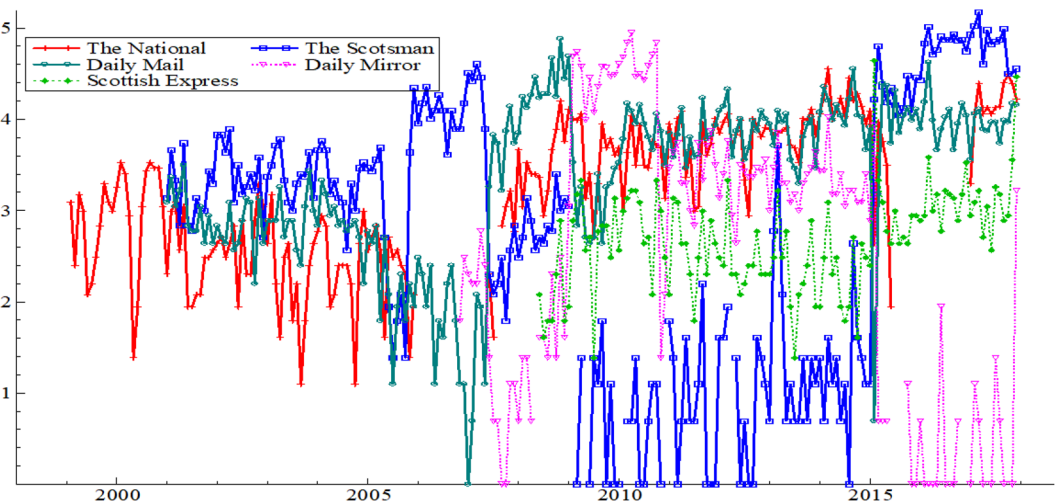


FIGURE 2 Plot of the logarithm of the number of newspaper articles for The National, The Daily Mail, The Scotsman, The Scottish Express, and The Scottish Daily Mirror. [Colour figure can be viewed at wileyonlinelibrary.com]

in nature. Figure 4 shows the logarithm of the number of times these words occur in our sample. There is no distinction in the frequency of these two words (“said” and “will”) between articles with positive and negative sentiment. However, word “not” is more likely to feature in articles with negative tonality. It is also worth noting that a common word “would” also appears more frequently in negative articles, as in a counterfactual scenario.

Based on the total sample, some common negative words appearing in the corpus are “Shocking,” “Bankrupt,” “Fraud,” “Bail,” and “Catastrophe.” On the other hand, positive words include “Acquisitions,” “Exciting,” “Innovation,” “Redevelopment,” “House Building,” and “Ventures.” During the referendum year (October 2013–September 2014), new words which recurrently appear in the corpus include “independence,” “currency,” “economic,” and “Union.” During the

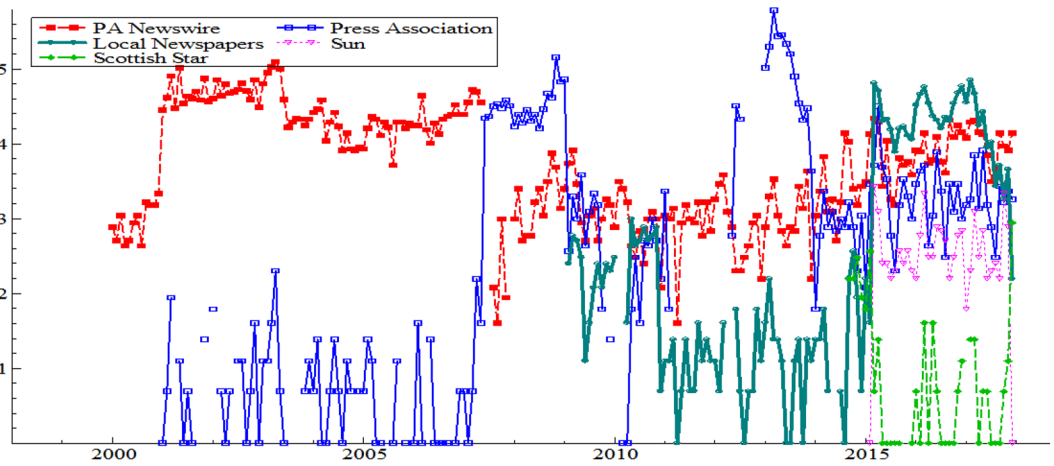


FIGURE 3 Plot of the logarithm of the number of newspaper articles for local newspapers, Press Association (PA), PA Newswire, The Scottish Sun, and The Scottish Star. [Colour figure can be viewed at wileyonlinelibrary.com]

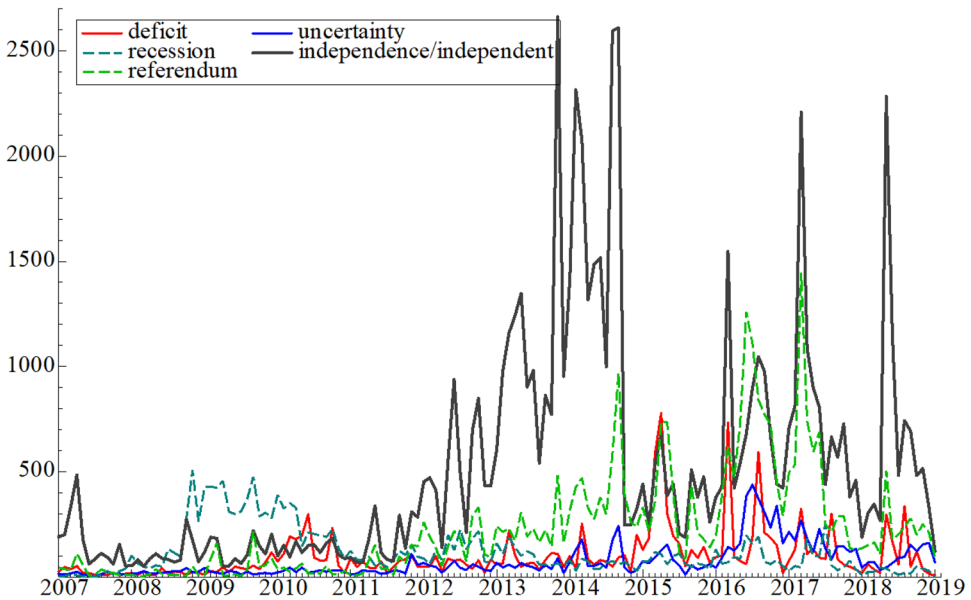


FIGURE 4 Plot of keywords. The figure shows the number of times the words (“Deficit,” “Recession,” “Referendum,” “Uncertainty,” and “Independence”) have been cited from 2007. [Colour figure can be viewed at wileyonlinelibrary.com]

referendum, in addition to the common words, positive words was associated with “expansion” and “regeneration,” whereas negative classified articles included “nationalism,” “Salmond,” “Euro,” “Sterling,” and “immigrants.”

3.2 | Classification of articles

In this section, we explain the classification of the articles. The sentiment indices are created by using Support Vector Machines for text categorization. To implement the procedure, 5 students

TABLE 1 Descriptive statistics on media implied sentiments.

UK newspapers			Scottish newspapers		
	Mean	Std Dev		Mean	Std Dev
City AM	-0.07	0.16	Daily Record and Sunday Mail	-0.27	0.278
Daily Mail and Mail On Sunday	-0.31	0.141	Herald	-0.14	0.163
Daily Mirror and Sunday Mirror	-0.31	0.225	National	-0.29	0.178
Daily Telegraph	-0.15	0.144	PA Newswire Scotland	-0.18	0.213
Evening Standard	-0.23	0.201	Press Association Mediapoint	-0.32	0.277
Financial Times	-0.13	0.127	Scotland on Sunday	-0.04	0.343
Guardian	-0.29	0.137	Scotland Regional News	-0.11	0.091
Independent	-0.32	0.153	Scotsman	-0.12	0.15
Observer	-0.39	0.172	Scottish Daily Mail	-0.33	0.187
Sun	-0.29	0.225	Scottish Daily Mirror	-0.3	0.698
Sunday Telegraph	-0.21	0.186	Scottish Daily Telegraph	-0.16	0.39
Sunday Times	-0.12	0.178	Scottish Express	-0.25	0.226
Times	-0.21	0.14	Scottish Local Newspapers	0.081	0.191
			Scottish Mail on Sunday	-0.17	0.325
			Scottish Metro	-0.26	0.333
			Scottish Star	-0.3	0.646
			Scottish Sun	-0.3	0.373
			Sunday Herald	-0.25	0.357

Note: The table shows the mean sentiment and the corresponding volatility for each newspaper for the sample for which the data is available.

were asked to read through a trained set of 1800 articles, and these were rated from -2 (very negative) to 2 (very positive). Subsequently, three categories were assigned from negative (-1), neutral (0) to positive (1). Articles which can be classified unanimously as positive or negative (defined as those with little discrepancy in the students' judgment of their tonality, for instance four students rating it as highly positive, and one remaining student rating it as low positive or negative) would be included in the final training set. The training set is then fed into the machine learning algorithm, which uses the Support Vector Machines algorithm, to identify common features of the articles within and to use this information to classify the remaining corpus.

The Support Vector Machine will extract features (words and combination of words) which are most likely to be present in the categories of "positive," "neutral," and "negative." A test sample of 300 articles was then used to check whether the algorithm properly classified.⁵ Then, we apply the machine learning algorithm to the remaining articles in the corpus.

Table 1 shows the mean and standard deviation of sentiments for both UK and Scottish⁶ newspapers. UK newspaper sentiments are more negative than the Scottish counterpart. This applies to The Independent, The Observer, The Daily and Sunday Mirror and The Daily and Sunday Mail. The last three are newspapers will communicate economic news mostly in times of economic

⁵ By using a combination of dictionary with the students training set, we ensured a classification accuracy of at least 80%.

⁶ It is worth pointing that the Scottish newspapers is defined here as newspapers which are also United Kingdom based but also have a Scottish edition, such as The Daily Telegraph and The Daily and Sunday Mail.

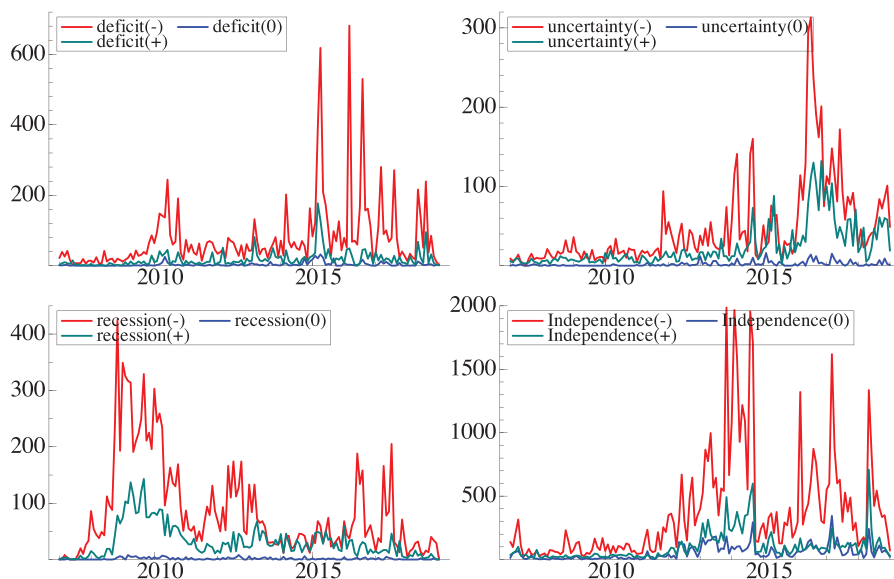


FIGURE 5 The plot shows the number of word occurrences for four words: deficit (top left), uncertainty (top right), recession (bottom left), and independence (bottom right). Each plot shows the number for each positive (+), neutral (0), and negative (–) sentiment article. [Colour figure can be viewed at wileyonlinelibrary.com]

duress, which may therefore explain the very negative mean. In terms of Scotland, it is found that the Press Association and The Scottish Sun and The Scottish Daily Mail are the most negative.

Country specific newspaper correlations in the United Kingdom and Scotland vary in magnitude. Within their geographical categories, UK and Scottish newspapers have an average correlation of 0.445 (Std Dev = 0.176) and 0.147 (0.109), respectively. The cross correlations between the newspapers are approximately equal to 0.193 (0.133). Newspapers covering the United Kingdom are more likely to agree in terms of the sentiment of the economic reports. However, this is less consistent across the Scottish sample, which although it exhibits a positive relationship, this is somewhat weaker.

Figure 5 considers each of the words of interest for articles with each sentiment category. It shows that these words appear predominantly in articles with negative sentiment. For this sentiment category, the number of articles responds to the external events following a pattern like the one discussed earlier based on Figure 5. Rather interestingly, there is little evidence of such responses in the documents with neutral sentiment. There are also articles where “Independence” has overall positive tonality prior to the Independence Referendum period. This may suggest that although the Scottish independence was predominantly portrayed as negative, there were also some articles that saw it in positive light. Following the EU Referendum, the number of times independence and referendum is cited becomes more common. The number of times Deficit and Recession has also increased following the results of the EU Referendum.

4 | EMPIRICAL RESULTS

In this section, we examine the relationship between the UK and Scottish mean sentiments in a more formal way. Figure 6 shows the time series for Scotland and the United Kingdom after averaging the sentiment indices across newspapers for each month.

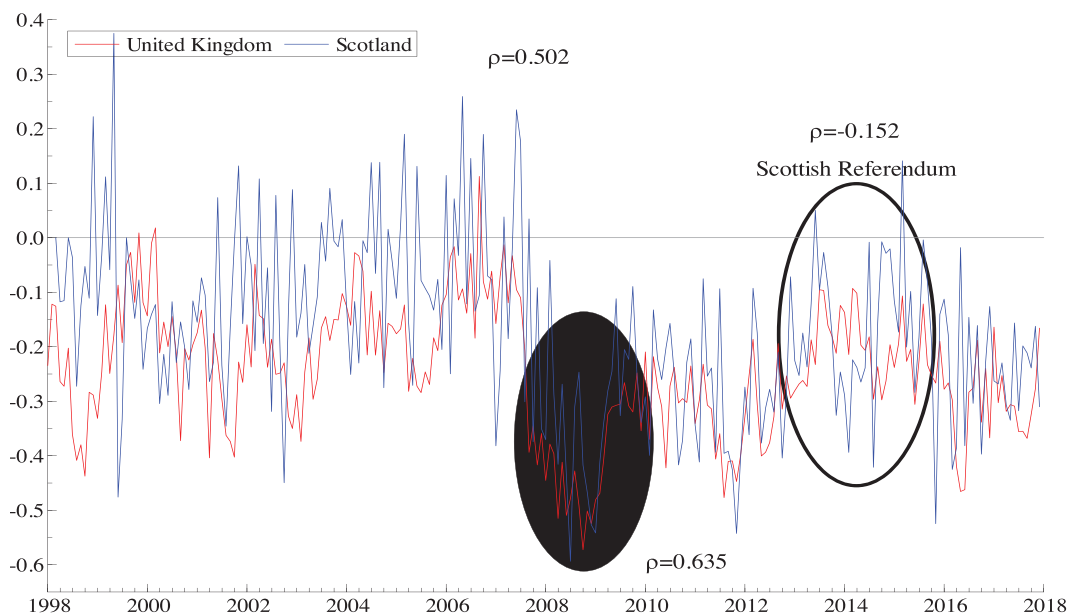


FIGURE 6 The figure shows the monthly time series plot for the period 1998–2019 for Scotland (blue) and United Kingdom (red). [Colour figure can be viewed at wileyonlinelibrary.com]

The UK and Scottish series share a common trend, from 1998 to 2018 which is indicative of fundamentals impacting both countries. However, the correlation for the whole sample is mildly positive at 0.502. Periods of economic or financial stress show more similar volatility of the sentiment indices, for instance for global financial crisis 2008–10 the correlation is 0.635. On the other hand, the period of around the Scottish Referendum shows that the correlation is negative at -0.152 . This weak correlation could be the result of diverging economic news due to opposing fundamentals, political motivated economic communications, or simply reflect uncertainty about the future. Generally, as mentioned before, the UK sentiments are lower than Scottish sentiments except for the referendum year and early 2000s.

Figure 7 shows stronger association between the UK and Scottish media sentiments when the mean sentiments are crucially negative (below the 0 line), and more disparity when sentiments are positive. Points on the lower end, which may be spurred by global shocks, therefore appear to affect United Kingdom and Scotland symmetrically. However, positive sentiments due to shocks affect Scotland and United Kingdom differently.

4.1 | Rolling correlations

Figure 7 shows that the association of the economic sentiment between the UK and Scotland across periods is not constant. We estimate rolling correlations between the sentiment indices for the window size; $T = 12, 24, 36, 48,$ and 60 months. A longer window size T implies a smoother correlation coefficient (ρ). Comparing ρ between a large and a small T may pinpoint the level of stress around a given period. Ideally, little or no instability would imply that the coefficient from a short and long window (12 and 60 months) is very close to each other.

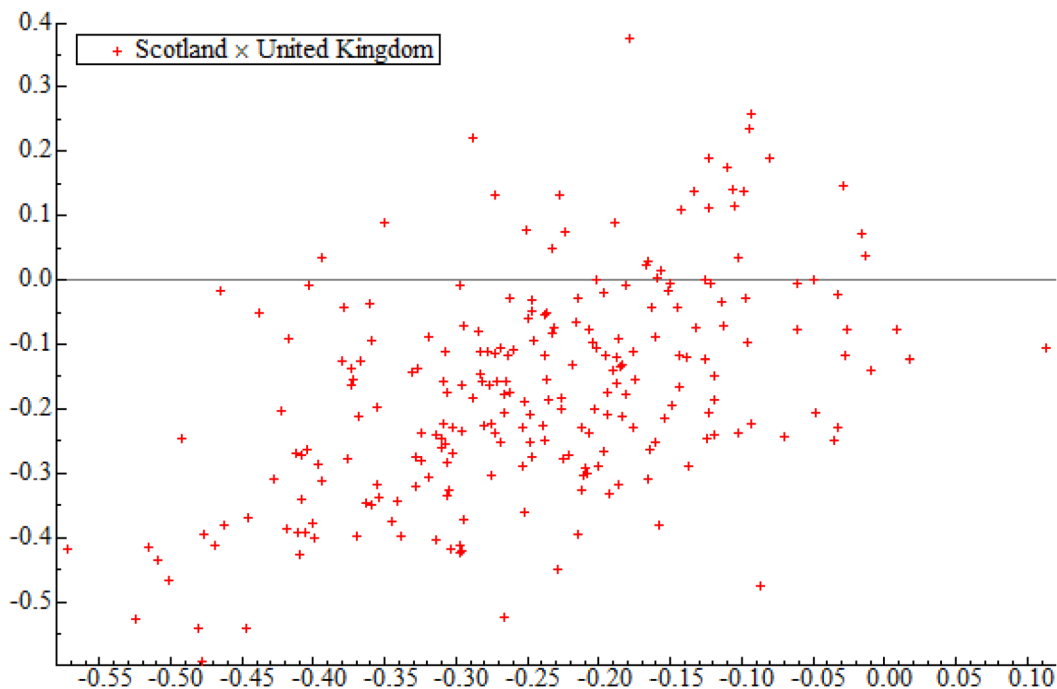


FIGURE 7 Scatter plot of UK and Scottish mean sentiments. Each point shows a particular observation in time for the UK and Scottish sentiments. [Colour figure can be viewed at wileyonlinelibrary.com]

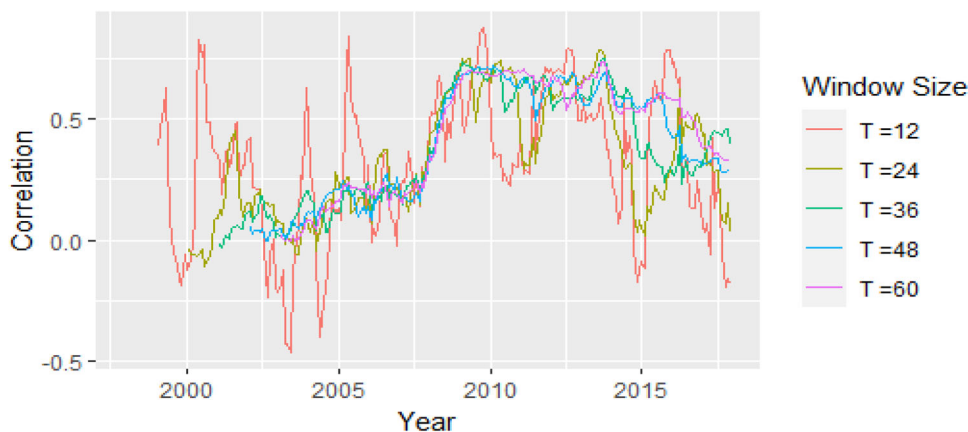


FIGURE 8 The figure shows the rolling correlation coefficient (ρ_T) using estimation windows of 12, 24, 36, 48, and 60 months. [Colour figure can be viewed at wileyonlinelibrary.com]

Reading from Figure 8, the correlation coefficient indicates considerable volatility preceding the Scottish Referendum. The substantial change is flagrant as from 2013. Examining the differences in the correlation (across the windows), we note that the difference in the correlations was insignificant before 2013. As from late 2013, the short-run correlations ($T = 12$) are much lower (even when compared to the small episodic drop after 2010). The magnitude of the drop is -0.4 .⁷

⁷We do not compare before 2005 because the samples of newspapers were rather small.

This drop strongly suggests a shift in the implied economic sentiment relationships. The high volatility, and the mere fact that the estimated intercept term and slope coefficient are statistically significantly different from 0 and 1, respectively, motivates the case for having a separate Scottish sentiment index.

4.2 | Three stage least squares

Taking into consideration potential endogeneity and cross correlation in the error terms, we can estimate a structural model with three stages least squares (3SLS) where Scottish sentiments and UK sentiments are jointly modeled. The model is estimated with two equations which are shown in the following equation:

$$\begin{aligned} s_{uk,t} &= a_{uk} + b_{uk,1}s_{scot,t} + \sum_{j=1}^p b_{uk,i}s_{uk,t-j} + e_{uk,t} \\ s_{scot,t} &= a_{uk} + b_{scot,1}s_{uk,t} + \sum_{j=1}^p b_{scot,i}s_{scot,t-j} + e_{scot,t}, \end{aligned} \quad (1)$$

where s_{uk} and s_{scot} are, respectively, the UK and Scottish economic sentiments. The results are illustrated in Appendix A1 for $p = 0,1,2$, and 3. The instruments are the lags until third lag for both the UK and Scottish sentiments. The results show that, by adding more lags to the specification, the magnitude of contemporaneous causation is reduced. The results observed showed that Scottish sentiments are more reactive to the United Kingdom than the other way round, which is expected.

One of the benefits of estimating Equation (1) is that He provides the contemporaneous relationship. An alternative approach is to estimate the reduced form equation. This is represented by the following reduce form:

$$\begin{aligned} s_{uk,t} &= a_{uk} + \sum_{j=1}^p b_{uk,i}s_{uk,t-j} + \sum_{j=1}^q b_{scot,i}s_{scot,t-j} + e_{uk,t} \\ s_{scot,t} &= a_{uk} + \sum_{j=1}^p b_{uk,i}s_{uk,t-j} + \sum_{j=1}^q b_{scot,i}s_{scot,t-j} + e_{scot,t}, \end{aligned} \quad (2)$$

In this equation, we can see that it includes lags of both Scottish and the UK sentiments. However, Equation (2) does not improve on Equation (1), but we can apply the automatic model selection represent the best model. In each specification, we consider the case where the maximum number of lags (p,q) is equal to 6, and we use automatic model selection approach of Castle et al. (2012) which considers coming up with the best model based on the trade-off of model fit, parameter significance test, and a battery of misspecification tests.

The coefficients reported in Table 2 corroborate the findings found earlier with the structural 3SLS. Both the median and mean of the UK sentiments display high persistence, as illustrated with estimates of the first two lags. The parameters are statistically significant and highly positive. Interestingly only these two lag UK parameters matter for modeling UK sentiments. However,

TABLE 2 Three stages least squares (3SLS) estimates for reduced form model of best fit.

	Mean		Median	
	UK	Scotland	UK	Scotland
Intercept	-0.041*** (0.012)	-0.022*** (0.022)	-0.043*** (0.012)	
UK (-1)	0.470*** (0.060)	0.383*** (0.091)	0.540*** (0.062)	0.344*** (0.085)
UK (-2)	0.356*** (0.059)		0.279*** (0.061)	
UK (-3)				
Scotland (-1)				
Scotland (-2)		0.159*** (0.061)		0.182*** (0.062)
Scotland (-3)		0.166*** (0.061)		0.185*** (0.061)
σ_{uk}	0.075		0.080	
σ_{scot}	0.147		0.146	
$\sigma_{uk,scot}$	0.309		0.296	
Log-Likelihood	400.57		388.75	
Sargan-Hansen test	17.72 (0.541)		23.65 (0.21)	

Note: The table illustrates the 3SLS coefficients for mean and median sentiments when automatic model selection is applied for the joint model. The maximum number of lags is six. The figures in brackets illustrate the standard errors.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

when Scottish sentiments are considered, it is found that UK sentiments cause Scottish sentiments with a lag. Moreover, Scottish sentiments also have some degree of persistence as illustrated by statistical significance at the second and third lag for both the mean and the median.

4.3 | Bi-causal relationships

In order to better understand the joint dynamics of UK and Scottish mean sentiment indices, we estimate vector autoregressions (VAR) of order 1 and 3.⁸ The VAR allows for feedback effects across both the UK and Scottish sentiments and considers the case of bicausal relationships.

Reading from Table 3, sentiments are found to be persistent across all estimated models. Focusing on causality, information contained in the UK sentiment indices will predict future values of the Scottish index. However, the coefficients on the lagged Scottish sentiment for the UK response (Panel A: UK equation) are not statistically significant. Within the theoretical framework, this is not unexpected as Scotland is one of the smaller states and local sentiment shocks are less likely to persist. When the response variable is Scotland (Panel B), the VAR (1) results show stronger response coming from lagged UK sentiment (0.457) and to a lesser extent Scotland (0.146). When a VAR (3) is estimated, the 1 month lag for the UK and two

⁸The models are estimated after finding that both variables are stationary in level form.

TABLE 3 The interdependence between Scottish and UK sentiments.

	VAR (1)		VAR (3)	
	Panel A: UK			
	UK	Scotland	UK	Scotland
Lag (1)	0.730*** (0.055)	0.005 (0.034)	0.456*** (0.067)	-0.010 (0.035)
Lag (2)			0.322*** (0.072)	0.031 (0.045)
Lag (3)			0.042 (0.069)	0.008 (0.034)
	Panel B: Scotland			
	UK	Scotland	UK	Scotland
	Lag (1)	0.457*** (0.121)	0.146** (0.074)	0.270* (0.150)
Lag (2)			0.018 (0.173)	0.157* (0.083)
Lag (3)			0.067 (0.115)	0.153*** (0.058)
Log-likelihood	386.61		406.03	
Obs	237		235	

Notes: The table illustrates the coefficients (excluding the intercept) for a VAR (1) and VAR (3) for the mean sentiments. The upper panel "UK" reports the coefficients when UK sentiment is the response variable, and the lower panel illustrates the Scottish case. The figures in brackets illustrate the robust standard errors.

Abbreviation: VAR, vector autoregressions.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

and three lags for Scotland are found to be significant, not very dissimilar to the findings in Table 2.

4.4 | Potential drivers of Scottish sentiments

The dynamics of Scottish and the UK-wide sentiment have so far been analyzed separately without including any macroeconomic controls in the regression models. One of the potential issues with this approach is the possibility of model misspecification because of omitting such variables. In the current context, however, considering the macroeconomic variables is constrained due to the lack of reliable monthly time series for Scottish data on important variables such as production, inflation, or wages. Recognizing the limitations of this approach, house price changes are used as a proxy variable for inflation, and output per hour as a proxy for production for both United Kingdom and Scotland. The first model considers house prices both in United Kingdom and Scotland as controls. Building on the estimates of the 3SLS models, where it was found that UK wide sentiments drive Scottish newspapers sentiments, we estimate an autoregressive distributed lag model (ARDL) model where the dependent variable is Scottish sentiment. The model considered

TABLE 4 Estimation of sentiment models with house price controls using ARDL.

	Mean		Median	
	Equation (3)	Preferred model	Equation (3)	Preferred model
Scotland (−1)	−0.008 (0.094)		0.0697 (0.089)	
Scotland (−2)	0.0464 (0.095)		0.124 (0.101)	0.1866** (0.081)
UK	0.6257*** (0.156)	0.789*** (0.033)	0.572*** (0.143)	0.644*** (0.073)
UK (−1)	0.246 (0.192)		0.145 (0.199)	
UK (−2)	−0.182 (0.164)		−0.118 (0.139)	
DLSHP	2.182*** (0.594)	1.657*** (0.464)	1.586** (0.738)	
DLSHP (−1)	0.961 (0.606)		1.166** (0.569)	
DLSHP (−2)	1.054 (0.716)		1.431* (0.741)	
DLUKHP	−2.043 (2.029)		−1.499 (1.873)	
DLUKHP (−1)	−0.758 (1.893)		−1.233 (1.952)	
DLUKHP (−2)	1.434 (2.073)		−0.544 (2.22)	

Note: The table illustrates the estimates for lagged Scottish and UK sentiments with log differences in the UK and Scottish house prices as control variables. The model is estimated for the mean and the median sentiment across the newspapers. “Scotland” and “UK” denote Scottish and UK-wide sentiment, respectively. “DLSHP” and “DLUKHP” denote the first difference in the house prices, for Scotland the whole UK, respectively.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

is as follows:

$$s_{scot,t} = \alpha + \sum_{i=0}^2 b_{uk,i} s_{uk,t-i} + \sum_{i=1}^3 b_{scot,i} s_{scot,t-i} + \sum_{i=0}^2 b_{hps,i} DLSHP_{t-i} + \sum_{i=0}^2 b_{hpuk,i} DLUKHP_{t-i} + \epsilon_t, \tag{3}$$

where the new variables DLSHP and DLUKHP are first differences in house prices in Scotland and the United Kingdom.

Table 4 provides the estimates of an ARDL for the mean and the median of the Scottish sentiment, with lags of the Scottish and UK sentiments and house price changes as explanatory variables. For the mean, both the contemporaneous UK sentiment and change in house prices are found to be positive and statistically significant. When the median is considered, the preferred model includes the contemporaneous UK sentiment and 2-month lag of the Scottish sentiments, which would seem that persistences of parameters are important.

TABLE 5 Estimation with quarterly output per hour and house price.

	Mean		Median	
	UK	Scotland	UK	Scotland
UK (−1)	0.544**	0.343	0.571**	0.446**
UK (−2)	0.075	−0.031	−0.003	−0.009
Scotland (−1)	0.056	0.141	0.136	0.245
Scotland (−2)	0.074	0.077	0.055	−0.023
UKOPH	−0.002	−0.002	−0.001	0.016
UKOPH (−1)	0.011	0.034	0.007	0.014
SOPH	−0.012	−0.008	−0.018	−0.019
SOPH (−1)	0.033**	0.011	0.040**	0.023**
DLUKHP	1.586	−1.146	1.794	−5.257
DLUKHP (−1)	0.415	1.120	1.587	0.392
SLSHP	−0.064	3.400	−0.108	4.253
SLSHP (−1)	−0.405	1.214	−1.268	2.549
Intercept	−0.085	−0.101*	−0.085	0.048*
σ_{uk}	0.071		0.077	
σ_{scot}	0.082		0.083	
$\sigma_{uk,scot}$	0.542		0.435	
Log-Likelihood	138		133	

Note: The table shows estimates for current estimates of mean and median UK and Scotland sentiments for the 2005Q4–2017Q4 ($N = 51$). UK and Scottish sentiments are endogenous, with output per hour (UK and Scotland) and changes in house prices being (UK and Scotland) being exogenous variables.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

4.5 | Output per hour

Quarterly series on output per hour is also available on the Scottish Government website.⁹ This variable can be used as a proxy for productivity. The model is estimated for the period 2005 until 2017 adding output as an established control.

Table 5 shows the 3SLS¹⁰ estimate with UK and Scottish sentiments having two lags. The macroeconomic variables (output per hour and house price changes) for both Scotland and United Kingdom are added contemporaneously and with one lag. The results show that the main driver of the sentiments at quarterly frequencies is the one quarter lag of UK sentiments and the lagged Scottish output for both mean and median sentiments. When the model with the mean sentiments is estimated, it is noted that most of the variables are not statistically significant. The result with the median sentiment offers the interesting perspective that both the lag and Scottish output per hour are positive and statistically significant.

The specification used to estimate the results in Table 5 is condensed into the model of best fit with the results illustrated in Table 6.

The best fitted model shows the most important explanatory variable being the lagged UK sentiments for both the UK and Scotland sentiments (Table 6). The persistence parameter appears in both equation of each model. Scottish productivity also comes up in both UK equations (mean

⁹ <https://www2.gov.scot/Topics/Statistics/Browse/Economy/Productivity>

¹⁰ The results for Scotland do not deviate much if a simple ARDL is applied as in Table 5.

TABLE 6 Estimation with quarterly output per hour and house price using three stages least squares (3SLS).

	Mean		Median	
	UK	Scotland	UK	Scotland
UK (−1)	0.784***	0.596***	0.815***	0.512***
SOPH (−1)	0.029**		0.037**	
SLSHP		2.766***		2.633**
SLSHP (−1)				2.757***
Intercept	−0.059**	−0.059*	−0.055**	−0.090**
Sargan–Hansen test	15.92 (0.458)		15.72 (0.400)	
Std Dev (UK)	0.071		0.077	
Std Dev (Scot)	0.082		0.083	
Cov (UK Scot)	0.542		0.435	
Log-Likelihood	130		133	

Note: The table shows the estimates for the model of best fit for the UK and Scotland sentiments for the period 2005Q4–2017Q4 ($N = 51$). UK and Scottish sentiments are endogenous, with output per hour (UK and Scotland) and changes in house prices being (UK and Scotland) being exogenous variables.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

and median). It is worth noticing that contemporaneous and lagged changes in house prices for Scotland also appear in the main equation.

5 | SCOTTISH INDEPENDENCE REFERENDUM EFFECTS

To better understand the impact of the Scottish Referendum in the relationship between the UK sentiments and sentiment persistence, a model with a dummy variable for Scottish Referendum is estimated. The weak sentiment correlation illustrated in Figure 8 between the United Kingdom and Scotland could be the result of Scottish newspapers reporting about Scotland in uncertain or negative lens because of weak economic data, or better data for the rest of United Kingdom. To answer this question, we augment Equation (3)¹¹ with a dummy variable for Scottish Referendum. Table 7 shows the results for each control¹² (change in house prices and output per hour) for the mean sentiments.

The results from Table 7 confirm that Scottish newspapers, on average, would have portrayed economic news negatively in the months and quarters leading to the referendum. Except for the 3SLS model, which shows no statistical significance, the coefficient on the dummy variable is strongly negative during the referendum year. The newspapers may be illustrating economic news with negative sentiment simply due to poor performing data describing the economy relative to the United Kingdom. However, as the results suggest controlling for these economy factors makes the negative effect even stronger, as suggested by a lower value of the dummy coefficient. For the best fitted model, the two variables which appear throughout—the UK sentiment index (contemporaneous or lag) and the dummy variable. In the case of house price inflation, lagged Scottish sentiments do not seem significant. Moreover, the results show that the best fit model does not include productivity (as expected from Tables 5 and 6).

¹¹ The lags have been set to a maximum of one.

¹² We estimate the equations for each control independently due to the frequency of availability.

TABLE 7 Scottish Referendum estimates using house price and productivity as controls.

	ARDL		3SLS					
	House price		Productivity		House price		Productivity	
Scot (-1)	-0.039 (0.085)		0.192 (0.129)	0.249 (0.059)	-0.068 (0.088)		0.299*** (0.143)	
UK	0.602*** (0.133)	0.773*** (0.032)	0.669 (0.09)	0.551 (0.051)				
UK (-1)	0.233 (0.185)		0.069 (0.170)		0.675*** (0.126)	0.692*** (0.091)	0.413 (0.169)	0.690*** (0.084)
UK CF	-1.487 (1.815)		0.004 (0.366)		-0.618 (2.042)		0.008* (0.011)	
UK CF (-1)	1.683 (1.401)		-0.001 (0.007)		2.511 (1.829)		-0.000 (0.011)	
Scot CF	2.009*** (0.569)	1.924*** (0.465)	-0.006 (0.008)		2.112*** (0.742)	1.856 (0.560)	-0.000 (0.008)	
Scot CF (-1)	0.509 (0.555)		-0.004 (0.009)		0.095 (0.766)		-0.004 (0.009)	
DUMMY	-0.133*** (0.042)	-0.118*** (0.039)	-0.119*** (0.035)	-0.094*** (0.028)	-0.137*** (0.049)	-0.125*** (0.043)	-0.070 (0.062)	-0.135*** (0.047)

Notes: The table reports the estimation results for Scotland from an ARDL and 3SLS models for mean sentiments. For the 3SLS model, only the Scottish sentiment response is reported. The model of best fit is reported in each alternative column. The columns house price and productivity illustrate the controls. Each second column provides the preferred model selected by the automatic model selection approach. The coefficient for the Scottish Referendum period dummy is illustrated in bold.

Abbreviation: 3SLS, three stages least squares.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

These results indicate that divergence of the economic sentiments for the United Kingdom and Scotland as portrayed by the newspapers at the time before the Scottish Independence Referendum is likely to be caused by factors other than the economy fundamentals. After controlling for fundamentals, the dummy variable becomes more negative. What may be inferred is that newspapers may be reflecting economic uncertainty to a greater extent.

5.1 | Volatility of sentiments and partisanship

Partisanship can be partly answered by investigating the standard deviation of sentiments over different periods. A high standard deviation across the newspapers would imply that there are mixed opinions communicated by newspapers; on the other hand, a low standard deviation would imply that there is unanimity in the opinions communicated. One flaw from hypothesizing the above would be the case where most or all newspapers have strong partisan views, which is unclaimed and not tested in this article. In economic wide crisis, it is common to think of low volatility across the newspaper sentiments, but electoral uncertainty may imply opposing viewpoints which create a high standard deviation. The model estimated is a simple OLS with the UK sentiment volatility, mean sentiments, and global financial crisis and referendum dummies:

$$\sigma_{scot,t} = \alpha + \beta_1 \sigma_{uk,t} + \beta_2 s_{uk,t} + \beta_3 s_{scot,t} + \beta_4 DUMFC_t + \beta_5 DUMSF_t + \varepsilon_t, \quad (4)$$

TABLE 8 Measurement of volatility.

	Baseline model	Preferred model
α	0.249*** (0.040)	0.327*** (0.010)
$\sigma_{uk,t}$	0.366* (0.207)	
$s_{uk,t}$	-0.107 (0.091)	
$s_{scot,t}$	0.039 (0.061)	
$DUMFC_t$	-0.007 (0.401)	
$DUMSF_t$	-0.049*** (0.019)	-0.059*** (0.016)

Note: The table illustrates the estimates from estimating Equation (4). The first column provides estimates for the model with the intercept term, UK standard deviation of the sentiment, the mean sentiment, and the two calendar dummies. The second column reports the best model results.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

where σ_t is the volatility in the sentiments across newspapers, $DUMFC_t$ is a Binary variable taking the value of 1 during the global financial crisis—January 2008 until December 2010, and $DUMSF_t$ is a dummy for the Scottish Referendum year.

Table 8 shows the positive relation between the standard deviation of the news-based sentiment in the United Kingdom and Scotland but fails to find any significance in the dummy variable for the global financial crisis. This result can be explained by the fact that the UK volatility parameter already includes this information. The referendum dummy variable is negative and highly significant. The positive coefficient in the standard deviation of the UK newspapers may imply that general economic uncertainties from UK newspapers are also present in Scottish newspapers. The mean sentiments for the UK and Scotland appear irrelevant. In a nutshell, the intra-dynamics of the Scottish newspapers appears to be similar. When the preferred model is fitted, the Scottish Referendum dummy variable becomes more negative.

5.2 | Scottish Referendum in individual newspapers

We next consider investigating Scottish Referendum at granular (individual newspaper level). This is motivated by the fact that some newspapers have different sample sizes and, by averaging sentiments across newspapers, the results may be different. Regressing sentiment series from each newspaper i on the mean UK sentiment with a dummy will capture the effect from each newspaper:

$$s_{i,t} = \alpha + \beta_{i,1}s_{uk,t} + \beta_{i,2}DUMSF_t + \varepsilon_{i,t}, \quad (5)$$

for each newspaper i to investigate the heterogeneity of the newspapers in their portrayal of economic sentiments, this effect is captured by parameter β_1 .

The results are shown in Table 9. They indicate that at individual newspaper level, there are

TABLE 9 Estimation of referendum effects for individual newspapers.

	Daily record	Herald	PA Newswire	PA	Scotsman	Daily telegraph	Local	Sun	Sunday Herald
Panel A: Estimates									
Intercept	-0.007	-0.001	-0.030	0.005	0.041	0.183	0.143**	0.095	-0.025
	0.052	0.034	0.080	0.084	0.057	0.089**	0.030	0.092	0.051
Average UK sentiment	0.967**	0.600**	0.517*	1.127**	0.407**	1.287**	0.123	1.355**	0.896**
	0.194	0.139	0.225	0.263	0.171	0.255	0.132	0.246	0.189
Dummy	-0.271**	-0.001	-0.058	-0.105*	-0.111**	-0.374**	-0.019	-0.043	-0.115*
	0.036	0.045	0.063	0.073	0.046	0.066	0.014	0.058	0.086
R-Bar-Squared	0.187	0.178	0.020	0.170	0.080	0.170	0.007	0.152	0.084
N	204	204	127	120	68	195	195	134	227
Panel B: Estimates (fixing $\alpha = 0, \beta_1 = 1$)									
Dummy	-0.272	0.070	0.001	-0.122	-1.519	-0.243	0.282	-0.012	-0.121
	(0.017)	(0.042)	(0.043)	(0.060)	-	(0.017)	(0.014)	(0.021)	(0.072)

Note: The table illustrates the results from estimating equation for each Scottish newspaper. The headers represent the dependent variable (sentiment for newspaper i) and the left hand table illustrate the parameters from Equation 4. The figures in brackets show the HAC standard errors. The Dummy variable is illustrated in bold. Panel B shows the results from a simulation where $\alpha = 0$ and $\beta_1 = 1$.

Abbreviation: PA, Press Association.

** and * represents 5% and 10% statistical significance.

varying degrees in the relationship with the average UK sentiment and different behaviors before the Scottish Referendum. The Daily Telegraph, The Sun, and Press Association have strong linkages with the UK media sentiments, as the slope coefficient considerably exceeds unity. This might be due to the coverage of the publisher(s) which is published in both UK and Scottish outlets, without observing a different brand name. Local and regional papers on the other hand do not associate as closely with the UK media sentiments. One of the reasons for this finding is linked to regionalism, and the fact that these newspapers may individually be more interested in reporting local as opposed to the UK-wide economic news.

The negative sentiment across the Scottish Referendum is significant and strongly varies across different newspapers. Prior to the Scottish Referendum, The Daily Telegraph exhibited more negative sentiment, followed by The Daily Record. These newspapers support both conservative and labor views in the rest of United Kingdom, and therefore, this result indicates that the Scottish Referendum crosses the normal left-right political spectrum in Scotland. Newspapers such as The Scotsman and The Sunday Herald also illustrate significant negative sentiments before the referendum lying closer to left-wing views.

Panel B shows evidence toward undershooting of the media sentiments. The estimation fixes the intercept term at zero and the slope coefficient β_1 at one. The estimated dummy coefficient will show if there is overshooting with respect to the UK-wide sentiments. A positive dummy coefficient would imply that the newspapers are more optimistic than the average UK sentiment. A negative dummy coefficient would mean that the sentiment is being undershot. The Daily Record and The Daily Telegraph undershoot the UK sentiments, implying that they were relatively negative. At the other extreme, it is found that local papers seem to be communicating much better optimism as compared to the UK sentiments.

6 | CONCLUSION

This article investigates the relationship between the UK and Scottish sentiments as implied by economic news communicated in newspapers. The first result is that there is a positive relationship between UK and Scottish sentiments over the whole sample. We further investigate causal links. After accounting for endogeneity, causality runs from UK to Scottish sentiments. The models of best fit for both Scottish and UK sentiments include the lagged UK sentiment. After taking into consideration the macroeconomic controls for the change in house prices and productivity, higher housing prices tend to lead to higher media implied economic sentiments. Productivity, on the other hand, does not impact implied media sentiments.

After controlling for macroeconomic variables and factors, it was found that Scottish newspapers tend to portray economic news in a negative light in the months prior to the EU Referendum. A broad view enlisted in this article is that Scottish newspapers react to potential future uncertainty. Although the word uncertainty does not appear as commonly in the papers, the results reflect negative uncertainty in the months prior to the Scottish Referendum where the relevant dummy variable was seen as being negative. Around the referendum period a consensus emerged regarding the uncertainty about the future economic conditions—in fact the consensus is stronger than during the global financial crisis, after accounting for the UK volatility. At a granular level, evidence is found of some partisanship—where local newspapers were more positive in terms of implied sentiment than the main broadsheets across Scotland.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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