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The Art of Central Bank Communication: A Topic Analysis on Words used by the Bank of Japan's Governorsⁱ

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Abstract

This paper addresses the art of central bank communication, in a semantic analysis which applies a topic model to the regular press conference documents of the Bank of Japan (BOJ)'s Gov. Masaaki Shirakawa and Gov. Haruhiko Kuroda. Based on the standard method of latent Dirichlet allocation (LDA) in the statistical natural language processing literature, our research on the communication strategies that the BOJ pursued under two governorships using over 70 press conference documents indicates significant differences between the Shirakawa and Kuroda governorships in terms of topic distribution. In early 2016, when the negative interest rate policy was introduced during the era of Kuroda's governorship, the ratio of "policy goal" topics decreased dramatically, despite being an essential feature of Gov. Kuroda's vocabulary relative to Gov. Shirakawa to that point in time. Since the ambiguity in the words of the governors is contained in "discretionary" topics, which include *to strengthen*, *to confront*, *to recognize*, *to plan* and so forth, the communication strategy in the Shirakawa governorship was considered "Delphic" in that the semantic ambiguity may reveal bad fundamental conditions concerning the Japanese economy.

Keywords: Monetary policy; Communication; Private information; Delphic; Odyssean; Discretion; Commitment; Latent Dirichlet allocation

JEL classification: E52, E58

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1 Introduction

Looking back to the centennial history of the US Federal Reserve System since its establishment in 1913, Romer and Romer (2013) presented narrative evidence of a link between pessimistic beliefs in the efficacy of monetary policy and policy inaction among then monetary policy-makers in the 1930s after the Great Depression, stagflation in the 1970s, and the Great Recession after 2008. The pessimistic views of the central bankers were revealed to forestall an idea of monetary policy as a panacea for remedying the economic crises.

Before the inflation targeting monetary policy framework was internationally accepted in the 1990s, central banks pursued monetary mystique by obscuring their private information on policy targets (Goodfriend, 1986). Since the inflation targeting framework was institutionalized, secrecy in implementing monetary policy has been replaced with transparency and accountability in targeting policy objectives. The role of private information of central banks in monetary policy efficacy has been discussed in the Barro-Gordon type of policy-game literature. Discretion in monetary policy forces a central banker to raise unanticipated inflation resulting in greater output than a potential one, so that the inflation rate would be higher than the policy target. To reduce the inflation bias, some forms of policy commitment on targeted inflation are required for central bankers to gain credibility. On the other hand, in the event of exogenous supply shocks in output, flexibility in policy targeting would be required for stabilization of output variations relative to the inflation bias. The tradeoff between credibility and flexibility is a rationale for central bank to ambiguously reveal its private information to the public (Canzoneri, 1985; Cukierman and Meltzer, 1986; Stein, 1989; Garfinkel and Oh, 1995).

Recently, more attention has also been paid to failures in the forward guidance policy that central banks in some advanced economies have followed as an

unconventional monetary policy measure (Campbell, et al, 2012). The forward guidance aims to raise inflation expectations through a policy commitment of continuing expansionary monetary measures consistently until the policy target is achieved and even after such achievement. The time-consistent policy option could in theory control the public's inflation expectations, but still presents weak evidence of its efficacy. A central bank's communication is considered as one of the causes of the policy's failure. The announcement of commitment to ongoing quantitative easing can be transmitted to dual effects. One effect is "Odyssean," which is an intended effect of anticipating an expansionary monetary policy. The other is "Delphic," which is an unintended effect of anticipating bad economic fundamentals. The Delphic communication of forward guidance may be a reason for the policy failures in raising the inflation expectations.

Communication strategy is now a policy tool for central banks that transmit private information on their beliefs about monetary policy and economic fundamentals (Blinder et al, 2008). This paper follows the aforementioned literature on the link between central bank communication of its private information and policy efficacy. We address the arts of central bank communication in the case of the BOJ. The BOJ experienced a drastic change in its monetary policy framework in 2013 when Haruhiko Kuroda replaced Masaaki Shirakawa as governor. Gov. Kuroda launched facilities for large-scale purchases of financial assets to expand the monetary base. There were no immediate formal changes in institutional arrangements for communication after his inauguration; we examine what has qualitatively changed in the BOJ's communication strategy. In the tradeoff between credibility and flexibility, which was more weight attached by each governor? Were there any symptoms of the Delphic effects of announcing the pessimistic views?

Recently, many researchers in the economic policy fields focus on the natu-

ral language processing techniques¹. As Keida and Takeda (2017) demonstrated using a latent semantic analysis (LSA) to detect similarities among documents, there are large dissimilarities in informational content at the regular press conferences held by the governors of the BOJ after every monetary policy committee. Natural language analysis detected changes in the communication strategy in the governorship from Gov. Shirakawa to Gov. Kuroda. It also showed that, in the era of Kuroda’s governorship, he made a significant change in communication strategy in early 2016 when he introduced the negative interest rate policy.

This paper applies a latent Dirichlet allocation (LDA) method of extracting relevant topics from the regular press conferences². The LDA analysis identifies three types of topics: policy objectives, policy instruments, or central bank’s discretion. During the Gov. Shirakawa period, a topic category regarding the bank’s discretion is most frequent, while for the Gov. Kuroda period the frequency of the category of the policy objectives or instruments increases. The evidence indicates that communication of the private information of the BOJ during the Gov. Shirakawa period was Delphic in that announcing unconventional measures including forward guidance revealed bad news on macroeconomic fundamentals concerning the BOJ policy.

The rest of this paper is organized as follows. Section 2 describes the BOJ’s communication strategy, particularly the role of regular press conferences held after every monetary policy meeting (MPM). Section 3 outlines the topic model

¹For example, Baker, Bloom and Davis (2016) and Arbatli et al. (2017) develop the indices on policy uncertainty using the term frequency in newspapers.

²Shirota et al. (2015) and Kawamura et al. (2016) analyze monetary policy using LDA. Shirota et al. (2015) focus on the specific topic in the MPM minutes. Kawamura et al. (2016) focus on the frequency of positive, negative, and ambiguous expressions in the BOJ’s monthly reports. They conclude that the BOJ adopted strategic information revelation using these expressions. On the other hand, we focus on the general communication in the press conferences of BOJ’s governor. We extract topics using all words of governors in the press conferences and investigate the change in the ratio of topics. Our approach has an advantage in that it compares the topic ratio variation and the BOJ’s policy stance.

and its standard method of inference (LDA). We present our corpus and the LDA results with some policy implications in section 4. Finally, some concluding remarks are made in section 5.

2 BOJ Communication and its Impacts

In this section, we provide a brief explanation of the institutional background of the BOJ's communication strategy. The Bank of Japan Law requires the Bank to clarify the content of its decisions regarding monetary policy to the public, as well as its decision-making processes. As a specific framework, the Law stipulates releasing the minutes and transcripts of MPMs, reporting to and attending the Diet, and public announcement of the Outline of Business Operations. In keeping with the principles of the Law described above, the Bank aims to establish a high degree of transparency with regard to its policies and operations to conduct external relations activities. Among the communication activities, releasing public statements on most of the Policy Board decisions and having the governor hold regular press conferences play a crucial role in the BOJ's communication process.

2.1 Governor's Regular Press Conference

The BOJ MPMs are held eight times in a year, each for two days. Immediately after relevant MPMs, "the Bank's View" in *the Outlook for Economic Activity and Prices* is released, and the full text is made available the next day. However, in principle, it takes a few weeks until the Summary of Opinions and the MPM Minutes is released. To disclose information in a timely manner, the governor holds a press conference after the end of every MPM, usually at 3:30 p.m. for around one hour. The abstract of the conference is available the next day.

The press conferences, which have been covered live on the internet since

Gov. Kuroda came to office, are held in Japanese and the abstract is also in Japanese. The regular press conferences have been covered live on internet, since Gov. Kuroda in office. The Japanese media audits and reports live from the conference. In the presence of news on changes in the BOJ's stance on monetary policy, financial market responses are often observed in the time between the Bank's View released at the end of MPM and the governor's regular press conference from 3:30 p.m.

2.2 Natural Language Processing and Monetary Policy

The most important advantage of a LDA method is the ability to extract topics from the corpus. Keida and Takeda (2017) investigate the similarity between press conference abstracts using a standard LSA method. They found that the 10 documents from the governorship of Shirakawa are very similar, and there is less similarity between documents from Gov. Shirakawa and Gov. Kuroda. They also found documents from the governorship of Gov. Kuroda are comparatively similar as a whole. On the other hand, in the era of Gov. Kuroda, the documents gradually change from 2013 to 2015 and change dramatically in early 2016 when he introduced the negative interest rate policy.

The LSA method clearly indicates that the changes in the governor and the policy stance result in changes in the content of press conferences. However, this method could not answer the question regarding what such changes are. Topic models and LDA methods are useful ways to show what did and did not change as the ratio of topics changed. In this paper, we focus on the extraction of topics in these documents using the LDA method and present the interpretation of these results.

3 Topic Model

3.1 Model Notation

Latent Dirichlet allocation (LDA) was first presented as a graphical model for topic discovery by Blei, Ng, and Jordan (2003). The same model was essentially proposed independently by Pritchard, Stephens and Donnelly (2000) in the study of population genetics.

In LDA, each document consists of a mixture of several topics. The topic distribution is assumed to have a sparse Dirichlet prior. Using the sparse Dirichlet prior, the LDA method assumes that documents cover only a small set of topics and that topics use only a small set of words frequently. In practice, this results in a better disambiguation of words and a more precise assignment of documents to topics. Each document is assumed to be characterized by a particular set of topics. This is similar to the standard bag of words model assumption, and makes the individual words exchangeable.

We now need to consider the model that describes how the documents are generated. The documents are “bags of words”, so we consider the process that selects the word following the topic distribution and assign it to a specific bag. D denotes the number of documents, N_d the number of words in document d , V the number of vocabulary in this corpus. The variable notations are defined as follows; α is the parameter of the Dirichlet prior on the per-document topic distributions, β is the parameter of the Dirichlet prior on the per-topic word distribution, θ_d is the topic distribution for document d , ϕ_k is the word distribution for topic k , $z_{d,n}$ is the topic for the n -th word in document d , and $w_{d,n}$ is the specific word.

3.2 Generative process

LDA assumed the following generative process for a corpus consisting of D documents each of the length N_d :

- Choose $\theta_i \sim \text{Dirichlet}(\alpha)$, where $i \in 1, \dots, D$
- Choose $\phi_k \sim \text{Dirichlet}(\beta)$, where $k \in 1, \dots, K$
- For each of the word position i, j , where $i \in 1, \dots, D$, and $j \in 1, \dots, N_i$
 - Choose a topic $z_{i,j} \sim \text{Multinomial}(\theta_i)$
 - Choose a word $w_{i,j} \sim \text{Multinomial}(\phi_{z_{i,j}})$

The length N_d is treated as independent of all the other data generating variables (w and z).

Figure 1 is the plate notation of the LDA model, which concisely captures the dependencies among the many variables in this model. The boxes are “plates” representing replicates, which are repeated entities. The outer plate represents documents, while the inner plate represents the repeated word positions in a given document; the position is associated with a choice of topic and word.

The model summarizes the following equations:

$$\theta_k \sim \text{Dirichlet}(\alpha) \tag{1}$$

$$\phi_k \sim \text{Dirichlet}(\beta) \tag{2}$$

$$z_{d,n} \sim \text{Multinomial}(\theta_k) \tag{3}$$

$$w_{d,n} \sim \text{Multinomial}(\phi_{z_{d,n}}) \tag{4}$$

3.3 Inference

According to the model, the total probability of the model is:

$$p(\mathbf{Z}, \mathbf{W}, \Theta, \Phi | \alpha, \beta) = p(\Theta | \beta) p(\Phi | \alpha) p(\mathbf{Z} | \Theta) p(\mathbf{W} | \mathbf{Z}, \Phi)$$

We have the simultaneous distribution that parameter Θ and Φ will be integrated out.

$$p(\mathbf{Z}, \mathbf{W} | \alpha, \beta) = p(\mathbf{Z} | \alpha) p(\mathbf{W} | \mathbf{Z}, \beta) \quad (5)$$

$$= \frac{\Gamma(\alpha K)^D}{\Gamma(\alpha)^{KD}} \prod_{d=1}^D \frac{\prod_{k=1}^K \Gamma(N_{d,k} + \alpha)}{\Gamma(N_d + \alpha K)} \times \quad (6)$$

$$\frac{\Gamma(\beta V)^K}{\Gamma(\beta)^{VK}} \prod_{k=1}^K \frac{\prod_{v=1}^V \Gamma(N_{k,v} + \beta)}{\Gamma(N_k + \beta V)}$$

N_{dk} is the number of words of topic k in document d and $N_d = \sum_{k=1}^K N_{d,k}$. N_{kv} is the number of words of vocabulary v in topic k and $N_k = \sum_{v=1}^V N_{k,v}$ is the number of words in topic k .

3.3.1 Sampling equation

The conditional probability of sampling the topic of the n -th word of document d , under the condition that a topic set without its topic is $\mathbf{Z}_{\setminus d,n}$ and the document set is \mathbf{W} , is given as follow:

$$p(z_{d,n} = k | \mathbf{W}, \mathbf{Z}_{\setminus d,n}, \alpha, \beta) \propto p(z_{d,n} = k | \mathbf{Z}_{\setminus d,n}) p(w_{d,n} | \mathbf{W}_{\setminus d,n}, z_{d,n} = k, \mathbf{Z}_{\setminus d,n}, \beta) \quad (7)$$

$$p(z_{d,n} = k | \mathbf{Z}_{\setminus d,n}) = \frac{p(z_{d,n} = k, \mathbf{Z}_{\setminus d,n} | \alpha)}{p(\mathbf{Z}_{\setminus d,n} | \alpha)} \quad (8)$$

$$= \frac{N_{d,k \setminus d,n} + \alpha}{N_d - 1 + \alpha K} \quad (9)$$

$$p(w_{d,n} | \mathbf{W}_{\setminus d,n}, z_{d,n} = k, \mathbf{Z}_{\setminus d,n}, \beta) = \frac{p(w_{d,n}, \mathbf{W}_{\setminus d,n} | z_{d,n} = k, \mathbf{Z}_{\setminus d,n}, \beta)}{p(\mathbf{W}_{\setminus d,n} | \mathbf{Z}_{\setminus d,n}, \beta)} \quad (10)$$

$$= \frac{N_{k,w_{d,n} \setminus d,n} + \beta}{N_{k \setminus d,n} + \beta V} \quad (11)$$

Substituting equation (9) and (11) into (7), we obtain the following equation.

$$p(z_{d,n} = k | \mathbf{W}, \mathbf{Z}_{\setminus d,n}, \alpha, \beta) \propto (N_{d,k \setminus d,n} + \alpha) \frac{N_{k,w_{d,n} \setminus d,n} + \beta}{N_{k \setminus d,n} + \beta V} \quad (12)$$

Note that $(N_d - 1 + \alpha K)$ does not depend on k and we can eliminate it from the denominator. Hyperparameters α and β can be estimated by maximizing the joint likelihood (5). We obtain the updating equation as follows.

$$\alpha^{new} = \alpha \frac{\sum_{d=1}^D \sum_{k=1}^K \Psi(N_{d,k} + \alpha) - DK\Psi(\alpha)}{D} \quad (13)$$

$$\beta^{new} = \beta \frac{K \sum_{d=1}^D \Psi(N_d + \alpha K) - DK\Psi(\alpha K)}{\sum_{k=1}^K \sum_{v=1}^V \Psi(N_{k,v} + \beta) - KV\Psi(\beta)} \quad (14)$$

$$V \sum_{k=1}^K \Psi(N_k + \beta V) - KV\Psi(\beta V)$$

Using these updating equations, we can estimate the hyperparameters α and β .

4 Results and Policy Implications

4.1 The Corpus

We analyze 70 abstracts of the regular press conference using LDA to extract latent topics³. The press conferences are held after the MPM, so that it tends to be the first announcement of the changes in the policy stance of the BOJ, which is why we focus on these. While the abstracts of the regular press conferences consist of questions from the press and answers from the governor, we use only the answers for our analysis.

The analysis period is from July 2012 to July 2018. The analysis includes 10 documents from the governorship of Shirakawa and 60 documents from that of Kuroda. We note that, in this period, the BOJ decreases the number of MPM for a year. It is held 14 times per year before 2016 and eight times per year after 2017. Therefore, the number of regular press conferences also decreased in this period.

The BOJ usually releases documents on governor's press conferences on its website one business day after the press conference. The documents consist of questions from the press and the governor's answers. We use only the governor's answers.

The data used in this paper are 70 documents released by the BOJ, in Japanese, as the official abstracts of the governor's regular press conference. The data period is from July 2012 to September 2018. The first 10 documents are the reports released by Gov. Shirakawa and the remainder are those released by Gov. Kuroda.

After morphological analysis using MeCab, we can obtain a set of words from a document. We focus only noun-common, noun-proper, noun-verbal,

³The codes used in this paper are available at https://github.com/masakeida/monetary_policy_lda.

noun-adjective-base, noun-number, and verb-main. Both nouns and verbs are identified by MeCab. Using only nouns and verbs, our analysis focuses on the semantics of the documents to avoid the effects of personal wordings.

4.2 Results

The LDA extracts topics from the corpus. We assume that there are three topics in these documents. Our results indicate that the LDA extracts topics corresponding to “policy goal,” “policy instruments,” and “discretion.” Table 1 presents the top 20 high-probability words for each topic.

Figure 2 shows the ratio of each topic in each document. As can be seen, there are two large changes in the ratios in the period. The first one occurred in 2013 when the governorship changed from Gov. Shirakawa to Gov. Kuroda. The second occurred from the end of 2015 to early 2016, in the era of Gov. Kuroda. Hereafter, we state this change occurred in early 2016.

4.3 Policy Implication

The first change consists of the change in policy stance from Gov. Shirakawa to Gov. Kuroda. In the first press conference held by Gov. Kuroda, he outlined his policy goal, achieving 2% inflation, thereby doubling the monetary base in two years, so the huge increase in the ration of “policy goal” topics is to be expected. In addition, under Gov. Kuroda’s policy stance, in which he expressed the clear policy goal, the occurrence of the topic of “discretion” decreases to almost zero. It is interpreted that his rule-based policy stance does not require discretion. The LDA method can detect the change of the governor of the BOJ fairly well.

The second change is a significant change in the words of the particular person, and this change has a persistent effect. It is a natural interpretation that the policy stance of Gov. Kuroda changed significantly. In fact, he introduced

the negative interest policy in early 2016. Furthermore, in this period, Gov. Kuroda was criticized for failure to achieve 2% inflation in two years from 2013. It is possible that was not enough for him to only discuss his policy goals during press conferences. The ratio of the topic of “policy instruments” also increases in this period.

5 Concluding Remarks

Communication strategies have become a policy instrument used by central banks to control expectations, especially to enhance financial markets’ credibility regarding time-consistent policies. This paper explores a statistical natural language processing of policy narratives with a focus on the Bank of Japan since 2012, which covers the periods when Masaaki Shirakawa and Haruhiko Kuroda held the position of governor. The LDA analysis also detects the three topics of policy goals, policy instruments, and discretion. During the transitional period from Shirakawa to Kuroda, the topic of “policy goals” increased. During the Kuroda period, in 2016, the topics of “policy instruments” increased. Our results are consistent with those of Keida and Takeda (2017). Since the ambiguity in the words of the governors is reflected in “discretionary” topics, the communication strategy in the Shirakawa governorship was considered “Delphic” in that the semantic ambiguity may reveal bad fundamental conditions concerning the Japanese economy. As our empirical analyses show, statistical natural language processing methods, including the LDA method, are useful to analyze monetary policy documents. Additional research could provide further insight into central bank communication.

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Table 1: Top 20 high probability words in each topics

topic 1: discretion		topic 2: policy instruments		topic 3: policy goal	
強化	strengthening	金融	finance	する	do
資金	funds	経済	economy	物価	prices
支援	supporting	政策	policy	思う	think
取組む	confront	緩和	easing	ある	exist
欧州	Europe	金利	interest rate	なる	become
供給	supply	市場	market	上昇	rising
認識	recognition	日本銀行	Bank of Japan	みる	view
状態	state	行う	do	安定	stable
質問	question	量的	quantitative	申し上げる	state
巡る	surrounding	質	quality	影響	influence
基金	funds	状況	status	成長	growth
図る	planning	決定	decision	2	2
意識	consciousness	実現	realization	消費	consumption
課題	subject	効果	effect	1	1
制度	institution	銀行	bank	目標	target
国民	citizen	国債	government bond	考える	think
主体	agent	長期	long-run	必要	needs
使う	use	マイナス	minus	見通し	outlook
基盤	basis	3	3	通り	following
担保	collateral	中央	central	価格	price

Figure 1: Plate notation representing the LDA model

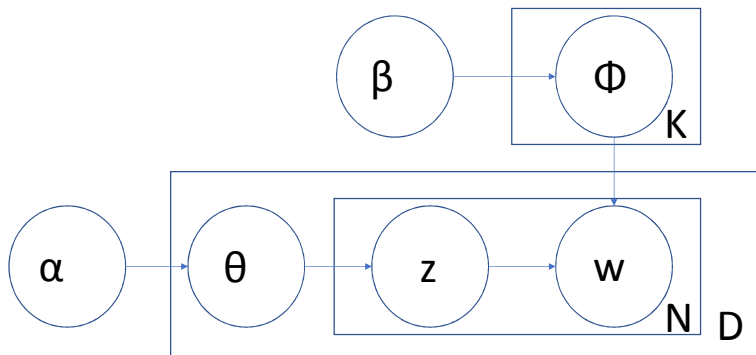


Figure 2: Topic ratio in the regular press conference

