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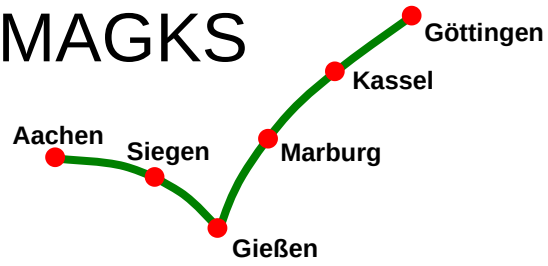

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Canadian Interest Rate Setting: The Information Content of Canadian and U.S. Central Bank Communication

Abstract

We explain Canadian target rate decisions using macroeconomic variables as well as Bank of Canada (BOC) and Federal Reserve (Fed) communication indicators. Econometrically, we employ an ordered probit model of a Taylor rule to explain and predict 60 target rate decisions between 1998 and 2006. We find that communications, and most especially speeches and testimony by Canadian Governing Council members, provide a significant and robust explanation of Canadian target rate decisions. However, prior to the introduction of fixed announcement dates, Canadian communications contained more information on upcoming policy moves. Finally, communications by the U.S. Federal Reserve Bank—which are much more frequent—outperform our Canadian communication indicators in explaining Canadian interest rate decisions.

JEL: E43, E52, E58

Keywords: Bank of Canada, Central Bank Communication, Federal Reserve Bank, Interest Rate Decision, Monetary Policy, Ordered Probit Model, Taylor Rule

1. Introduction

The recent history of Canadian monetary policy is well-suited for a case study on central bank communication. Starting with the first oil crisis in 1973, Canada's inflation rate was 4 percent or higher. After introduction of the inflation target regime (IT) in 1991, the Bank of Canada (BOC) became successful in keeping inflation below 3 percent. However, the move to the IT and the emphasis on reducing inflation rates was accompanied by, perhaps even contributed to, a weak economic performance (Curtis, 2005). In addition, several steps intended to enhance central bank transparency have been taken: from September 1998 onward, the Bank of Canada has intervened in the foreign exchange market only under exceptional circumstances. In September 2000, it introduced "fixed announcement dates" (FADs); previously, target rate[1] changes could effectively occur on any business day.[2] With the introduction of FADs, the BOC seemingly became more "independent" from the Federal Reserve Bank (Fed). The BOC has not explicitly referred to any prior decisions by the Fed in its post-meeting statements since May 2000.

Today, BOC communication occurs via several formal and informal channels: post-meeting statements accompanying target rate decisions and the quarterly monetary policy report,[3] as well as speeches and congressional hearings by members of the Governing Council. Usually, these communications contain an 18–24-month-ahead economic outlook for the Canadian economy. In recent years, it also has become common practice to indicate the future course of BOC monetary policy. The more formalized channels, such as statements and monetary policy reports, are used infrequently (eight and four publications per year, respectively) and thus it is chiefly speeches that are the main channel for conveying new information to private economic agents. Canadian financial market returns and volatility are significantly affected by these less formal types of communication (see Hayo and Neuenkirch, 2010a).

This paper combines two branches of the existing literature. One of these branches deals with estimating monetary policy reaction functions or Taylor rules (Taylor, 1993) for Canada. Curtis (2005) calculates a Taylor rule and finds that the constant term and the reaction to the current core CPI inflation rate are declining over time (1987–1994 and 1995–2000 subsamples), reflecting the success of the IT. The coefficient of the change in the

[1] The Bank of Canada used the bank rate as the key policy rate until April 2001; thereafter, the overnight rate. For the sake of simplicity, we use the term "target rate."

[2] The Bank of Canada had four key objectives when it introduced the new system for announcing target rate decisions: reduced uncertainty in financial markets, more emphasis on medium-term monetary policy, increased transparency regarding the BOC's interest rate decisions, and greater focus on the Canadian rather than the U.S. economic environment (Parent et al., 2003).

[3] Until 1999, the monetary policy report was published semi-annually as in the United States.

Canadian dollar/U.S. dollar (CAD/USD) exchange rate becomes insignificant in the second subsample, suggesting that the BOC no longer tightens the target rate to prevent a depreciation of the exchange rate. Finally, the BOC eases its monetary policy stance when the unemployment rate is higher than its natural rate. This coefficient is increasing over time, mirroring the enlarged scope of expansionary monetary policy after the reduction in the average rate of inflation. Muscatelli et al. (1999) use recursive least squares to estimate a Canadian Taylor rule for the period 1975–1996. When the federal funds rate is included in the equation, the coefficients for expected inflation and output gap are insignificant. The authors also restrict the sample to the period after the money supply targeting regime in Canada (1982–1996 subsample), which yields significant and positive coefficients for the output gap and the CAD/USD exchange rate, but not for inflation expectations. Fougere (2001) concludes that BOC monetary policy is characterized by both forward-looking and backward-looking behavior after the introduction of the IT. His estimates also reveal that the BOC gives significant weight to output stabilization, since the coefficient on the output gap is about 40 percent of the summarized inflation gap coefficients. Nikolsko-Rzhevskyy (2008) estimates a real-time forward-looking Taylor rule for the period 1988–2007. The coefficient of the inflation forecast is significant in all specifications and larger than unity when the federal funds rate is not included. The output gap is either insignificant (once he allows for interest rate smoothing) or unexpectedly negative, suggesting misdirected monetary policy. Changes in the CAD/USD exchange rate do not significantly explain interest rate setting.

The second relevant branch of the literature involves incorporating communication into a Taylor rule for the European Central Bank (ECB) and the Fed. Heinemann and Ullrich (2007) construct an indicator measuring the "hawkishness" of the ECB based on counting the number of relevant words in the monthly press conference statements. Integrating this wording indicator into a Taylor rule ordered probit model, they show that it can improve the model's fit. However, a model solely based on this indicator performs worse than the baseline Taylor rule. Jansen and de Haan (2009) examine whether ECB communication is useful in predicting its policy decisions. Using ordered probit models, they find that statements about the main refinancing rate and future inflation are significantly related to interest rate decisions. An out-of-sample evaluation shows, however, that communication-based models do not outperform models based on macroeconomic data in predicting decisions. Lapp and Pearce (2000) investigate the information content of asymmetric directives in post-meeting statements for the likelihood of intermeeting changes in policy during the Greenspan chairmanship. They show that a bias in Federal Open Market Committee (FOMC) policy

decisions significantly affects the probability that the target will be changed in the period between two meetings. Pakko (2005) examines the predictive content of post-meeting statements in a Taylor rule setting. He finds that statements convey information useful for forecasting changes in the federal funds target rate, even after controlling for policy responses to inflation and the output gap. Hayo and Neuenkirch (2010b) explain federal funds target rate decisions using macroeconomic variables and FOMC communication indicators. Using an ordered probit model of a Taylor rule, they show that Fed communication indicators significantly explain target rate decisions and have more explanatory power than a baseline Taylor rule, both in and out of sample.

In this study, we explain Canadian monetary policy using (1) a Taylor rule incorporating macroeconomic data as well as (2) BOC and Fed communications, which are examined on the basis of their written content. To our knowledge, there are no other studies explaining Canadian target rate decisions that employ a discrete approach and all types of BOC as well as Fed communication. Econometrically, we use an ordered probit model to take into account the discrete nature of Canadian target rate decisions. Our sample starts on January 30, 1998 and ends on December 5, 2006 and includes 60 target rate decisions. The purpose is to analyze whether central bank communication improves the predictability of target rate decisions. Accordingly, our first research questions are: Do BOC communications provide information additional to that already incorporated in a real-time Taylor rule? If yes, does the FAD system (establishing a system of regular statements about future monetary policy) lessen the importance of informal intermeeting communication? Another special feature of this paper is that it takes into consideration that Canada is closely integrated with the United States, both in real and financial terms.[4] Given the relative size of the two economies, it is valuable to study the influence of U.S. variables on Canadian interest rate decisions. This leads to our third research question: Can Canadian monetary policy be explained by changes in the federal funds target rate, U.S. macroeconomic variables, or communication by the Fed—even after introduction of the FAD system?

The remainder of the paper is organized as follows. In the next section, we describe the construction of our communication indicators and the other variables, as well as the econometric methodology. Section 3 studies the extent to which communication helps explain

[4] About two-thirds of total portfolio investments in Canada are due to U.S. investors. The trade share with the United States is large (68 percent in 2006). In 95 percent of all currency transactions, Canadian dollars are converted into U.S. dollars and vice versa. Sources: IMF Coordinated Portfolio Investment Survey, IMF Direction of Trade Statistics, BIS Triennial Central Bank Survey (2007), and own calculations.

and predict target rate decisions. Section 4 presents further specifications and robustness checks. Section 5 concludes.

2. Data and Econometric Methodology

Our analysis takes advantage of a new data set introduced by Hayo and Neuenkirch (2010a) that includes indicator variables for 119 speeches and congressional hearings, covering all members of the Governing Council, as well as 60 post-meeting statements and 32 monetary policy reports. The communications are sorted into two categories depending on whether they indicate likely increases or decreases in the BOC target rate. Communications that directly reference monetary policy are easily interpreted. For example, when the BOC states that *"we will need to continue to reduce monetary stimulus to avoid a buildup of inflationary pressures and to contribute to sustainable, solid economic growth"* (Governor David Dodge, September 20, 2004), a target rate hike is imminent. However, other statements are not so straightforward. For example, speeches stressing potential inflationary pressures or addressing an undervaluation of the Canadian dollar can be seen as indirect indications of a future rate hike; however, speeches presenting a bright economic outlook (in terms of GDP growth or positive employment news) can also be read as an indication of future rate hikes because in good economic times, the BOC needs to take steps to prevent the economy from overheating. Hayo and Neuenkirch (2010a) point out that the BOC typically does not talk extensively about rate cuts and thus a speech about a negative economic outlook can be a particularly useful indicator of this possibility.[5]

We employ a ternary variable for every communication event that takes the value +1 when the central bank leans toward a rate hike, 0 when the monetary policy will likely remain unchanged, and –1 when loose monetary policy is a strong possibility. We thus include information that refers either directly to the future course of monetary policy or indirectly via inflation pressures, an undervalued currency, or the economic outlook.[6] Our sample contains

[5] In a very few cases, a positive economic outlook coincides with a trend toward loose monetary policy or a pessimistic outlook is communicated together with tighter monetary policy. As the monetary policy stance is a more direct indicator of future target rate decisions, these rare cases are coded based on the information about the monetary policy stance.

[6] Our approach of restricting the coding to directional indications is generally in line with most extant literature (for an extensive literature overview, see Blinder et al., 2008). A few papers (e.g., Rosa and Verga, 2007), however, use a finer grid that is suggestive of magnitude of the inclination. Furthermore, there are several available indicators (unfortunately, however, not for the BOC) that attempt to assign a continuous spectrum to communication events, one example being the monetary policy communicator provided by the Swiss Economic Institute after every ECB post-meeting statement. However, a finer grid or a continuous indicator is difficult to construct out of communications other than the post-meeting statements. The former are not very standardized and thus content analysis software—which would be required for the construction of a finer grid—fails to detect finer systematical patterns in these communications.

60 target rate decisions. Sometimes, more than one communication event takes place in the period between BOC meetings and we thus need to construct an indicator that captures the monetary policy stance over the entire intermeeting period. For this purpose, we net out the instances of tighter and looser monetary policy inclinations and code the communication indicators accordingly.[7] If the number of positive and negative news events is the same or if no communication occurs during an intermeeting period, the variable is coded 0.

Our communication indicator is illustrated in Figures 1a–1c, where the BOC target rate is the black line and our communication indicators are symbolized by + (indicator suggests rate increase), ● (rate expected to be constant), and – (rate predicted to decrease).

Figure 1a: Bank of Canada Target Rate and Last Post-Meeting Statement

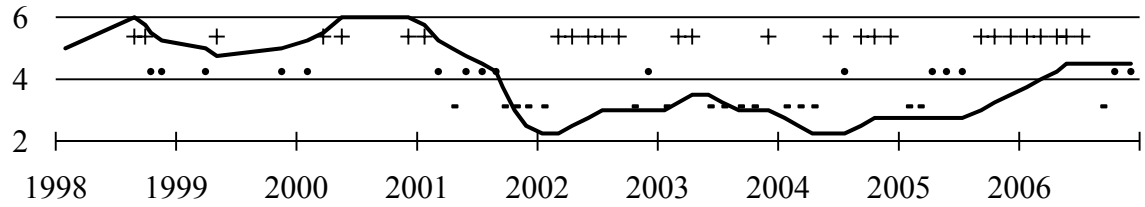


Figure 1b: Bank of Canada Target Rate and Monetary Policy Reports

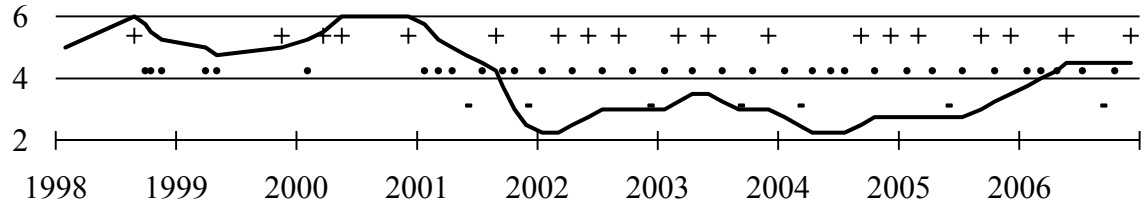
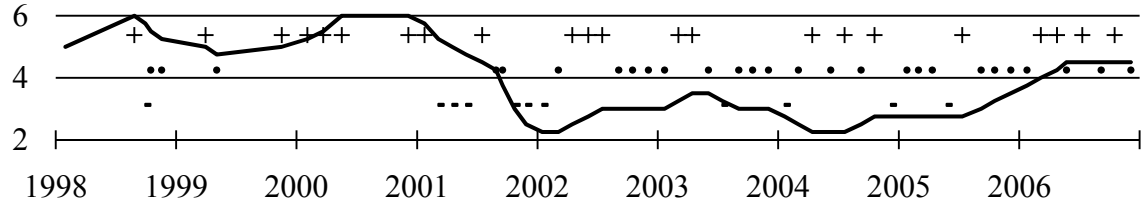


Figure 1c: Bank of Canada Target Rate and Speeches & Testimonies Indicator



We could also use a scale up to +2 (down to –2) when both monetary policy and economic outlook point in the same direction. As pointed out earlier, the BOC gradually increased the frequency and the content of its communication during our sample. So, a scaling up to +2 could distort the results as earlier speeches sometimes lack a monetary policy part. Furthermore, it is questionable whether an indication via both variables makes a rate change more likely. Finally, some preliminary estimations show that the +1/0/–1 coding approach is more appropriate.

[7] During the sample period, there are only two intermeeting periods with conflicting signals in BOC communication. Robustness tests show that results do not change when we explicitly control for the dispersion in communication. Furthermore, in our view, four indications of higher monetary policy, for example, do not result in a four-times-higher probability of a rate hike. Consequently, we use the +1/0/–1 scale and ensure the validity of our results with extensive robustness tests.

Compared with the actual target rate decisions, there is an upward bias in the data that is chiefly due to those communications expressing an overly optimistic economic outlook, as in times of unchanged monetary policy our indicator is sometimes positive (see Figure 1a). Jansen and de Haan (2009) and Hayo and Neuenkirch (2010b) find a similar phenomenon for the ECB and the Fed. Furthermore, we find that the BOC is very cautious about mentioning rate cuts. Only when a rate cut is truly imminent do the majority of speeches signal such a decision. In the intermeeting period before an increase of the target rate (19 target rate hikes), one or more types of communication mention such a possibility. At least one of these indicators turns negative or changes from positive to neutral when the BOC lowers its target rate at the next meeting (20 target rate cuts). Figures 1c and 1b show the low frequency of speeches and, in particular, monetary policy reports; there are many intermeeting periods during which no communication events occur.

Our econometric methodology employs a discrete choice variation of the interest rate setting rule proposed by Taylor (1993). We model the situation of financial agents who want to qualitatively predict[8] interest rate setting by the BOC. However, as the BOC publishes its macroeconomic forecasts only quarterly, agents have to form expectations about the BOC's internal estimates of the relevant macroeconomic variables. For this purpose, agents rely on several macroeconomic indicators that are publicly available before the time of the actual interest rate decision. Our Taylor rule incorporates the annualized monthly core CPI inflation rate (which excludes the more volatile food and energy components) as the BOC emphasizes the importance of this measure. The monthly unemployment rate is used to proxy real economic conditions (Curtis, 2005). As the BOC also focuses on the external value of the Canadian dollar in its mission statement (*low and stable inflation, a safe and secure currency, and financial stability*), we add to our equation the deviation of the monthly CAD/USD exchange rate from its long-run trend. To deal with potential endogeneity problems, we instrument all three variables by their respective lagged values.[9] Preliminary regressions show that our Taylor rule yields the best fit when including the forecasts of today's values. Actual unemployment and inflation figures are officially available only after a delay, i.e., figures for month t are published during the month t+1. Thus, the instrumented indicators are appropriate proxies of the figures forecast and used by the central bank as input in its interest rate

[8] In our definition, a "correct prediction" implies that the outcome to which the model assigned the highest probability is what actually occurred.

[9] Auxiliary regressions show that the first, eighth, ninth, and tenth lags of core CPI inflation rate, the first and third lags of the unemployment rate, and the first lag of the deviation of the CAD/USD exchange rate from its long-run trend are strong instruments. Tests for overidentification and weak instruments (Staiger and Stock, 1997) support this instrument choice.

decisions. To ensure stationarity of our variables (Hu and Phillips, 2004), we apply both the augmented Dickey-Fuller (1979) test and the KPSS test (Kwiatkowski et al., 1992). The results consistently show that the first differences of the core CPI inflation rate and the unemployment rate, as well as the CAD/USD gap,[10] are stationary (see Table A1 in the Appendix).[11]

Econometrically, we use an ordered probit model to account for the discrete nature of Canadian target rate decisions (Jansen and de Haan, 2009; Hayo and Neuenkirch, 2010b). Our specification is:

$$
\begin{aligned}
(1)\ Target\ Rate\ Decision_t^* &= \alpha_1 Target\ Rate\ Decision_{t-1} + \alpha_2 \Delta U.S.Target\ Rate_t \\
&+ \beta_1 \Delta Core\ CPI\ Inflation\ Rate_t + \beta_2 \Delta Unemployment\ Rate_t \\
&+ \beta_3 CAD/USD\ Gap_t + \gamma_1 Last\ Statement_t + \gamma_2 Monetary\ Policy\ Report_t \\
&+ \gamma_3 Speeches\ \&\ Testimony + \varepsilon_t
\end{aligned}
$$

where the dependent variable is the latent continuous variable representing the change in the BOC target rate at meeting t. Again, we use a ternary variable (+1 represents a rate hike; 0 an unchanged rate; –1 a rate cut) to describe the change in monetary policy.[12] Target rate changes occur only if the value of the index function is either below a lower unobserved threshold τ_1 or higher than an upper unobserved threshold τ_2.

Our Taylor rule incorporates three groups of explanatory variables. First, lagged target rate decisions are included to capture interest rate smoothing behavior (α_1).[13] The impact of changes in the federal funds target rate since the previous BOC meeting (in percentage points) is described by α_2 (see Figure A1 in the Appendix for a comparison of Canadian and U.S. target rates). Second, changes in the core CPI inflation rate (β_1), changes in the

[10] The CAD/USD gap is derived based on its trend, estimated by a Hodrick-Prescott filter (1997), for 1995–2008 (λ = 14,400). Other variations of the CAD/USD exchange rate or different proxies, such as the real exchange rate or the Canadian-dollar effective exchange rate index, perform substantially worse.

[11] In addition to avoiding any problems caused by undesirable time-series characteristics, the Taylor rule specification with core CPI and unemployment rate in first differences and the deviation of the CAD/USD from its long-run trend yields the best fit.

[12] During our sample period, the BOC raised or lowered the target rate once by 100 bps, once by 75 bps, five times by 50 bps, and 33 times by 25 bps. Instead of the ternary variable, we could use a septuplicate (+4/+2/+1/0/–1/–2/–3) variable to describe BOC behavior. However, our model does very well at describing whether rate changes occur, but it fails to precisely differentiate between small and large interest rate steps.

[13] We employ a lagged dependent variable rather than an autoregressive error specification (Rudebusch, 2002) based on results presented by Castelnuovo (2003). However, the interpretation of interest rate smoothing behavior is still a subject of debate (Rudebusch, 2006).

unemployment rate[14] (β_2), and the CAD/USD gap (β_3) capture real-time macroeconomic information.[15] Third, communication enters the equation via three variables: lagged post-meeting statements (γ_1), monetary policy reports (γ_2), and our communication indicator based on speeches and testimony (γ_3). The residuals ε_t are assumed to follow a standard normal distribution, which implies that the probabilities of the different outcomes can be written as:

$$\Pr[Target\ Rate\ Decision_t = -1|z_t] = \Phi(\tau_1 - z_t'\beta)$$

$$\Pr[Target\ Rate\ Decision_t = 0|z_t] = \Phi(\tau_2 - z_t'\beta) - \Phi(\tau_1 - z_t'\beta)$$

$$\Pr[Target\ Rate\ Decision_t = 1|z_t] = \Phi(\tau_2 - z_t'\beta)$$

where Φ denotes the cumulative standard normal distribution and z_t is our vector of explanatory variables. The ordered probit models are estimated by maximum likelihood (Maddala, 2006) and the threshold variables are obtained simultaneously with the vector of estimated coefficients on the explanatory variables β.

3. Explaining and Predicting BOC Target Rate Decisions with Communication

In this section, we present the results of our empirical estimations employing different specifications based on Equation (1). Column (1) of Table 1 shows the model based on Canadian macroeconomic news only, Column (2) incorporates BOC communication variables only, and Column (3) uses both types of information. Measured by the pseudo R^2, the joint model (Column (3)) has a slightly better fit than the macro model in Column (1), whereas the communication model (Column (2)) shows the smallest explanatory power.

Interest rate smoothing is evident in all three specifications, as lagged target rate decisions help explain current ones. In all specifications, there is a positive impact of movements in the U.S. federal funds rate since the last BOC meeting. The coefficients of changes in the core CPI inflation rate and the unemployment rate are significant in the Taylor rule model and they remain significant at a 10 percent level in the joint model. The CAD/USD gap is also significant in Models (2) and (3), with similar coefficients. An increasing core CPI inflation rate and a decreasing unemployment rate lead to higher interest rates as the BOC reacts either to contain inflationary pressures or to stabilize the business cycle, respectively. In

[14] We evaluated several other variables reflecting the economic conditions in Canada—monthly GDP and several variations of it, the IVEY purchasing manager index (available since December 2000), and the quarterly capacity utilization rate—but none of them performed as well in explaining target rate decisions.

[15] The use of the monetary conditions index and some variations of it did not reveal significant coefficients. The index was used by the BOC until the end of 2006 to guide monetary policy decisions. It was constructed as a weighted sum of the changes in the short-term interest rate (the 90-day commercial paper rate) and the exchange rate (as measured by the Canadian-dollar effective exchange rate index) from a given base period.

the case of an undervalued currency (with respect to its long-run trend), the BOC tightens monetary policy so as to strengthen the Canadian dollar. These results deviate somewhat from findings of Curtis (2005), Muscatelli et al. (1999), Fougere (2001), and Nikolsko-Rzhevskyy (2008) as in each of those studies at least one macroeconomic variable is not significant.

Table 1: Explaining Bank of Canada Target Rate Decisions with BOC Communication

	(1)		(2)		(3)	
	Taylor Rule		**Communication**		**Joint Model**	
Last Rate Decision	1.48	***	1.09	***	1.52	***
U.S. Rate Change	6.48	***	4.45	***	6.79	***
Δ(Core CPI Inflation Rate)	1.58	**	---		1.72	*
Δ(Unemployment Rate)	–2.09	**	---		–1.88	*
CAD/USD Gap	0.24	***	---		0.23	***
Last Statement	---		0.56	**	0.20	
Monetary Policy Reports	---		0.13		0.19	
Speeches & Testimony	---		0.74	**	0.77	**
Lower Cut Point	–0.77	**	–0.90	***	–0.80	**
Upper Cut Point	1.98	***	1.91	***	2.66	***
LR Statistic	43.94	***	30.93	***	40.14	***
Pseudo Log-Likelihood	–26.50		–28.35		–23.82	
Pseudo R^2	0.60		0.57		0.64	
Overidentifying Restrictions	5.07		---		3.48	
Correct Predictions	48/60		48/60		48/60	

Notes: */**/*** denote significance at the 10/5/1 percent level. Huber (1967)/White (1980) robust standard errors are used.

Monetary policy reports are insignificant in both the communication and the joint model, which reflects the low frequency of this type of communication (26 nonzero observations). Previous statements, as well as speeches and testimony, significantly explain target rate decisions in Model (2), whereas the former become insignificant in Model (3), indicating collinearity with the macroeconomic variables. Our communication indicators significantly contribute to the explanation of interest rate decisions as a statistical test shows that these are jointly significant in Models (1) ($Chi^2(3) = 12.91$***) and (3) ($Chi^2(3) = 6.30$*). Furthermore, statements and monetary policy reports cannot be excluded jointly from Model (3) ($Chi^2(2) = 5.02$*).[16] Table 1 also shows that all three models correctly explain target rate decisions (48 out of 60 decisions). Given the relatively low frequency of Canadian central bank communication, it does not appear to contain any information additional to that included in macroeconomic variables. The opposite phenomenon can be found in the case of the U.S.

[16] When excluding one of these variables from Model (3), the other variable remains insignificant.

Federal Reserve, where the more frequent central bank communication dominates the information content of inflation expectations and the output gap (Hayo and Neuenkirch, 2010b).

Table 2 shows the average marginal effects.[17]

Table 2: Average Marginal Effects for Models (1)–(3)

	Prob[Rate Cut]	Prob[No Change]	Prob[Rate Hike]
(1) Taylor Rule			
Last Rate Decision	–0.14 ***	–0.07 ***	0.21 ***
U.S. Rate Change	–0.60 ***	–0.42 ***	1.02 ***
Δ(Core CPI Inflation Rate)	–0.15 **	–0.10 **	0.25 **
Δ(Unemployment Rate)	0.19 **	0.14 **	–0.33 **
CAD/USD Gap	–0.02 ***	–0.02 ***	0.04 ***
(2) Communication Model			
Last Rate Decision	–0.13 ***	–0.02 **	0.15 ***
U.S. Rate Change	–0.54 ***	–0.08	0.62 ***
Last Statement	–0.07 **	–0.01 *	0.08 **
Monetary Policy Reports	–0.02	0.00	0.02
Speeches & Testimony	–0.09 **	–0.01 **	0.10 ***
(3) Joint Model			
Last Rate Decision	–0.14 ***	–0.04 **	0.18 ***
U.S. Rate Change	–0.63 ***	–0.23 *	0.86 ***
Δ(Core CPI Inflation Rate)	–0.16 *	–0.06	0.22 *
Δ(Unemployment Rate)	0.17 *	0.06	–0.24 *
CAD/USD Gap	–0.02 ***	–0.01	0.03 ***
Last Statement	–0.02	–0.01	0.03
Monetary Policy Reports	–0.02	–0.01	0.02
Speeches & Testimony	–0.07 *	–0.03 ***	0.10 **

Notes: The figures show the average of marginal effects over all observations. */**/*** denote significance at the 10/5/1 percent level.

In the Taylor rule specification of Model (1), a one-point higher value for the last target rate decision[18] increases (decreases) the probability of a hike (cut) today by 21 (14) percentage points (pp). A 1 pp change in the U.S. target rate during the intermeeting period exerts a large influence on today's rate decision (–60 pp for cuts; +102 for hikes). A 1 pp higher core CPI inflation rate raises (lowers) the chance of a rate hike (cut) by 25 (15) pp. If

[17] For simplicity and to conserve space, we focus on the impact on target rate cuts and target rate hikes in the discussion.

[18] That is, either no change in the target rate instead of a rate cut or a rate hike instead of an unchanged target rate.

the unemployment rate goes up by 1 pp, a rate hike (cut) is less (more) likely by 33 (19) pp. Finally, a 1 percent undervaluation of the Canadian dollar with respect to its long-run trend raises (reduces) the probability of a rate hike (cut) by 4 (2) pp. When using only communication variables to explain BOC decisions, the importance of interest rate smoothing decreases (–13 pp for rate cuts; +15 for rate hikes), as does that of U.S. influence (–54 for cuts; +62 for hikes). Some information in the lagged rate decisions is captured by the influence of lagged post-meeting statements. A one-point change in the last statement causes a rate cut (hike) to be less (more) likely by 7 (8) pp. The speeches and testimony indicator affects the probability of target rate movements in a similar way (–9 pp for rate cuts; +10 for rate hikes). In the joint model, lagged Canadian and U.S. target rate decisions significantly influence the probabilities of all three categories. The average marginal effects of speeches and testimony as well as those of statements become less significant and insignificant, respectively.

Due to unavailability of appropriate data, we cannot study the out-of-sample performance of the models. However, to approximate an out-of-sample assessment, we re-estimate Models (1)–(3) initially for the subsample 1998–2003 and predict target rate decisions for the remaining period using a recursive window of out-of-sample forecasts that requires re-estimating the model after every period.[19] Table 3 shows that the predictive ability of the Taylor-rule-based Model (1) is the best, as 18 out of 24 interest rate decisions are correctly anticipated. For instance, all hikes are correctly predicted, whereas Models (2) and (3) fail to forecast two hikes.

Table 3: Approximating Out-of-Sample Predictions Using Recursive-Window Estimations

	(1)	**(2)**	**(3)**
	Taylor Rule	**Communication**	**Joint Model**
Target Rate Cuts	2 / 3	2 / 3	2 / 3
No Change in Target Rate	7 / 12	7 / 12	7 / 12
Target Rate Hikes	9 / 9	7 / 9	7 / 9
All Rate Decisions	18 / 24	16 / 24	16 / 24

Notes: The initialization period is 1998–2003 (36 rate decisions) and parameters are updated every period throughout the remaining sample period 2004–2006 (24 rate decisions).

Instead of using recursive-window estimations that update parameters in every period, we can test temporal stability by estimating parameters over the period 1998–2003 and then

[19] We start by estimating each model using the first 36 observations and then evaluate whether the model correctly predicts the interest rate decision at t = 37. Next, we re-estimate the models using the first 37 observations and predict the outcome at t = 38, and so on.

using the resulting models to derive predictions by plugging in values for the relevant variables in each period. Table 4 shows that the communication model (Model (2)) performs best when holding coefficients constant, whereas the other two models, especially Model (3), deteriorate in predictive ability.

Table 4: Approximating Out-of-Sample Predictions Using a Fixed Estimation Period

	(1)	**(2)**	**(3)**
	Taylor Rule	**Communication**	**Joint Model**
Target Rate Cuts	2 / 3	2 / 3	2 / 3
No Change in Target Rate	5 / 12	8 / 12	4 / 12
Target Rate Hikes	9 / 9	7 / 9	7 / 9
All Rate Decisions	16 / 24	17 / 24	13 / 24

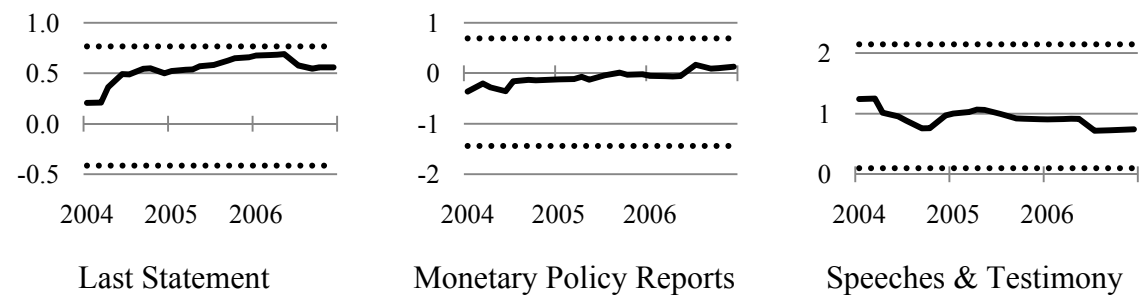
Notes: The initialization period is 1998–2003 (36 rate decisions) and the out-of-sample period is 2003–2006 (24 rate decisions).

Testing parameter instability using Chow-type tests at a 5 percent confidence level (see Figure 2) does not permit rejecting constancy in the case of the Taylor rule model (Model (1)) or the communication model (Model (2)). These results suggest that both models are robust and reliable devices for predicting BOC target rate decisions, even out of sample.

Figure 2: Parameter Stability of Models (1) and (2)

(1) Taylor Rule Model

(2) Communication Model



Notes: Parameter estimates based on one-step updating over the period 2004–2006 and 95 percent confidence bands based on coefficient estimates from the subsample 1998–2003.

4. Further Results and Robustness Tests

We have shown that Canadian central bank communication is as useful as standard macroeconomic variables in explaining target rate decisions. Yet, as stated in the introduction, there was a significant break in central bank decision making, which could (de-)emphasize the importance of communication. To assess the impact of organizational change on central bank decision making, we test whether introduction of FAD induced a significant break in the impact of central bank communication (see Table 5).

Table 5: Influence of FAD System on Target Rate Change Explaining Ability

	(4)	**(5)**	**(6)**
Last Rate Decision	1.62 ***	1.48 ***	1.76 ***
U.S. Rate Change	6.84 ***	6.93 ***	6.85 ***
Δ(Core CPI Inflation Rate)	1.72	1.77 *	2.30 **
Δ(Unemployment Rate)	–1.84 *	–1.86	–1.98 *
CAD/USD Gap	0.22 ***	0.24 ***	0.27 ***
Last Statement	---	0.20	0.23
…before FAD	–0.55	---	---
…FAD	0.34	---	---
Monetary Policy Reports	0.23	---	0.10
…before FAD	---	7.79 ***	---
…FAD	---	0.10	---
Speeches & Testimony	0.77 **	0.69 *	---
…before FAD	---	---	1.92 *
…FAD	---	---	0.44
Lower Cut Point	–0.97 ***	–0.78 **	–0.79 **
Upper Cut Point	2.75 ***	2.65 ***	2.76 ***
LR Statistic	85.57 ***	85.56 ***	87.01 ***
Pseudo Log-Likelihood	–23.08	–23.09	–22.36
Pseudo R^2	0.65	0.65	0.66
Overidentifying Restrictions	3.14	4.27	3.87
Correct Predictions	48/60	48/60	49/60

Notes: */**/*** denote significance at the 10/5/1 % level. Huber/White robust standard errors are used.

Before December 2000, target rate changes could occur on any business day and often replicated a Fed decision taken the day before.[20] Thereafter, the BOC committed itself to a pre-defined schedule of eight meetings a year, with only one exception—the rate cut on September 17, 2001 following the market depressing incidents on 9/11. As there are only 60 observations, our model fails to converge when we split all three communication variables at

[20] In 7 out of 10 decisions, the BOC directly refers to a U.S. decision.

the same time.[21] Splitting the post-meeting statements (Model (4)) reveals no significant impact of this type of communication during either subsample, thus confirming the results obtained by Model (3), where the coefficient is also insignificant.

Model (5) shows that monetary policy reports have a large impact before the FAD system was implemented. After the FAD was introduced, their impact is similar to the one in Model (3) and the difference between pre-FAD and FAD coefficients is statistically significant ($Chi^2(1) = 229$***). Thus, in the absence of a regular meeting schedule, even the infrequent monetary policy report (semi-annual in 1998–1999, quarterly in 2000) helps explain target rate decisions. Speeches, too, are more important in the period prior to FAD and insignificant thereafter. However, we do not find a statistically significant difference ($Chi^2(1) = 1.93$). To conclude, BOC communication significantly improves explanation of target rate changes in the period prior to FAD, whereas in the FAD subsample, the impact is insignificant.

It appears that before the FAD system was implemented, communication variables provide some indication that a policy action is imminent. Thus, to some extent the fixed schedule of policy decisions obviates the need for clear and frequent communication by the central bank. To support this hypothesis, we enlarge our data set by hypothetical announcement days before the introduction of the FAD. In the pre-FAD period, in 7 out of 10 instances, the BOC mimics the Fed's changes one day after a U.S. decision. Thus, we use the day after the scheduled U.S. decisions as a proxy for possible Canadian interest rate decision days (16 additional decision days) during the pre-FAD period. Lagged Canadian and U.S. interest rate decisions, the communication indicators, and the macroeconomic variables are re-coded according to this new set of interest rate decision days. Re-estimating Models (1)–(3) (see Table A3 in the Appendix) shows that the communication variables remain significant, whereas some of the macroeconomic indicators become insignificant. These results are driven by the pre-FAD period where communication is a good predictor of the next interest rate decision, i.e., there is communication when a rate change is imminent and there is no communication when the BOC has decided to leave its target rate unchanged.

Next, we focus on the question of whether U.S. variables improve the explanatory power of our model. Regardless of whether the BOC attempts to act independently of the Fed, Canada is closely integrated in real and financial terms with the United States, and the Canadian economy very much depends on the economic situation in its large neighboring economy. Therefore, U.S. news could be important in explaining interest rate decisions in

[21] Neither is it possible to create interaction dummies capturing the decreasing impact of communication post-FAD.

Canada. Models (1)–(6) of Tables 1 and 5 show that federal funds target rate movements, which occur in the period between two meetings, significantly and robustly explain BOC rate decisions. In Table 6, we analyze whether other U.S. variables, such as macroeconomic news and Fed communication, provide additional explanatory power. Accordingly, we add U.S. macroeconomic news and a Fed communication indicator to Equation (1).[22]

Table 6: Influence of U.S. Variables on Target Rate Change Explaining Ability

	(7)	**(8)**
Last Rate Decision	1.85 ***	1.75 ***
U.S. Rate Change	5.58 ***	5.23 ***
Δ(Core CPI Inflation Rate)	1.84 *	1.82 **
Δ(Unemployment Rate)	–2.02 *	–2.43 **
CAD/USD Gap	0.26 ***	0.30 ***
Last Statement	0.08	---
Monetary Policy Reports	0.26	---
Speeches & Testimony	0.61	---
Δ(U.S. Inflation Expectations)	0.77	---
U.S. ISM Gap	0.01	---
U.S. Communication Indicator	0.62	1.01 *
Lower Cut Point	–0.51	–0.26
Upper Cut Point	3.19 ***	2.98 ***
LR Statistic	87.20 ***	83.06 ***
Pseudo Log-Likelihood	–22.27	–24.34
Pseudo R^2	0.66	0.63
Overidentifying Restrictions	6.44	6.37
Correct Predictions	48/60	51/60

Notes: */**/*** denote significance at the 10/5/1 % level. Huber/White robust standard errors are used.

U.S. macroeconomic variables and Fed communications are insignificant in Model (7) and provide no additional explanatory power. There is collinearity between U.S. and Canadian variables, as Canadian speeches and testimony are now insignificant and Canadian macroeconomic variables are less significant. Model (8) is the final model obtained from a general-to-specific testing-down process of Model (7).[23]

The U.S. communication indicator is the only communication variable to survive the testing-down process and it significantly explains Canadian interest rate decisions. Model (8) correctly explains 51 out of 60 BOC target rate decisions. Even though U.S. and Canadian

[22] The U.S. macroeconomic and Fed communication variables are obtained from Hayo and Neuenkirch (2010b).
[23] Although showing an insignificant t-test statistic, the U.S. communication indicator cannot be excluded from Model (7) as one of a group of six insignificant variables ($Chi^2(6) = 10.92$*). However, the other five variables can be excluded ($Chi^2(5) = 6.94$).

monetary policy are not always synchronized (see Figure A1, particularly the years 2002–2004), the much more frequent U.S. communication better anticipates upcoming Canadian rate decisions than do models incorporating only Canadian variables. This additional explanatory power of Fed communications cannot be traced back directly to the interconnectedness of both economies (i.e., U.S. economic conditions) inasmuch as this is captured by the ISM gap and the change in U.S. inflation expectations, which are both insignificant.

However, developments in U.S. monetary policy play an important role in several ways. Actual Fed target rate changes directly influence the interest rate path of the BOC, but Fed interest rate setting also exerts an indirect influence via the CAD/USD exchange rate. A Fed decision to tighten its monetary policy puts pressure on the CAD/USD exchange rate. Since the BOC puts a significant weight on the external value of the Canadian dollar in its interest rate decisions, it reacts to a change in exchange rates. Thus, the U.S. communication indicator—which measures the inclination of the future course of U.S. monetary policy—not only signals U.S. changes but, via the exchange rate channel, also Canadian interest rate changes.

Based on a benchmark Taylor rule, Hayo and Neuenkirch (2010b) find that communication can improve the accuracy of forecasts in the case of the Fed. While monthly data on output and inflation expectations are adjusted on pre-scheduled dates, informal communication can be employed in a more timely manner and can be based on a broader range of indicators. The BOC communicates very infrequently with the public compared to the Fed (see Figure A2 in the Appendix for a comparison of Canadian and U.S. communication days). However, Fed communication, which is much more frequent, influences Canadian monetary policy. Our results suggest that if the BOC is interested in increasing the predictability of its monetary policy decisions, it should communicate more frequently with the private sector.

5. Conclusions

In this paper, we explain BOC target rate decisions by means of macroeconomic variables as well as with various forms of BOC and Fed communication. We focus on the question of whether BOC communication contains information additional to that already incorporated in a real-time Taylor rule. The communication indicator is derived from post-meeting statements and the quarterly (semi-annual) monetary policy report, as well as from the content of speeches and congressional hearings by Governing Council members. Econometrically, we

use an ordered probit model to take into account the discrete nature of target rate decisions. The sample starts January 30, 1998 and ends December 5, 2006, covering 60 target rate decisions and a period characterized by increasing transparency in Canadian monetary policy. Our communication indicator summarizes the communication that takes place in the period between BOC meetings and is based on a data set constructed by Hayo and Neuenkirch (2010a). Changes in the core CPI inflation rate, the unemployment rate, and deviation of the CAD/USD rate from its long-run trend are employed as macroeconomic variables.

First, the communication variables provide a significant and robust explanation of the BOC's target rate decisions. Including the communication indicator helps explain the same number of target rate decisions as does a Taylor rule or a model incorporating both types of news (48 out of 60). Regarding the different types of communication, speeches and testimony, as well as post-meeting statements, contain more explanatory power than the less frequent monetary policy reports.

Second, the communication variables generate only slightly less accurate one-step-ahead forecasts than the model using only macroeconomic variables: the outcome of 16 out of 24 BOC meetings over the period 2004–2006 (in comparison to 18 out of 24) is correctly predicted. Using a fixed estimation period, the communication model slightly outperforms the macro model (17/24 vs. 16/24). In addition, the coefficients of both models appear to be stable over time.

Third, communication (monetary policy reports, speeches and testimony) is very useful for predicting target rate changes in the period prior to implementation of the fixed announcement days (FAD) system but is less useful thereafter. The more formalized and regular type of communication, post-meeting statements, has no significant impact in either subsample. We interpret the findings as an indication that in the pre-FAD regime communication variables worked as a signal that a policy action is imminent. The fixed schedule of policy decisions obviates the need for such a signal. Therefore, under the FAD system, regularly monitoring macroeconomic news appears to be more helpful in predicting target rate decisions than does relying on official communications by the BOC.

Fourth, including U.S. variables other than federal funds target rate changes reveals at least two interesting insights. In a model with Canadian macroeconomic news and the U.S. communication indicator, the latter (i) significantly explains Canadian interest rate decisions and (ii) improves the model's fit (51 out of 60 decisions are explained correctly) over a model using only Canadian variables.

The results of our study suggest that BOC communication, particularly in its more informal guise, such as speeches by BOC members, contains useful information about future monetary policy. However, agents could predict Canadian rate decisions with the same degree of accuracy by monitoring macroeconomic developments in Canada. Furthermore, even though U.S. and Canadian monetary policy are not always synchronized, the much more frequent U.S. communication provides a better indication of upcoming Canadian rate decisions than do models relying only on Canadian variables. Therefore, if the BOC is interested in improving the predictability of its policy decisions, our analysis suggest that it should consider following the Fed in terms of increasing the number of communications it makes to the public. A higher frequency of central bank communications results in a more timely and accurate flow of information and better ensures that private markets are able to form precise expectations of interest rate decisions.

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Appendix

Table A1: Unit Root Tests

	ADF	ADF w/ Trend	KPSS	KPSS w/ Trend
Unemployment Rate	–1.72	–2.1	0.57 **	0.15 **
Δ(Unemployment Rate)	–7.59 ***	–7.52 ***	0.12	0.12
Core CPI Inflation Rate	–2.47	–2.44	0.17	0.17 **
Δ(Core CPI Inflation Rate)	–8.69 ***	–8.62 ***	0.08	0.08
CAD/USD Gap	–3.51 **	–3.49 *	0.13	0.07

Notes: The ADF test assumes a unit root under the null hypothesis. The KPSS test assumes that the series is stationary under the null hypothesis. The number of lags (0 in all cases) for the ADF test is selected on the basis of the Schwartz criterion. All test equations contain a constant. */**/*** denote significance at the 10/5/1 percent level.

Table A2: Descriptive Statistics

	Mean	Median	Max.	Min.	Std. Dev.	–1	0	1
Canadian Rate Decisions	–0.02	---	---	---	0.81	20	21	19
U.S. Rate Decisions	–0.004	0	0.75	–1.00	0.30	---	---	---
Δ(Core CPI Inflation Rate)	0.01	0.06	0.61	–0.64	0.25	---	---	---
Δ(Unemployment Rate)	–0.04	–0.04	0.55	–0.92	0.22	---	---	---
CAD/USD Gap	0.39	0.50	7.66	–6.75	3.01	---	---	---
Statements	0.17	---	---	---	0.85	17	16	27
Monetary Policy Reports	0.20	---	---	---	0.63	7	34	19
Speeches & Testimony	0.18	---	---	---	0.73	11	27	22
Δ(U.S. Inflation Expectations)	0.01	0	1.40	–2.40	0.50	---	---	---
U.S. ISM Gap	–1.43	–0.87	10.04	–19.23	7.07	---	---	---
U.S. Comm. Indicator	0.57	---	---	---	0.789	15	13	32

Figure A1: Bank of Canada Target Rate vs. Federal Funds Target Rate

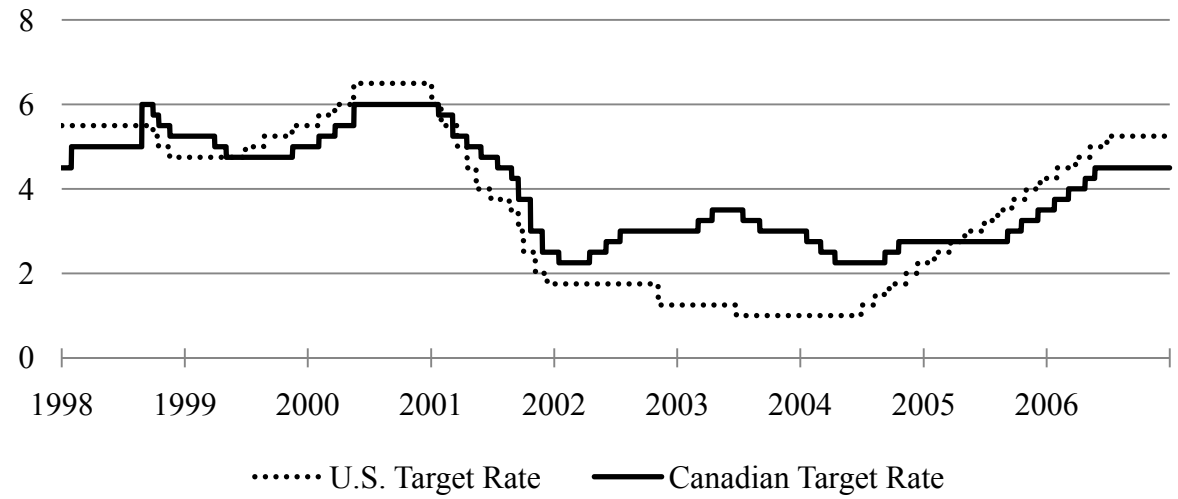

Table A3: Explaining Bank of Canada Target Rate Decisions (Augmented Data Set)

	(1')		(2')		(3')	
	Taylor Rule		**Communication**		**Joint Model**	
Last Rate Decision	1.17	***	0.82	***	0.99	***
U.S. Rate Change	6.21	***	4.71	***	5.80	***
Δ(Core CPI Inflation Rate)	0.82		---		0.55	
Δ(Unemployment Rate)	–1.13		---		–0.67	
CAD/USD Gap	0.19	***	---		0.14	***
Last Statement	---		0.60	**	0.39	
Monetary Policy Reports	---		0.17		0.17	
Speeches & Testimony	---		0.68	**	0.63	*
Lower Cut Point	–1.10	***	–1.02	***	–0.98	***
Upper Cut Point	1.70	***	1.86	***	2.03	***
LR Statistic	53.05	***	32.74	***	40.12	***
Pseudo Log-Likelihood	–39.67		–38.39		–35.97	
Pseudo R^2	0.50		0.52		0.55	
Overidentifying Restrictions	3.19		---		1.99	
Correct Predictions	57/76		62/76		61/76	

Notes: Models (1)–(3) are re-estimated after enlarging the data set by hypothetical announcement days before December 2000. */**/*** denote significance at the 10/5/1 percent level. Huber (1967)/White (1980) robust standard errors are used.

Figure A2: Canadian Communication Days vs. U.S. Communication Days