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Effect of Monetary Policy Statement on Overnight Policy Rate

(Kesan Penyata Dasar Monetari terhadap Kadar Polisi Semalaman)

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ABSTRACT

This study examines the causal effects of the key characteristics of Monetary Policy Statement (MPS) on the decision made for the overnight policy rate (OPR). It constructs the monetary data on hawkish and dovish sentiment from 106 MPS released by Bank Negara Malaysia (BNM) between May 2004 and November 2020, by using text mining method. Data were mined by identifying selected 12 hawkish and dovish words as well as the characteristics of MPS. The findings showed that MPS content can be used to predict OPR decision. The study further found that while hawkishness is associated with a decision of increased OPR, dovishness is conversely related with a decision of decreased OPR. Accordingly, the study established that the day of the week when a particular MPS is released, together with Zeti's leadership in May 2000 - April 2016 period, are factors associated with decisions to increase OPR. However, the number of days between two MPS statements are released is shown to be associated with OPR decrease. This study therefore suggests that MPS release appear predictive of BNM's monetary conduct.

Keywords: Dovish; Hawkish; monetary policy statement; Malaysia; overnight policy rate; sentiment data

ABSTRAK

Kajian ini meneliti kesan ciri kunci Penyata Dasar Monetari (MPS) terhadap keputusan kadar dasar semalaman (OPR). Ia membina data sentimen monetari hawkish dan dovish daripada 106 MPS yang diumumkan oleh Bank Negara Malaysia (BNM) bagi tempoh antara Mei 2004 dan November 2020 dengan menggunakan kaedah perlombongan teks. Data yang dikenal pasti adalah 12 perkataan hawkish dan dovish dan ciri MPS. Ditemui bukti empirikal bahawa isi kandungan MPS dapat digunakan untuk meramal keputusan OPR. Kajian ini terus menemui bahawa perkataan hawkish adalah berkaitan dengan keputusan meningkatkan OPR, sifat dovish adalah sebaliknya berhubung dengan keputusan sebaliknya. Sewajarnya, kajian ini menubuhkana bahawa hari di mana MPS diumumkan bersama dengan kepimpinan Zeti dalam Mei 2000- April 2016 adalah faktor berkaitan dengan keputusan untuk menaik OPR. Walau bagaimanapun, nombor hari antara dua MPS yang dikeluarkan adalah ditunjukkan berkaitan dengan penurunan OPR. Dengan ini, kajian ini mencadangkan bahawa MPS yang diwaswaskan mempaparkan ramalan kelakuan menetari BNM.

Kata kunci: Dovish; Hawkish; jawatankuasa dasar monetari; Malaysia; kadar dasar semalaman; data sentimen
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INTRODUCTION

This study offers a comprehensive understanding on the nature of Monetary Policy Statement (MPS, hereafter) released by the MPC of Bank Negara Malaysia (BNM, hereafter) between 2004 and 2020, as well as its causal effect on policy rate decisions. The so-called text mining method has been applied to source data from the text of the MPS which can be described as either hawkish or dovish in its monetary stance. It includes the monetary decisions subsequently announced, date and day of statement released, duration between each statement released, and the word count of the statement.

The Monetary Policy Committee (MPC, hereafter) is an authority formed by the central bank of a country in order to table and make decisions on monetary policy. In light of the rising importance of transparency and independence of central banks in monetary conducts, it becomes an international trend in adopting MPC in the monetary decision making process since the 1990s. For example, in achieving the targeted [low] inflation rates, transparency and monetary communication are crucial for the MPC in formulating the appropriate

inflation targeting monetary framework. Favourable outcomes of the monetary policy undoubtedly depend on the market's expectation as derived from the central bank communication (Bernanke & Mishkin 1997). The implication of MPC is that, it allows the central bank to convey effectively the relevant information directly to the public through the MPC minutes and/or MPS official statements.

Generally speaking, the MPC's official publication, either minutes or statements, is a monetary communication for announcing the monetary decision following the respective MPC meetings. Most of the decisions are related to changes in interest rates. The central bank either releases the MPC minutes or statements or both, in its institutional capacity and practice. The monetary policy statement serves as a press release that summarizes information documented in the MPC minutes. The release constitutes an announcement of MPC's monetary decision(s) with a brief description of the concurrent economic condition that justifies such decision(s).

Monetary communication is considered as a fundamental vehicle that 'bridges' between the central bank and the market participants to ensure effectiveness in the implementation of the monetary policy. Transparency is similarly crucial in such monetary communication. As noted by Poole and Rasche (2000), the monetary policy from the central bank must be predictable and understandable by the market(s) in order to ensure stability of the market's reaction in the light of well-defined information. Issing (2014) added that an effective monetary communication is crucial in order to achieve two goals; namely transparency in the disclosure of information to market participants, and to guide market participants in priming them up for more 'accurate' expectation of the monetary policy. The central bank that provides greater transparency in its monetary communication performs better in stabilizing inflation, and shaping the 'right' inflation expectation (Minegishi & Cournede 2009).

In the case of Brazil, as example, transparency managed to minimize the conflict between central bank and market participants regarding inflation expectation (Montes et al. 2016). Countries experiencing unfavourable (high) inflation rate and depressing economic growth, have endeavoured to improve their transparency with greater disclosure of monetary information as the appropriate step to take (Geraats 2009). Issues related to the degree of transparency remain controversial, as there is a gap between theory and actual practice (Geraats 2006). Transparency is about the rational disclosure of information and not about unconditional honesty in revealing all relevant information. The disclosure of information is critical in order to create a common understanding between central bank and market participants in order to realise the desired economic objective (Winkler 2000). More commonly however the central bank generally prefers to release only the MPS, although the minutes recorded more details to enable greater transparency.

The relatively limited number of studies on this topic mainly reported on central banks in Europe, and the Federal Open Market Committee (FOMC) of the Fed (Reeves & Sawicki 2005; Lucca & Trebbi 2009; Rosa 2011a,b; Kurov 2012; El-Shagi & Jung 2015; Kahveci & Odabas 2016). They did not examine the association between MPS and decisions on policy rates, but studied the reactions of the stock market (financial markets, and exchange rates) on the MPS, while three studies (Lucca & Trebbi 2009; El-Shagi & Jung 2015; Kahveci & Odabas 2016) dealt with the nature of MPS. There was no '*stand-alone*' study on MPC for a small open economy such as Malaysia. According to the Laws of Malaysia Act 701 - Central Bank of Malaysia Act 2009, the MPC shall only formulate monetary policy at a duly convened meeting, and a MPS must be published to announce the monetary decision made along with the fundamental economic justification(s) underlying it. The MPC is specifically given "*the responsibility for formulating the monetary policy and the policies for the conduct of monetary policy operations*" (Government of Malaysia 2009). Within this context, this study shall examine the effect of MPS on overnight policy rate in the country for the period 2004-2020.

This study differs from that of Garcia-Herrero and Remolona (2008) in sourcing from thrice more MPSs (106 releases) issued by BNM between August 2003 and August 2007. The authors examined 32 releases sourced from 12 central banks in Asia and the Pacific. They reported on MPS release frequency, length of statements, classified as either backward- or forward-looking information, word counts, and on policy decision in rate changes. In comparison, the present study constructs a set of MPS data, hawkish and dovish, from 106 MPS releases between 6 May, 2004 and 3 November 2020 (as tabulated in Table A.1, in Appendixes). The study makes a case from fresh empirical evidence that MPS released by the BNM are informative, transparent [to some extent], and predictable. Decisions on policy rate were made through word count, both hawkish and dovish, on the monetary stance.

This paper is organized into five sections. Following the introduction, the next section documents a review of the relevant literature comprising analyses of minutes and/or statements published by respective central banks. Section 3 describes data construction sourced from official MPS releases from BNM, including methodology on data mining and analysis. Section 4 reports the empirical results, and Section 5 concludes the study.

LITERATURE REVIEW

This section reviews existing studies that examined minutes from the MPC and/or MPSs released abroad. Indeed, empirical studies on the Malaysian MPS are

still rudimentary. Garcia-Herrero and Remolona (2008) conducted a group study of 12 central banks in Asia and the Pacific concerning some of the most basic devices the central banks use to communicate with the markets. They established that it is not so much the length of the MPS that matters but the extent to which it focuses on forward-looking information. In the case of Malaysia, BNM has released the MPS eight times a year between August 2003 and August 2007 with an average statement length of 188 words. Given non-inflation-targeting statements the BNM released relatively short MPSs during the said period. Policy rate changes and their probability of change were 3.00 and 1.00, and forward-looking content scored 3.61 positioning Malaysia in front of Japan (2.83) and Korea (1.02).

The current trend in content analysis of monetary policy statements and/or minutes will be examined briefly here. One of the relatively few studies reported is Lucca and Trebbi (2009) who analysed 82 FOMC statements available between May 1999 and December 2008. The authors formulated a 'hawkish-dovish' scale by identifying the semantic orientation of each sentence in the statement and then converting them into an automatic score using computer science techniques. They further employed the vector autoregressive (VAR) approach to determine the causal effects between 'hawkish-dovish' semantic score and treasury yield. The study confirmed that the FOMC statement communication produced a significant effect on longer-term nominal yields.

In a more comprehensive study Kahveci and Odabas (2016) showed the core characteristics of monetary policy statements published by the Fed, the European Central Bank (ECB) and the Central Bank of the Republic of Turkey (CBRT) through using content analysis of Diction 7 software. They classified the contents of the statement according to two tones; namely optimism [positive] tone, and certainty [negative] tone. The study established that the Fed had shifted their optimism tone to certainty tone prior to the global financial crisis in 2008, but there were no changes in the tone of the monetary policy statements coming from ECB and CBRT. Lim (2017) examined both the MPC minutes and MPS published by the Bank of Thailand (BOT) over the period 2008 [2011]-2016. They analysed the readability and monetary sentiment, either hawkish or dovish, through text mining the top 100 words that most frequently appeared in both documents. The study also related the finding to the issues (or topics) discussed by the MPC as mentioned in its publications. Lim indicated that the 'hidden' messages extracted from the minutes appear to be informative and revealing enough to comprehend the sentiments of MPC members in predicting future monetary decisions.

El-Shagi and Jung (2015) similarly examined the MPC minutes issued by the Bank of England to further elucidate whether these were sufficiently informative for market participants to predict future monetary movements in line with the importance of transparency in monetary communication. The estimated ordered (Probit) models were found to be predictable in tracing interest rate changes according to the voting records in the minutes. The MPC minutes were sufficiently predictive of the short-term future policy rate since their contents helped to unveil market expectation of future monetary movements. This would suggest that given well-defined information in the minutes, both the central bank and market participants can share the same 'mode' of interpretations. Mathur and Sengupta (2019) employed textual analysis to examine the characteristics of MPS issued by the Reserve Bank of India (RBI) between 1998 and 2017. It accounted for word counts (frequencies) and the linguistic complexity of the text. The ordinary least squares (OLS, hereafter) estimator was employed to estimate the causal effects of the variables on the prices and trade volumes in the equity markets. The study however did not support the underlying hypotheses. More recently, Baranowski et al. (2021) found that central bank publications could significantly predict future monetary movements. The finding was based on empirical results of tone analysis (i.e., either dovish or hawkish) on text documented in the Introductory Statements of European Central Bank (ECB). There was a positive connection between the type of tones and future monetary decisions, as postulated in the conventional hypothesis that published MPS are predictable on upcoming decisions, such as policy rates. In a recent study Haryo et al. (2021) assessed the texts of the Central Bank of Indonesia's monetary policy communication (i.e., the monthly policy interest rate press release announcements) and identified their potential relation to expectation of inflation. They found that their text readability was relatively stable. The clarity and readability of the texts were negatively correlated with the inflation expectations whereas the tone of the text was positively associated.

In complement, another group of MPC studies is available that relates MPC announcements, mainly minutes and/or statements, to financial market (Reeves & Sawicki 2005; Rosa 2011b; Kurov 2012; Papadamou & Siriopoulos 2014; Chortareas & Noikokyris 2014), and exchange rate market (Rosa 2011a).

DATA AND METHODOLOGY

The data used in this study were sourced through the text mining approach from 106 available MPS released after their respective MPC meetings between May 2004 and November 2020 that spanned the study period. Wu and Hock (2021) for example, captured the news sentiment and its impact on the stock market fluctuation. The MPS in this study were obtained from the official page of the BNM which announced the Overnight Policy Rate (OPR, hereafter) Decision and Statement.[1] The underlying variables are given in Table 1. The five alternative measures of dependent variables on policy rate, and the OPR announced in the MPS were used interchangeably in analysis for robustness check and comprehensiveness.

The independent variables were further classified into three groups. The first group concerned the monetary sentiments that were dovish (T_DOVISH) or hawkish (T_HAWKISH) as constructed from the MPS by text mining approach[2], which captured the monetary outlook of the BNM. Another [alternative] measure was the H-D score, which was the difference between total number of hawkish words and dovish words (see, Hantzsche & Mellina 2018).

The second group of independent variables were the day of the week (DAY) that a particular MPS was released, the duration in days between two MPS statements released (DURATION), and total number of words printed in each MPS (T_WORD). These variables inform on the basic characteristics of the MPS released. The last variable was, D_GZETI that represents the BNM governor, Tan Sri Zeti Aziz (Zeti, hereafter), who was in tenure for 16 years (May 2000 - April 2016). She was followed by Tan Sri Muhammad Ibrahim (May 2016 – June 2018) and subsequently the present governor, Tan Sri Nor Shamsiah Mohd. Yunus (effective July 2018). The leadership of the governor is generally considered to characterise MPC members in determining the monetary decisions (Hix et al. 2010; Hansen et al. 2014; Smales & Apergis 2016). The time series plots of these variables are shown in Figure A.1 for reference. The plots virtually demonstrate how these 'variables' behave and innovate over time.

Table 2 lists down the 12 hawkish and dovish words identified from the MPS through text mining exercise with reference to past studies such as Lim (2017). Generally, hawkish sentiment refers to the monetary conduct that concerns low inflation rate thus favouring a higher one. If the MPS is found to be skewed towards hawkish, the rationale is on higher economic growth and inflation rate, hence it would concern price stability and sustainability as conveyed in the 'positive' words. Conversely, dovish sentiment skews towards stimulating economic growth that favours a lower interest rate. If the MPC skews toward dovish, it involves the 'negative' words. Where economic growth is slow, words such as 'recovery', 'contractionary', and 'stimulus' would appear in the MPS.

Such text mining exercise is required to satisfy two criteria. The first is that the words are repeated in different publications. This is identified through word counting approach, mainly the word finding function in the app, that the statement has been opened (read). The second criterion is that the words selected are the descriptive adjective economic terms describing economic situations. The word search is conducted manually using the "*find text or tools*" in the respective viewer i.e., the *Adobe Acrobat*. Descriptive words are preferred in order to avoid selecting nouns (i.e., inflation, growth and price) and words repetition as descriptive adjectives which are usually paired up with nouns (i.e., subdued inflation, price stability and strong growth). The nouns selected comprise terms employed in economic studies (i.e., stimulus, recovery, sustainability, momentum and pressure) to identify an economic situation. The selected descriptive words are able to identify the monetary standpoint, such as inflation, interest rate, and economic growth, and are positively related. The same descriptive words are thus applicable in identifying economic conditions and monetary stance. For example, high economic growth leads to high inflation, hence higher interest rate.

TABLE 1. The variables

Dependent variable:	Description
OPR	Overnight Policy Rate, %.
ΔOPR	Change in OPR, % the difference between current and previously announced OPRs.
D_ΔOPR	A dummy variable, where 1= OPR change (increase or decrease); 0 = unchanged).
D_OPR_I	A dummy variable, where 1 = OPR increases; 0 = otherwise (either decreases or unchanged).
D_OPR_D	A dummy variable, where 1 = OPR decreases; 0 = otherwise (either increases or unchanged).
Independent variable:	
T_DOVISH	Total dovish words.
T_HAWKISH	Total hawkish words.
H-D	The difference between T_HAWKISH and T_DOVISH.
DAY	Day of the week, where 1 = Monday, 2 = Tuesday, … and 5 = Friday.
DURATION	Duration (in days) in between releases of two MPS official documents.
T_WORD	Total words printed in each MPC statement, i.e., its length.
D_GZETI	A dummy variable, where 1 = Zeti Aziz as BNM governor for the MPS released between May 2004 and Mac 2016); 0 = otherwise.

Notes: This table describes all variables considered in this study. Data were sourced from MPC statements available between May 2004 and November 2020.

TABLE 2. Word classification of Dovish and Hawkish

	Dovish	
1	Low	Low, lower, slow, slower; refers to price level, growth level
2	Reduce	Reduced interest rate
3	Weak	Weak growth, weak inflation
4	Decline	Decline in prices, growth
5	Subdue	Subdued inflation
6	Modest	Modest growth, inflation
7	Moderate	Moderate growth, inflation
8	Risk	Adverse/downside risk on economic growth
9	Uncertain	Uncertainties of economic conditions
10	Recovery	Economic recovery
11	Contraction	Economic contractionary
12	Stimulus	Fiscal stimulus, monetary policy stimulus
	Hawkish	Descriptive words
1	High	High growth, high prices
2	Increase	Increase in interest rate, growth, prices, risks
3	Strong	Strong growth, demand
4	Positive	Growth, price level
5	Expansion	Expansionary, expansion in economic sectors
6	Steady	Positive growth
7	Stable	Stable market environment and growth
8	Raise / Rise	Raised interest rate
9	Pressure	Inflationary pressure; demand pressure; high inflation
10	Stability	Price stability, financial market stability
11	Sustain	Sustainability, sustainable
12	Momentum	Positive strength on growth

Notes: This table provides the 12 descriptions listed respectively for both dovish and hawkish words.

Table 3 records the summary statistics of the [continuous] variables that reflect the basic characteristics of MPS released, namely OPR, ΔOPR, Day, Duration T_ WORD, T_DOVISH, and T_HAWKISH. The average OPR is around 3.0% as indicated by both mean and median. The highest OPR is 3.50% that is decided by the MPC between April 2006 to October 2008, while the lowest at 1.75% is decided between July 2020 and November 2020. The variation of OPR is 0.46%. However, the change in OPR (ΔOPR) is relatively zero (median) or decreasing by 0.01% with 0.14% variation. The MPS is officially released to the public between Wednesday (by mean) and Thursday (by median). The average duration between two MPS releases is about 57-63 days with the longest duration at 98 days, and the shortest at 15 days. For other variables, namely T_WORD, T_DOVISH, and T_HAWKISH, the word count of each MPS is about 331 (by median) and 557 for a lengthy one, and the shortest at only 76 words. The total dovish and hawkish words are approximately equal at 990 and 966 respectively.

TABLE 3. Summary statistics of selected variables

	OPR	ΔOPR	DAY	DURATION	T_WORD	T_DOVISH	T_HAWKISH
Mean	2.98	-0.01	3	57	329	9	9
Median	3.00	0.00	4	63	331	9	9
Maximum	3.50	0.30	-	98	557	23	23
Minimum	1.75	-0.75	-	15	76	0	0
Standard. Dev.	0.46	0.14	-	18	107	5	5
					Total:	990	966

Notes: This table reports the conventional used descriptive statistics i.e., mean, median, maximum, minimum, and standard deviation, for the selected variables as listed. ΔOPR is the difference of two periods OPR. "-"stands for not applicable. The MPS were collected between May 2004 and November 2020.

TABLE 4. Summary statistic of words classifications of Dovish and Hawkish

Dovish words:						
	CONTRACTION	DECLINE	LOW	MODERATE	MODEST	RECOVERY
Mean	0.113	0.274	1.642	1.849	0.415	0.764
Maximum	3	3	7	6	3	7
Minimum	0	0	0	0	0	0
Sum	12	29	174	196	44	81
	REDUCE	RISK	STIMULUS	SUBDUE	UNCERTAIN	WEAK
Mean	0.377	1.877	0.179	0.198	0.821	0.83
Maximum	6	6	4	2	5	4
Minimum	0	0	0	0	0	0
Sum	40	199	19	21	87	88
Hawkish words:						
	EXPANSION	HIGH	INCREASE	MOMENTUM	POSITIVE	PRESSURE
Mean	0.774	1.226	1.047	0.585	0.358	0.726
Maximum	4	8	9	3	3	3
Minimum	0	0	0	0	0	0
Sum	82	130	111	62	38	77
	RAISE/RISE	STABILITY	STABLE	STEADY	STRONG	SUSTAIN
Mean	0.406	0.321	0.698	0.434	1.075	1.462
Maximum	4	2	4	3	7	7
Minimum	0	0	0	0	0	0
Sum	43	34	74	46	114	155

Notes: This table reports the conventional descriptive statistics used, i.e., mean, maximum, minimum, and sum (total) for all 12 dovish and hawkish words, respectively. The MPS were collected between May 2004 and November 2020.

Table 4 provides the summary statistics of mean, maximum, minimum, and sum (total) respectively for each 12 dovish and 12 hawkish words. These were counted (its frequency) from the 106 MPS releases from BNM. Of the dovish words, both 'risk' and 'moderate' appeared most frequently with a total of 199 and 196 respectively. The least dovish word used, is 'contraction' with only 12 mentions in the collected MPS. The word refers to either a relatively severe downturn, or shortfall in economic growth. As noted, the BNM has a propensity to using mild words such as 'moderate' and 'modest' to describe negative aspects of the country's economic condition. Among the hawkish words, 'sustain' is the most repeated in the MPS, with 155 times. The words 'stability' 'positive' were only repeated at 34 and 38 times respectively. The MPC has regularly stressed on economic sustainability and sustaining price stability when the economy is in an expansionary stage. In addition, the MPC prefers to use a 'centric' tone in delivering its message to connote a situation of not being too pessimistic or too optimistic, rather more of a 'neutral' one.

The core analysis of this study is to estimate the causal effects of dovish and hawkish words as well as other basic characteristics of the MPS released (as in Table 1) and the associated OPR announcements. The base line equations (1)-(3) are to estimate the causal effects of the monetary sentiments, hawkish and dovish, made solely in bivariate and trivariate frameworks. Equation (4) substitutes these equations by using H-D score that measures the difference between word count of hawkish and dovish sentiments that describe the monetary stance of the BNM. It serves as a robustness check.

$$OPR_i = f(T\_DOVISH) \quad (1)$$
$$OPR_i = f(T\_HAWKISH) \quad (2)$$
$$OPR_i = f(T\_DOVISH, T\_HAWKISH) \quad (3)$$
$$OPR_i = f(H\text{-}D) \quad (4)$$

Where the subscript i of OPR represents ΔOPR, D_ΔOPR, D_OPR_I, and D_OPR_D and interchangeability as described in Table 1. More comprehensively, the basic characteristics of MPS are incorporated into equations (1)-(4) in a multivariate framework as per equations (5)-(10). These comprise DAY, DURATION, and T_WORD.

$$OPR_i = f(T\_DOVISH, T\_HAWKISH, DAY) \quad (5)$$
$$OPR_i = f(H\text{-}D, DAY) \quad (6)$$
$$OPR_i = f(T\_DOVISH, T\_HAWKISH, DAY, DURATION) \quad (7)$$
$$OPR_i = f(H\text{-}D, DAY, DURATION) \quad (8)$$
$$OPR_i = f(T\_DOVISH, T\_HAWKISH, DAY, DURATION, T\_WORD) \quad (9)$$
$$OPR_i = f(H\text{-}D, DAY, DURATION, T\_WORD) \quad (10)$$

Lastly, equations (11)-(13) in a multivariate framework considers the leadership of the BNM's first woman governor, Zeti Akhtar Aziz. Equation (11) is the preferred equation for statistical inference since it

incorporates all possible independent variables, while equation (12) is for comparison purpose between T_DOVISH and T_HAWKISH, and H-D, respectively.

$$\text{OPR}_i = \text{f(T\_DOVISH, T\_HAWKISH, DAY, DURATION, T\_WORD, D\_GZETI)} \quad (12)$$
$$\text{OPR}_i = \text{f(H-D, DAY, DURATION, T\_WORD, D\_GZETI)} \quad (13)$$
$$\text{OPR}_i = \text{f(T\_DOVISH, T\_HAWKISH, D\_GZETI)} \quad (14)$$

The OLS estimator is utilized for estimation when the dependent variables, viz. OPR and ΔOPR, are continuous. For the discrete dependent variable (with a zero-one dummy) such as D_ΔOPR, D_OPR_I, and D_OPR_D, binary models (i.e., Probit, and Logit) are estimated. These variables are not explained here since they are well documented in the conventional econometric textbooks and widely applied by empiricist researchers. Both Probit and Logit models offer relatively consistent results in terms of size and sign, as with their estimates documented in Tables B.1-B.5. Both binary models are briefly outlined as follows: Let's refer to a binary regression model, $P(Y=1|X)=F(\beta_0 + \beta_1 X_1 + \ldots \beta_p X_p)$ in which the Logit model considers $F(u)=1/1+\exp(-u)$, and where the Probit model is based on $F(u)=\Phi(u)$, a standard normal cumulative distribution function. It is assumed that $0<F(u)<1$, with an increasing F. More generally, the Logit model is based on the logistic function to model situations where there are two possible outcomes or categorical outcomes. The Probit model, however is based on the Probit function in determining the likelihood that an item or event will fall into one of a range of categories by estimating the probability that observation with specific features will belong to a particular category. The dependent variable is categorical which can only take on one of the two values, i.e., yes or no, true or false.[3] Positive values of the estimated coefficients imply that increasing X_p will increase the probability of the response, while negative values imply the opposite.

EMPIRICAL RESULTS

The estimates of equations (1)-(13) with alternative dependent variables are in Tables B.1-B.5 in the Appendixes. Overall, for the OLS estimator, the R^2 is between 15% and 35%. For the binary models, the McFadden R^2 are between 17% and 28% for dependent variable when one (1) is OPR increases, and between 55% and 67% when one (1) is OPR decreases. The estimated binary model correctly predicts between 91% and 93% of the observations as shown in Table B.4, and between 90% and 96% as in Table B.5. Nevertheless, tests by Andrews (1988) and Hosmer-Lemeshow (1989) suggest mixed evidence of the problems relating to the goodness-of-fit for binary models. It can be due to the relatively small sample size of 106 as adopted in this study.

The discussion on empirical results is based on three groups according to their independent variables used as described in the previous section. The first group is based on the estimated equations (1)-(4) relating to the monetary sentiment whether hawkish (T_HAWKISH) or dovish (T_DOVISH), and the difference between them (H-D). The second group considers the basic characteristics of the MPS identified, namely DAY, DURATION, and T_WORD as informed by the estimated equations (5)-(8). Lastly, we look at the OPR decision made under the leadership of Zeti among others, namely Muhammad Ibrahim, and Nor Shamsiah Mohd. Yunus, the recent one from the estimated equations (11)-(13). Equations (9)-(13) are preferred because of their comprehensiveness and feasibility in a multivariate framework after all independent variables have been taken into account. For example, equations (1) and (2) are based on a bivariate framework by only considering whether dovish or hawkish, but both sentiments and 'other independent variables' are simultaneously printed in a single MPS.

Firstly, with reference to the estimated equations (11) and (12) reported in Tables B.1 and B.2, the monetary sentiment of being dovish and hawkish were found to be statistically significant at least at 10% level. The estimated sign for dovish is negative, -0.012, while positive for hawkish, 0.010 and 0.034. It implies that additional dovish words printed in the MPS reduced the announced OPR change by 0.012%. In fact, more hawkish words released into the MPS would expect a 0.034% rise in OPR or 0.010% change in OPR announced by MPS. It is in line with the expectation that a hawkish scenario leads to a monetary policy that indicates rising interest rates. This results in a higher cost of borrowing by both households and firms due to higher interest repayments leading to decreases in spending and investment. On the other hand, a dovish scenario suggests the opposite indicating a fall of interest rates. Conversely, the H-D has a positive causal effect on OPR (i.e., 0.010 and 0.029). Similar findings are observed that changes in dummy OPR, namely when it increases (D_OPR_I) or when it decreases (i.e., a reversed sign is expected), can be alternatively used to capture OPR (Tables B.4 and B.5). Nevertheless, none of these independent variables, T_DOVISH, T_HAWKISH, and H-D (and others) are statistically significant, even at 10% level, when changes in dummy OPR are considered (Table B.3).

The three characteristics identified from the MPS, namely DAY, DURATION, and T_WORD, are incorporated into the estimated equations (5)-(12). The day of the week (DAY) has significant positive impact on the change in OPR (Table B.2) with estimated coefficients of 0.018 and 0.019. If the MPS is released a day late, it is most likely the decision for rising OPR. This finding is consistent with similar implication associated with the decrease in dummy variable OPR, which is negatively associated with the variable (DAY) with their estimated coefficients between -0.644 and -2.045 from binary models (Table B.5). This implies that when the MPS is released a day late, the probability for OPR to decrease will be lower. The MPC meets at least six times a year to decide on the OPR and publishes the MPS following

each meeting to explain its decisions. Most of the MPS are released on Thursday (38.0%), and least on Monday (8.5%) and increasing again on Friday (15.1%). The pattern suggests that the shock of rising OPR on the markets, such as stock market, can be smoothed out during the weekend. The DURATION, i.e., the number of days between the previous and latest MPS released, has a negative implication (statistically significant at 10%) on the OPR with estimated coefficient of -0.005 (Table B.1). This indicates that if the MPC statement is released a day later, the OPR announced will be 0.005% lower. It can be partially explained by the observation that the duration becomes relatively longer since 2010, with relatively lower OPR announced. However, this variable does not influence OPR decision if alternative dependent variable(s) is being used. Other characteristics, such as T_WORD captured by the equations (9)-(12), are statistically insignificant at 10% level for all proxies of OPR decision. From these findings, the basic characteristics of MPS appear to reveal sufficient information for market participants to enable them to predict the OPR decision that will be released by the MPC.

The estimated equations (11)-(13) incorporate the leadership variable in modelling OPR decision by the MPC. As shown in Table B.2, the change in OPR decision is statistically significant at 1% level with estimated coefficients of 0.075 and 0.080. This finding is supported by other proxy variables of OPR decision, namely OPR increases dummy (Table B.4), and OPR decreases dummy (Table B.5) from their binary models. It should be noted that this finding serves more as a 'signal' on OPR decision by the MPC rather than signifying any influence on the decision making. The MPC decision is based on consensus among committee members and not based on the BNM's Governor solely. This can be partially explained by the Malaysian economics performance during their tenure of leadership. Zeti's governorship was challenged by two downturns i.e., 0.5% and -1.5% growth rates in 2001 and 2009, respectively. Without these two outliers, the growth rates would be between 4.4% and 7.4%. The economic growth achieved in 2017 was 5.8% and 4.8% in 2018. The present BNM governor faced a recession in 2020 (-5.5% economic growth) due to Covid-19 pandemic. Growth however improved to 4.4% in 2019 and 3.1% in 2021.

It was observed that the presentation (writing style) of the collected MPS, was increasingly becoming more straightforward and precise thus contributing to greater readability. This presentation however took a sudden change by 3 November 2020, with the unprecedented onset of the Covid-19 pandemic that prompted the BNM to adopt a more dovish monetary position in order to combat the ensuing economic downturn. In this study the OPR decisions made by the previous MPS were also considered. The empirical results were accordingly re-estimated by using the lagged one period (t-1) independent variables. Their findings showed relative consistence in both their significance and estimated coefficients.[4]

This study complements that of Garcia-Herrero and Remolona (2008) which comprised only 32 pieces of MPS released between August 2003 and August 2007 (i.e., 4 years x 8 times a year, Table 7, p. 28). The study also collated 106 MPS from the BNM between May 2004 and November 2020, a much longer study period. The authors found an average of 188 words per MPS, in contrast to the 329 words in this study. Further, the OPR changed three times in the earlier study (over the 2003-2007 period) as against five times in the present study ((i.e., 18 times divided by 3.4, a 5-year interval for the period 2004-2020)). The probability of a subsequent increase in policy rate, given a previous increase, was 1.00. However, the estimated coefficients of lagged one dummy variable OPR increases on OPR increases, are 1.103 and 2.015 for Probit and Logit models respectively. Both results were statistically significant at 5% level. The predicted probability by the Logit model was 0.882, and for the Probit model, 0.667. It should be noted that this study did not duplicate the study by Garcia-Herrero and Remolona (2008) in examining forward-looking and backward-looking information of MPS[5]. But the hawkish-dovish information used to model the OPR decision was based on MPS characteristics. Both hawkish and dovish word counts on the MPS provided meaningful interpretation as basis for the OPR decision.

CONCLUSION

This study examined the causal effects of key MPS characteristics on decision making for the overnight policy rate (OPR). Hawkishness was shown to increase OPR whereas dovishness facilitated prediction on a decision to reduce it. MPS released on a later day was believed to influence decision to raise OPR. Longer durations averaging 63 days, made between two MPS statement releases, might favour decision to reduce OPR. Most decisions made during *Zeti's* leadership, between the May 2000-April 2016 period, were associated with increased OPR. The present study had relevant policy implication, in particular for ensuring efficient and transparent monetary communication between the BNM and market participants. It suggests that MPS released by BNM to the public are '*more than just words*. Perhaps, a better institutional practice and more excellent governance in the BNM would be expected and recommended, at least through initiating higher transparency and more quality information disclosure. Such recommendation should allow for market participants to conduct more accurate prediction(s) on the monetary policies (policy rates) made by the BNM.

This study was constrained by the following limitations: Firstly, the study materials were sourced from MPS documents published between May 2004 and November 2020. They were publicly accessible from the BNM official website. However, for comprehensiveness and comparison the MPS that span the Covid-19

pandemic should usefully be included in the study for the additional insight special to that period. Secondly, this study mainly focuses on the monetary standpoint, i.e., drawing on basically hawkish-dovish information as well as depicted characteristics from the MPS. It may miss through omission other potential determinants of the OPR decision-making. Among these were the forward-looking and backward-looking information, the role of market (and media) sentiment, and the impact of relevant macroeconomic variables such as economic growth, inflation, unemployment rate. Thirdly, data mined from the MPS were conducted manually with the "*find text or tools*" of the document viewer, the *Adobe Acrobat*. As such, errors and omissions may potentially occur. Lastly, this study employed the conventional econometrics techniques, i.e., OLS, Logit, and Probit estimators out of convenience and simplicity of use. They tended to produce mixed findings. Similar outcome was produced when the study adopts various measures of dependent variables for deriving OPRs.

Papers related to MPS topics are relatively few and the research area deserves further investigation. Updating MPS will eventually lead to broader and comprehensive findings. A dummy variable capturing the Covid-19 pandemic in Malaysia can be added to provide additional insight. Indeed, comparisons among central banks, either in Asia, the Pacific or globally, as in Garcia-Herrero and Remolona (2008), should be instructive. Future investigations should include omitted variables as mentioned earlier in order to ensure comprehensiveness, and to improve the goodness-of-fit for the estimated models. Further, the text mining exercise can be more accurately carried out using text mining software such as Levity, MeaningCloud, Textable and SAS Text Miner. Lastly, other or new econometric techniques, such as semi- and non-parametric models, can be employed in future investigations to avoid the restrictive and unrealistic assumptions made by analysts who are aware of the functional form in the relationship between the dependent and explanatory variables.

NOTES

1 Accessed at https://www.bnm.gov.my/web/guest/opr-decision-and-statement, on 23 July, 2021.

2 The primary dataset extracted from the 106 MPS are available from the corresponding author upon request.

3 Accessed at https://vitalflux.com/logit-vs-probit-models-differences-examples/#:~:text=Logit%20and%20probit%20 models%20are,or%20not%20something%20will%20happen, on 27 April, 2023.

4 The results are available from the corresponding author upon request.

5 According to them (Garcia-Herrero and Remolona 2008, p.14), backward-looking information is about how the economy has performed in recent periods, while forward-looking information is about an assessment of how the economy is likely to perform going forward.

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APPENDIXES

TABLE A.1. Word count of Dovish, Hawkish, and Hawkish-Dovish

No.	Date	Total Hawkish, H	Total Dovish, D	H-D	No.	Date	Total Hawkish, H	Total Dovish, D	H-D
1	26-May-04	15	5	10	54	09-Mar-12	7	10	-3
2	25-Aug-04	9	3	6	55	11-May-12	5	10	-5
3	30-Nov-04	12	3	9	56	05-Jul-12	5	9	-4
4	28-Feb-05	6	2	4	57	06-Sep-12	4	9	-5
5	25-May-05	13	1	12	58	08-Nov-12	6	8	-2
6	24-Aug-05	14	4	10	59	31-Jan-13	8	5	3
7	30-Nov-05	8	0	8	60	07-Mar-13	9	6	3
8	15-Dec-05	0	0	0	61	09-May-13	9	11	-2
9	20-Jan-06	1	1	0	62	11-Jul-13	8	8	0
10	22-Feb-06	9	0	9	63	05-Sep-13	13	11	2
11	26-Apr-06	13	2	11	64	07-Nov-13	9	14	-5
12	22-May-06	4	2	2	65	29-Jan-14	9	8	1
13	28-Jul-06	7	5	2	66	06-Mar-14	7	9	-2
14	25-Aug-06	6	3	3	67	08-May-14	5	6	-1
15	26-Sep-06	6	3	3	68	10-Jul-14	10	8	2
16	24-Nov-06	7	4	3	69	18-Sep-14	7	9	-2
17	26-Jan-07	5	3	2	70	06-Nov-14	9	9	0
18	26-Feb-07	5	3	2	71	28-Jan-15	12	16	-4
19	27-Apr-07	9	5	4	72	05-Mar-15	12	16	-4
20	28-May-07	8	3	5	73	07-May-15	11	14	-3
21	24-Jul-07	5	2	3	74	09-Jul-15	10	13	-3
22	24-Aug-07	6	5	1	75	11-Sep-15	10	22	-12
23	30-Oct-07	5	7	-2	76	05-Nov-15	10	19	-9
24	26-Nov-07	6	9	-3	77	21-Jan-16	6	18	-12
25	29-Jan-08	9	10	-1	78	09-Mar-16	5	14	-9
26	25-Feb-08	7	6	1	79	19-May-16	6	10	-4
27	29-Apr-08	12	11	1	80	13-Jul-16	9	16	-7
28	26-May-08	12	11	1	81	07-Sep-16	9	14	-5
29	25-Jul-08	20	14	6	82	23-Nov-16	7	12	-5
30	25-Aug-08	7	11	-4	83	19-Jan-17	14	12	2
31	24-Oct-08	8	11	-3	84	02-Mar-17	14	6	8
32	24-Nov-08	6	18	-12	85	12-May-17	15	6	9
33	21-Jan-09	2	17	-15	86	13-Jul-17	14	6	8
34	24-Feb-09	2	15	-13	87	07-Sep-17	12	6	6
35	29-Apr-09	5	17	-12	88	09-Nov-17	18	3	15
36	26-May-09	1	7	-6	89	25-Jan-18	23	7	16
37	29-Jul-09	3	12	-9	90	07-Mar-18	17	7	10
38	25-Aug-09	3	6	-3	91	10-May-18	22	6	16
39	28-Oct-09	7	10	-3	92	11-Jul-18	13	5	8
40	24-Nov-09	7	10	-3	93	05-Sep-18	15	9	6

contiue ...

... continued

41	26-Jan-10	9	7	2	94	08-Nov-18	16	10	6
42	04-Mar-10	9	10	-1	95	24-Jan-19	12	9	3
43	13-May-10	10	8	2	96	05-Mar-19	14	14	0
44	08-Jul-10	9	10	-1	97	07-May-19	11	15	-4
45	02-Sep-10	9	12	-3	98	09-Jul-19	10	9	1
46	12-Nov-10	7	10	-3	99	12-Sep-19	11	10	1
47	27-Jan-11	16	10	6	100	05-Nov-19	9	14	-5
48	11-Mar-11	17	8	9	101	22-Jan-20	8	14	-6
49	05-May-11	20	6	14	102	03-Mar-20	5	17	-12
50	07-Jul-11	13	10	3	103	05-May-20	4	16	-12
51	08-Sep-11	13	17	-4	104	07-Jul-20	2	23	-21
52	11-Nov-11	8	14	-6	105	10-Sep-20	6	19	-13
53	31-Jan-12	9	13	-4	106	03-Nov-20	5	17	-12

Notes: This table provides a summary of the total (word count) of Dovish, Hawkish, and the different number between Hawkish and Dovish, H-D. A total of 106 MPS collected and reviewed between the stated dates.

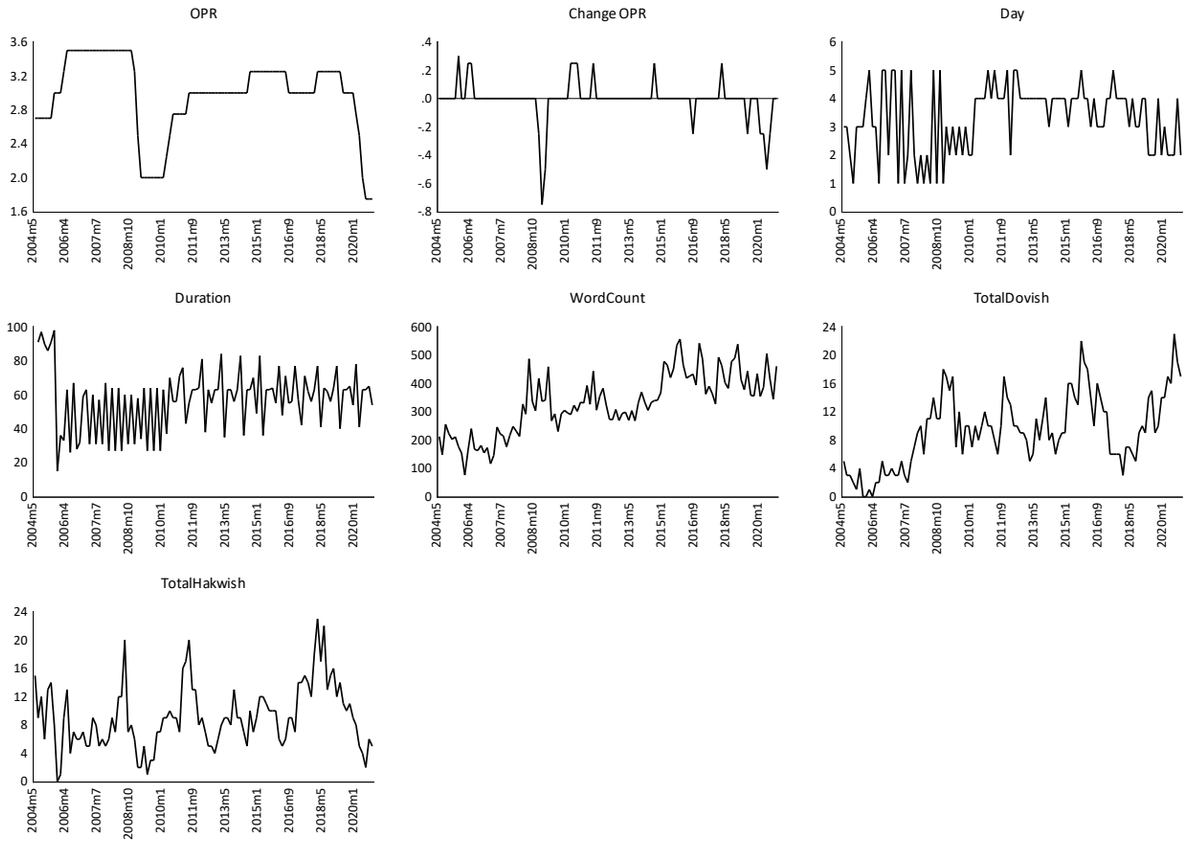

FIGURE A.1. The time series plots of underlying variables

Notes: This figure consists of 7 selected variables used in this study over the periods May, 2004 and November 2020 the MPS available for the public. They virtualize the changes occur over time.

TABLE B.1. Estimates of equations (1) – (13), dependent variable –overnight policy rate, OPR (%)

Method: OLS													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	-0.027 (0.113)		-0.025 (0.117)		-0.025 (0.110)		-0.025 (0.086)*		-0.019 (0.208)		-0.024 (0.101)		-0.022 (0.116)
T_HAWKISH		0.027 (0.102)	0.025 (0.091)*		0.023 (0.097)*		0.029 (0.004)***		0.033 (0.075)*		0.034 (0.073)*		0.031 (0.062)*
H-D				0.025 (0.033)**		0,024 (0.035)**		0.027 (0.017)**		0.027 (0.013)**		0.029 (0.006)***	
DAY					0.030 (0.555)	0.029 (0.580)	0.038 (0.406)	0.040 (0.405)	0.038 (0.409)	0.040 (0.387)	0.029 (0.537)	0.030 (0.525)	
DURATION							-0.005 (0.075)*	-0.004 (0.108)	-0.005 (0.085)*	-0.004 (0.092)*	-0.005 (0.090)*	-0.005 (0.095)*	
T_WORD									-0.000 (0.673)	-0.000 (0.991)	0.000 (0.851)	0.000 (0.516)	
D_GZETI											0.183 (0.313)	0.189 (0.290)	0.174 (0.268)
Constant	3.229 (0.000)***	2.729 (0.000)***	2.985 (0.000)***	2.984 (0.000)***	2.901 (0.000)***	2.887 (0.000)***	3.088 (0.000)***	3.115 (0.000)***	3.116 (0.000)***	3.116 (0.000)***	2.868 (0.000)***	2.861 (0.000)***	2.772 (0.000)***
R^2	0.088	0.071	0.148	0.148	0.154	0.154	0.192	0.191	0.194	0.191	0.215	0.213	0.171
Adjusted R^2	0.080	0.062	0.132	0.140	0.129	0.137	0.160	0.167	0.154	0.159	0.167	0.174	0.147
F-statistic	10.079	7.954	8.955	18.083	6.180	9.349	5.952	7.964	4.778	5.914	4.471	5.370	7.036
(*p*-value)	(0.002)	(0.006)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Durbin-Watson	0.129	0.122	0.138	0.138	0.156	0.157	0.221	0.218	0.225	0.217	0.226	0.224	0.150

Notes: The following tables report the estimated equations (1)-(13) by OLS, Logit, and Probit estimators, respective. ***, **, * denote significance level 1%, 5% and 10%, respectively, and the reported value in bracket (.) is *p*-value. The dependent variable is varying by those are defined as in Table 1, For Tables B.1 and B.2, the OLS with heteroscedasticity and autocorrelation consistent (HAC) estimator has been applied for standard errors and covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000). The estimated coefficient remains unchanged for both sign and size but their significant level.

TABLE B.2. Dependent variable –change in OPR between current and previous OPR, ΔOPR (%)

Method: OLS													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	-0.012 (0.003)***		-0.011 (0.001)***		-0.011 (0.000)***		-0.011 (0.000)***		-0.010 (0.030)**		-0.012 (0.016)**		-0.010 (0.005)***
T_HAWKISH		0.010 (0.017)**	0.009 (0.006)***		0.008 (0.011)**		0.008 (0.012)**		0.010 (0.008)***		0.010 (0.006)***		0.012 (0.000)***
H-D				0.010 (0.001)***		0.010 (0.001)***		0.010 (0.001)***		0.010 (0.002)***		0.011 (0.000)***	
DAY					0.019 (0.023)**	0.018 (0.032)**	0.019 (0.031)**	0.018 (0.037)**	0.019 (0.031)**	0.018 (0.033)**	0.014 (0.048)**	0.014 (0.052)*	
DURATION							-0.000 (0.966)	-0.000 (0.761)	0.000 (0.985)	0.000 (0.987)	0.000 (0.979)	-0.000 (0.999)	
T_WORD									-0.000 (0.629)	-0.000 (0.328)	0.000 (0.514)	0.000 (0.366)	
D_GZETI											0.080 (0.004)***	0.079 (0.004)***	0.075 (0.006)***
Constant	0.101 (0.000)***	-0.103 (0.055)*	0.010 (0.709)	-0,007 (0.657)	-0.043 (0.249)	-0.065 (0.037)**	-0.041 (0.282)	-0.057 (0.103)	-0.033 (0.453)	-0.033 (0.451)	-0.142 (0.005)***	-0.140 (0.004)***	-0.081 (0.037)**
R^2	0.189	0.112	0.281	0.279	0.306	0.301	0.309	0.305	0.311	0.311	0.354	0.354	0.329
Adjusted R^2	0.181	0.104	0.267	0.272	0.285	0.288	0.281	0.285	0.276	0.283	0.315	0.321	0.309
F-statistic	24.209	13.179	20.087	40.200	14.971	22.189	11.184	14.787	8.930	11.274	8.967	10.838	16.645
(*p*-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Durbin-Watson	1.198	0.968	1.177	1.162	1.297	1.265	1.299	1.270	1.299	1.298	1.349	1.338	1.236

TABLE B.3. Dependent variable – Dummy variable, D_ΔOPR where 1 = OPR changes (Either increase or decrease in OPR), and 0 = Unchanged

Method: Logit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	0.087 (0.091)*		0.086 (0.096)*		0.089 (0.090)*		0.087 (0.098)*		0.096 (0.257)		0.105 (0.215)		0.073 (0.178)
T_HAWKISH		-0.014 (0.816)	-0.002 (0.974)		0.027 (0.684)		0.026 (0.701)		0.032 (0.691)		0.029 (0.721)		-0.020 (0.759)
H-D				-0.052 (0.168)		-0.044 (0.247)		-0.044 (0.245)		-0.030 (0.449)		0.037 (0.365)	
DAY					-0.350 (0.141)	-0.274 (0.212)	-0.382 (0.667)	-0.316 (0.172)	-0.380 (0.126)	-0.355 (0.147)	-0.320 (0.180)	-0.317 (0.203)	
DURATION							0.007 (0.667)	0.010 (0.530)	0.007 (0.659)	0.007 (0.657)	0.007 (0.688)	0.007 (0.679)	
T_WORD									-0.001 (0.890)	0.002 (0.399)	-0.002 (0.643)	0.001 (0.789)	
D_GZETI											-0.554 (0.413)	-0.531 (0.440)	-0.594 (0.316)
Constant	-2.459 (0.000)***	-1.465 (0.012)	-2.438 (0.006)***	-1.641 (0.000)***	-1.617 (0.112)	-0.764 (0.294)	-1.875 (0.123)	-1.171 (0.248)	-1.828 (0.148)	-1.710 (0.161)	-1.036 (0.521)	-0.939 (0.556)	-1.733 (0.130)
McFadden R^2	0.030	0.001	0.030	0.020	0.053	0.036	0.055	0.039	0.055	0.047	0.062	0.053	0.041
LR statistic	2.926	0.054	2.927	1.943	5.151	3.501	5.266	3.775	5.285	4.486	5.954	5.082	3.920
(*p*-value)	(0.087)	(0.815)	(0.231)	(0.163)	(0.161)	(0.174)	(0.261)	(0.287)	(0.382)	(0.344)	(0.428)	(0.406)	(0.270)

Method: Probit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	0.045 (0.103)		0.045 (0.107)		0.045 (0.114)		0.044 (0.122)		0.053 (0.284)		0.057 (0.250)		0.037 (0.216)
T_HAWKISH		-0.007 (0.823)	0.003 (0.925)		0.019 (0.594)		0.018 (0.617)		0.024 (0.600)		0.023 (0.616)		-0.006 (0.859)
H-D				0.024 (0.205)		-0.019 (0.345)		-0.019 (0.339)		-0.013 (0.546)		-0.015 (0.478)	
DAY					-0.202 (0.143)	-0.162 (0.212)	-0.218 (0.125)	-0.183 (0.173)	-0.218 (0.125)	-0.203 (0.147)	-0.197 (0.174)	-0.183 (0.199)	
DURATION							0.004 (0.670)	0.005 (0.535)	0.004 (0.656)	0.004 (0.660)	0.004 (0.691)	0.004 (0.692)	
T_WORD									-0.001 (0.834)	0.001 (0.383)	-0.001 (0.636	0.001 (0.722)	
D_GZETI											-0.276 (0.483)	-0.258 (0.513)	-0.308 (0.372)
Constant	-1.394 (0.000)***	-0.892 (0.005)***	-1.428 (0.003)***	-0.972 (0.000)***	-0.923 (0.109)	-0.450 (0.301)	-1.069 (0.119)	-0.681 (0.250)	-1.030 (0.148)	-0.992 (0.156)	-0.634 (0.487)	-0.619 (0.495)	-1.044 (0.105)
McFadden R^2	0.028	0.001	0.028	0.017	0.051	0.033	0.052	0.036	0.053	0.044	0.067	0.049	0.036
LR statistic	2.695	0.050	2.704	1.631	4.896	3.195	5.041	3.492	5.085	4.259	6.406	4.685	3.496
(*p*-value)	(0.101)	(0.822)	(0.259)	(0.201)	(0.180)	(0.202)	(0.283)	(0.322)	(0.406)	(0.372)	(0.379)	(0.455)	(0.321)

TABLE B.4. Dependent variable – dummy variable, D_OPR_I where 1 = OPR increases, and 0 = OPR either decrease or unchanged

Method: Logit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	-0.189 (0.030)**		-0.220 (0.031)**		-0.232 (0.029)**		-0.234 (0.027)**		-0.182 (0.193)		-0.366 (0.041)**		-0.219 (0.031)**
T_HAWKISH		0.153 (0.032)**	0.153 (0.031)**		0.145 (0.042)**		0.148 (0.048)**		0.197 (0.090)*		0.213 (0.075)*		0.253 (0.006)***
H-D				0.175 (0.004)***		0.172 (0.005)***		0.176 (0.006)***		0.190 (0.007)***		0.268 (0.002)***	
DAY					0.261 (0.474)	0.198 (0.585)	0.244 (0.504)	0.178 (0.620)	0.234 (0.511)	0.238 (0.500)	0.282 (0.473)	0.227 (0.544)	
DURATION							0.001 (0.953)	-0.000 (0.995)	0.000 (0.989)	0.000 (0.982)	-0.005 (0.817)	-0.005 (0.793)	
T_WORD									-0.004 (0.577)	-0.003 (0.358)	0.007 (0.409)	0.002 (0.593)	
D_GZETI											3.494 (0.052)*	3.098 (0.053)*	2.435 (0.073)*
Constant	-0.956 (0.132)	-3.980 (0.000)***	-2.373 (0.019)**	-2.900 (0.000)***	-3.115 (0.039)**	3.585 (0.010)***	-3.121 (0.100)*	-3.496 (0.060)*	-2.806 (0.150)	-2.820 (0.147)	-7.797 (0.017)**	-7.014 (0.014)**	-5.457 (0.005)***
McFadden R^2	0.093	0.074	0.17	0.164	0.179	0.170	0.184	0.175	0.189	0.189	0.278	0.271	0.240
LR statistic	5.734	4.564	10.466	10.132	11	10.442	11.312	10.772	11.634	11.629	17.067	16.648	14.796
(*p*-value)	(0.017)	(0.033)	(0.005)	(0.001)	(0.012)	(0.005)	(0.023)	(0.013)	(0.04)	(0.02)	(0.009)	(0.005)	(0.002)
% Correct	91.509	91.509	91.509	91.509	91.509	91.509	91.429	91.429	90.476	91.429	93.333	91.429	91.509
H-L statistic	7.852	13.427*	10.984	10.172	8.025	8.901	10.882	8.719	11.395	11.339	9.309	7.924	3.431
Andrews stat.	53.609***	58.823***	63.179***	62.657***	63.797***	65.517***	74.321***	64.911***	73.42***	73.322***	70.330***	68.718***	52.667***

Notes: The "% Correct" is based on expectation-prediction evaluation for binary specification – the estimated equation. The goodness-of-fit tests i.e. Hosmer-Lemeshow (H-L) (1989) and Andrews (1988) tests. The null hypothesis for H-L tests is "The observed and expected proportions are the same across all doses", while for the Andrews tests is "The model is correctly specified".

Method: Probit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	-0.097 (0.029)**		-0.107 (0.031)**		-0.114 (0.029)**		-0.116 (0.027)**		-0.084 (0.251)		-0.188 (0.050)**		-0.111 (0.034)**
T_HAWKISH		0.082 (0.036)**	0.082 (0.039)**		0.077 (0.054)*		0.079 (0.058)*		0.109 (0.088)*		0.126 (0.060)*		0.144 (0.006)***
H-D				0.092 (0.004)***		0.091 (0.005)***		0.094 (0.006)***		0.098 (0.007)***		0.149 (0.002)***	
DAY					0.159 (0.421)	0.131 (0.496)	0.150 (0.448)	0.122 (0.523)	0.146 (0.452)	0.152 (0.431)	0.164 (0.440)	0.145 (0.480)	
DURATION							0.000 (0.973)	-0.000 (0.981)	0.000 (0.973)	0.001 (0.962)	-0.003 (0.772)	-0.003 (0.776)	
T_WORD									-0.002 (0.534)	-0.002 (0.409)	0.004 (0.440)	0.002 (0.485)	
D_GZETI											2.004 (0.042)**	1.862 (0.044)**	1.445 (0.062)*
Constant	-0.618 (0.029)**	-2.212 (0.000)***	-1.403 (0.011)**	-1.612 (0.000)***	-1.862 (0.023)**	-2.075 (0.005)***	-1.853 (0.065)*	-2.023 (0.035)**	-1.685 (0.104)	-1.700 (0.100)*	-4.497 (0.010)***	-4.229 (0.009)***	-3.238 (0.004)***
McFadden R^2	0.095	0.075	0.169	0.166	0.180	0.174	0.185	0.180	0.192	0.191	0.284	0.280	0.246
LR statistic	5.878	4.651	10.399	10.230	11.083	10.717	11.393	11.052	11.796	11.748	17.417	17.190	15.144
(*p*-value)	(0.015)	(0.031)	(0.006)	(0.001)	(0.011)	(0.005)	(0.022)	(0.011)	(0.038)	(0.019)	(0.008)	(0.004)	(0.002)
% Correct	91.509	91.509	91.509	91.509	91.509	91.509	91.429	91.429	91.429	91.429	91.429	91.429	92.453
H-L statistic	7.612	10.518	12.780	10.068	13.322	8.575	8.351	8.522	11.559	11.309	6.931	6.137	4.873
Andrews stat.	53.602***	64.792***	73.789***	62.831***	75.781***	67.115***	62.347***	68.091***	71.77***	71.541***	66.641***	60.797***	61.617***

TABLE B.5. Dependent variable –dummy variable, D_OPR_D where 1 = OPR decreases, and 0 = OPR either increase or unchanged

Method: Logit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	0.415 (0.001)***		0.388 (0.001)***		0.618 (0.012)**		0.623 (0.013)**		0.752 (0.031)**		0.668 (0.035)**		0.382 (0.009)***
T_HAWKISH		-0.289 (0.013)**	-0.339 (0.034)**		-0.194 (0.237)		-0.224 (0.207)		-0.186 (0.317)		-0.290 (0.205)		-0.399 (0.028)**
H-D				-0.372 (0.000)***		-0.397 (0.001)***		-0.422 (0.001)***		-0.401 (0.003)***		-0.469 (0.005)***	
DAY					-1.714 (0.025)**	-1.178 (0.035)**	-2.034 (0.024)**	-1.655 (0.032)**	-2.168 (0.026)**	-1.680 (0.032)**	-2.045 (0.063)*	-1.861 (0.075)*	
DURATION							0.034 (0.409)	0.041 (0.276)	0.039 (0.352)	0.038 (0.343)	0.037 (0.446)	0.036 (0.470)	
T_WORD									-0.006 (0.530)	0.003 (0.687)	-0.009 (0.428)	-0.004 (0.650)	
D_GZETI											-2.099 (0.150)	-2.560 (0.085)*	-2.295 (0.032)**
Constant	-7.760 (0.000)***	-0.290 (0.706)	-4.928 (0.014)**	-4.487 (0.000)***	-6.638 (0.128)	-1.438 (0.311)	-5.596 (0.110)	-2.694 (0.184)	-5.333 (0.146)	-3.349 (0.205)	-1.321 (0.792)	0.755 (0.856)	-3.081 (0.226)
McFadden R^2	0.369	0.134	0.465	0.463	0.604	0.565	0.614	0.583	0.621	0.586	0.664	0.650	0.551
LR statistic	22.726	8.265	28.619	28.551	37.222	34.814	37.734	35.829	38.137	35.991	40.760	39.898	33.925
(*p*-value)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% Correct	89.622	91.509	92.453	93.396	96.226	96.226	96.190	95.238	96.190	95.238	95.238	95.238	93.396
H-L statistic	4.114	8.460	1.466	1.540	1.658	2.998	0.760	1.425	0.858	3.053	0.458	0.606	0.731
Andrews stat.	71.275***	52.308***	68.156***	66.611***	64.047***	74.936***	73.394***	66.846***	70.426***	76.376***	73.57***	70.733***	80.335***

Method: Probit													
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
T_DOVISH	0.236 (0.000)***		0.223 (0.001)***		0.334 (0.008)***		0.345 (0.009)***		0.422 (0.033)**		0.377 (0.035)**		0.209 (0.010)**
T_HAWKISH		-0.146 (0.013)**	-0.175 (0.037)**		-0.118 (0.209)		-0.134 (0.184)		-0.114 (0.281)		-0.162 (0.188)		-0.219 (0.027)**
H-D				-0.206 (0.000)***		-0.223 (0.000)***		-0.240 (0.001)***		-0.226 (0.003)***		-0.257 (0.003)***	
DAY					-0.921 (0.024)**	-0.644 (0.035)**	-1.137 (0.023)**	-0.907 (0.031)**	-1.213 (0.026)**	-0.930 (0.029)**	-1.106 (0.067)*	-0.956 (0.079)*	
DURATION							0.021 (0.368)	0.023 (0.265)	0.024 (0.324)	0.021 (0.327)	0.019 (0.492)	0.017 (0.529)	
T_WORD									-0.004 (0.540)	0.002 (0.650)	-0.005 (0.405)	-0.002 (0.639)	
D_GZETI											-1.180 (0.134)	-1.404 (0.081)*	-1.291 (0.027)**
Constant	-4.444 (0.000)***	-0.288 (0.502)	-2.927 (0.010)***	-2.474 (0.000)***	-2.460 (0.130)	-0.819 (0.288)	-3.128 (0.113)	-1.564 (0.165)	-2.998 (0.149)	-1.968 (0.179)	-0.765 (0.785)	0.392 (0.865)	-1.710 (0.244)
McFadden R^2	0.389	0.134	0.475	0.472	0.607	0.570	0.620	0.589	0.626	0.593	0.671	0.656	0.566
LR statistic	23.986	8.249	29.288	29.067	37.404	35.089	38.068	36.204	38.461	36.411	41.228	40.302	34.838
(*p*-value)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% Correct	89.623	91.509	92.453	93.396	96.226	96.226	96.190	95.238	96.190	95.238	95.238	95.238	93.396
H-L statistic	3.474	8.521	1.041	1.144	1.759	2.285	0.585	2.742	0.679	2.398	0.410	0.626	2.031
Andrews stat.	63.244***	51.55***	59.357***	60.035***	50.348***	68.438***	53.530***	58.069***	44.919***	59.239***	60.445***	63.501***	74.99***