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The Information Content of Central Bank Minutes*

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Abstract

One characteristic feature of central banks today is that policy decisions are almost exclusively made by a committee rather than by a single policy maker. Another is that central banks are considerably more transparent than they used to be. Together, this has brought to the fore an important but so far unresolved issue: to what extent should a central bank's communication reflect the full spectrum of opinions among its committee members? Does information on all members' views make monetary policy easier to understand and predict, or does it make it harder? We address this issue by employing a novel method. We measure the sentiment and tone of the minutes of the Swedish central bank using an automated content analysis that converts the qualitative information in the minutes to a quantitative measure. We find that this measure is useful in predicting future policy rate decisions.

Keywords: Central Bank Communication, Minutes, Content Analysis.

JEL Classification: D71, D83, E52, E58.

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1. Introduction

Central banking has changed quite dramatically in recent decades. One significant trend has been toward increased transparency and more abundant communication. Another trend has been toward delegating policy decisions to committees rather than to single policy makers.⁴ These developments have brought to the fore an important but so far unresolved issue: to what extent should the central bank's communication reflect the full spectrum of opinions among the committee members? Does information on all members' views make monetary policy easier to understand and predict, or does it make it harder?

The communication of most central banks typically reflects only the view of the majority, or the "collegial" view of the monetary policy committee (MPC). If there has been disagreement within the MPC, it is typically not made public. However, some types of communication from some central banks reflect the fact that decisions are indeed made by a committee, where members may have different opinions and may sometimes disagree about the policy decisions. Obvious examples are the minutes and voting records of the monetary policy meetings. The number of central banks that publish minutes and voting records has increased in the last decade, but still only constitutes a small minority.⁵

In this paper, we address the question of whether information about the views of all MPC members is helpful in predicting future monetary policy. We do this by employing a method that is novel in this context. We measure the sentiment and tone in the minutes of the Swedish central bank (Sveriges Riksbank) using an automated content analysis that converts the qualitative information in the minutes to a quantitative measure. We then investigate how useful this measure is for predicting the Riksbank's future policy decisions.

The study contributes to the existing literature in several ways. To date, only limited research has been conducted on central bank minutes as a means of communication and as a carrier of information about future policy in particular. A small body of research investigates whether the *voting record* is predictive of future policy, but the discussion during the policy meeting preceding the voting has so far been neglected, despite the fact that it is potentially very informative. We find that the measure of the tone in the minutes helps to predict future policy decisions and that it does a better job than the voting record.

The study also relates to a body of research that investigates the extent to which central bank communication adds information to the information already contained in macroeconomic variables. Most of the studies have focused on the communication policy of the European Central Bank, and the typical result is that central bank communication increases the predictability of policy decisions, even when controlling for macroeconomic conditions. This study confirms this result for the Swedish Riksbank, as well as for a means of communication (central bank minutes) not previously investigated.

Furthermore, the method we use to extract information from the minutes is in itself quite novel. Automated content analysis typically attempts to measure the tone of a text by counting the relative frequency of some pre-specified key *single* words. However, the semantic meaning of a specific word often depends on the context of use. For example, while the word "recovery" in isolation appears to carry a positive message, the phrase "sluggish recovery" does not. This problem can be mitigated by carefully designing the single-word list. In this paper, however, we instead search for two-word combinations of a noun and an adjective, such as "higher inflation"

⁴ Blinder, Ehrmann, Fratzscher, De Haan and Jansen (2008) and Minegishi and Courmède (2009) provide surveys of the role of transparency in monetary policy. Surveys of the literature on monetary policy committees are found in, for example, Sibert (2006), Blinder (2007) and Maier (2007).

⁵ Geraats (2009) reports that, in 2006, only 16 out of 98 surveyed central banks published minutes within eight weeks of the policy decision, and only 10 central banks published voting records.

or “slower growth”. Although searching for combinations of words rather than for single words increases the precision of the search, it seems to be a rarely used method, at least in the field of economics.⁶

The remainder of the paper is organised as follows. Section 2 provides some institutional facts and descriptive statistics about the Swedish Riksbank and its policy rate decisions. Section 3 reviews the debate on publishing minutes and voting records, as well as the rather limited empirical literature in this research area. The body of research that investigates whether central bank communication has an information content, over and above the information contained in macroeconomic variables, is also briefly reviewed. In Section 4, we explain why minutes may contain unique information in comparison with other means of communication. An overview of the literature on the quantification of qualitative information, such as different types of central bank statements, is given in Section 5. In Section 6, the measure we employ in our estimations is described more in detail. Section 7 offers econometric evidence on the information content of the minutes, and Section 8 sums up and concludes.

2. Institutional facts and descriptive statistics

When the Swedish parliament gave the Riksbank statutory independence in 1999 to conduct monetary policy with a goal of price stability, it also created the Executive Board – a monetary policy committee of six full-time members who were to decide on the policy rate. Since 2008, the Executive Board, hereafter for simplicity called the MPC, normally holds six policy meetings a year.⁷ In the past, the frequency of interest rate decisions was somewhat higher, seven to nine times a year 2000-2007.⁸

There is no fixed speaking order at the policy meeting and the meeting structure is quite informal. At the end of the meeting, the Governor sums up the interest rate proposals put forward and puts them to a vote. The decision is taken by a majority vote. In case of a tie, which to date has happened on four occasions, the Governor has the casting vote.

Overall, disagreement in the Riksbank’s MPC is quite common. In around 40 per cent of the meetings up until December 2011, at least one member dissented. This is a smaller share than in, for example, the Bank of England, where at least one member has dissented in over 60 per cent of the meetings, but it is still clear that decision-making at the Riksbank is not collegial, either explicitly or implicitly. The Riksbank’s MPC is most often characterised as an individualistic committee in terms of Blinder’s (2004) taxonomy.

On the same day the interest rate decision is announced, a press conference is held and a Monetary Policy Report is published. The minutes of the monetary policy meeting, which contain the voting record, are published about two weeks later. Voting records have been attributed from the start in 1999. These show who has dissented, together with the policy rate preferred by those dissenting. Since May 2007, the minutes have also been attributed to show who said what during the discussion. Since May 2009, the voting result and the main motivation for possible dissenting votes have been reported in the press release announcing the interest rate decision.

⁶ There are however a few exceptions, such as Heinemann and Ullrich (2007) and Lucca and Trebbi (2009).

⁷ The Executive Board can choose to have fewer or more meetings. It can also decide to hold ad hoc meetings at very short notice, such as was the case a few days after the terrorist attacks on 9/11 and in 2008 after the default of Lehman Brothers.

⁸ In 1999, as many as 20 meetings were held where a decision about the policy rate was taken. This frequency was found to be unnecessarily high, however, and the number of meetings was cut substantially.

3. Related literature

The debate on publishing minutes and voting records

While transparency of monetary policy is nowadays considered crucial, the exact nature of the desired transparency is still debated. An intense discussion is taking place on whether or not minutes and voting results from monetary policy meetings should be published. This debate is a part of a broader discussion of whether it is beneficial or detrimental to disclose the MPC members' individual views.

Advocates argue that public minutes and voting results are necessary for effective monitoring and evaluation, and to make monetary policy easier to understand and hence the bank's future behaviour easier to predict (see, for instance, Geraats, Giavazzi and Wyplosz, 2008). Furthermore, and in particular if minutes and voting results are attributed, the members' individual responsibility becomes more apparent, strengthening the members' incentives to prepare thoroughly for the meetings (Gersbach and Hahn 2008a).

Critics argue that publishing minutes and voting results may just confuse matters. For instance, Issing (2005) fears that economic agents will attach more importance to MPC members' individual opinions than to the relevant economic arguments: "Particularly in a monetary union comprising several countries, the voting behavior of national central bank governors in particular might be interpreted from a "national" perspective – irrespective of how the members cast their votes and their reasons for doing so." (Issing 2005, p. 73). More generally, publishing minutes and voting results are believed to make it more difficult for a central bank to "speak with a single voice", which, in turn, often is seen as crucial for transparency and clarity.

Another case against publishing voting results and minutes, in particular if they are attributed, is that this might have the effect of making the discussion at the policy meeting less honest and frank, and more limited and "tied to script". It might, for instance, transfer real debate to discussions prior to the meeting so that the whole meeting becomes a mere stage for already scripted-out positions. Members might, as expressed by Alan Greenspan, "be concerned that their half-thought-through, but nonetheless potentially valuable, notions would... be made public" (as cited in Meade and Stasavage 2008, p. 74). As a result, members may be more inclined to agree with each other. Meade and Stasavage (2008) provide some evidence from the Federal Reserve's Federal Open Market Committee that publishing verbatim transcripts of the FOMC meetings made members more reluctant to offer dissenting opinions. The pros and cons of revealing information about the deliberations of individual MPC members, for example by publishing individual voting records, have been explored in a number of theoretical papers (see, for instance, Gersbach and Hahn 2008b, 2009 and Weber 2010).

In a questionnaire study, Apel, Claussen and Lennartsdotter (2010) collect the views of present and former members of the Riksbank's MPC on this and other issues. As noted above, in Sweden, minutes have been attributed since May 2007. The members were asked to give their opinion on four statements: that the discussion at the monetary policy meetings would be more inhibited and less spontaneous or in some other way poorer if the minutes were attributed; that the discussion would be better with attributed minutes; that the members would invest more time and work in the monetary policy preparation work with attributed minutes; and that there would be more focus on the individual members with attributed minutes.

The statement that the discussion would become more inhibited and less spontaneous received least support among the respondents. Most support was given to the statement that attributed minutes would improve the discussion. Members with actual experience of attributed minutes were more positive than those without. Of the former, none thought that discussion had become more inhibited, while many of them agreed with the statement that members would probably invest more time and effort in the monetary policy preparation work.

Empirical evidence on whether information about diverging views within the MPC is helpful in predicting future policy is quite scarce. Ehrmann and Fratzscher (2007) construct a measure of the degree of dispersion in the statements of members of the Federal Reserve's Open Market Committee during the inter-meeting period. They find that more dispersed communication is associated with less predictable policy decisions at short and medium-term horizons. Using a related measure of the degree of dispersion, Rozkrut, Rybiński, Sztaba and Szwaja (2007) obtain a similar result for the Hungarian central bank, but find that dispersion in statements in the MPC of the Czech central bank appears to enhance the markets' understanding of central bank thinking, making policy decisions easier to predict.

While these studies give a mixed and perhaps overall slightly pessimistic view regarding the usefulness of revealing information on disagreement within the MPC, studies based on voting records paint a more optimistic picture. Gerlach-Kristen (2004) finds that the voting record of the Bank of England's MPC helps predict future policy changes. Notably, she finds that if a minority has favoured, for instance, a lower interest rate than the rest of the committee, it is more likely that the MPC will loosen monetary policy at the next meeting. Gerlach-Kristen (2009) shows that it is primarily the dissenting votes of the outsiders at the Bank of England's MPC that have a significant effect on future policy changes. More recently, the approach of Gerlach-Kristen has been applied in other studies, confirming that voting records also provide important information about future policy rate changes in other countries: Gerlach-Kristen and Meade (2010) (the United States), Horváth, Šmídková and Zápál (2010) (the Czech Republic, Hungary, Poland, Sweden, the United Kingdom and the United States) and Sirchenko (2011) (Poland).

In this paper, we relate to this strand of the literature but focus on the content of the minutes. Our working hypothesis is that there is information in the minutes that is not captured by the voting record.

The informativeness of central bank communication

This study also relates to a literature that studies the effectiveness of central bank communication as a monetary policy instrument. It relates in particular to a body of research that aims at investigating whether central bank communication makes monetary policy easier to predict in the sense that it adds information to the information already contained in macroeconomic variables. Most of this research has focused on the communication policy of the European Central Bank (ECB) (see, for instance, Heinemann and Ullrich, 2007; Rosa and Verga, 2007; Jansen and De Haan, 2009; Rosa, 2009; and Sturm and De Haan, 2011).⁹

The typical approach is to investigate whether some indicator of ECB communication has a significant impact in a Taylor rule model. With the exception of Jansen and De Haan (2009), these studies find that the communication indicator is an important explanatory variable of future changes in the ECB's policy rate. ECB communication hence appears to provide complementary information with respect to macroeconomic variables.

In this study, we investigate, in a similar way, whether the minutes of the Riksbank's policy meetings add information that helps to predict future policy decisions. There is, however, a noteworthy difference in comparison to the studies referred to above. The communication indicator in those studies reflects the official view of the ECB. For example, the indicator is, in many cases, based on the ECB President's introductory statement to the monthly press conference which is used, more or less explicitly, as a sort of signalling device. Hence, the

⁹ Other aspects of the effectiveness of central bank communication are studied in other lines of research. For example, Jansen and De Haan (2010) investigate whether the communication of the ECB has been consistent over time, which makes it easier for observers to properly infer the bank's message.

forward guidance about upcoming interest rate decisions provided by the communication indicator is explicit and intentional. The measure computed from the Riksbank's minutes, however, does not represent the official central bank view in the same way. It reflects a discussion in which all Board members' opinions are voiced and where there frequently is disagreement. The purpose of publishing the minutes is, of course, to be transparent about the discussions and analyses within the Riksbank and thereby make it easier to understand the Riksbank's policy. But the possible forward guidance provided by this measure is not intentional in the same way as for the ECB communication indicator.

4. Why may the minutes be particularly informative?

Why, then, may minutes be especially informative regarding future policy? The way in which minutes, as well as voting records, differ from Monetary Policy Reports is straightforward. The policy report typically reflects only the majority view of the monetary policy committee. Whether the voting result, as in the case of the Riksbank, was 6-0, 5-1, 4-2 or 3-3 (with the Governor using his casting vote) is not reflected in the report, at least not to a first approximation.

But why would the informative content in the minutes and voting records differ? Is not the voting record the most appropriate quantification of the minutes' qualitative content? After all, the arguments that the MPC members put forward during the policy meeting merely justify how they will eventually vote, do they not? We argue that this is not necessarily the case. It seems quite reasonable that members sometimes raise concerns about issues they consider important but not sufficiently important to warrant a dissenting vote. Results from the questionnaire study by Apel, Claussen and Lennartsdotter (2010) suggest that MPC members sometimes refrain from dissenting, despite considering that another decision than the majority view would have been better – there is a “bargaining margin” in the policy rate decisions and the decision reached is regarded as being sufficiently close to what the members would have advocated.

Assume, for example, that, on a specific occasion, two members think that lowering the policy rate is a possible option. They put forward this option during the meeting but, in the end, they refrain from dissenting and vote, as do the other members, for leaving the policy rate unchanged. This means that the voting result is 6-0, giving the impression that there are no differing opinions. Hence, the voting record conveys the same message as does the monetary policy report, which is typically silent about diverging views. The minutes, in contrast, will contain the information that two members were considering lowering the policy rate and that the voting result was not all that far from being 4-2. The implicit message in the minutes is thus more “dovish” than both the voting record and the monetary policy report. In time for the next meeting, it may have become clear that lowering the policy rate is indeed a good idea and the two members that were already close to voting for this at the previous meeting may be joined by others.

A related reason for why the voting record might not be the most appropriate representation of the policy inclination, pointed out by Geraats (2006), has to do with the fact that policy rates tend to be adjusted in discrete steps, typically 0.25 percentage points. Suppose that all members think that the desired policy rate is 3.1 per cent, but, due to the restriction of adjustment to steps of 0.25 percentage points, they vote for leaving the policy rate at 3 per cent. Thus, the information that all members would have preferred a somewhat higher policy rate is not reflected in the voting record. Supposedly, the desired policy rate is better captured by the tone of the minutes.

More generally, concerns that MPC members might have will influence how they express themselves during the discussion. This, in turn, will affect the sentiment and tone of the minutes – even if other policy alternatives are not explicitly discussed and put to a vote. And capturing the sentiment and tone in a text is exactly what content analysis aims to do. Not considering the minutes could therefore mean that useful information is disregarded.

5. Quantifying qualitative information

While quantitative analysis of the content of texts has a fairly long tradition in disciplines like linguistics and political science, it has only quite recently found its way into economics. There are basically two ways of quantifying qualitative information. One is manual content analysis, that is to say reading a text, classifying it according to its content and coding it on a numerical scale. For example, a text may be classified as having either a negative, neutral or positive tone and be coded on, for instance, a three-point scale ranging from -1 to +1. Finer grid scales are also sometimes used. These numerical values can then be used to investigate the impact of the text, for example a speech or a press release, on some variable, for example the price of an asset.

Examples of studies that use manual classification and coding schemes are Andersson, Dillén and Sellin (2006), investigating the effects of various monetary policy signals from the Riksbank on the term structure of interest rates; Bulíř, Čihák and Šmídková, (2008), measuring the clarity of the monetary policy measure of the European Central Bank; Rosa (2009), investigating the predictive power of statements of the ECB on its future actions; and Conrad and Lamla (2010), analysing the effect of the ECB's monetary policy communication on the level and volatility of the EUR-USD exchange rate. The two studies mentioned earlier, Ehrmann and Fratzscher (2007) and Rozkrut, Rybiński, Sztaba and Szwaja (2007), also use manual coding when constructing their measures of the degree of dispersion in the views of committee members.

The other way of quantifying qualitative information is to use a computer programme to count how frequently certain words appear in a text – an automated “search-and-count-words” approach. Based on a pre-specified wordlist, dictionary or “bag of words”, the words are classified as having, for example, negative or positive tones. A numerical score can then be computed for the text as a whole based on this classification, placing it somewhere on a negative-positive scale.

For example, suppose that we are interested in measuring the tone of a financial newspaper article on a particular day. We find that the article contains a lot of negative words such as “volatility”, “risk” and “fraud”. It is then likely that the tone of the article as a whole will be pessimistic. In other words, a central presumption is that the frequency of the words reflects the tone of the text as the number of negative and positive words in good writing should correlate to the overall message of the text.¹⁰

Examples of studies that use such automated content analysis of texts are Armesto, Hernandez-Murillo, Owyang and Piger (2009), measuring the information content of the Beige Book; Bligh and Hess (2010), analysing the impact of Greenspan's speeches, testimonies and FOMC statements on financial market variables; Blix Grimaldi (2010), making use of information contained in ECB communication to develop an indicator of financial stress for the euro area; Born, Ehrmann and Fratzscher (2010), investigating the effects of central banks' communication on financial stability issues; and Demers and Vega (2010), measuring the impact of earnings press releases on stock prices.

Automated content analysis of texts has some advantages. Compared to manual classification and coding, it is far less labour-intensive, relies less on subjective judgment, and is easier to replicate. Moreover, just as in classical regression analysis, computerised analysis makes it easier to detect systematic patterns that would otherwise likely be missed. At the same time, however, a computer programme may miss nuances in a text that a human might not. Hence, it is advisable to include some element of manual cross-checking, and the method may perhaps therefore best be thought of as semi-automated.

¹⁰ To take an extreme example, a text that contains 99 percent negative words but has one sentence with a positive tone that overrides the rest would be considered an unbalanced text.

The use of a pre-specified wordlist is not without complications. Recent research in business and finance indicates that general dictionaries developed for other disciplines misclassify common words in financial texts (Henry and Leone, 2010, and Loughran and McDonald, 2011). If the tone of a text is not adequately captured, the same problem of bias and spurious correlations may occur as when a classical regression analysis is misspecified. It is therefore a good idea to use context-specific wordlists, specifically designed for the problem being investigated, in much the same way as one chooses which variables to include in classical regression analysis. In addition, in smaller samples, like the one in this study, a context-specific wordlist is likely to better retain predictive ability (Henry and Leone, 2010).

6. A measure of the full spectrum of views

In this study, we rely on the automated search-and-count-words approach. As we are interested in explaining future policy-rate decisions, it is natural to try to capture the tone of the Riksbank's minutes with regard to its dovishness or hawkishness – that is whether the (implicit) message, the policy inclination, is toward loosening or tightening policy. We construct two quantitative measures – *dove* and *hawk* – by an automated search on each set of minutes from the 82 monetary policy meetings that were held from January 2000 to February 2011.

In order to make the hawkish-dovish classification, we design a context-specific list which, in contrast to most other studies that tend to use *single* words, consists of combinations of a noun and an adjective such as “higher inflation” and “lower growth”. Obviously, the first expression can be categorised as hawkish while the other can be classified as dovish. Using such two-word combinations avoids the problem that the semantic meaning of single words often is ambiguous and depends on the context in which they are used.

The chosen nouns are “inflation”, “cyclical position”, “growth”, “price”, “wages”, “oil price” and “development”, which closely reflect the goals and concerns of the monetary policy maker.¹¹ The adjectives are those that are frequently associated with at least some of the six nouns. Furthermore, the adjectives are antonyms so that, when combined with a noun, the two-word phrase represents directly opposite concepts, in this case *dovish* and *hawkish*. The dovish adjectives we have chosen are “decreasing”, “slower”, “weaker” and “lower”, while the hawkish adjectives are “increasing”, “faster”, “stronger” and “higher (including basic forms of the adjectives – “slow”, “weak”, “low”, etc.).

We perform an automated search for the two-word combinations and collect them into a matrix in which each entry shows the number of occurrences of a certain phrase in each one of the documents. For example, a row could be the minutes released on 28 February 2011 and the columns could be the phrases “higher inflation”, “lower inflation”, “weaker growth” and “stronger growth”. We then collapse the matrix into a dovish and a hawkish column in which, for each document released at time t , the sum of the entries in the dovish and hawkish columns

¹¹ The search-and-count was performed on the Swedish version of the minutes (see Appendix for the list of words and their translation). Fully accurate translations into English may sometimes be difficult to achieve. For example, the English term “cyclical position” is the closest translation of the Swedish word “konjunktur”, which is commonly used in Swedish economic texts but is difficult to translate accurately into English. To some extent, the same goes for the Swedish word “utveckling” with its closest English translation “development”. The search-and-count was furthermore performed on stem-nouns, so that each word entered in the algorithm with a wildcard. For example, for inflation* the algorithm searched nouns and compound nouns such as inflation, inflation expectations, inflationary pressure and inflation outlook. The frequency of the selected nouns (including the wildcard entries) was the following: inflation – 4536, development – 2777, cyclical position – 1646, growth – 1915, price – 2593, wage – 636 and oil price – 451. The frequency of the adjectives was: low(er) – 1897, weak(er) – 1654, high(er) – 1760, strong(er) – 1501, fast(er) – 1129, increasing – 424, increased – 1084, slow(er) – 406, decreasing – 149, decreased – 359.

represents the basic measures $dove_t$ and $hawk_t$, respectively.¹² Table 1 reports the overall frequency of dovish and hawkish two-word combinations for each of the selected nouns.

Table 1. Overall frequency of two-word combinations for each noun

	Hawkish	Dovish
inflation*	254	145
price*	85	38
wage*	87	13
oil price*	111	14
cyclical position*	77	199
growth*	140	79
development*	65	121

Note: * denotes a wildcard allowing for compound nouns, for example, “inflation expectations”.

To determine the net effect of the minutes, we calculate a *Net Index* following the methodology of indices based on positive and negative stories in news as, for example, in Birz and Lott (2011):

$$Net\ Index = \left[\left(\frac{\#hawk}{\#hawk + \#dove} \right) - \left(\frac{\#dove}{\#hawk + \#dove} \right) \right] + 1,$$

where $\#hawk$ and $\#dove$ are the number of hawkish and dovish phrases, and the addition of 1 excludes negative numbers. This measure can be interpreted as the “net hawkishness” of each of the minutes. In addition to determining the net effect, we also explore the effect that the basic measures $dove_t$ and $hawk_t$ have separately.

Figure 1 shows the *Net Index* and the change of the policy rate. The *Net Index* is lagged so that, at each point in time, it corresponds to the next policy-rate decision. As can be seen, the two series are positively correlated, that is, a high degree of “net hawkishness” tend to be associated with policy rates increases, and vice versa.

¹² Following Henry and Leone (2010), we have adopted an equally-weighted specification to compute our two basic measures so that each entry has the same weight of any other entry.

Figure 1. The Net Index and the change of the Riksbank's policy rate



Note: Net Index is on the right-hand axis, policy rate change is on the left-hand axis.

7. Econometric evidence

To investigate the predictive content of the minutes for future policy rate decisions, we use the following simple specification as a starting point:

$$\Delta r_{t+1} = \alpha_1 \Delta r_t + \alpha_2 \text{Net Index}_t + \varepsilon_{t+1} \quad (1).$$

Δr_{t+1} is the policy rate decision at $t+1$, that is, at the next policy meeting, Δr_t the policy rate decision at t , Net Index_t the measure of the net hawkishness of the minutes from the policy meeting at t , and ε_{t+1} is a stochastic error term.

We regress the future change of the policy rate on the net hawkishness of the minutes, controlling for the change of the policy rate in the previous period. We estimate equation 1 over the period from January 2000 to February 2011. Similar to other studies with discretionary dependent variables, we use the ordered probit techniques.¹³ In particular, we order the dependent variable around interest rate changes of (greater than or equal to) -25, 0 and (greater than or equal to) +25 basis points. Table 2 shows the estimation results. The estimates in column (ii) suggest that the variable *Net Index* helps to predict the next policy decision, that is, a relative increase of the minutes' hawkishness is more likely to be related to an increase in the policy rate than to a decrease. Likewise, a relative increase in the dovishness is related to a decrease of the future policy rate.¹⁴ Column (iii) shows that the results of the estimation, when the future policy rate decision is regressed on the basic measures *hawk* and *dove* separately, are consistent with the results in column (ii).

¹³ See Greene (2005).

¹⁴ Results are robust using different subsamples, for example with respect to the recent global financial crisis. The introduction of the repo rate path from February 2007 might have changed the information content of the minutes, but the results are also robust to this change. Notably, when the information on the policy rate path is added to the model in equation 1 in the form of a dummy, it turns to be significant but not robust to different sample lengths.

Table 2. Ordered probit estimation results

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Δr_t	1.11*** (0.000)	1.03*** (0.000)	1.02*** (0.000)	0.99*** (0.000)	0.95*** (0.000)	1.11*** (0.000)
Net Index _t		49.06*** (0.000)				
Net Index extended _t				51.24*** (0.000)		
Hawk _t			0.06** (0.006)			
Dove _t			-0.08** (0.019)			
Hawk extended _t					0.06*** (0.004)	
Dove extended _t					-0.08** (0.025)	
Skew _t						213.41 (0.386)
\hat{Y}_{-25}	-1.02*** (0.000)	47.84*** (0.000)	-1.16*** (0.005)	50.02*** (0.000)	-1.07*** (0.011)	-1.03 (0.000)
\hat{Y}_{25}	0.83*** (0.000)	50.00*** (0.000)	1.00** (0.009)	52.16*** (0.000)	1.08*** (0.007)	0.84 (0.000)
Pseudo-R ²	0.17	0.26	0.26	0.26	0.26	0.17
Adj. Pseudo-R ²	0.15	0.22	0.21	0.22	0.21	0.14
Prob (LR)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: p-values in parentheses. *, **, *** denote significance at the 10% level, 5% level, and 1% level, respectively. The number of observations is 82. Equations (i) to (vi) are estimated with ordered probit. We have used the QML (Huber/White) standard errors and covariance.

In Table 2 column (iv) and (v) we report the results of two robustness checks. To test the sensitivity of our results to the chosen two-word combinations, we extended the noun list to comprehend four additional nouns that are somewhat more uncommon than the ones used in column (ii) – “employment”, “unemployment”, “recovery” and “cost”, and their associated compound nouns such as, for example, “recovery expectations” and “unemployment prospects”.¹⁵ We then computed a new measure based on the extended list of two-word combinations, called *Net Index Extended*.

As Table 2 shows, the *Net Index Extended* measure is significant, indicating that, even when the search-and-count is performed on a larger and possibly noisier set of two-word combinations, the predictive power of the minutes is preserved.

Finally, Table 2 column (vi) reports the results for an alternative specification where the future policy rate is regressed on a measure based on voting records instead of the minutes. Following Gerlach-Kristen (2004) we construct the measure:

$$skew = average(r_j) - r ,$$

where r_j denotes the rate that the committee member j votes for and r is the rate that the majority favours – that is, the decided-upon policy rate. If all MPC members vote for the same interest rate, the average of their views regarding the appropriate level of the policy rate coincides with the policy rate r . Occasionally, however, some members will dissent and vote for a lower or

¹⁵ The frequency of these additional nouns (including the wildcard entries) was: employment – 429, unemployment – 415, recovery – 405, cost – 418. Their overall frequency of dovish (hawkish) two-word combinations is: employment – 14 (32), unemployment – 33 (24), recovery – 10 (17), cost – 5 (33)

higher policy rate, so that the *skew* measure will differ from zero. As noted in Section 2, this has been the case in more than a third of the Riksbank's policy meetings.

We include the *skew* measure instead of the *Net Index* in equation (1). It turns out that in this sample the *skew* measure is not informative about the next policy rate decision.¹⁶

The cut-off point estimates (that is, the switching points around which the dependent variable is ordered: decrease (-25), unchanged (0) and increase (+25)) are significant as reported at the bottom of Table 2.

The interpretation of coefficients is notably difficult in probit models as coefficients do not correspond to the marginal contribution of the independent variables to the dependent variable, as in linear regression. However, estimated coefficients together with cut-off points are useful for computing the probability of each event.¹⁷ For example, the probability of a rate increase is given by

$$1 - \Phi(\hat{\gamma}_{25} - \hat{\alpha}_1 \text{Net Index}_t - \hat{\alpha}_2 \Delta r_t),$$

where Φ denotes the cumulative density function of the normal distribution. Assuming no rate change at the previous meeting and fixing *Net Index* at its mean value, the estimated probability of a rate increase in our main specification of the model (column (ii) in Table 2) is 18 percent. Correspondingly, the probability of a rate cut is 12 percent and is given by

$$\Phi(\hat{\gamma}_{-25} - \hat{\alpha}_1 \text{Net Index}_t - \hat{\alpha}_2 \Delta r_t),$$

whereas that of no-change of the interest rate is 70 percent and is given by

$$\Phi(\hat{\gamma}_{25} - \hat{\alpha}_1 \text{Net Index}_t - \hat{\alpha}_2 \Delta r_t) - \Phi(\hat{\gamma}_{-25} - \hat{\alpha}_1 \text{Net Index}_t - \hat{\alpha}_2 \Delta r_t).$$

The probability of a rate increase jumps to 34 percent in the case of an increase of the *Net Index* variable of one standard deviation above its mean and leaving $\Delta r_t=0$, whereas the probability of a rate decrease declines to 5 percent and that of no change equals 61 percent. In the opposite case (that is, assuming that the relative dovishness of the minutes increases (*Net Index* declines one standard deviation below its mean)), the probability of a rate increase is 8 percent, whereas the probability of a rate decrease is greater and equal to 25 percent and that of no change is 67 percent.

Thus, the probability that the interest rate will be left unchanged is greater than the probability associated with a repo rate increase or decrease. Nevertheless, a repo rate increase/decrease is significantly more likely to happen when the *Net Index* variable increases/decreases. Overall, the results suggest that the linguistic content of the minutes helps to predict the future policy rate.

Minutes, macroeconomic information and market expectations

One question that arises is whether the information content of the minutes is preserved when other relevant information is added to the model. Has the information from the minutes a predictive value over and above the macroeconomic information that is generally available? If macroeconomic variables contain all the relevant information for the next policy rate, then the *Net Index* measure would be largely insignificant.

¹⁶ The *skew* measure is significant in a shorter sample (up to 2009). However, it becomes insignificant also in the shorter sample when information about the policy rate path is included in the model.

¹⁷ In the probit model, the coefficient "beta" measures a unit of change in the cumulative normal probability that the dependent variable falls in a certain category for a unit of change in the independent variable.

To test this possibility, we estimate an extended specification of equation (1), a Taylor-type rule, where we include GDP growth and CPI inflation:

$$\Delta r_{t+1} = \alpha_1 \Delta r_t + \alpha_2 \text{Net Index}_t + \alpha_3 \text{GDP growth}_t + \alpha_4 \text{Inflation}_t + \varepsilon_{t+1} \quad (2).$$

Similar equations have been estimated in studies on the predictive content of voting records (for example Sirchenko, 2011) and in the body of research that studies the effectiveness of central bank communication in general as a monetary policy instrument (for example Rosa, 2009). In the latter type of literature, which has focused on the communication policy of the ECB, it is typically found that ECB communication has a significant impact in Taylor-type rule models. As noted above, a difference between the measure of ECB communication and the measure used in this study is that the possible forward guidance of the ECB measure is much more explicit and intentional than the possible forward guidance of the *Net Index*. Table 3 shows the results in column (ii).

Table 3. Ordered probit estimation results including macroeconomic information

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Δr_t	0.73*** (0.004)	0.72*** (0.003)	0.60** (0.020)	0.69*** (0.005)	0.52** (0.05)	0.70*** (0.004)
Net Index _t		29.19** (0.021)				
Net Index Extended _t				32.05** (0.018)		
Hawk _t			0.06*** (0.007)			
Dove _t			-0.02 (0.486)			
Hawk extended _t					0.07*** (0.001)	
Dove extended _t					-0.02 (0.329)	
ΔGDP_t	0.35*** (0.000)	0.29*** (0.001)	0.32*** (0.000)	0.29*** (0.001)	0.33*** (0.000)	0.35*** (0.000)
Inflation _t	0.05 (0.667)	0.04 (0.765)	0.03 (0.821)	0.03 (0.801)	0.03 (0.710)	0.07 (0.579)
Skew _t						362.09 (0.165)
$\hat{\gamma}_{-25}$	-0.31 (0.315)	28.61** (0.023)	-0.12 (0.808)	31.45** (0.019)	0.03 (0.958)	-0.31 (0.330)
$\hat{\gamma}_{25}$	1.80*** (0.000)	30.93** (0.015)	2.26*** (0.000)	33.78** (0.012)	2.45*** (0.000)	1.86*** (0.000)
Pseudo-R ²	0.28	0.32	0.33	0.32	0.33	0.29
Adj. Pseudo-R ²	0.23	0.25	0.25	0.25	0.26	0.23
Prob (LR)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: p-values in parentheses. *, **, *** denote significance at the 10% level, 5% level, and 1% level, respectively. The number of observations is 82. Equations (i) to (iv) are estimated with ordered probit. We have used the QML (Huber/White) standard errors and covariance. ΔGDP denotes GDP quarterly growth year on year. The inflation variable is based on monthly CPI changes year on year.

The *Net Index* is significant even when macroeconomic information is added to the model specification – that is, the minutes are informative even when information about macroeconomic developments is taken into account.¹⁸ When studied separately, the *hawk* measure is significant

¹⁸ The fairly low predictive ability of the Taylor-type variables also appears to be a common result in studies of the ECB; see, for example, Rosa (2009).

while the variable *dove* does not have a predictive power for the policy rate. The *Net Index Extended* in column (iii) is significant, confirming the robustness of the results, whereas the *skew* measure is not.¹⁹

Do the minutes also include valuable additional information in comparison to the information embedded in financial prices? To test for this, we control for market expectations as measured by the slope of money market rates' term structure and, alternatively, the change in price of forward rate agreement contracts (FRA).²⁰ Thus, we estimate the following two specifications:

$$\Delta r_{t+1} = \alpha_1 \Delta r_t + \alpha_2 \text{Net Index}_t + \alpha_3 (i_{pt}^l - i_{pt}^s) + \varepsilon_{t+1} \quad (3)$$

$$\Delta r_{t+1} = \alpha_1 \Delta r_t + \alpha_2 \text{Net Index}_t + \alpha_3 (i_{pt}^{\text{fra}} - r_t) + \varepsilon_{t+1} \quad (4),$$

where i_{pt}^l and i_{pt}^s are the money market rates of maturity l and s , respectively, where $l > s$,

i_{pt}^{fra} denotes the price of FRA contracts one day before the publication of the minutes and where r_t is the interest rate agreed upon about two weeks before the minutes' release.²¹ Notably, since the FRA contracts are based on about two more weeks of information as compared to the minutes, this should be a disadvantage for the *Net Index*. Table 4 and Table 5 report the results of equation (3) and (4), respectively.

Table 4. Ordered probit estimation results including market participants expectations as measured by the slope of money market term structure

l	s	(i)		(ii)		(iii)		(iv)		(v)		(vi)		(vii)	
		1m	t/n	3m	t/n	12m	t/n	3m	1m	6m	1m	6m	3m	12m	6m
Δr_t		1.10*** (0.000)		1.00*** (0.000)		0.98*** (0.000)		0.87*** (0.001)		0.96*** (0.000)		1.05*** (0.000)		1.04*** (0.000)	
Net Index _t		33.19*** (0.002)		40.29*** (0.000)		41.09*** (0.000)		50.83*** (0.000)		43.95*** (0.000)		37.69*** (0.001)		33.91*** (0.003)	
Money Market Rate Spread _t		-2.47** (0.023)		0.32 (0.721)		0.78** (0.070)		5.37*** (0.000)		2.57** (0.002)		3.59** (0.014)		2.69* (0.030)	
\hat{p}_{-25}		31.80*** (0.003)		39.15*** (0.000)		40.20*** (0.001)		49.91*** (0.000)		43.06*** (0.000)		36.75*** (0.001)		33.15*** (0.004)	
\hat{p}_{25}		33.95*** (0.002)		41.26*** (0.000)		42.42*** (0.000)		52.41*** (0.000)		45.52*** (0.000)		39.07*** (0.000)		35.44*** (0.002)	
Pseudo-R ²		0.27		0.24		0.26		0.32		0.31		0.28		0.28	
Adj. Pseudo-R ²		0.22		0.19		0.21		0.27		0.26		0.23		0.23	
Prob (LR)		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	

Note: p-values in parentheses. *, **, *** denote significance at the 10% level, 5% level and 1% level, respectively. The number of observations is 80. Equations (i) to (vii) are estimated with ordered probit with QML (Huber/White) standard errors and covariance. l and s denote maturities of money market rates (STIBOR) with $l > s$. t/n, 1m, 3m, 6m and 12m are the maturities tomorrow next, 1 month, 3 months, 6 and 12 months. Money market interest rates are those at the day before the publication of the minutes.

¹⁹ As an additional way of discriminating between the *Net Index* and the *skew* measure we first regressed *Net Index* on *skew*. We then used the residual from this estimation (the part of *Net Index* not explained by *skew*) in the simple model (1) instead of *Net Index*. It turned out that this variable has a significant impact on the next policy rate change. When doing the procedure the other way around, the impact of the next policy rate change of the unexplained part of *skew* is not significant.

²⁰ Market interest rates should reflect market participant expectations about future policy rates. A common measure of market expectations is the slope of interest rates' term structure. Another measure is the price of interest rate derivatives such as forward contracts.

²¹ Money market rates in this specification are interbank market rates (STIBOR) at different maturities. The shortest maturity available in the Swedish market is tomorrow next (t/n). FRA contracts are highly liquid contracts based on the 3-month interbank market (STIBOR). There are 12 positions. To estimate equation (4), at each time we chose the first position which reflects policy expectations about 3 months ahead and therefore more closely relates to policy expectation for the next policy decision Δr_{t+1} .

Table 5. Ordered probit estimation results including market participants expectations as measured by Forward Rate Agreement contract prices

	(i)	(ii)	(iii)	(iv)	(v)
Δr_t	1.03*** (0.000)	0.89*** (0.001)	0.94*** (0.000)	0.84*** (0.001)	0.87*** (0.001)
Net Index _t		34.38*** (0.006)			
Net Index Extended _t				40.01*** (0.002)	
Hawk _t			0.03 (0.293)		
Dove _t			-0.07** (0.021)		
Hawk extended _t					0.04 (0.122)
Dove extended _t					-0.07** (0.020)
FRA Spread _t	2.87*** (0.000)	2.44*** (0.000)	2.59*** (0.000)	2.53*** (0.000)	2.55*** (0.000)
$\hat{\gamma}_{-25}$	-0.51** (0.043)	33.66*** (0.006)	-0.94** (0.019)	39.28*** (0.002)	-0.84** (0.044)
$\hat{\gamma}_{25}$	1.84*** (0.000)	36.21*** (0.003)	1.62*** (0.000)	41.88*** (0.001)	1.76*** (0.000)
Pseudo-R ²	0.3	0.35	0.35	0.36	0.36
Adj. Pseudo-R ²	0.26	0.30	0.29	0.31	0.29
Prob (LR)	0.000	0.000	0.000	0.000	0.000

Note: p-values in parentheses. *, **, *** denote significance at the 10% level, 5% level and 1% level, respectively. The number of observations is 80. Equations (i) to (v) are estimated with ordered probit with QML (Huber/White) standard errors and covariance. FRA spread is the spread between FRA rate and the policy rate. FRA rate is at the day before the publication of the minutes while the policy rate is the rate agreed about two weeks before the release of the minutes. The table reports the spread of the current FRA (1 position). Results are robust to FRAs with different maturities, such as between 3 and 6 months (FRA second position).

In Table 4, not surprisingly, the term structure spread based on very short interest rates (tomorrow next) is not significant, as short-term rates tend to be very volatile and their movement may be related to other factors such as short-term liquidity in the interbank market. Money market spreads at longer maturity are significant and it could be argued that they better reflect the difference between short and long-term expectations. The *Net Index* remains highly significant in most specifications.

In Table 5, the spread between the forward rate agreement contract and the policy rate that was decided upon about two weeks before the publication of the minutes reflects whether market participants are expecting a tightening or a loosening of the policy rate. The FRA spread is highly significant. This also holds for the *Net Index*, although not necessarily for the hawk and dove measures separately.²²

8. Conclusion

To date, only limited research has been done on exploiting the information contained in central bank minutes. In this paper, we show that information about the spectrum of views within a committee, as reflected in the minutes, is useful in predicting future policy actions. More specifically, we measure the sentiment and tone in the minutes of the Swedish Riksbank by an automated content analysis that converts the qualitative information in the minutes to a

²² As in equation (1), the results hold also for a shorter sample, for example from January 2000 to February 2007. The variable *skew* is not significant when included in the model of equations (3) and (4) instead of the *Net Index*.

quantitative measure of the degree of hawkishness-dovishness. We then investigate how useful this measure is for predicting the Riksbank's future policy decisions. We find that the measure helps to predict future policy after controlling for macroeconomic variables and market expectations, suggesting that the minutes contain valuable but neglected information. We interpret the results as supporting the view that publishing information about individual views should be an integrated and natural part of a communication strategy aimed at making monetary policy easier to understand and predict.

More generally, the method employed in this paper seems to be a promising avenue for research on monetary policy and central bank communication. After all, monetary policy is not only about changing the policy rate to achieve price stability. To a considerable degree, it is also about conveying a message through different means of qualitative communication. This aspect has been neglected in the literature.

Appendix. The Swedish words used in the search and their English translation

Nouns

Swedish	English
inflation*	inflation
pris*	price
lön*	wage
oljepris*	oil price
konjunktur*	cyclical position
tillväxt*	growth
utveckling*	development
sysselsättning*	employment
arbetslöshet*	unemployment
återhämtning*	recovery
kostnad*	cost

Note: * denotes a wildcard allowing for compound nouns, for example, “inflationsförväntningar” (“inflation expectations”).

To construct a hawkish or dovish two-word combination, these nouns are combined with the following adjectives, where this is appropriate from a linguistic point of view.

Adjectives

Hawkish		Dovish	
Swedish	English	Swedish	English
hög*	high*	låg*	low*
		lägre	
stark*	strong*	svag*	weak*
stigande	increasing	fallande	decreasing
		sjunkande	
öka*	increase*	minska*	decreas*
snabb*	fast*	långsam*	slow*

Note: * denotes a wildcard allowing for inflections, for example “hög”, “högre” (“high”, “higher”). Moreover, in Swedish, unlike in English, when the noun is definite, the adjective is inflected, for example “hög inflation”, “den höga inflationen” (“high inflation”, “the high inflation”).

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