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The role of media in the credit crunch: The case of the banking sector

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ABSTRACT

Using a Vector Autoregression framework, this paper investigates the dynamic relationship between the intensity of negative media speculation and the market performance of financial institutions. Evidence is provided that over the sub-prime crisis period pessimistic coverage Granger-caused the returns on banking indices, while causality in the opposite direction proved weaker. These findings may imply that journalists not only report on the state of economic reality, but also play an active role in creating it. Investors acting upon sentiment implicit in media reports would have been able to improve their investment performance, as measured by Sharpe ratios and Jensen's alphas.

1. Introduction

The notion of the self-fulfilling prophecy has its origins in sociological literature (Thomas and Thomas, 1928; Merton, 1948) and has since found numerous applications in the fields of Economics and Finance. In general terms, the concept can be succinctly defined as a situation in which outcomes materialize, as a result of being widely anticipated. The application of this idea appears in Farmer and Guo (1994), who construct a model in which rational agents holding self-fulfilling beliefs drive the economic change. It is shown to provide a more accurate reflection of the dynamic interdependencies within the U.S. economy compared to standard business cycle models. In a similar spirit, Obstfeld (1986) develops a theoretical framework in which the actions of speculators can lead to a balance-of-payments crisis, simply because they expect the currency to be attacked. Finance scholars have also considered the possibility that self-fulfilling prophecies could be the rationale behind the formation of asset price bubbles (Flood and Garber, 1980) and the profitability of technical trading rules (Taylor, 1992).

In the context of our study, the perceptions of economic actors become critical, as they are the key to the survival of fractional reserve banking. The confidence of depositors in the health of financial intermediaries can become self-validating, as has been outlined by Diamond and Dybvig (1983). Theirs is a model with multiple equilibria, capable of explaining the delicate balance between undistorted financial operations and bank runs. The smooth functioning of the system is reliant upon the faith in the solvency of financial institutions. However, diminished confidence stemming from the belief that others will withdraw their deposits can lead to a situation where widespread panic ensues. Under the sequential-service constraint, which common practice imposes on banks, it becomes rational for individuals to run on deposits when confronted with an instigating factor. Facing *en masse* deposit withdrawals, banks come under extreme pressure, as there is a mismatch between

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the liquidity of their assets and liabilities. The dangers posed by bank failures are particularly worrisome, as the effects spill over to other sectors, thus having wider implications in terms of disrupting production and welfare within society.

Perceptive observers have noted that the confidence underpinning successful banking operations can be seriously threatened by unbalanced media reporting. One of a number of voices that have articulated this concern is that of the former Irish Minister for Finance the late Brian Lenihan, who remarked in his recent conference address (Lenihan, 2010):

> "There is a tendency to paint black and white pictures, to overstate difficulties, to use emotive language. . .It is important for journalists to be aware of the self-fulfilling nature of doomsday scenarios. I do not wish to exaggerate the point, but it is undoubtedly the case that the media can undermine or promote confidence in our economy".

The gravity of these assertions becomes particularly apparent in the context of the subprime crisis and further empirical investigation of this issue is warranted.

The primary objective of this paper is to assess the impact of recorded levels of media sentiment on stock market returns within the banking industry. We hypothesize that the intensification of pessimistic press coverage can lead to lower valuations of financial institutions, as the confidence level of investors and depositors decreases. Findings suggest that the frequency with which negatively charged keywords appear in English language publications Granger-causes banking sector returns. These findings are robust across several countries and expressions. Using an impulse–response and variance decomposition approach we probe the dynamics of the intertemporal relationship between the media and stock markets. A simulation of trading strategies suggests that investors who had paid close attention to media content could have improved their portfolio performance, as measured by raw returns, Sharpe ratios and Jensen's alphas.

The remainder of the paper is organized as follows. The next section reviews the literature on the relationship between media sentiment and stock market returns. In Section 3 we describe our data sources and the construction of variables. We then report the analysis of summary statistics. Section 4 constitutes the main body of our investigation, where we employ a range of econometric techniques and the practical implications for investors follow in Section 5. The penultimate part analyzes the robustness of our results. We end the paper with an overview of our analysis and some concluding remarks.

2. Media attention and stock market returns

Several earlier studies examined the link between certain aspects of coverage and fluctuations in asset prices. Thus far, no consensus has been reached with regard to the statistical significance of this nexus. One of the more conclusive studies on this topic is that of Tetlock (2007), which traces the influence of the pessimistic words contained in a popular *Wall Street Journal* column on the subsequent returns on the Dow Jones Industrial Average. His findings indicate that the intensification of pessimism produces an initial change in the index, which is reversed shortly thereafter. The ephemeral nature of this effect signifies that that it may be driven by the sentiment of noise traders, rather than constituting a reaction to genuine information about the underlying fundamentals. A follow-up study by Tetlock et al. (2008) uses company-level data to gauge the impact of gloom-laden firm-specific stories on stock prices. It has been established that the reports from the *Dow Jones News Service* hold greater predictive power for firms' stock returns than those from the *Wall Street Journal*, presumably because of the greater speed with which the information is disseminated by the former media outlet. Upon considering an active news-based trading strategy, the authors conclude that the potential profits are dwarfed by the incurred transaction costs.

Mitchell and Mulherin (1994) investigate whether the quantity of news announcements can affect the absolute value of returns. The results show a statistically significant relationship that is stronger for individual stocks than for the overall market index. From an economic perspective, however, increases in the number of announcements translated only into slight improvements in returns. Interestingly, stock prices tended to move with greater magnitude on days when the front-page headlines in the *New York Times* were printed in a larger font (see also Niederhoffer, 1971). A further study by Barber and Odean (2008) notes that it is mainly the buying behavior of individual investors that is affected by media attention. Institutional investors, who are likely to use more formalized investment criteria, are not as prone to purchasing stocks that dominate media coverage.

Another strand of research considers whether the activity on Internet stock message boards is predictive of the future direction of stock price movements. Antweiler and Frank (2004) review a large number of postings on the Yahoo! Finance and Raging Bull websites and qualify the sentiment contained therein. Although they report that the degree of bullishness of the posted content does not forecast returns, there is some evidence suggesting a weak short-lived response in returns to the volume of messages. Das and Chen (2007) attempt to capture the mood of message board users by employing a different sentiment extraction technique. In mapping the link between the sentiment index and future equity valuations, they present findings which narrowly verge on statistical significance. The strength of the relationship is further weakened when variables are made stationary by applying first-differencing.

Shiller (2000) draws attention to the possibility that media hype could have been, at least in part, responsible for the inflation and subsequent bursting of the Internet bubble. He argues that media was responsible for creating an atmosphere conducive to speculative behavior on the part of investors. Bhattacharya et al. (2009) formally test this assertion by compiling a large dataset of news items concerning IPOs of Internet companies and by using human judgment to categorize them according to the tone of their content. Results show that the media selectively devoted its attention to certain types of information depending upon the phase of bubble development. Consequently, Shiller's claim that news providers

over-hyped Internet stocks finds some validation in the data. This statement must be tempered with the fact that news coverage did not induce large price movements during the speculative period. According to the calculations of Bhattacharya et al. (2009), it accounted for only for 2.9% of the difference in returns between Internet stocks and those in the control sample.

It is not always the case that investors will respond to information in a rational manner. Huberman and Regev (2001) present a case study on the stock price reaction to an article published in the *New York Times* in May 1998. The paper reported a significant discovery in cancer research, to which a biotechnology company EntreMed held exclusive rights. The stock price of the company skyrocketed by over 330% in the course of one day and a positive effect spread to other firms within the biotechnology sector. Remarkably, this was a reaction to what was an essentially old piece of information. The story had previously featured in *Nature* and other news outlets as early as November 1997. In this instance, actions of investors could be deemed irrational, particularly in the view that a part of the price reaction recorded in May 1998 remained permanent.

The contribution our paper makes to this ongoing debate is to consider the role that the media played during a period of intense turbulence in the financial markets. Over a relatively short period of time, a barrage of potentially disastrous events that threatened to destabilize the global economy occurred. The momentum with which news of these happenings arrived startled most investors, who scrambled for explanations in order to make sense of the situation. One could argue that the demand for news increased and greater attention became focused on media reports. From this we can quite plausibly suggest that investors began to rely more heavily on the media to justify their decision-making. We corroborate this intuition by documenting a relationship between stock returns and media pessimism that is more robust than that which had been previously uncovered in the literature.

3. Data

We derive our measures of pessimistic media attention by focusing on all English language news contained in the Lexis-Nexis database. More specifically, we recorded the number of articles mentioning negatively charged phrases over monthly intervals. Three phrases were chosen as proxies for the level of fear, namely “Credit Crunch”, “Financial Crisis” and “Bank Failures”, as they characterize the uncertainty that permeated the society. These were also the terms that came to be buzzwords used by a media struggling to make sense of the unfolding situation. For instance, during the height of the crisis the term “Credit Crunch” became so prevalent, that its inclusion was almost requisite to relaying negative information. Since our interest lies in the stability of the banking sector, we included only phrases with negative connotations. In our opinion, optimistic phrases do not carry the same potential to trigger bank runs and market crashes. Analysis of upbeat terminology would be perhaps better-suited to other periods and contexts, thus we encourage other researchers to pursue this potentially fruitful avenue of research.

The study covers three countries with established capital markets, where English is an official language (US, UK, Canada). In order to represent the stock price movements within the banking industry, we have used the value-weighted FTSE Banks indices downloaded from Datastream. All returns are continuously compounded and expressed in local currency. Denominating returns in US dollars, however, does not change our conclusions.[2] The sample period extends from the end of January 2005 to the end of May 2010. This timeframe is appropriate, as it allows us to examine the unique events that took place in the banking sector over the recent years. At this point we also want to note that the use of phrases like “Credit Crunch” was very sporadic prior to the beginning of our sample.

Panel A in Fig. 1 depicts market trends within the sector during the length of time considered. From the graphs it is apparent that the period starting in May 2007 and ending in February 2009 was tempestuous for the markets, in which the valuations of banks fell in unison across the countries. During the aforementioned period, both UK and US indices dropped by more than three quarters of their original value. Canada was not immune to the problems of the credit crunch, as it was forced to deal with the difficulties in the asset-backed commercial paper market (Bank of Canada, 2007). Overall, however, it managed to weather the storm relatively well. Ratnovski and Huang (2009) argue that the resilience of the Canadian banks grew out of a lower dependency on wholesale funding, as well as a conservative regulatory environment and structural factors that encouraged prudent lending practices. Over the entire sample period, the Canadian banking index actually increased in value.

At a glance, it is possible to map the change in the media variables plotted in Fig. 1 to the landmark events occurring during the financial crisis. According to Brunnermeier (2009), the early signs of things to come became visible in February 2007, when delinquency rates among subprime borrowers increased. The following month, the terms “Credit Crunch” and “Bank Failures” began to appear in publications more frequently than usual. In June 2007, one of the leading investment banks Bear Stearns came under pressure, as two of its hedge funds were unable to meet their margin calls. The concerns were reflected in media pessimism with all of the news variables registering higher values. Notably, the “Credit Crunch” variable experienced over a nine-fold rise in July and an almost eight-fold increase thereafter in August 2007. In general, the month of August saw disruptions of banking operations intensify, as BNP Paribas suspended normal activities on three of its money market funds, the ECB was forced to provide liquidity and the German bank Sachsen LB became a casualty of the events that unfolded (Edmonds et al., 2010; Bank of England, 2009).

[2] Results can be obtained from authors upon request.

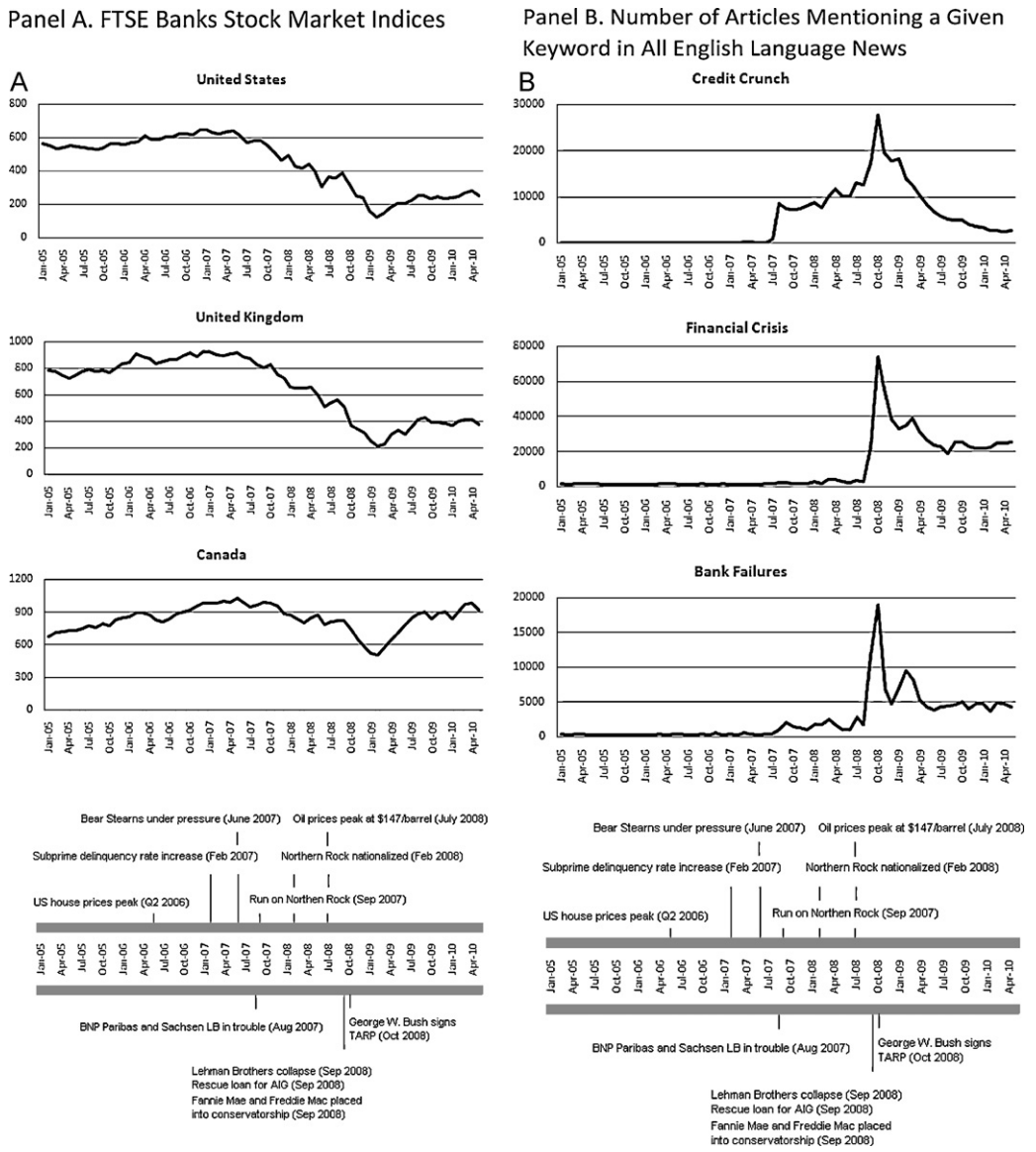

Fig. 1. Data plots. Panel A displays the trends in FTSE Banks indices in local currencies sourced from Datastream. The variables in Panel B track, on a monthly basis, the number of articles appearing in the LexisNexis database that contain the particular phrases given above.

Further evidence of the deepening troubles followed in September 2007, when the British bank Northern Rock suffered a run by its panicked depositors (Shin, 2009). In that particular month, the number of hits for "Bank Failures" had more than doubled. Despite efforts to alleviate the pressures, the bank eventually had to be nationalized in February 2008. The emergency sale of Bear Sterns to JP Morgan Chase & Co. in March further fueled negative attention, with all media variables exhibiting elevated levels as compared to the previous month. Events brought the situation to its nadir in September 2008, when Fannie Mae and Freddie Mac went into conservatorship, Lehman Brothers filed for bankruptcy, Bank of America acquired Merrill Lynch, and the insurance giant AIG received a rescue loan from the Federal Reserve. Meanwhile, in the UK, the deeply distressed Bradford & Bingley became semi-nationalized and was partly sold off to one of its competitors (Edmonds et al., 2010). In early October, George W. Bush signed the Troubled Asset Relief Program (TARP) and the HM Treasury introduced a support package designed to alleviate the strain on UK banking. This was also the month when our pessimistic keyword count levels reached their maximum. Since then, as confidence in the system began to be slowly restored, the optimism of journalists grew. Overall, it can be concluded that our media pessimism variables reflect the perceived intensity of the crisis and the atmosphere of uncertainty around the time.

Table 1
Summary statistics. The first three variables in Panel A record the number of articles in the LexisNexis database that mention a given phrase in a particular month. The remaining variables in Panel A denote the FTSE Banks indices denominated in the local currency for each of the countries analyzed in our study. Panel B reports the first-differenced keyword hits and continuously compounded returns on the indices listed in Panel A. The sample period spans from January 2005 to May 2010. The figures reported in the second and third column represent the arithmetic averages and a measure of volatility. The following two columns juxtapose the results of the Augmented Dickey–Fuller (ADF) stationarity tests (Dickey and Fuller, 1979) and the corresponding MacKinnon (1996) one-sided *p*-values. The lag length for the test was selected using the Akaike Information Criterion (Akaike, 1973, 1974) with the maximum length being set at ten. An alternative stationarity test designed by Phillips and Perron (1988) was performed and the results are given in the last two columns.

	Mean	Standard deviation	ADF test	*p*-Value	Phillips–Perron test	*p*-Value
Panel A. Variables in levels						
Credit_Crunch	4919.2769	6216.9278	−1.7458	0.4036	−1.5851	0.4843
Financial_Crisis	10969.9231	15375.1030	−1.6563	0.4482	−1.9254	0.3188
Bank_Failures	2466.7077	3315.8409	−1.8353	0.3604	−2.9032	0.0505
FTSE_Banks_US	443.0992	164.3638	−0.3938	0.0903	−0.4722	0.8892
FTSE_Banks_UK	652.8125	226.5421	−0.8476	0.7979	−0.3833	0.9052
FTSE_Banks_Canada	835.7337	118.2101	−2.1699	0.2191	−2.0590	0.2617
Panel B. Transformed variables						
ΔCredit_Crunch	42.4688	2242.0369	−3.5564	0.0096	−8.0909	0.0000
ΔFinancial_Crisis	377.5000	7861.4900	−7.1987	0.0000	−8.8109	0.0000
ΔBank_Failures	61.3125	2329.2216	−9.4086	0.0000	−15.1839	0.0000
Returns_US	−0.0127	0.1040	−6.0268	0.0000	−6.0506	0.0000
Returns_UK	−0.0113	0.0844	−2.5933	0.1002	−5.2954	0.0000
Returns_Canada	0.0048	0.0553	−4.9571	0.0001	−4.9624	0.0001

Table 2
Pearson correlation coefficients for the transformed variables. This table reports Pearson product–moment correlation coefficients between the variables used in our studies. The *p*-values for the null hypotheses that the correlation coefficients are not different from zero are reported in parentheses. The variables *ΔCredit_Crunch*, *ΔFinancial_Crisis* and *ΔBank_Failures* represent the change in the number of hits recorded for these particular phrases in the LexisNexis database. For each country in our sample, the remaining variables are defined as the continuously compounded returns on the FTSE Banks indices. Each return series is expressed in domestic currency. The time period under consideration begins in January 2005 and ends in May 2010.

	ΔCredit_Crunch	*ΔFinancial_Crisis*	*ΔBank_Failures*	*Returns_US*	*Returns_UK*	*Returns_Canada*
ΔCredit_Crunch	1.0000 (–)					
ΔFinancial_Crisis	0.7603 (0.0000)	1.0000 (–)				
ΔBank_Failures	0.7253 (0.0000)	0.7364 (0.0000)	1.0000 (–)			
Returns_US	0.0744 (0.5592)	−0.0307 (0.8098)	0.0360 (0.7774)	1.0000 (–)		
Returns_UK	−0.3151 (0.0112)	−0.3951 (0.0012)	−0.3242 (0.0090)	0.7453 (0.0000)	1.0000 (–)	
Returns_Canada	−0.0961 (0.4502)	−0.0778 (0.5413)	−0.0093 (0.9417)	0.7450 (0.0000)	0.6913 (0.0000)	1.0000 (–)

Table 1 provides the summary statistics for the variables used in our study. From the averages provided, it becomes apparent that "Financial Crisis" was the most commonly used of the terms that we consider, and the frequency with which the phrase "Credit Crunch" appeared is twice that of "Bank Failures". Also reported in the table are the results of the Augmented Dickey–Fuller (ADF) stationarity tests (Dickey and Fuller, 1979), together with the corresponding MacKinnon (1996) one-sided *p*-values. The lag length for the test was selected using Akaike Information Criterion (Akaike, 1973, 1974) and capped at ten. In order to check the robustness of the findings obtained through ADF testing, we employ the nonparametric stationarity test of Phillips and Perron (1988) and present the results in the last two columns of the table. Overall, there is overwhelming evidence that the variables expressed in levels are integrated of order 1 and must be transformed to achieve stationarity. For this reason, we apply first differencing to our media variables and calculate returns from the index series. First differencing removes both stochastic and any possible deterministic trends. The transformed variables reported in Panel B are then used in the empirical analysis that follows.

The correlation coefficient matrix with the corresponding *p*-values is reported in Table 2. The high degree of interdependency between the differenced measures taken to represent media attention encourages us to believe that the commentators' mood has been efficiently captured, regardless of the phrase used. Most of the contemporaneous relationships between the news variables and bank returns are in the expected direction and are statistically significant for the UK. However, as we subsequently demonstrate, a dynamic model is needed to capture the full extent of the interplay between published pessimism and the stock markets. The correlations between returns on bank indices across countries are strong and significant, with the relationship between Canada and the UK being the weakest. This is consistent with the previous findings of Dimson et al. (2002) for the more broadly defined stock market indices.

4. Results

In selecting the appropriate modeling approach, one must consider the possibility that the media variable could be endogenous (Mitchell and Mulherin, 1994). Journalists may not only be the precipitators of self-fulfilling news, but may also recount the evolution of past stock prices. For this reason, our study adopts a Vector Autoregression (VAR) methodology, introduced by Sims (1980). Within this framework, we can accommodate more than one endogenous variable and no *a priori*

Table 3
Granger causality tests. Panels A–C report the results of the Granger causality tests by keyword. These results are based on nine Vector Autoregression (VAR) models, each of which includes two endogenous variables, namely the returns in the domestic banking industry and the change in the frequency of the appearance of negative phrases in the published media. Within each model, we test for causality in both directions using the Granger (1969) approach. For each null hypothesis of no causality, *F*-statistics along with the corresponding *p*-values are provided. The number of lags in the models was determined using the Akaike Information Criterion (Akaike, 1973, 1974) with the maximum lag length set at eight. Stock returns have been calculated employing the FTSE Banks indices for each of the three countries in our samples. These are expressed in domestic currency units and are continuously compounded. The media variables are constructed by counting the number of articles in which the keywords appear within a particular month. These are subsequently transformed to achieve stationarity using first-differencing.

	United States		United Kingdom		Canada	
	F-statistic	*p*-Value	*F*-statistic	*p*-Value	*F*-statistic	*p*-Value
Panel A. Models with *ΔCredit_Crunch* variable						
H_0: change in media pessimism does not Granger-cause stock returns	8.9074	0.0000	9.9419	0.0000	6.5545	0.0001
H_0: stock returns do not Granger-cause the change in media pessimism	1.8977	0.1251	1.5396	0.1954	2.0849	0.0836
Panel B. Models with *ΔFinancial_Crisis* variable						
H_0: change in media pessimism does not Granger-cause stock returns	9.6057	0.0000	5.9799	0.0002	6.1547	0.0002
H_0: stock returns do not Granger-cause the change in media pessimism	6.5894	0.0000	1.6794	0.1577	2.3731	0.0529
Panel C. Models with *ΔBank_Failures* variable						
H_0: change in media pessimism does not Granger-cause stock returns	13.9672	0.0000	10.4083	0.0000	6.2960	0.0001
H_0: stock returns do not Granger-cause the change in media pessimism	3.4427	0.0070	2.2406	0.0653	2.0148	0.0933

restrictions are imposed on the structure of the relationship. A related methodology is that of Granger (1969), which allows us to neatly disentangle cause from effect. It is to Granger causality tests that we first turn in order to begin our investigation.

Through testing the nature of the link between bank returns and the change in media pessimism, we can determine the extent to which each of the variables is a function of its own past values and those of the second variable. The *F*-statistics reported in Table 3 are derived by comparing the residual sum of squares from the initial regression and one in which the coefficients on the lags of the second variable are restricted to zero. The lag length selection both for the Granger causality tests discussed here, and the VAR models that follow, has been selected using the Akaike Information Criterion (Akaike, 1973, 1974). To alleviate the problem of vanishing degrees of freedom, we have restricted the maximum lag length to eight. Since there are three stock markets and three terms, we must consider nine different specifications of the model.

The results of the Granger causality tests in Table 3 clearly show that the current climate of journalistic opinion can influence the future valuations of banking stocks. The null hypothesis that the change in media pessimism does not Granger-cause stock returns is strongly rejected in all of the models analyzed. Thus, the claim that negative news reporting can become a self-fulfilling prophecy is corroborated in the data. When we examine the causality in the opposite direction, our tests deliver mixed findings. At the conventional five percent significance level, only two out of nine models indicate causality running from the stock market to news stories. One can infer from this that the returns from previous months do not dominate the current media narrative.

Figs. 2–4 plot the accumulated generalized impulse response functions for each of the nine VAR models. A reader interested in this analytical tool should refer to Pesaran and Shin (1998), while a more detailed exposition of the VAR methodology can be found in Hamilton (1994). Our graphs show that following an introduction of a one standard deviation positive shock in the differenced media pessimism variables, the cumulative returns in the banking sector of each country fall over the subsequent five to eight month period. The magnitude of these drops bears both a strong economic and statistical significance. Depending upon the combination of country and keyword, this ranges from −8.33% to −15.99%. Although the size of these figures appears large, one ought to remember that the estimation was based on a period that included a chain of events that was distinctly dramatic in nature. It is the Canadian market that experiences the 'mildest' reaction in this simulation, presumably due to the relative strength of its banking sector. An interesting point to note is that almost all bank indices show a noticeable reversal following the half-year mark. In general, the change in intensity of negative keyword use is not substantially depressed following the introduction of a positive innovation in bank returns.

There are potentially two competing explanations for the behavior of returns following a change in journalistic perception. It could be reasoned that it is rationalized by the shifting sentiment of the investing public, or alternatively, by the fact that journalists forecast future events better than investors. We believe that the latter justification is highly implausible for several reasons. Firstly, as a group, professional market watchers are more numerous than reporters. According to the data published by SIFMA (2011) the number of people employed in the US Securities Industry stood at 811,700, while the tally of news analysts, reporters and correspondents reached 69,300 (Bureau of Labor Statistics, 2010). From this we can conclude that greater resources are at the disposal of investors. Secondly, journalists do not bear financial responsibility for expressing their opinions on the state of the economy, whereas traders have to live with the consequences of their predictions. Thirdly, corporate insiders, who are universally acknowledged to have the best access to corporate information, feature as an integral part of the market landscape (Seyhun, 1986). Journalists, on the other hand, are not privy to such sensitive information. If this was indeed the case, they would have a strong financial incentive to become investors themselves. Finally, in light of the existing literature on the speed of stock price reaction (see for instance Patell and Wolfson (1984) and Kim et al. (1997))

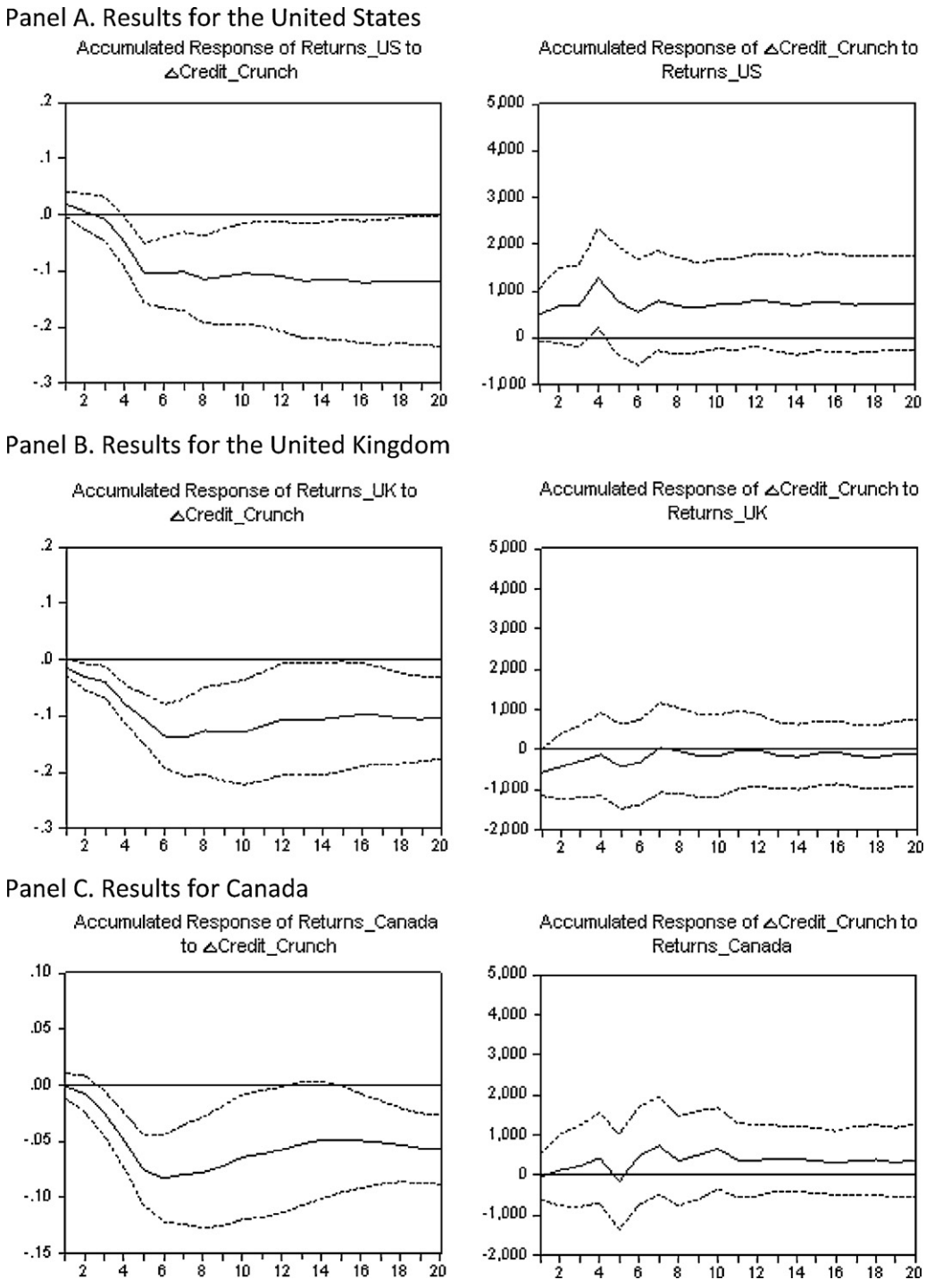

Fig. 2. Accumulated responses to Generalized One S.D. Innovations ± 2 S.E. for models including the *ΔCredit_Crunch* variable. The accumulated impulse response functions were generated from VAR models including a differenced media variable and returns on the banking indices. The data were sourced from LexisNexis and Datastream. The lag length was selected using the Akaike Information Criterion with a maximum set at eight. The models presented in Panels B and C are based on five lags, while the optimal lag length for the U.S. model is four. (Panel A) Results for the United States. (Panel B) Results for the United Kingdom. (Panel C) Results for Canada.

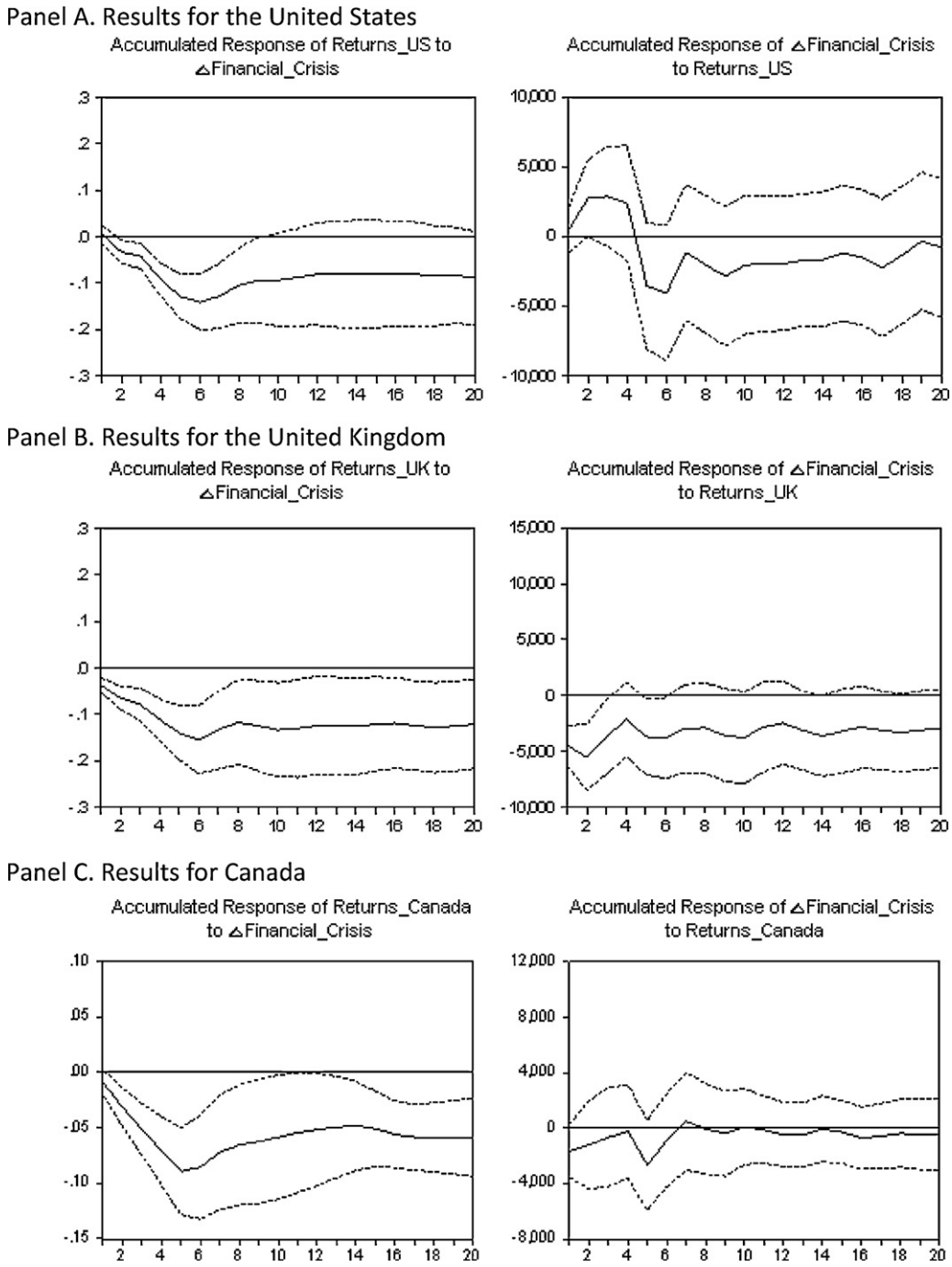

Fig. 3. Accumulated responses to Generalized One S.D. Innovations ± 2 S.E. for models including the *ΔFinancial_Crisis* variable. Shown in the figure are the accumulated impulse–response functions generated from three VAR models including two endogenous variables each. The first variable records the change in the number of articles in LexisNexis mentioning the negative phrase listed above. Returns in each country are continuously compounded, pertain to the indices on the banking sector, and are denominated in local currency. The optimal lag length in models for the US, the UK and Canada are eight, five and five, respectively. (Panel A) Results for the United States. (Panel B) Results for the United Kingdom. (Panel C) Results for Canada.

it is difficult to accept that near-efficient markets would take over six months to digest published information (see the impulse–response functions).

For all of the aforementioned reasons, it is more reasonable to assume that the reaction of prices captures the slowly eroding investor confidence that occurs as a result of continued exposure to downbeat news coverage. The pessimism generated by the media appears to spread at a certain rate of contagion, subsequently manifesting itself in return distribution.

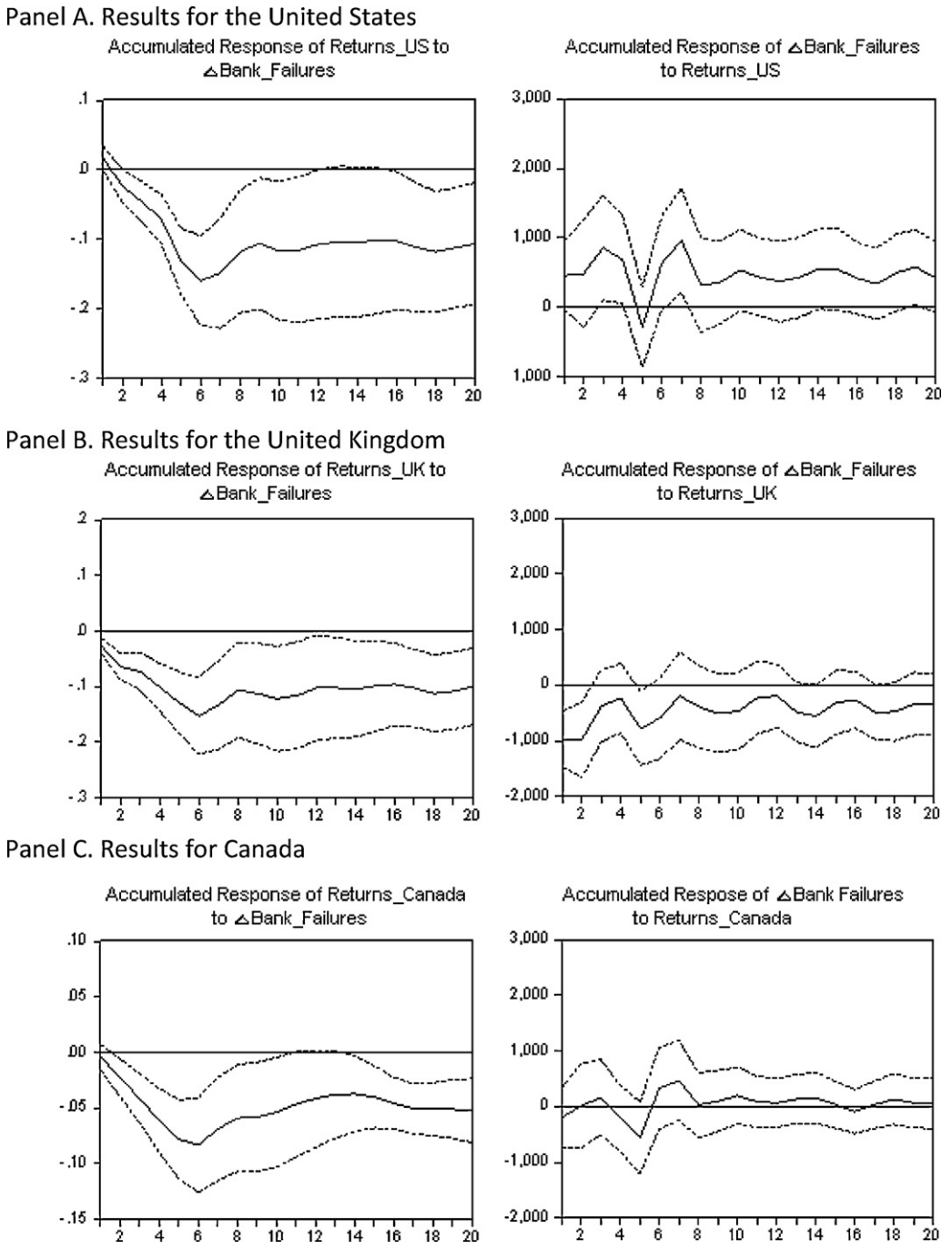

Fig. 4. Accumulated responses to Generalized One S.D. Innovations ± 2 S.E. for models including the *ΔBank_Failures* variable. Depicted in the graphs are the accumulated impulse responses from the VAR models using two variables each. The first variable is constructed by measuring the change in the frequency with which the phrase "Bank Failures" is mentioned in articles taken from the LexisNexis database. Returns are continuously compounded, expressed in local currency and based on FTSE Banks indices sourced from Datastream. The optimal lag length for the VAR models for the US is six and for the UK and Canada this is set at five.

The prices seem to initially overreact, we presume as a result of the depressed sentiment among noise traders and begin to partially rebound after about six months, as arbitrageurs take advantage of the deviation from fundamental values. This proposed explanation is offered in the spirit of Tetlock (2007).

Table 4 reports the forecast error variance decompositions for the nine VAR models used in our study. Three different forecast horizons are considered, namely six, twelve and eighteen months. In general terms, variance decomposition, sometimes also referred to as innovation accounting, measures the degree of informational contribution of one variable to a forecast

Table 4
Variance decomposition. The table below reports the forecast error variance decomposition for nine different bivariate Vector Autoregression (VAR) models. All three panels consider a separate media variable along with bank index returns in each of the countries. The media variables are defined as the first differenced number of all English language articles included in the LexisNexis database that mention a specific keyword in a given month. Bank returns are continuously compounded, expressed in local currency and constructed using the FTSE Banks indices sourced from Datastream. Within each VAR model, we compute the proportional contribution of innovations in one variable to the forecast error variance in both itself and the other variable. The decomposition is performed at three different forecast horizons, namely six, twelve and eighteen months. Numbers in the table are expressed in percentage terms.

	Horizon	United States		United Kingdom		Canada	
Variable explained		By innovations in					
		Bank Returns	Media Variable	Bank Returns	Media Variable	Bank Returns	Media Variable
Panel A. Models with *ΔCredit_Crunch* variable							
Bank returns	6 months	56.0886	43.9114	51.7865	48.2135	54.6658	45.3342
	12 months	56.0542	43.9458	53.1472	46.8528	53.2549	46.7451
	18 months	55.7395	44.2605	53.9362	46.0638	52.8406	47.1594
Media variable	6 months	7.6517	92.3483	5.4187	94.5813	13.5162	86.4838
	12 months	8.7246	91.2754	8.1370	91.8630	17.5841	82.4159
	18 months	8.9080	91.0920	8.4181	91.5819	17.5956	82.4044
Panel B. Models with *ΔFinancial_Crisis* variable							
Bank returns	6 months	49.1661	50.8339	42.8183	57.1817	52.6612	47.3388
	12 months	61.1599	38.8401	40.6978	59.3022	49.8979	50.1021
	18 months	62.2479	37.7521	41.1071	58.8929	49.4321	50.5679
Media variable	6 months	47.4769	52.5231	9.5564	90.4436	14.5648	85.4352
	12 months	52.1909	47.8091	11.7744	88.2256	16.9011	83.0989
	18 months	51.5073	48.4927	12.1132	87.8868	17.3434	82.6566
Panel C. Models with *ΔBank_Failures* variable							
Bank returns	6 months	38.3132	61.6868	37.8049	62.1951	58.0252	41.9748
	12 months	40.0441	59.9559	33.6384	66.3616	53.0287	46.9713
	18 months	40.2477	59.7523	34.1865	65.8135	52.2604	47.7396
Media variable	6 months	29.1528	70.8472	7.8514	92.1486	17.0417	82.9583
	12 months	32.8301	67.1699	12.5544	87.4456	19.4222	80.5778
	18 months	32.4575	67.5425	12.5069	87.4931	19.8461	80.1539

of other variables in the system. More precisely, the forecast error variances in the endogenous variables are accounted for by innovations in themselves and the remaining variables in the model (Lütkepohl, 1991). For eight of the nine models investigated, we discover that at all three horizons the innovations in bank returns explain a relatively small proportion of the forecast error variance of the differenced media variables. On the other hand, changes in media sentiment account for a large fraction of bank return forecast error variance. Taken together, these findings corroborate our conclusions drawn from Granger causality tests and impulse–response analysis, this being that negative media attention drives down future bank returns, while the relationship running in the opposite direction is less robust.

5. Trading strategies

The practical importance of our findings can be readily measured by the efficacy of trading simulations. Taking our cue from the signals provided by the negative word counts, we design strategies that guide the timing of investments in the banking sector. We operationalize two trading strategies for each of the keywords. An individual following *Strategy A* would invest in a banking index-replicating portfolio when the frequency of pessimistic phrase use is lower than expected and would invest in one-month Treasury bills when the negative word count rises above its expected value.[3] The expected value is defined as the average number of keyword hits over the previous twelve months. The signal is generated at the end of the month, thus prompting the investing direction for the following month.

Strategy B uses the same signals as *Strategy A*, however when the number of keywords is higher than expected, the investor should take a short position on the banking stocks. Our calculations factor in the imposition of the short-selling ban in all three countries. In an attempt to stabilize the markets, the Securities and Exchange Commission acting in unison with Financial Services Authority and Ontario Securities Commission temporarily prohibited the short-selling of financial shares in September 2008. The ban was subsequently lifted in October in the US and Canada, while in the UK it remained in force until January 2009. In constructing the trading strategy, we assume that during the period when legal restrictions applied the investor would purchase T-bill instead of engaging in short-selling.

Each of the panels contained in Table 5 describes the outcomes of simulations of seven different trading approaches. The first strategy, denoted as Buy & Hold, is a passive one and sets a benchmark against which the remaining investment methods can be compared. For each country we run *Strategy A* and *Strategy B* using the levels of each of the three media

[3] We used the yield on one-month T-bills sourced from Datastream. Our investor receives signals on a monthly basis and, as a consequence, the investment commitment should not exceed one month period.

Table 5
Profitability of media-based trading strategies. The table below reports the results of trading simulations based on the media sentiment variables. The first strategy labeled *Buy & Hold* is passive, in the sense that it involves buying a banking index-replicating portfolio at the beginning of the sample period and holding it until the end. *Strategy A* involves investing in one-month Treasury bills when the number of articles mentioning a given pessimistic phrase exceeds its expected value. The expected value is defined as the average value of the media variable over the past twelve months. When the count falls below the expectation, the investor holds a FTSE Banks replicating portfolio. The signals are generated at the end of the month and determine the position for the following month. *Strategy B* is similar to *Strategy A*, with the exception that instead of buying the Treasury bills, the investor takes a short position on the bank index. This does not, however, apply to months when short-selling was banned, in which case the investor uses T-bills as an alternative. We simulate the strategies for each of the keywords and markets considered in the study. Since twelve month period to calculate the expected values of media variables is needed, we begin the simulation in February 2006 using a signal generated at the end of January 2006. The trading period ends in May 2010. Columns two and three provide arithmetic averages of monthly returns and volatility, while column four reports the Sharpe ratios (see Sharpe (1966, 1994)). The next column displays the intercept from a CAPM-type regression carried out in the spirit of Jensen (1968). The MSCI country indices sourced from Datastream proxy for the market portfolios in these regressions. The *Excess return per rebalancing* is calculated as the annualized Jensen's alpha divided by the average number of portfolio rebalances per year.

Trading strategy	Returns	Standard deviation	Sharpe ratio	Jensen's alpha	Excess return per rebalancing
Panel A. Results for the United States					
Buy & Hold	−1.5543%	11.4952%	−0.5281	−0.9988%	
Strategy A (Credit crunch)	1.6576%	5.5055%	0.9123	1.7286%	12.8413%
Strategy B (Credit crunch)	4.3655%	10.3827%	1.3833	4.0453%	30.0508%
Strategy A (Financial crisis)	0.8335%	3.1966%	0.8984	0.7201%	3.4042%
Strategy B (Financial crisis)	2.7839%	10.9238%	0.8808	2.0946%	9.9020%
Strategy A (Bank failures)	0.6183%	5.8268%	0.3657	0.6018%	1.5647%
Strategy B (Bank failures)	2.3126%	11.0353%	0.7231	1.8167%	4.7233%
Panel B. Results for the United Kingdom					
Buy & Hold	−1.5286%	9.2210%	−0.6789	−1.0617%	
Strategy A (Credit crunch)	1.2073%	5.7668%	0.5492	1.2312%	9.1457%
Strategy B (Credit crunch)	1.9390%	7.0203%	0.8120	1.7899%	13.2963%
Strategy A (Financial crisis)	0.7705%	3.8540%	0.6887	0.6356%	3.0044%
Strategy B (Financial crisis)	1.1270%	7.1988%	0.5438	0.6636%	3.1368%
Strategy A (Bank failures)	0.3941%	4.6089%	0.2936	0.3192%	0.8298%
Strategy B (Bank failures)	0.3588%	7.2792%	0.1705	0.0071%	0.0186%
Panel C. Results for Canada					
Buy & hold	0.1473%	5.9936%	−0.0297	0.0696%	
Strategy A (Credit crunch)	1.2627%	4.0690%	0.8948	1.1347%	8.4295%
Strategy B (Credit crunch)	1.8705%	5.4803%	1.0468	1.7160%	12.7472%
Strategy A (Financial crisis)	1.2294%	2.9452%	1.4371	1.0609%	5.0151%
Strategy B (Financial crisis)	1.8516%	5.4869%	1.1699	1.6166%	7.6422%
Strategy A (Bank failures)	0.7674%	3.6264%	0.7254	0.6122%	1.5918%
Strategy B (Bank failures)	0.9062%	5.7240%	0.5458	0.6964%	1.8108%

variables. Displayed in the table are measures of reward and risk, alongside the performance measures proposed by Sharpe (1966, 1994) and Jensen (1968). In computing Jensen's alpha, we use MSCI country equity indices taken from Datastream. The final column labeled "Excess Return per Rebalancing", reports the annualized Jensen's alpha divided by the average number of portfolio rebalances required per year to implement the strategy. With the exception of the initiation and closing down of the portfolio, each rebalancing requires two transactions (for instance, selling equities and buying bonds, or vice versa). The profitability of the trading strategy is then dependent upon whether investor's rebalancing costs fall below the figures given in the final column.

Examination of the figures reported in Table 5 uncovers evidence of a rather curious stock market anomaly. It appears that, for each of the countries considered, the media-based trading strategies outperform the Buy & Hold benchmark, while exhibiting lower total risk. Therefore it is perhaps not surprising that Sharpe ratios favor the active trading rules. The average monthly excess returns, as expressed by Jensen's alpha, confirm the outperformance on a risk-adjusted basis. As referred to previously, the frequency of trading dictates the extent of profitability. This frequency was lowest for the term "Credit Crunch" and highest for "Bank Failures", which is reflected in the last column. The magnitude of the numbers reported, allows us to suggest that the abnormal profits generated would surpass transaction costs for the majority of the strategies. Although the "excess returns per rebalancing" figures seem rather high for some of the investment rules, the investor would not be able to make reliable *ex-ante* predictions about which of the strategies would be the most lucrative.

6. Robustness checks

Our analysis assumed that market participants would have access to all English language newspapers. In the digital era we inhabit, this assumption probably does not conflict strongly with reality. For instance, there is nothing stopping a trader in London from reading an online version of the *New York Times*. It may be argued, however, that market participants would be predisposed to reading their own national newspapers. In order to identify the local effects, rather than rely on global newsfeeds, we gathered information on the total number of pessimistic hits in each of the countries separately. We then

used this information to re-specify our models in a way that each country was treated in isolation. It has been found that the domestic media effect is comparable to the global one. Despite geographical boundaries the media content appears to maintain a broadly similar profile.

A possible concern with the adopted mode of analysis is that the content of the articles surveyed may be in fact not as pessimistic, as the keywords imply. For instance, a piece referring to credit crunch may hold an air of optimism. If this problem is indeed prevalent, this may introduce a degree of noise into our media sentiment measures. As a full review of the content of each of the almost 1.2 million articles included in our sample would be to say the least impractical, we instead draw a random sample of 50 news items for each keyword (150 news items in total). The articles were carefully studied and assessed for the tone that each adopted. Only 3 were deemed optimistic and all of these related to specific companies or assets rather than being general prognostications on the state of the economy. With the fraction of optimistic items standing as low as 2% of the overall sample, we conclude that the measurement error in the construction of our proxies appears to be negligible. This finding, in turn, also undermines the argument that algorithmic trading could have fallen foul of the content noise.

Furthermore, we performed an alternative collection of keyword counts by restricting our search domain to only major world newspapers. LexisNexis defines these as over 40 key newspapers around the world that are generally recognized to provide the most complete and reliable information. We replicated our analysis using this altered definition of article hits and arrived at results which are qualitatively and quantitatively similar. This perhaps is not surprising, as the smaller newspapers are likely to take their cues from subjects covered in press with wider circulation. The implication of this finding is that investors may not need to cast their net any more widely than the major broadsheets.

Finally, we check whether there is a differential reaction between larger and smaller banks. As financial intermediaries occupy a pivotal role within the economy, policy-makers try to ensure that they operate smoothly. However, some 'too big to fail' banks are viewed by many as more fundamental than others to the stability of the system, which could have ramifications for the bailout policies in turbulent times. The stock market indices used in our analysis thus far were value weighted, which tilted our focus towards these large intermediaries. To address this possible shortcoming, we have also constructed equally weighted portfolios based on all banks for which data were available in Datastream. Our main conclusions are maintained in models with equally weighted indices, which attest to the fact that the reaction to news is not strongly differentiated according to bank size.

7. Conclusions

The context of the subprime crisis has encouraged a great deal of speculation on the influence of media commentary on real world events. Perceptive observers have voiced their suspicions that the role the media played served to exacerbate the severity of the situation experienced by financial institutions. In times when the possibility of bank runs becomes less remote, shoring up the confidence of the general populous becomes more important than ever. We contribute to this area by empirically examining whether the frequency of negative journalistic opinions aggravated the sharp falls in the market value of equity in the banking sector. More specifically, we have collected data on the number of English language publications that used phrases with negative connotations particular to this series of events. The behavior of these media variables was then linked to the series of returns in the banking sector within the Vector Autoregression framework.

Granger causality test results demonstrate that media reports can influence the future movements of stock prices, while the evidence that journalists simply echo previous months' market developments is somewhat weaker. According to our simulations, an increase in negative coverage induces a statistically significant response in the future returns on banking stocks. The results from the variance decomposition analysis confirm the conclusions regarding the strength and directionality of the relationship between the published news and the markets. When confronted with these findings, one is inclined to argue that commentators ought to strike a fine balance between exercising their freedom of speech and using overly dramatic language to report current affairs. While the alarmist punditry may sell newspapers, it appears that engaging in this activity could result in detrimental economic and financial consequences for society. Libel laws define boundaries at the level of firms and individuals, but the same dissuasive legislation could not be applied at a sectoral or macro level.

Not only does our study yield insights for media professionals, but could also act as a guide for stock market investors. We have uncovered easy to implement media-based strategies that beat the simple buy-and-hold approach on a risk-adjusted basis. Trading rules founded upon the number of articles using pessimistic keywords, specific to the situation, have delivered improved Sharpe ratios and positive Jensen's alphas. The abnormal gains generated by most of these active trading strategies surpassed reasonable portfolio rebalancing costs. However, one needs to realize that underlying our results is a period of heightened volatility. Further studies are required to ascertain whether these results are transferable to other periods and markets. Additional investigation is also required to identify causal relationships of the type discussed here using firm-level data.

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