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Article — Published Version

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Intereconomics

Suggested Citation: Sauter, Oliver; Schroff, Sebastian; Spankowski, Ulli; Burghof, Hans-Peter (2013) : Talking by numbers: Communicated uncertainty of the ECB, Intereconomics, ISSN 1613-964X, Springer, Heidelberg, Vol. 48, Iss. 5, pp. 287-292, <https://doi.org/10.1007/s10272-013-0471-x>

This Version is available at:

<https://hdl.handle.net/10419/126403>

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Talking by Numbers – Communicated Uncertainty of the ECB

Using a novel approach, this paper analyses the deliberately communicated uncertainty of the ECB to the market. Specifically, it semantically analyses the uncertainty expressed in official ECB press statements. The analysis shows how the ECB tries to alert or appease the market with different levels of communicated uncertainty. The appeasement through low uncertainty communication levels is particularly pronounced during times of financial distress. Further, the analysis shows that the ECB tried to alert the market through an increasing level of communicated uncertainty prior to the outbreak of the global financial crisis.

Over the last two decades, central banks all over the world have continuously improved their openness and transparency. This policy change has been associated with more detailed communication to the public, driven by the desire to improve the management of market expectations in order to gain more direct control of market movements. The essential role of steering markets by influencing expectations is highlighted, for example, by Woodford, who states that “not only do expectations about policy matter, but, at least under current conditions, very little else matters”.¹

This substantial change in communication marked the starting point of the close attention paid to any kind of central bank communication or activity by financial market participants. An important reason for this increased interest is that the accurate assessment of speeches, interviews, press statements and other publications can be an important factor for forecast-

ing market movements. With the onset of the financial crisis and the new prominent role of central banks to act as lenders of last resort and to guarantee the stability of the financial system, central bank communication has become even more important.

Central banks are well aware of the power of their wording on the perception of market participants and their potential reactions. Hence, many central banks – including the European Central Bank (ECB) – are likely to weigh every single word carefully before it is communicated to the public. For this reason, and to avoid leaving too much room for speculation regarding the true intention of the council, minutes from the regular ECB council meetings are not made public. Instead, the ECB communicates its perception of the economy and the corresponding interest rate decisions mainly via official press statements, which follow its periodical meetings. This enables the ECB not only to publish its assessment of the development of macroeconomic key variables, but also to determine the level of uncertainty concerning these variables that it wishes to communicate to the public. As a matter of fact, the level of communicated uncertainty can differ significantly from the uncertainty perceived by the council. However, this degree of freedom gives the ECB the power to steer expectations in a very controllable way, a feature that would vanish if the minutes of the meetings were published.

To capture this deliberately communicated uncertainty, we semantically analyse ECB press statements. With respect to the overall macroeconomic and monetary situation, this allows us to measure how much uncertainty the ECB intends to communicate to the market. To analyse the statements, we adopt a methodology which turns the qualitative ECB statements into a quantitative indicator. Specifically, we track the occurrence of words that signal economic uncertainty in each press statement. The resulting time series is compared to the standard market uncertainty measure VSTOXX. Further, we

* Financial support from Boerse Stuttgart and the EU project FIRST under grant agreement n. 257928 is gratefully acknowledged.

¹ M. Woodford: Central Bank Communication and Policy Effectiveness, presented at the Federal Reserve Bank of Kansas City symposium “The Greenspan Era: Lessons for the Future”, Jackson Hole, Wyoming, 25-27 August 2005, p. 3.

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conduct a Markov-switching analysis to identify possible regime switches in the communicated uncertainty.

Our results indicate that the ECB changes its wording depending on the economic situation. This observation has been particularly pronounced during the ongoing debt crisis that has dominated European financial markets in recent years. Our findings add a new perspective to previous research analysing central bank communication.

Literature review

In the field of financial economics, Tetlock was the first to quantify the textual sentiment of financial news media and analyse its interaction with the stock market.² He documents a strong link between media pessimism and a downward pressure on stock prices as well as decreased trading activity. He concludes that the tone of news has a direct impact on investor behaviour and corresponding market movements. To capture the tone of news, Tetlock relies on the Harvard IV-4 Psychosocial Dictionary, which classifies words as positive or negative. Specifically, he counts the number of negative and positive words based on their connotation according to the dictionary.

Loughran and McDonald question the use of the Harvard dictionary in the financial domain.³ They argue that in the financial context, certain words often have different meanings than they do in other areas of life. For example, the word “liability” does not carry a negative meaning in the financial context, whereas in everyday use it is negatively afflicted. Since the Harvard dictionary was originally developed in the psychological and sociological context, it cannot be used to accurately capture the meaning of words in financial texts. To overcome this shortcoming, Loughran and McDonald develop an alternative dictionary that is specifically directed at capturing the sentiment of words in the financial domain.

Lately, the semantic analysis of central bank communication has attracted growing interest. Apel and Grimaldi measure the sentiment of the Swedish Riksbank minutes to predict monetary policy decisions.⁴ For sentiment detection, they construct an alternative word list and find that central bank minutes predict future policy actions. Grimaldi employs Loughran and McDonald’s dictionary to assess financial distress.⁵ Specifically,

he analyses the sentiment expressed in ECB monthly bulletins to identify financial distress and argues that extracted information can be a valuable contribution to an overall financial distress indicator. Mayes and Montagnoli use minutes from the Bank of England, the Czech National Bank and the Sveriges Riksbank to analyse how they communicate uncertainty.⁶ Closely related to this paper is research by Baker et al., who develop an overall economic uncertainty indicator based on the combination of three individual indicators: media news sentiment, tax code provisions and forecast dispersion.⁷

We contribute to the literature by exploring a field which is – although related to the previously mentioned studies – very different. Similar to Baker et al., we apply textual sentiment analysis. However, we specifically focus on the amount of uncertainty in official central bank press releases instead of media news. Naturally, the amount of uncertainty in official central bank communication channels captures something completely different than media coverage on central bank policy. Also, in contrast to Mayes and Montagnoli, we measure the level of communicated uncertainty to the public instead of measuring the level of uncertainty within the central bank.

Data and methodology

The ECB itself perceives a well-structured and transparent supply of information as a key element of successful central bank communication.⁸ Hence, all the information provided in official ECB press statements is deliberately chosen to convey a specific message. In fact, it can be assumed that every single word – as well as the absence of certain words – is driven by a specific desired impact on financial markets.

Hence, to capture and compare the ECB’s desired level of communicated uncertainty over time, the well-structured communication framework is ideally suited due to its standardised setting.⁹ In contrast, this is not the case during central bank committee meetings, where discussions do not have to follow a strict diction and thus can vary substantially. For this

2 P.C. Tetlock: Giving Content to Investor Sentiment: The Role of Media in the Stock Market, in: *The Journal of Finance*, Vol. 62, No. 3, 2007, pp. 1139–1168.

3 T. Loughran, B. McDonald: When Is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10-Ks, in: *The Journal of Finance*, Vol. 66, No. 1, 2011, pp. 35–65.

4 M. Apel, M.B. Grimaldi: The Information Content of Central Bank Minutes, *Sveriges Riksbank Working Paper Series*, No. 261, 2012.

5 M.B. Grimaldi: Up for count? Central bank words and financial stress, *Sveriges Riksbank Working Paper Series*, No. 252, 2011.

6 D. Mayes, A. Montagnoli: Uncertainty and monetary policy, 2011 version of paper presented at the CES ifo Venice Summer Institute “Central Bank Communication, Decision-Making and Governance”, Venice, Italy, 23–24 July, 2010.

7 S.R. Baker, N. Bloom, S.J. Davis: Measuring Economic Policy Uncertainty, <http://www.policyuncertainty.com>, accessed 10 December 2012; S.R. Baker, N. Bloom, S.J. Davis: Policy uncertainty: a new indicator, in: *CentrePiece – The Magazine for Economic Performance* 362, Centre for Economic Performance, LSE, 2012; S.R. Baker, N. Bloom, S.J. Davis: Europe Monthly Index, <http://www.policyuncertainty.com>, accessed 10 December 2012.

8 European Central Bank: Transparency in the monetary policy of the ECB, *Monthly Bulletin*, November 2002, pp. 59–66.

9 On the possible difficulties of communication with different groups of interest, see e.g. L. Bini Smaghi: The Value of Central Bank Communication, *Financial market speech series at the Landesbank Hessen-Thüringen permanent representation of Hessen in Brussels*, 20 November 2007.

reason, we also exclude the Q&A period following each press statement. Questions and – at least to some extent – answers are not as well considered as official press statements.¹⁰

Our sample period covers all press statements released after the first monthly meeting of the Governing Council in the period from January 2002 to August 2012. Although press releases are also available prior to the start of our sample period, the ECB only adopted a well-structured and coherent monthly documentation in November 2001, which is why press releases before 2002 are not considered in our analysis. Although press statements do not have the informational depth that minutes would provide, they have the advantage of a standardised textual structure across all publications. For example, the statements always consist of a general introduction, an economic analysis, a monetary analysis and a conclusion. The total number of analysed press statements is 127.¹¹ On average, each statement contains 1397 (median 1542) words.

To transform the qualitative textual content into a quantitative indicator, we adopt a “bag of words” approach, i.e. we actually count the words which are related to a specific semantic content. Specifically, we obtain the uncertainty in ECB statements by summing the occurrence of words that are contained in the “uncertainty words” classification provided by Loughran and McDonald.¹² This list contains words that are typically associated with uncertainty in the financial context, such as “risk” and “ambiguity”, as well as sub-forms like “risked”, “riskier” and “riskiness”.¹³

Analysing the sentiment of a specific document with the help of word classifications has become widely accepted in academic research.¹⁴ The potentially controversial issues that need to be considered when applying this methodology are outlined below.

Choice of word list: Loughran and McDonald state that the foremost consideration for meaningful content analysis lies in the right criteria list, i.e. the right signal words must be identified.¹⁵ For this reason, Loughran and McDonald adjusted the

Harvard IV-4 dictionary to fit properly into the financial context rather than using the original version, which was intended for the sociological and psychological context.

Relative frequency: Like any other methodology, the bag of words approach has its shortcomings. For example, the word “recession” has a very different meaning depending on whether it is preceded by the word “weak”, “strong”, or “no”. However, the idea behind the bag of words approach is that a high frequency of similar signal words must be correlated with the author’s intended tone for the document and, in our case, the current market assessment. Thus, the relative frequency of signal words mitigates a change in the meaning of a signal word which may stem from potential modifying words (e.g. “weak”, etc.). For example, the more frequently the word “risk” is used, the higher the author’s risk perception. With regard to our data, ECB representatives, in particular the president, do not loosely use potentially destabilising words such as “uncertainty” or “risk” in their statements. The committee is well aware of the possibility that financial markets may misinterpret their meaning.¹⁶ Thus, we can assume that it only matters to a very limited extent whether the word combination “little uncertainty” or “high uncertainty” is used. As long as a signal word related to “uncertainty” appears, the ECB president’s intention is to deliberately draw the attention of the public to the respective issue. If not, he would have chosen a different phrase. Hence, regardless of whether a recession is classified as strong or weak, by using the word, the author intends to draw attention to a recession. The same holds for uncertainty – what matters is not whether it is low or high but rather that uncertainty is in fact prevailing.¹⁷ In sum, the deliberately worded and well-structured nature of ECB press statements provides an ideal environment for utilising a bag of words approach.

Negation: It is more likely that a positive expression will be negated, e.g. “no high uncertainty” rather than “no less uncertainty”. Hence, negated words can be excluded as an extra entry from a word list without changing the results significantly.¹⁸ Moreover, the relative frequency argument would suggest that the whole expression would be excluded rather than using a negation.

Empirical results

Descriptive statistics

Table 1 provides descriptive statistics of the communicated uncertainty of the ECB. In the following, we refer to this varia-

10 Of course, one could assume that the Q&A session is part of some strategic game, well grounded into the overall strategy of the ECB, which simply functions as a different communication channel. However, we focus on the standardised part to ensure comparability over time.

11 There were four months during our sample period in which no ECB press statement was given. We have overcome this lack of data by working with the mean of the preceding and following statement.

12 T. Loughran, B. McDonald, op. cit.

13 The full list contains 291 words and is available at http://www3.nd.edu/~mcdonald/Data/Finance_Word_Lists/LoughranMcDonald_Uncertainty.csv.

14 See, for instance P.C. Tetlock, op. cit.; T. Loughran, B. McDonald, op. cit.; M. Apel, M.B. Grimaldi, op. cit.; S.R. Baker et al.: Measuring Economic ..., op. cit.; or S.R. Baker et al.: Policy Uncertainty ..., op. cit.

15 T. Loughran, B. McDonald, op. cit.

16 See R. Reeves, M. Sawicki: Do financial markets react to Bank of England communication?, External MPC Unit 15, Bank of England, 2005.

17 M.B. Grimaldi, op. cit.

18 T. Loughran, B. McDonald, op. cit.; M.B. Grimaldi, op. cit.

Table 1

Descriptive statistics

Observations	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis
127	31.76	30.00	11.00	62.00	11.42	0.63	-0.14

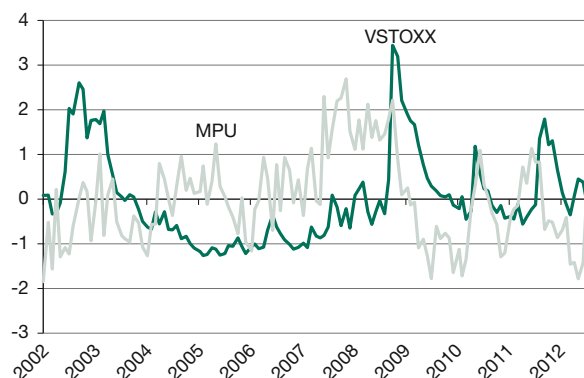
ble as monetary policy uncertainty (MPU). The MPU gives us a numerical value for the amount of uncertainty communicated by the ECB. A high MPU value indicates a high level of uncertainty communicated by the ECB, whereas the opposite is true for a low value. The distribution of the MPU series is positively skewed, which implies that the mass of the distribution is concentrated on the left with relatively few high values. Further, it displays negative excess kurtosis, indicating a flat distribution with relatively large variations between observations. These time-series properties provide some first indication that communicated uncertainty fluctuates considerably during our sample period, but it only rarely reaches very high levels. This is in line with the reasoning that central banks commonly attempt to appease financial markets and stabilise expectations instead of actively promoting uncertainty.

Monetary policy uncertainty vs. financial market uncertainty

We use the VSTOXX as a benchmark measure of market uncertainty in Europe. The VSTOXX index is based on EURO STOXX 50 real-time option prices.¹⁹ It provides a reliable benchmark for market expectations of near- and long-term volatility and hence the aggregated uncertainty of market participants. Figure 1 plots the standardised VSTOXX with a dark green line. It displays four distinct hikes, representing high levels of market uncertainty in 2003, late 2008, mid-2010 and late 2011. Linked to those peaks are the second Gulf War (i.e. the invasion of Iraq) in 2003, the September 2008 Lehman Brothers bankruptcy, the first Greek bailout request in 2010 and the resignation of Greek Prime Minister Papandreou in tandem with the second Greek bailout request in August 2011.²⁰ The light green line depicts our monetary policy uncertainty indicator MPU, which is obtained by analysing the textual content of ECB press statements. We average the data as a rolling three-month window to obtain a smoother picture.²¹

As Figure 1 shows, financial market uncertainty was more strongly influenced than ECB communicated uncertainty by the second Gulf War around 2003. This suggests that particularly in the short run, equity markets are more sensitive to ma-

Figure 1

VSTOXX and monetary policy uncertainty (MPU)

Source: STOXX Limited; authors' calculations.

for macroeconomic events such as natural disasters or wars than they are to monetary policy.

The period between 2004 and late 2008 is characterised by relatively low levels of market uncertainty according to the VSTOXX indicator. There is only a slight increase prior to the Lehman Brothers bankruptcy, followed by a distinct peak afterwards. What is striking is the rise of the MPU, which began to increase gradually in mid-2006, then sharply in early 2007, before peaking in November 2007. This pattern is of special interest, as this pronounced rise was not accompanied by a similarly large increase in the VSTOXX. The MPU peak can be ascribed to the beginning of the financial crisis, which is often dated to around mid-2007, when the first sub-prime mortgage losses emerged. Further, in 2007 the first financial institutions announced the termination of their financial activity in US mortgage derivatives. It seems as though the ECB was gradually prompting the public to pay more attention to financial market risk and economic uncertainty even before these events actually materialised. We consider this as an alert phase of ECB communication.

The period before 2006 is rather difficult to interpret in terms of the ECB's communicated uncertainty. Figure 1 does not exhibit a clear pattern here that could be attributed to macroeconomic events such as the international stock market crashes during 2002 or the second Gulf War in 2003.²² A possible explanation for a reduction in communicated uncertainty could be the continuous appreciation of the euro against the dollar during this period, which is a signal in and of itself for low economic uncertainty within the eurozone.

Interestingly, as the VSTOXX rose to its all-time high at the end of 2008, the MPU markedly decreased towards an all-time

19 See <http://www.stoxx.com> for further details on how the VSTOXX is calculated.

20 See S.R. Baker et al.: Measuring Economic ..., op. cit.; and S.R. Baker et al.: Policy Uncertainty ..., op. cit.

21 Both series have been standardised according to $z = (x - \mu)/\sigma$.

22 See e.g. J.B. Carlson, E.A. Pelz: A Retrospective on the Stock Market in 2000, Federal Reserve Bank of Cleveland, January 2001.

low. We assume that the sharp drop in communicated uncertainty around 2008/2009 is connected to a phase of market appeasement by the ECB. 2008 marked the beginning of the first severe challenge in the history of ECB strategy, and particularly its communication policy. The overall economic situation was so grim that it forced the ECB to discard all indications of uncertainty from its official communication in order to appease the market of its fear of the ongoing turmoil. Together with other measures such as the enormous liquidity provisions, the ECB successfully reduced market uncertainty in the following months, as indicated by the VSTOXX decrease.

This adds a new communication-focused view of the overall crisis management of the ECB. The appeasing effect of non-standard measures in the aftermath of the crisis has been highlighted, for example, by González-Páramo.²³ In addition, there has been a lively debate over the extent to which proper communication can reduce overall uncertainty.²⁴ Yet there has been no discussion on the extent to which a shift in the *wording* of communication concerning uncertainty has contributed to the decline in overall uncertainty and thus to a stabilisation of the European economy after the global financial crisis. The importance of this question, i.e. how a reduction of uncertainty contributes to economic growth, has been analysed by Baker et al.²⁵

We assume a strong interconnection between the level of the ECB's communicated uncertainty on the one hand and market uncertainty on the other. This assumption is supported by our findings for the period before the Lehman bankruptcy, when the ECB entered an alert phase starting in 2006. However, there is a possibility that this interconnection between the two uncertainty indicators has changed over time. While the ECB attempted to alert the market prior to the Lehman bankruptcy, it has struggled with cyclical appeasement attempts in the aftermath. Since the VSTOXX and MPU declines in 2009, both measures have shown very similar patterns, sharing ups and downs throughout the following three years of the ongoing eurozone crisis. The ECB's appeasement attempts through lower communicated uncertainty levels are clearly visible. Sharp reductions in the number of uncertainty terms in the ECB's official communications following events that created significant market turmoil can be seen twice, namely after the

peaks resulting from the 2010 Greek bailout request and the 2011 Greek bailout referendum. The poor market conditions in 2011 forced the ECB to reduce its uncertainty communication to an all-time low in 2012.

The distinct drop in MPU in late 2008 marks an important switch in the communication strategy of the ECB, allowing us to distinguish between ECB uncertainty communication before and after the onset of the crisis. Before 2008, the ECB managed its communication in a straightforward manner, with the ability to alert financial markets countercyclically. This was likely due to the fact that no severe challenge had emerged. Since 2008, the ECB appears to have struggled to appease financial markets through various means and hence has reduced the communication of uncertainty to a minimum. Additionally, it seems as if the ECB does not communicate its future expectations of the overall macroeconomic situation anymore, as uncertainty is communicated more in parallel with market uncertainty as measured by the VSTOXX. One possible explanation for this strategy is that the ECB was well aware of the fragility of the financial system and therefore did not want to fuel additional market uncertainty by expressing concerns in its communication. This, however, may lead to a weakening of the ECB's credibility and cause market participants to lose their trust in the ECB and its ability to restore stability to European financial markets.

To provide further insights into the apparent switches in ECB communication, we perform a more thorough analysis of the MPU in the next section by running a Markov-switching analysis.

Markov-switching analysis

Given a time series, the Markov-switching analysis identifies two or more regimes or states by their mean or variance with the help of a likelihood estimation.²⁶ Perlin's method, which we utilise in this paper, delivers the probability that one or the other state is prevailing.²⁷ Based on the data derived from the semantic analysis of press statements, we adopt the Markov-switching approach to identify different regimes of communicated uncertainty by the ECB. The resulting probabilities that support the prevailing regime are given in Figure 2.²⁸

Figure 2 allows us to distinguish between two regimes, as indicated in Table 2. The states differentiate themselves through

23 J. González-Páramo: The response of the Eurosystem to the financial crisis, Keynote Speech at the European Parliament's Special Committee on the Financial, Economic and Social Crisis, Brussels, 10 November 2009.

24 See, for example, B. Born, M. Ehrmann, M. Fratzscher: Central bank communication on financial stability, Working Papers Series 1332, European Central Bank, 2011; and J. Asmussen: Building trust in a world of unknown unknowns: central bank communication between markets and politics in the crisis, Speech at the European Communication Summit 2012, Brussels, 6 July 2012.

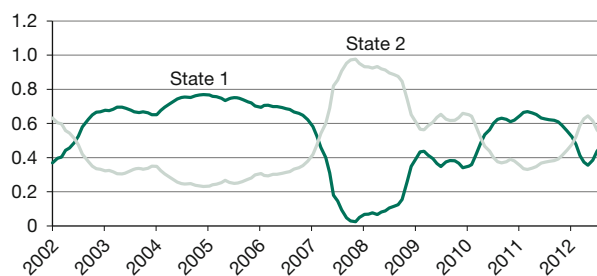
25 See S.R. Baker et al.: Measuring Economic ..., op. cit.; and S.R. Baker et al.: Policy Uncertainty ..., op. cit.

26 See J.D. Hamilton: Time Series Analysis, Princeton University Press, 1994.

27 M. Perlin: MS_Regress – The MATLAB Package for Markov Regime Switching Models, 2012.

28 For an intensive introduction of Markov-switching in time series, please refer to J.D. Hamilton, op. cit.

Figure 2
Markov-switching probabilities



Source: Authors' calculations.

different variances: State 1 exhibits a variance of 0.756 and State 2 a variance of 1.134.²⁹

The differentiation shown in Table 2 fits well with our previous reasoning. We classify State 1 (dark green line) as the “stable environment”. It lasts from 2003 until the end of 2006. Although the financial crisis is said to have begun in mid-2007, the ECB changed its uncertainty communication well before the actual onset, as detailed above. At this point, we observe a regime switch in the ECB’s communication, which lasts until the end of 2009. We classify this second regime as the “crisis environment”, depicted by the light green line in Figure 2. In line with our graphical findings, we see that State 2 prevails during the appeasement period shown in Figure 1. In 2010, we observe the reintroduction of the stable environment, which lasts until the end of 2011. This finding may be connected to the recovery of stock markets, most notably the German DAX, while the switch back to the crisis regime in 2012 may be connected to the communicative challenges of the ECB during the European sovereign debt crisis.

This Markov analysis reinforces our descriptive findings in the previous section. ECB communication during the calm economic environment in the pre-crisis years was more straightforward and less essential for steering financial markets in comparison to the second half of our sample period, for which the MPU indicator shows a higher variance. Hence, communication of uncertainty was more pronounced during these times in order to exert a stronger influence on financial markets. This means that during the crisis regime, uncertainty-related words have been either widely avoided or used extensively, in order to leave no space for misinterpretation of ECB comments.

In sum, our findings depict a consistent picture in which ECB communication policy plays a distinctive role during times of distress. Under these conditions, ECB communication is more

²⁹ Due to the fact that these probabilities do not switch in an immediate manner, a yearly state differentiation seems to be sufficient to specify a reasonable regime switch.

Table 2
Discrimination of states

From the beginning of	Until the end of	State
2003	2006	1
2007	2009	2
2010	2011	1
2012	Sampling period	2

accentuated and exhibits greater variance. Furthermore, the level of the ECB’s communicated uncertainty and the market measure VSTOXX, while closely linked, are not synchronised with each other.

Conclusion

The increased transparency of major central banks is accompanied by an increase in the scrutiny applied to their communication. This paper aims for an assessment of central bank communication by semantically analysing ECB press conference statements. Our analysis differs from previously adopted approaches in that our indicator expresses the *willingness* of the central bank to communicate uncertainty to the public by explicitly making use of uncertainty-related words. The central bank is free to choose when and to what extent it wants to communicate uncertainty to the market. While this might be negligible during times of financial stability, it can be a decisive feature of central bank policy in times of economic turmoil such as the recent financial crisis, since communication can be a powerful tool to reduce market uncertainty.

In general, the level of uncertainty communicated by the ECB is closely linked to the market uncertainty measure VSTOXX. However, the ECB’s communicated uncertainty reacted in a timelier manner than the VSTOXX did before the crisis, then became substantially lower following the Lehman bankruptcy in late 2008. We argue that this is due to an overall appeasement approach by the ECB to reduce overall uncertainty in financial markets. A corresponding pattern can be observed during the European sovereign debt crisis, in which communicated uncertainty was reduced around severe events that had the potential to destabilise financial markets. Our findings thus point to a switch in the ECB uncertainty communication strategy after 2008. However, this switch from countercyclical alerts to pro-cyclical appeasement risks a loss in reputation and trust in the central bank.

To support our reasoning, we employ a Markov-switching analysis that identifies two different communication regimes. These regimes can be described as “stable” and “crisis” regimes. The findings indicate that during turbulent times, the “crisis” regime – with a higher variance in the use of uncertainty-related terms – prevails, which supports our graphical findings.