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Understanding Monetary Policy and its Effects: Evidence from Canadian Firms Using the Business Outlook Survey

Abstract

Using real time data, we show that the monetary policy rule in Canada is better described by a Taylor rule augmented with business sentiment which is captured in survey data. Stronger survey results are correlated with a significantly higher policy rate over the period of study (2001–18). Taylor rules including a measure of business sentiment have significantly better predictive accuracy. Using these modified Taylor rules in vector autoregressions and data from the Bank of Canada's quarterly Business Outlook Survey, we study the impact of monetary policy on firms' expectations of sales and prices, financing conditions and investment decisions. Given our short sample, we focus on estimates of firms' responses to monetary shocks obtained by local projections (Jordà 2005). A 100-basis-point shock in the Bank's target rate leads firms to expect significantly lower sales and slower output price growth, report tighter credit conditions and lower investment intentions. Results are robust to using Champagne and Sekkel's (2018) new monetary policy measure.

JEL-Codes: D220, E520, E440.

Keywords: firm dynamics, transmission of monetary policy, interest rates.

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"The Business Outlook Survey…is an important complement to the other material that the [Monetary Policy Review Committee] and the Governing Council rely on and serves as a 'reality check' on regional economic developments."

John Murray, Bank of Canada Review, Autumn 2013

1. Introduction

The Taylor rule (Taylor 1993) is a simple, intuitive and stylized way to represent monetary policy. While observers have documented that actual policy rates in many advanced economies have deviated importantly from the Taylor Rule (TR) starting in the early 2000s (Taylor 2013), policy rates in Canada have remained relatively close to those predicted by a TR. Projection models at the Bank of Canada (the Bank henceforth) use a TR to model the Bank's reaction function (Gervais and Gosselin 2014; Dorich et al. 2013).

However, a central bank's information set is broader than the output and inflation gaps when deciding on the level of the policy rate. For instance, the Bank relies on insights from the *Business Outlook Survey* (BOS), a quarterly survey of Canadian businesses compiled by the Bank's regional offices (Murray 2013). Business survey data are a useful source of complementary information for monetary policy-makers because they can provide reliable and timely measures of economic conditions (compared to national accounts data for example, which are published with a lag).

In this paper, we first study the extent to which the monetary policy rule in Canada is better described by TR augmented with business sentiment. We estimate TR on Canadian data in real-time (Orphanides 2001) to mimic the information set available to the Bank's Governing Council at the time of the interest rate decision. The Bank's predicted target rate increases with both output and inflation gaps. We then add a measure of business sentiment captured by survey data to the TR to test whether it matters for monetary policy. Our measure of business sentiment is either the BOS indicator or the Index of Business Confidence (IBC) from the Conference Board of Canada.[1] We find that the monetary policy rule is consistently better approximated by TR augmented with business sentiment. Stronger (weaker) survey results are correlated with a significantly higher (lower) policy rate over the period of study (2001–18). Moreover, TR including a measure of business sentiment have significantly better

[1] The BOS indicator is a measure of business sentiment derived from a principal component analysis of the *Business Outlook Survey* results (Pichette 2012, Pichette and Rennison 2011, and Pichette and Robitaille 2017). The Index of Business Confidence is a simple average of major survey questions in the Conference Board of Canada's business confidence survey, see appendix A.

predictive accuracy. This is true for both conventional (i.e., backward-looking) and forward-looking TR.

Second, we use BOS data to study how monetary policy affects firms' expectations of sales and prices, financing conditions and investment decisions. Our baseline model is a recursive vector autoregression (VAR) with a TR *à la* Stock et Watson (2001). The TR includes a measure of business sentiment, the IBC. The interest rate variable is the overnight rate targeted by the Bank. As a robustness analysis, we use Champagne and Sekkel's (2018, C&S henceforth) new monetary policy measure for Canada as the policy rate. This new monetary policy measure builds on Romer and Romer (2004) and Cloyne and Hürtgen's (2016) narrative approach. Given our short sample (2001Q1-2018Q1) and limited degrees of freedom, we focus on the estimates of firms' responses to a monetary shock obtained by local projections (Jordà 2005). Following a 100-basis-point shock in the Bank's target rate, firms expect significantly lower sales and slower output price growth, report lower investment intentions and tighter credit conditions. Results are robust to applying the same shock from C&S new shock measure. These results are intuitive and agree with the effects of monetary policy described in the literature (Christiano et al. 1999).

The contributions to the literature are twofold. First, to our knowledge, this paper is the first to demonstrate empirically that survey data provides a better approximation of the monetary policy rule. Our research therefore contributes to the literature on extensions of Taylor rules in a unique way (Ball 1999; Svensson 2000; Käfer 2014). The second innovation of the paper is to shed light on the impact of monetary policy on firms' expectations of sales and prices, financing conditions and investment decisions using business survey data. While several papers have used survey data on bank lending conditions to study the effects of monetary policy on banks,[2] research on how monetary policy affects firms' is, at best, limited (Ehrmann 2004).

The rest of the paper is structured as follows: Section 2 describes the survey data with a focus on the BOS. Section 3 underscores the importance of estimating a TR in real time, describes different versions of the TR, and presents results regarding the relevance of survey data for monetary policy decisions. Section 4 presents our baseline model, a recursive VAR, and estimates of the effects of monetary policy on firms' expectations of business conditions, financing conditions and investment

[2] See Kashyap and Stein (2000) for an example using US data, and Maddaloni and Peydró (2011) for an example with European data.

decisions. The section focuses on results obtained by local projections given our small sample size. Finally, section 5 concludes.

2. The Survey Data

Since the autumn of 1997, the Bank's regional offices have conducted quarterly interviews with firm representatives who are at the most senior levels of their organizations, namely the *Business Outlook Survey* (BOS).[3] These interviews are structured around a survey questionnaire. Responses to qualitative questions are used to provide insights on specific macroeconomic variables. The BOS provides the Bank with valuable and timely information and is a one of the key inputs into the monetary policy decision process (Murray 2013). Information published in the BOS precedes national accounts data releases and individual BOS questions correlate reasonably well with first-released estimates of macroeconomic data, with peak correlations often in lead quarters (Table 1).[4] For example, Indicators of future sales have proven to be one of the most informative BOS question, with a one-quarter-ahead peak correlation of 86% with first-released estimates of real GDP growth.

To add business sentiment to the TR, we use a statistical summary measure of the information contained in the BOS, namely the BOS indicator. As a robustness analysis, we also use the Index of Business Confidence (IBC) from the Conference Board of Canada's quarterly business confidence survey (Figure 1).[5] Using a second measure of business sentiment serves as a robustness check to evaluate whether it is the BOS itself, or business sentiment more generally, that matters for monetary policy.

Moreover, the BOS offers a unique opportunity to study how monetary policy affects firms'. The analysis of the effects of monetary policy on firms covers the 2001Q1 to 2018Q1 period and four main survey questions: (i) expectations of future sales (indicators of future sales), (ii) credit conditions, (iii) investment intentions, and (iv) expected output price growth (output prices).[6] Figure 2 shows that these BOS variables tend to lead the Canadian business cycle.

[3] Survey respondents are typically the chief executive officer, president, chief financial officer, chief operating officer or treasurer.

[4] Pichette and Robitaille (2017) find that BOS variables significantly improve the forecasts of real GDP and investment growth. In real time, BOS variables are found to produce better nowcasts of first-released data.

[5] Table A1 shows the BOS questions used to form the BOS indicator. The IBC is a composite indicator of three survey questions; see appendix A.

[6] Analysis starts in 2001 only because not all survey variables are available from 1997. See Appendix A for more details on BOS questions.

3. The (augmented) Monetary Policy Rule

This section presents the estimation framework and results for several versions of the TR.

3.1. Taylor rule in real time

The literature has argued that policy decisions should be analyzed in real time, i.e., using information that was available at the time the policy decision was made (Orphanides 2001; Croushore 2011). As is well known, data (and nowcasts or forecasts) can be substantially revised from initial estimates and policy-makers may have made different policy decisions had they had access to the latest vintage of data. We therefore use the Bank's nowcasts of the output gap when estimating conventional TR (i.e., backward-looking; Taylor 1993), and real-time forecasts of inflation and the output gap when estimating forward-looking TR. We follow Koenig et al.'s (2003) approach for the estimation in real time.[7] This implies estimating one regression using what Koenig et al. call *"real-time-vintage"* estimates of the output gap (and of forecasts of core inflation and the output gap in forward-looking TR).[8]

Specifically, we estimate conventional (1) and forward-looking (2)[9] versions of the TR that include an interest-smoothing term:[10]

$$i_t = c + \Theta_i i_{t-1} + \Theta_\pi(\pi_{t-1} - \pi^*) + \Theta_y \hat{y}_t + \gamma' * Z_t + \varepsilon_t \quad (1)$$

$$i_t = c + \Theta_i i_{t-1} + \Theta_\pi(\hat{\pi}_{t+2} - \pi^*) + \Theta_y \hat{y}_{t+2} + \gamma' * Z_t + \varepsilon_t, \quad (2)$$

where i_t is the overnight rate (i.e., the Bank's key policy rate), $\hat{y}_t$ is the nowcast of the output gap, and the term $(\pi_{t-1} - \pi^*)$ denotes the difference between last quarter's inflation and the target inflation rate. In (2), $\hat{\pi}_{t+2}$ and $\hat{y}_{t+2}$ denote the two-quarters-ahead forecasts of core inflation and the output gap, respectively. Θ_i is the interest-rate-smoothing term. The parameters Θ_π and Θ_y are the

[7] An alternative method common in the literature is an approach pioneered in Stark and Croushore (2002), which amounts to rolling regressions. Each regression uses data on inflation and the output gap available at each point in time (i.e., each vintage of data produces one set of parameters for the TR). Results using this approach are similar and can be found in Appendix B (Figures B1 to B3).

[8] Koenig et al.'s (2003) approach to estimating unbiased parameters rests on the following assumption: "revisions to the first-release left-side data […] are unpredictable using data available at the time it is issued." This is trivially true for the overnight rate which is never revised.

[9] Because monetary policy affects output and inflation with a lag, the literature has put forth forward-looking versions of TRs. A comprehensive overview of the design of forward-looking TRs is presented in Rudebusch and Svensson (1999), Batini and Haldane (1999), and Galí (2015), for instance.

[10] The literature provides evidence for interest rate smoothing in explaining the federal funds rate. (e.g., Clarida et al. 1998, 1999 and 2000, Coibion and Gorodnichenko 2012).

sensitivities of the overnight rate to the deviation of inflation from the target and to the output gap, respectively. Z_t is a vector containing the per cent change in the Bank's commodity price index (BCPI) and the nominal USD/CAD exchange rate at date *t*, and *γ'* is a vector of parameters. ε_t is the error term.

In practice, central banks do not follow a TR in a mechanical way, and researchers have augmented the TR with variables such as the exchange rate (Ball 1999; Svensson 2000; Markov and Nitschka 2013). We contribute to this literature by augmenting the TR with a measure of business sentiment, e.g., the BOS indicator. For example, (1) becomes:

$$i_t = c + \Theta_i i_{t-1} + \Theta_\pi(\pi_{t-1} - \pi^*) + \Theta_y \hat{y}_t + \gamma' * Z_t + \Theta_{BOS} BOS_{t-1} + \varepsilon_t \qquad (3)$$

We include the BOS indicator lagged by one quarter because the BOS is published during the first week following the quarter during which it was conducted (e.g., the BOS for 2018Q1, referred to as the spring survey, was published on April 9, 2018, i.e., in 2018Q2).[11]

3.2. Results

The estimated coefficients (Table 2) are in line with their expected signs. Monetary policy tends to tighten in response to positive output and inflation gaps: coefficients are positive and significant at conventional levels. This is true in both a conventional TR (column 1 and equation 1), and in forward-looking TR where lagged total inflation is replaced with the Bank's real-time two-quarters-ahead forecast of core inflation (column 2 and equation 2). Interestingly, the Bank appears to respond more strongly to anticipated *core* inflation than to past *total* inflation, a result in line with the literature (e.g., Markov and Nitschka 2013).[12]

The rest of Table 2 shows estimation results when a measure of business sentiment is included in TR. The main takeaway message is that business sentiment is positively and significantly correlated with the overnight rate in Canada. The higher adjusted R^2 suggest that the monetary policy rule in Canada is better captured by TR augmented with business sentiment.

[11] The same is true for the IBC.

[12] The estimated coefficient of the lagged overnight rate is highly significant (1 per cent), and underscores the importance of interest rate smoothing (or interest rate persistence) in the Canadian monetary policy rule.

Figure 3 compares the actual policy rate (in blue) to policy rates predicted by variants of the TR (Table 2). Interest rate nowcasts given by TR broadly track the actual rate.[13] Table 3 presents the results of the nowcasting exercise using TR. For each TR, it shows the root-mean-squared error (RMSE) and the mean absolute error (MAE). We formally evaluate the nowcast accuracy of the different TR using a test proposed by Clark and West (2007) which is applicable to nested models.[14] Test results indicate that the augmented TR (i.e., columns 2 and 3) have significantly better predictive accuracy. Hence, these test results also suggest that monetary policy is better described by TR augmented with business sentiment, in both the conventional and forward-looking versions.

Overall, the preceding results could be viewed as providing empirical support to Murray's (2013) description of the Bank's Governing Council decision making process. The Bank's Governing Council may have a comprehensive approach when deciding on the appropriate monetary stance in Canada, considering business sentiment in addition to Statistics Canada data and in-house model forecasts. Indeed, measures of business sentiment are relatively reliable and timely measures of economic conditions (Figures 1&2).

4. The Effect of Monetary Policy on Firms' Expectations

In this section, we first present our baseline model used to study the impact of monetary policy on firms' expectations of sales and prices, financing conditions and investment decisions, namely a recursive VAR. Next, we argue that due to relatively few observations, we focus on firms' responses to monetary shocks estimated using local projections.

4.1. Baseline model

VARs remain one of the most used tools to estimate the effects of monetary policy (Christiano 2012). We estimate a parsimonious VAR at a quarterly frequency with three endogenous variables expressed in levels:[15] (i) a BOS variable (e.g., indicators of future sales), (ii) the (CPI) price level, and (iii) an interest rate variable. The interest rate variable is either the overnight rate targeted by the

[13] One notable exception is the Great Recession, when all TR versions called for more monetary policy easing as they crossed the zero lower bound, while the actual policy rate remained at 0.5 per cent, the level the Bank judged to be the effective lower bound at that time. The Bank provided additional monetary easing through unconventional tools (including forward guidance about the future path of policy rates).
[14] See a presentation of Clark and West's (2007) proposed test statistic (p. 294) at the bottom of Table 2.
[15] We have at most 69 observations (17 years of quarterly data) which limits the degrees of freedom in the VAR.

Bank or, following C&S (2018), the cumulative sum of their new monetary policy shock measure.[16] The interest rate variable is ordered last in the VAR, i.e., we assume that monetary policy responds to, but does not affect non-policy variables contemporaneously. This corresponds to a recursive identification strategy (Stock and Watson 2001).

If we use the Bank's target rate as the interest rate variable, then the interest rate equation is the equivalent of a TR (e.g., (3)) where the BOS indicator is replaced by the IBC:[17]

$$i_t = c + \Theta_i i_{t-1} + \Theta_\pi(\hat{\pi}_{t+2} - \pi^*) + \Theta_y \hat{y}_{t+2} + \Theta_{IBC} IBC_{t-1} + \Theta_{FSI} FSI_{t-1} + \mu * Ln(CPI)_{t-1} + \gamma' * Z_t + \tau * t + \varepsilon_t, \quad \text{(iii)}$$

where the terms $\hat{\pi}_{t+2}$ and $\hat{y}_{t+2}$ are the real time two-quarters-ahead forecasts of core inflation and the output gap, and IBC_{t-1} is the lagged IBC. These variables are treated as exogenous. Θ_{IBC}, Θ_{FSI}, μ and τ measure the sensitivity of the overnight rate to the IBC, the BOS future sales indicator, the log price level based on the CPI and the trend, respectively. As before, Z_t is a vector containing the per cent change of the BCPI and the nominal USD/CAD exchange rate at date *t*.

Our sample spans 2001Q1 to 2018Q1 when the interest rate variable is the overnight rate. Otherwise, when using C&S monetary shocks, our sample ends in 2015Q3. We employ one lag in the VAR estimations.[18]

4.2. Results

Estimating the system of equations in the VAR and using these to estimate the impulse response functions (IRFs) is challenging given the short time series of the BOS. Hence, we construct and focus our analysis on the IRFs obtained using the single-equation approach advocated by Jordà (2005), namely local projections. Local projections have been increasingly used to study the effects of economic shocks (e.g., Auerbach and Gorodnichenko, 2013) and are more robust to misspecification (Jordà). Nevertheless, we also report the IRFs obtained using VAR coefficients.

[16] From C&S (p. 10): "Since VARs usually include the levels of macroeconomic variables as well as the level of interest rates, we cumulate our new monetary policy shock series […]."

[17] Using the IBC instead of the BOS indicator tries to minimize any collinearity problems that might arise when estimating the VAR because some information contained in the lagged BOS variable considered is also included in the lagged BOS indicator (see Table A1).

[18] According to the Schwarz information criterion and to a corrected version of the Aikake information criterion (using the covariance matrix unadjusted for degrees of freedom), one lag is the recommended lag structure in almost all VAR systems (maximum of 4 lags allowed; tests performed in Eviews and available upon request).

Figure 4 presents the responses of indicator of future sales, investment intentions, credit conditions, and expected output price growth following a 1 percentage point shock in the Bank's target rate together with 95 percent confidence intervals.[19] Following that contractionary shock, the responses of all survey variables are both intuitive and highly significant (95 percent). Expectations of sales activity, as measured by Indicators of future sales (hereafter, IFS), decline immediately after the shock and remain depressed for more than 2 years. The peak effect – roughly 15 percentage points corresponding to seven tenth of a standard deviation of the IFS series – occurs 5 quarters after the shock. The shock effects then fade as the change in the balance of opinion on IFS reverts to zero after about 3 years.

Using C&S (2018) new measure of monetary policy shocks instead, the response of IFS to a 1 percentage point shock is strikingly similar, although it takes slightly longer to become significant and is less often significant (Figure 5). However, the peak effect is more pronounced.[20] IFS decline by 1.5 standard deviations 5 quarters after the shock (same timing of peak effect as before) and the response is highly significant (95 percent) from the 2nd to 8th quarter (about 30% less often than before).

Expected output price growth also falls in response to the contractionary shock. We observe peak declines of four and nine tenth of a standard deviation 3 and 4 quarters following the shock in the target rate or in the C&S series, respectively (Figures 4&5).

The effects of a 100-basis-point monetary shock on credit conditions are intuitive since an increase in the balance of opinion on credit conditions corresponds to tighter financing conditions reported by firms (Figures 4&5). Credit conditions tighten by, at most, six and nine tenth of a standard deviation 6 and 5 quarters after the shock in the target rate or in the C&S measure, respectively.

Finally, firms' investment decisions decline in response to an unexpected 1 percentage point increase in interest rates. Investment intentions remain significantly reduced for more than 2 years following the shock in the target rate (Figure 4), whereas the effects of the shock from the C&S

[19] The confidence intervals are conditional error bands (Jordà 2009). These are robust to serial correlation in the impulse response coefficient estimates.

[20] These observations also hold for the responses of the other BOS variables (i.e., responses are similar but take slightly longer to become significant and are less often significant, with a higher peak effect).

measure are significant for a little over a year (Figure 5). We find peak declines of four and eight tenth of a standard deviation 6 and 4 quarters following the shock from the respective interest rate series.

Note that in almost all cases (except output prices), when the Bank's target rate is the interest rate variable (Figure 4), responses based on VAR coefficients (green lines with circles) are qualitatively similar to local projections, though generally less pronounced. On the contrary, when the interest rate variable is the C&S measure (Figure 5), responses based on VAR coefficients are largely not statistically significant and counterintuitive for both IFS and credit conditions. This suggests that misspecification errors may affect VAR results, which is why we lend more credibility to the responses estimated by local projections.

Interestingly, the (CPI) price level rises in response to a 1 percentage point target rate shock (i.e., the "price puzzle") in conventional VARs (Figure C1, appendix C). However, when the response is estimated by local projections the price level significantly decreases 2 to 4 quarters after the shock, reminiscent of Jordà (2009) and in line with theory. Using C&S new measure of shocks similarly produces intuitive results, with the price level declining following a 1 percentage point shock, whichever type of IRF is considered (Figure C2, appendix C). Again, the decline is much more pronounced when the response is estimated by local projections.

5. Conclusion

This paper finds that the monetary policy rule in Canada is better described by Taylor rules augmented with business sentiment. Specifically, we use a measure of business sentiment derived from the Bank of Canada's quarterly *Business Outlook Survey*. As a robustness check, we also use the Index of Business Confidence from the Conference Board of Canada's business confidence survey. We estimate conventional and forward-looking Taylor rules in real time and find that business sentiment is positively and significantly correlated with the overnight rate. We also show that Taylor rules augmented with business sentiment have significantly better predictive accuracy than Taylor rules including only output and inflation gaps. A possible interpretation of these results is that the Governing Council of the Bank of Canada may have a comprehensive approach when deciding on the appropriate monetary stance in Canada, considering business sentiment in addition to Statistics Canada data and in-house model forecasts.

This paper also provides new insights into the effects of monetary policy on firms' expectations of sales and prices, financing conditions and investment decisions. Responses estimated using local projections (Jordà 2005) are intuitive. A 100-basis-point shock in the Bank's target rate leads firms to expect significantly lower sales and slower output price growth, report tighter credit conditions and lower investment intentions. The effects of the same shock from C&S (2018) new monetary policy shock measure for Canada are strikingly similar and generally stronger, albeit less often significant.

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Tables and Charts

Table 1: Correlations of selected BOS variables with first-released estimates of macroeconomic data (2001Q1 to 2018Q1)

		Correlation								
Survey variable[1]	Macroeconomic variable	T-4	T-3	T-2	T-1	T	T+1	T+2	T+3	T+4
Indicators of future sales[2]	Real GDP growth[3]	-0.15	0.04	0.27	0.51	0.74	0.86	0.78	0.58	0.33
Investment intentions	Real investment growth[4]	-0.18	-0.06	0.11	0.31	0.50	0.63	0.66	0.58	0.44
Output prices	GDP deflator momentum[5]	-0.40	-0.20	-0.07	0.23	0.45	0.59	0.49	0.14	-0.24
Credit conditions	Real investment growth	0.16	0.06	-0.05	-0.18	-0.32	-0.48	-0.56	-0.57	-0.53

Notes: 1. BOS variables are expressed as balances of opinion, i.e. percentage of firms reporting that indicators have improved minus the percentage reporting that indicators have deteriorated; except for credit conditions where it is the percentage of firms reporting tightened credit conditions minus the percentage reporting eased. 2. Indicators of future sales series starts in 2003:Q3. 3. Year-over-year growth rates. 4. Real investment refers to gross fixed capital formation. 5. Momentum refers to the year-over-year change in the year-over-year growth rate.

Table 2: Real-time estimations of the Taylor rule (TR)

	Taylor rule		Augmented Taylor rule		Alternative Augmented TR	
	Backward-looking	Forward-looking	Backward-looking	Forward-looking	Backward-looking	Forward-looking
	(1)	(2)	(3)	(4)	(5)	(6)
Overnight rate$_{t-1}$	0.85***	0.90***	0.86***	0.89***	0.88***	0.91***
	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.02)
Total Inflation$_{t-1}$-2	0.06***		0.02		0.03	
	(0.02)		(0.02)		(0.02)	
Core Inflation$_{t+2}$-2		0.22**		0.17**		0.19**
		(0.09)		(0.08)		(0.09)
BOS indicator$_{t-1}$			0.17***	0.16***		
			(0.05)	(0.04)		
IBC$_{t-1}$					0.14***	0.14***
					(0.05)	(0.04)
Output Gap$_{t \text{ or } t+2}$	0.17***	0.20***	0.08*	0.10***	0.09***	0.11***
	(0.03)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)
Observations	68	68	68	68	68	68
Adj. R-squared	0.970	0.972	0.977	0.979	0.975	0.977

Notes: HAC standard errors in parentheses. *, **, *** denote significance at the 10, 5 and 1% levels.
Estimation sample: 2001Q1 to 2018Q1. Standard/backward-looking Taylor rules use last quarter's actual total inflation, while forward-looking Taylor rules use 2-quarters-ahead forecasts of core inflation and the output gap. The augmented Taylor rule refers to specifications including both the output gap and the BOS indicator. The alternative augmented Taylor rule refers to the specification where the BOS indicator is replaced with the IBC instead. All estimations include the nominal USD/CAD exchange rate and the Bank's commodity price index (BCPI) (in USD), both expressed in per cent change (Q/Q).

Table 3: Forecast performance of different Taylor rule models

Prediction Accuracy Analysis

Backward-looking Taylor rules[1]

	TR with Output Gap and Inflation Gap only (1)	TR augmented with lagged BOS Indicator (2)***	TR augmented with lagged Index of Business Confidence (3) ***
RMSE	0.230	0.204	0.211
ratio to baseline (1)		*0.89*	*0.92*
MAE	0.177	0.160	0.166
ratio to baseline (1)		*0.90*	*0.94*

Forward-looking Taylor rules[2]

	(1)	(2)***	(3)***
RMSE	0.226	0.196	0.200
ratio to baseline (1)		*0.87*	*0.88*
MAE	0.173	0.148	0.159
ratio to baseline (1)		*0.86*	*0.92*

Notes: Test for predictive accuracy proposed by Clark and West (2007) where *, **, *** denote significance at the 10, 5 and 1% levels.
1. TR estimated using lagged total CPI inflation and the Bank's real-time nowcast of the output gap. 2. TR estimated using the Bank's real-time 2-quarter-ahead forecasts of core inflation and 2-quarter-ahead forecasts the output gap.
All TR estimations include the nominal USD/CAD exchange rate and the Bank's commodity price index (BCPI), both expressed in per cent change (Q/Q). Prediction sample: 2001Q2 to 2018Q1.

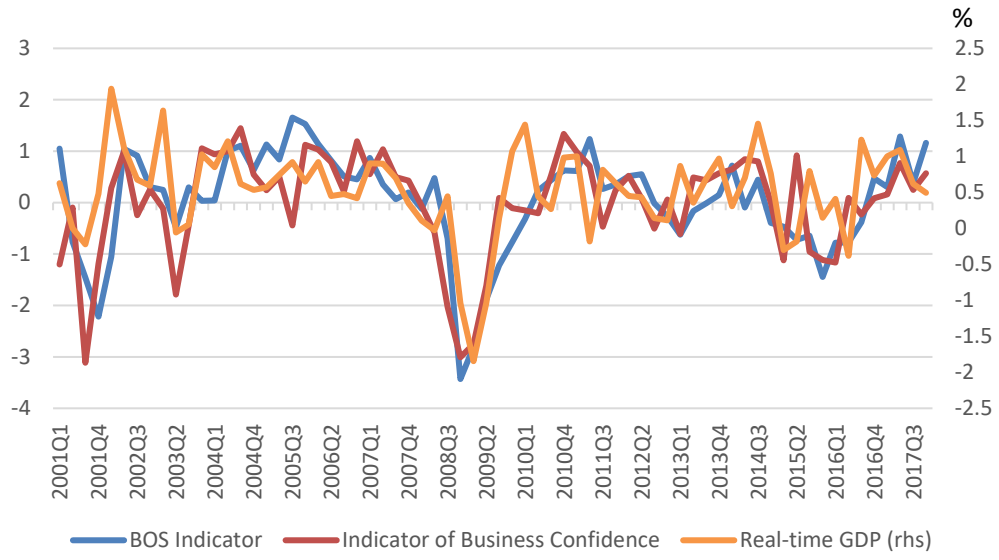
The test statistic proposed by Clark and West (2007, p. 294) is the following:

$$\hat{f}_{t+\tau=}(y_{t+\tau} - \hat{y}_{1t,t+\tau})^2 - [(y_{t+\tau} - \hat{y}_{2t,t+\tau})^2 - (\hat{y}_{1t,t+\tau} - \hat{y}_{2t,t+\tau})^2]$$

where $\hat{y}_{1t,t+\tau}$ and $\hat{y}_{2t,t+\tau}$ are the period t τ-step ahead forecasts of $y_{t+\tau}$ from (i) model 1, the parsimonious model, and (ii) model 2, the larger model that nests model 1, respectively. Model 2 reduces to model 1 if some model 2 parameters are set to zero. Under the null, the additional parameters in model 2 should not help prediction. Hence, the mean squared prediction error (MPSE) from model 1 is expected to be *smaller* because the parameters that should be set to zero in model 2 introduce noise in the forecasting process. In finite samples, this inflates model's 2 MPSE. Clark and West "recommend that the point estimate of the difference between the MPSEs of the two models be adjusted for the noise associated with the larger model's forecast." Thus, the introduction of the second squared term within brackets. The resulting statistic's ($\hat{f}_{t+\tau}$) standard error is computed using the Newey-West procedure with 4 lags.

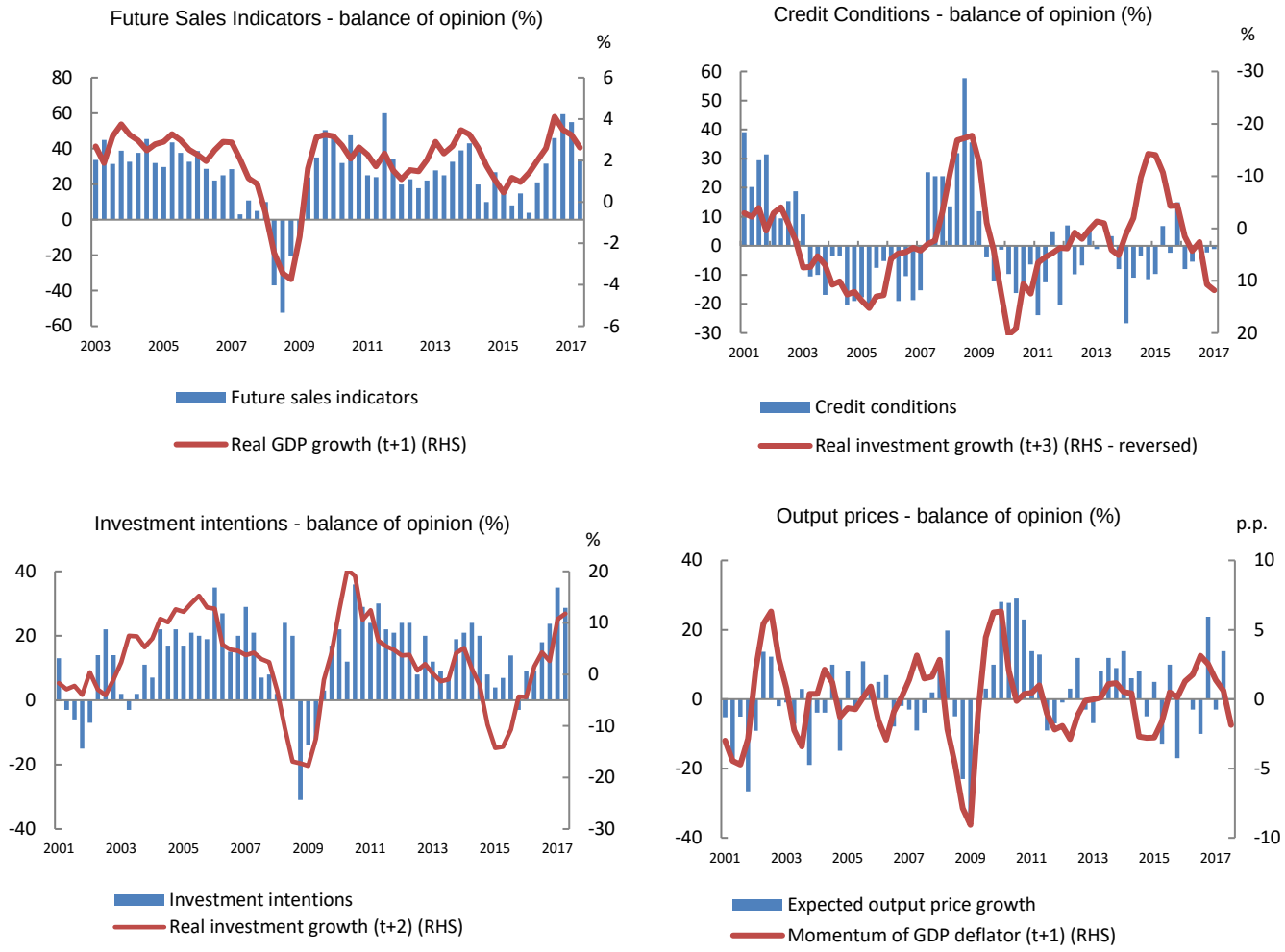
Figures

Figure 1: Business sentiment data tracks first-released estimates of GDP growth



Notes: There is no natural unit of measurement for the BOS indicator. Thus, its values have been standardized (centered on its mean and divided by its standard deviation). The same transformation is applied to the IBC. Real-time GDP growth is measured as the per cent change (Q/Q).

Figure 2: Business Outlook Survey indicators (in blue) lead first-released estimates of macroeconomic data (red)



Note: BOS variables are expressed as balances of opinion, i.e. percentage of firms reporting that indicators have improved minus the percentage reporting that indicators have deteriorated; percentage of firms reporting tightened credit conditions minus the percentage reporting eased. Year-over-year growth rates displayed for real-time real GDP and investment. Investment refers to gross fixed capital formation. Momentum refers to the year-over-year change in the year-over-year growth rate. Sample: 2001:Q1 to 2018:Q1 (except for Indicators of future sales: 2003:Q3 to 2018:Q1).

Figure 3: Comparison of predicted Taylor rule policy rates estimated in real time

(Current quarter predictions done à la Koenig et al. (2003) using real-time vintage data available at the time of the monetary policy decision)

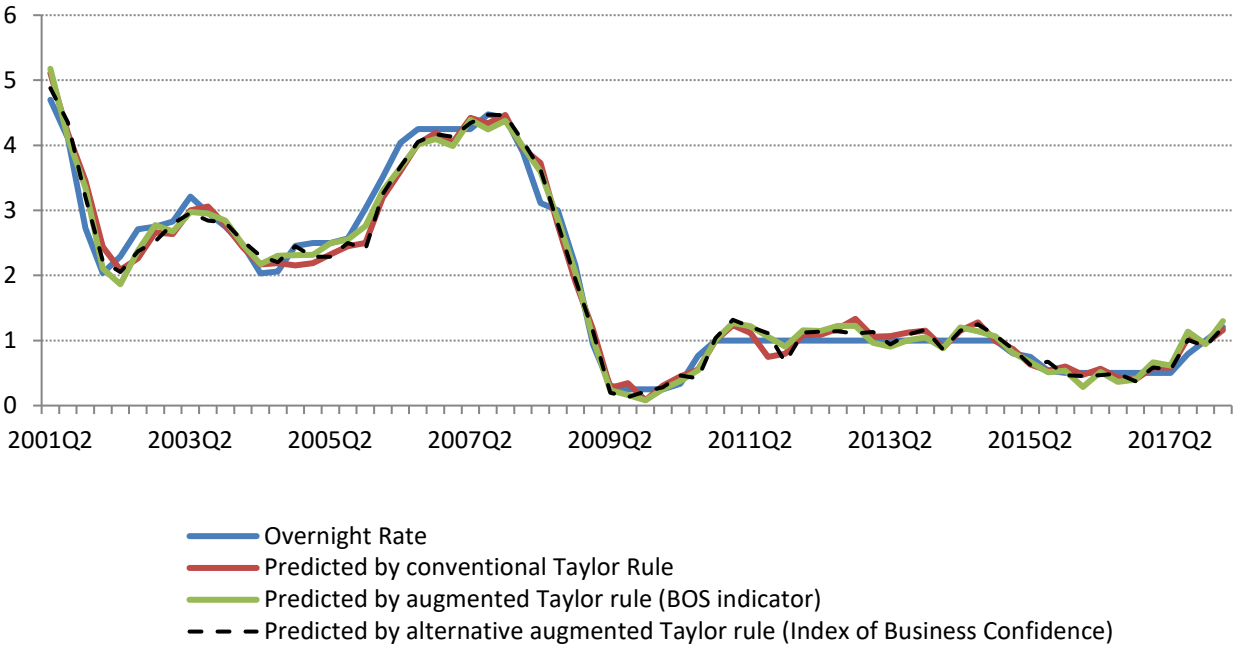
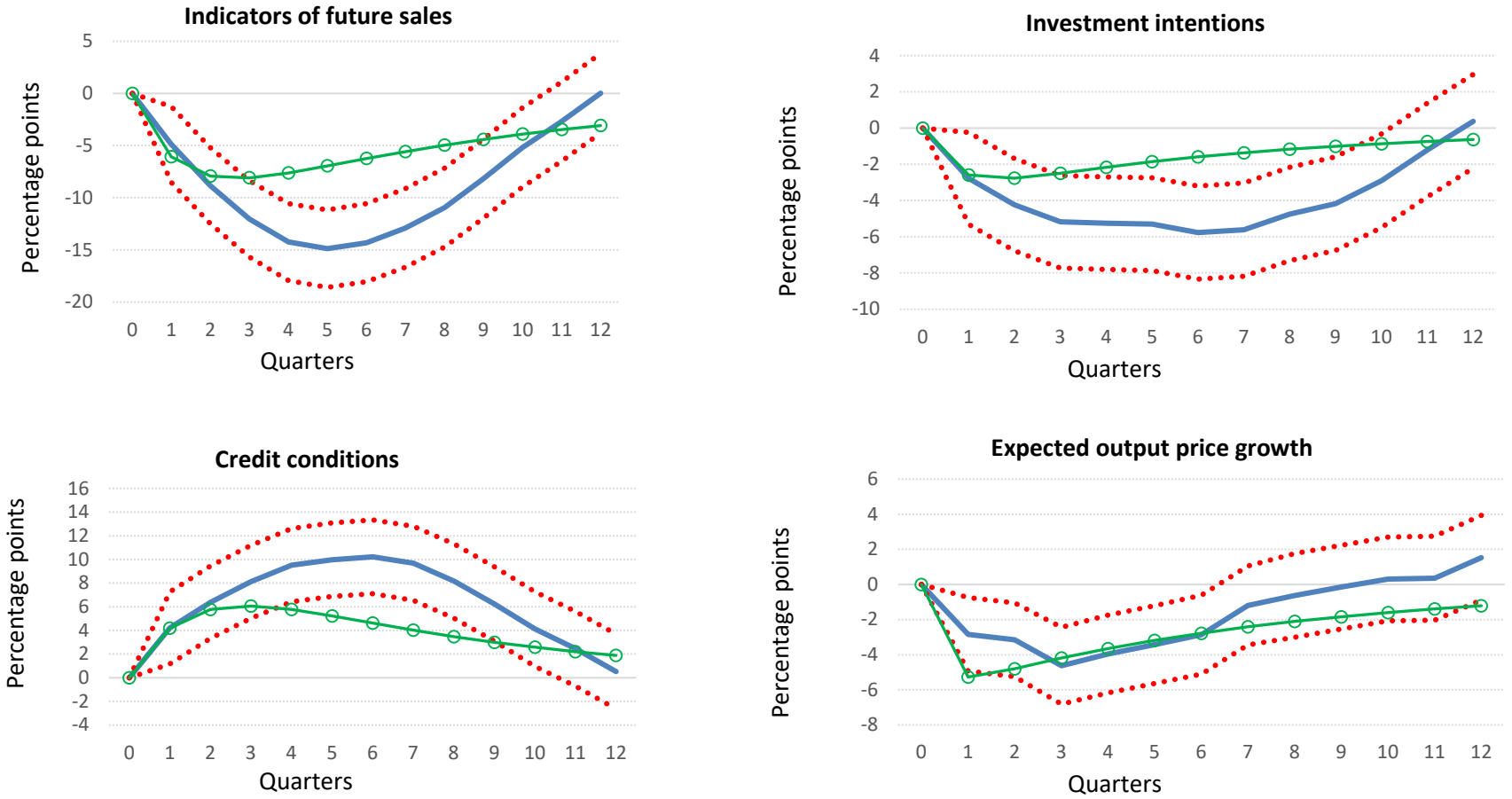
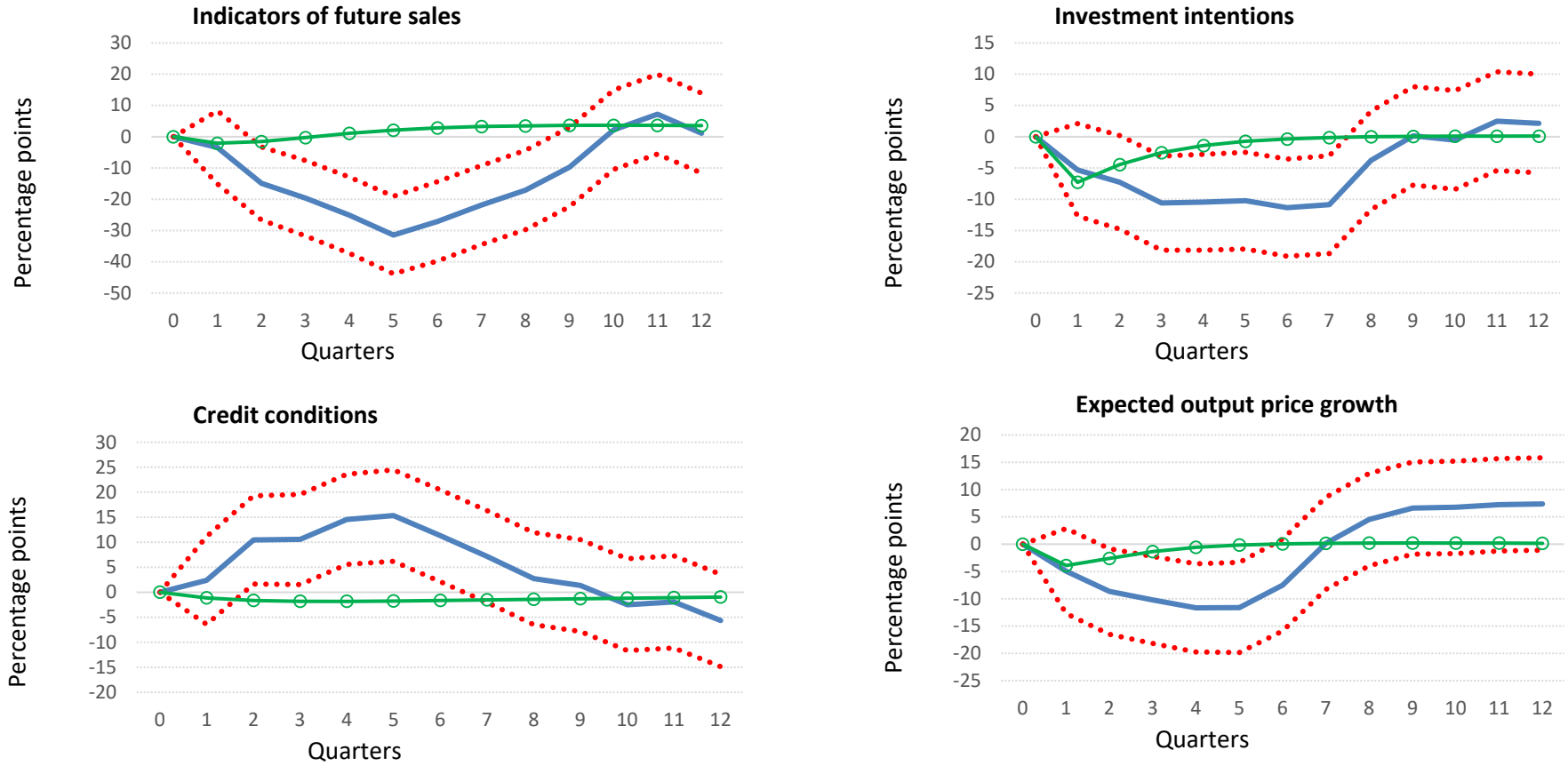


Figure 4: Response of Business Outlook Survey variables to a target rate shock



Notes: Impulse responses to a 100-basis-point contractionary monetary shock with corresponding 95 percent conditional confidence intervals. Impulse response calculated by local projections using Ocakverdi's program "localirfs" (Eviews) with one lag on VAR systems. The VARs include a BOS variable (e.g., indicators of future sales), the (quarterly) price level (log CPI) and the Bank's target rate. Exogenous control variables include the real-time two-quarters-ahead forecasts of core inflation and the output gap, and the per cent change (Q/Q) in the (quarterly) BCPI (in USD) and the nominal USD/CAD exchange rate. Line with circles corresponds to standard impulse responses derived from VAR coefficients. Sample: 2001:Q1 to 2018:Q1 (except for Indicators of future sales: 2003:Q3 to 2018:Q1).

Figure 5: Response of Business Outlook Survey variables to a shock from Champagne and Sekkel's (2018) new measure of monetary policy



Notes: Impulse responses to a 100-basis-point contractionary monetary shock with corresponding 95 percent conditional confidence intervals. Impulse response calculated by local projections using Ocakverdi's program "localirfs" (Eviews) with one lag on the VAR systems. The VARs include a BOS variable (e.g., indicators of future sales), the (quarterly) price level (log CPI), and Champagne and Sekkel's (2018) (cumulative sum of) new monetary policy shock series as the interest rate variable. Exogenous control variables include the real-time two-quarters-ahead forecasts of core inflation and the output gap, and the per cent change (Q/Q) in the (quarterly) BCPI (in USD) and the nominal USD/CAD exchange rate. Sample: 2001:Q1 to 2015:Q3 (except for Indicators of future sales: 2003:Q3 to 2015:Q3).

Appendix A: An Overview of the BOS and the BCS

1. Business Outlook Survey (Bank of Canada)

The consultations with businesses are structured around a survey questionnaire that focuses on sales, investment, prices, and credit conditions. All the information gathered is qualitative in nature and most often expressed as a balance of opinion, that is, the percentage of positive responses minus the percentage of negative response. Below are the BOS questions (see also Martin 2004) used in the analyses of the effects of monetary policy shocks:

1) **Indicators of future sales:** Have your recent indicators of future sales (order books, advanced bookings, sales inquiries, etc.) improved, deteriorated or remained the same compared to 12 months ago?
2) **Investment intentions:** Over the next 12 months, do you expect your investment spending on machinery and equipment to be higher, lower or the same compared with the past 12 months?
3) **Output prices:** Over the next 12 months, do you expect the prices of the products or services that you sell to increase at a greater, lesser or the same rate compared with the past 12 months?
4) **Credit conditions:** How have the terms and conditions for obtaining financing changed over the last three months compared to the previous three months? Have they tightened, eased, not changed?

Table A1 summarizes the BOS questions used in the BOS indicator and their respective time horizon.

Table A1: BOS questions used in the BOS indicator

Survey question	Horizon
Balance of opinion[a] on past sales growth	Past 12 months
Balance of opinion on future sales growth	Next 12 months
Balance of opinion on investment in machinery and equipment	Next 12 months
Balance of opinion on employment	Next 12 months
Ability to meet an unexpected increase in demand[b]	Current
Percentage of firms facing labour shortages	Current
Balance of opinion on labour-shortage intensity	Current
Balance of opinion on input prices	Next 12 months
Balance of opinion on output prices	Next 12 months
Balance of opinion on credit conditions	Past 3 months

Notes:
a. Percentage of firms responding "greater," "higher" or "more" minus percentage of firms reporting "lesser," "lower" or "less."
b. Percentage of firms responding "some" or "significant" difficulty.

2. Business confidence survey (Conference Board of Canada)

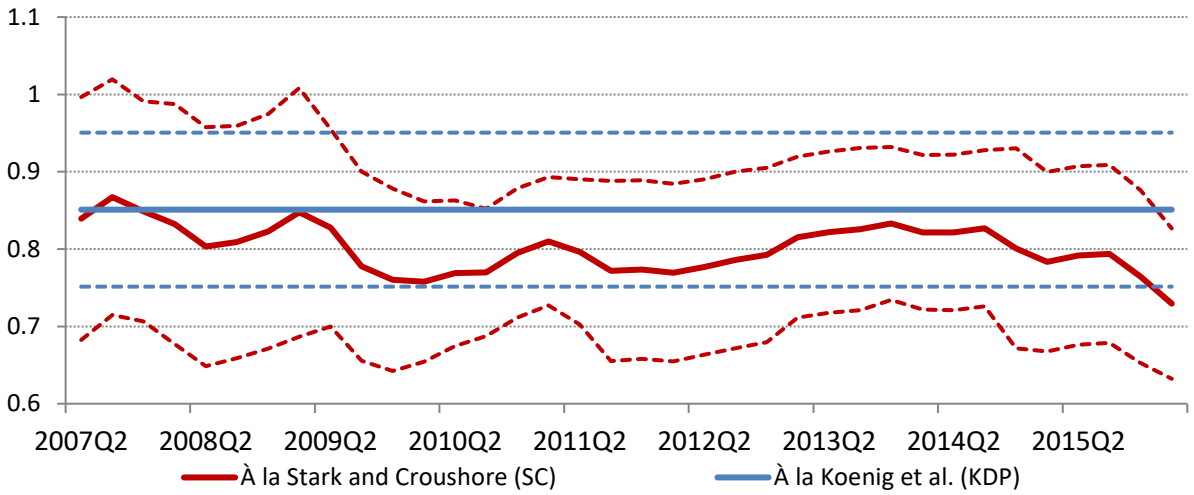
The Index of Business Confidence (IBC) we use in section 3 is a composite indicator of the difference between changes in the positive and negative responses to three variables included in the survey, rebased to 2002 values. The variables included are (i) the firm's financial position (number of firms responding "improve"

minus number responding “worsen”); (ii) planned expenditure on machinery and equipment (number of firms responding “good time to undertake expenditures” minus number of firms responding “bad time”); and (iii) capacity pressures (number of firms responding “at, close to, or above capacity” minus number reporting “substantially below capacity”).

Appendix B: Alternative estimations of the Taylor rule

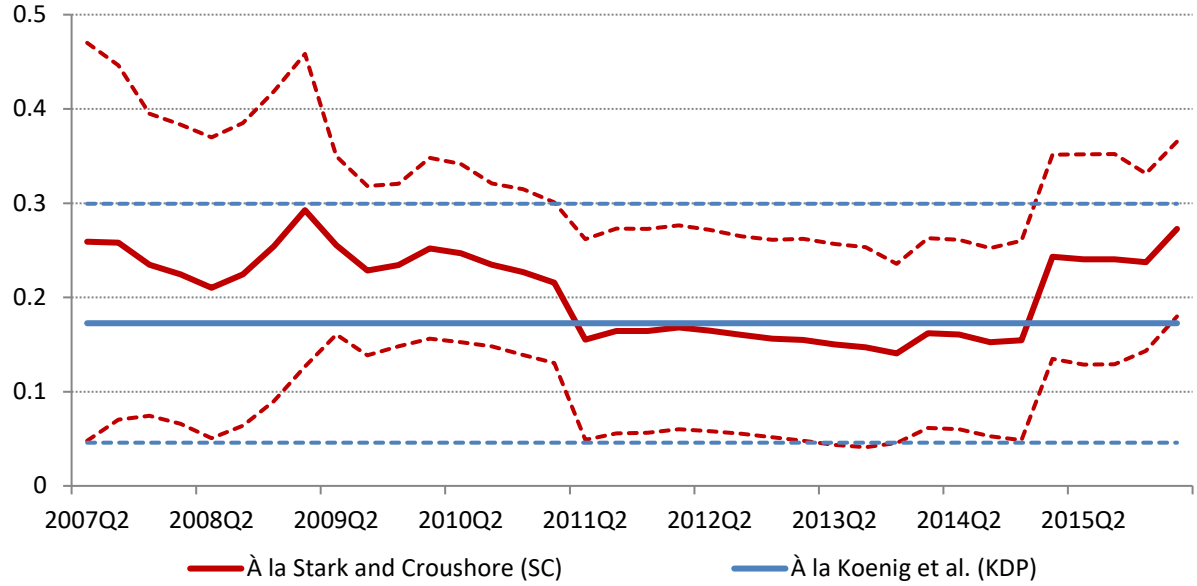
The following figures and table are reproduced from Verstraete and Suchanek (2017).

Figure B1: Real-time estimated coefficients of *lagged overnight rate* in a conventional Taylor rule: *à la* Stark and Croushore (2002) or *à la* Koenig et al. (2003)



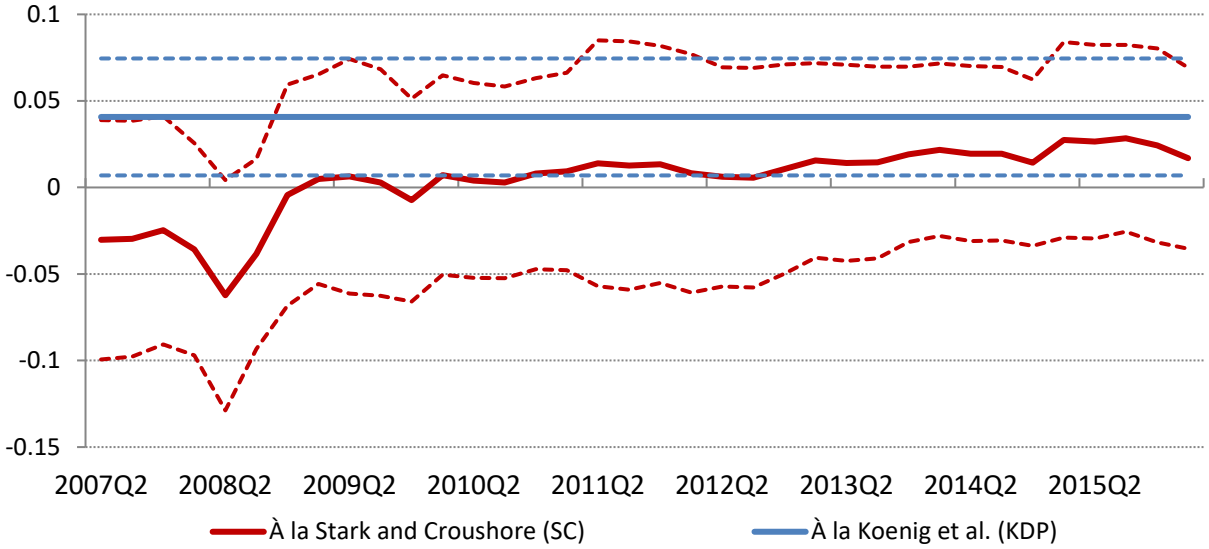
Notes: 1) Estimation samples: from 2001Q2 to date indicated on x-axis for estimations *à la* SC; from 2001Q2 to 2016Q2 using first estimates for estimations *à la* KDP. 2) Dotted lines refer to 95% confidence intervals.

Figure B2: Real-time estimated coefficients of the *output gap* in a conventional Taylor rule: *à la* Stark and Croushore (2002) or *à la* Koenig et al. (2003)



Notes: 1) Estimation samples: from 2001Q2 to date indicated on x-axis for estimations *à la* SC; from 2001Q2 to2016Q2 using first estimates for estimations *à la* KDP. 2) Dotted lines refer to 95% confidence intervals.

Figure B3: Real-time estimated coefficients of the *inflation gap* in a conventional Taylor rule: *à la* Stark and Croushore (2002) or *à la* Koenig et al. (2003)



Notes: 1) Estimation samples: from 2001Q2 to date indicated on x-axis for estimations *à la* SC; from 2001Q2 to 2(first estimates for estimations *à la* KDP. 2) Dotted lines refer to 95% confidence intervals. 3) "Inflation gap" measu difference of lagged total inflation and inflation target.

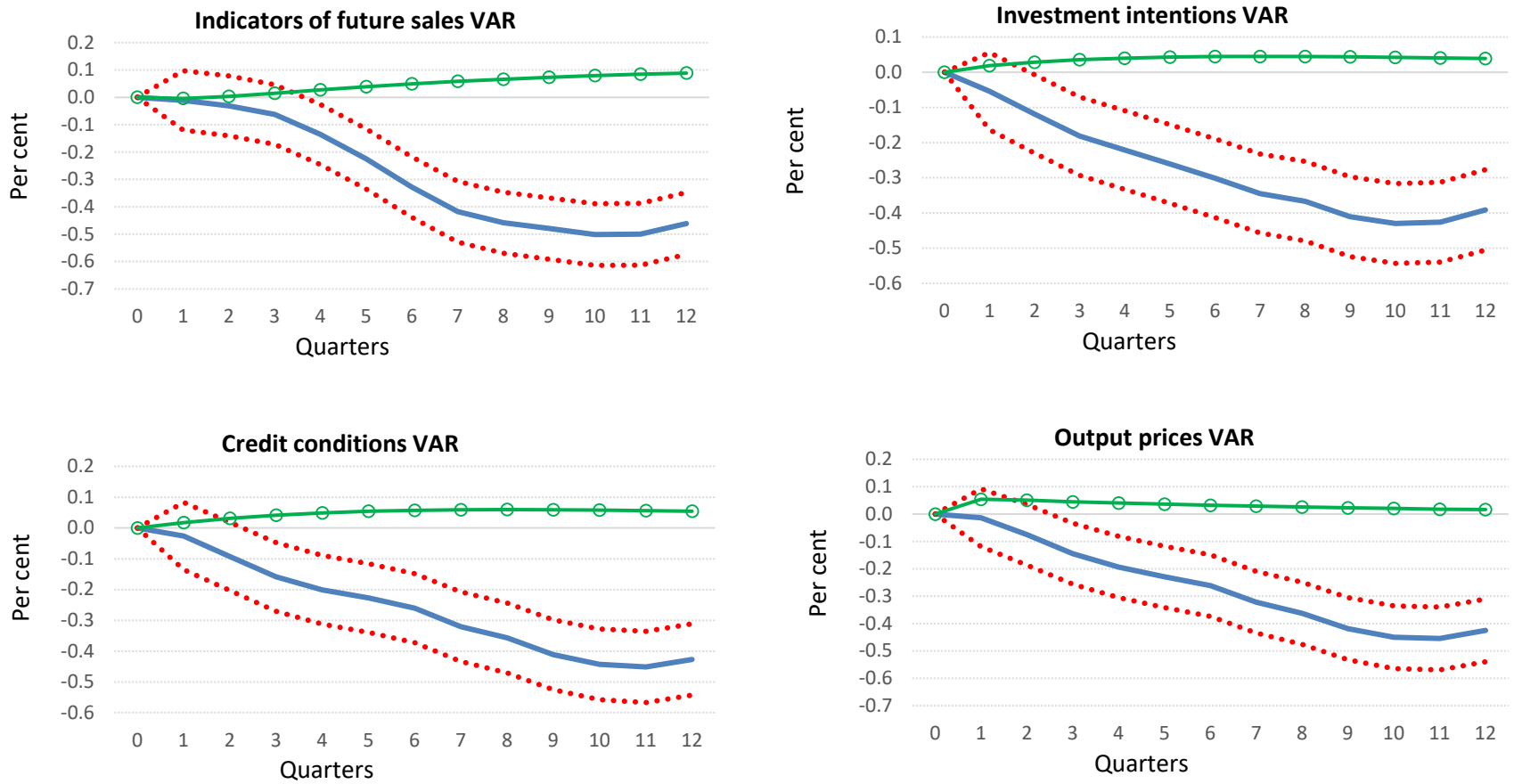
Table B1: Real-time estimations *à la* Koenig et al. (2003) of the Taylor rule using an extended sample (1993Q4–2016Q1)

	Taylor rule		Augmented Taylor rule	
	Backward-looking	Forward-looking	Backward-looking	Forward-looking
	(1)	(2)	(3)	(4)
i_{t-1}	0.973***	0.976***	0.93***	0.936***
	(0.033)	(0.025)	(0.023)	(0.022)
CPI_{t-1}-2	0.018		-0.006	
	(0.028)		(0.025)	
CPI_{t+2}-2		0.463***		0.417**
		(0.159)		(0.141)
IBC_{t-1}			0.302***	0.283***
			(0.078)	(0.055)
Output Gap$_t$	0.042	0.043	-0.007	-0.009
	(0.051)	(0.042)	(0.055)	(0.043)
C	0.082*	0.186**	0.081**	0.172**
	(0.088)	(0.072)	(0.076)	(0.074)
Observations	91	91	91	91
Adj. R-squared	0.93	0.938	0.944	0.951

Notes: HAC standard errors in parentheses. *, **, *** denote significance at the 10, 5 and 1% level. Estimation sample: 1993Q4 to 2016Q1. Conventional/backward-looking Taylor rules use last quarter's actual total inflation, while forward-looking Taylor rules use 2-quarters-ahead forecasts of core inflation. The augmented Taylor rule refers to specifications including both the output gap and the IBC.

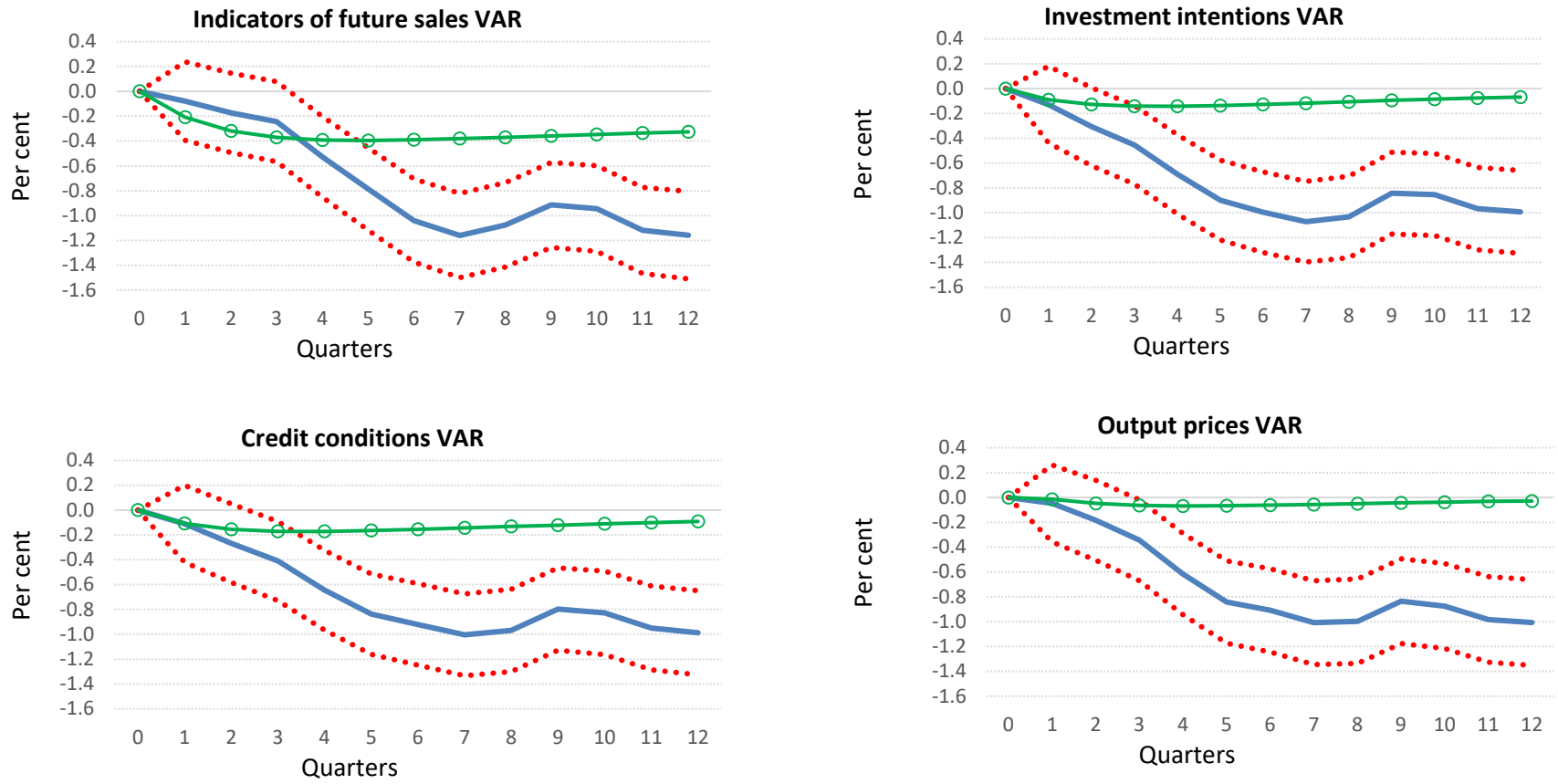
Appendix C: Other IRFs

Figure C1: Response of Price level (CPI) to target rate shock in different VARs



Notes: Impulse responses to a 100-basis-point contractionary monetary shock with corresponding 95 percent conditional confidence intervals. Impulse response calculated by local projections using Ocakverdi's program "localirfs" (Eviews) with one lag on VAR systems. The VARs include a BOS variable (e.g., indicators of future sales), the (quarterly) price level (log CPI) and the Bank's target rate. Exogenous control variables include the real-time two-quarters-ahead forecasts of core inflation and the output gap, and the per cent change (Q/Q) in the (quarterly) BCPI (in USD) and the nominal USD/CAD exchange rate. Line with circles corresponds to standard impulse responses derived from VAR coefficients. Sample: 2001:Q1 to 2018:Q1 (except for Indicators of future sales: 2003:Q3 to 2018:Q1).

Figure C2: Response of Price level (CPI) to a shock from Champagne and Sekkel's (2018) new measure of monetary policy in different VARs



Notes: Impulse responses to a 100-basis-point contractionary monetary shock with corresponding 95 percent conditional confidence intervals. Impulse response calculated by local projections using Ocakverdi's program "localirfs" (Eviews) with one lag on the VAR systems. The VARs include a BOS variable (e.g., indicators of future sales), the (quarterly) price level (log CPI), and Champagne and Sekkel's (2018) (cumulative sum of) new monetary policy shock series as the interest rate variable. Exogenous control variables include the real-time two-quarters-ahead forecasts of core inflation and the output gap, and the per cent change (Q/Q) in the (quarterly) BCPI (in USD) and the nominal USD/CAD exchange rate. Sample: 2001:Q1 to 2015:Q3 (except for Indicators of future sales: 2003:Q3 to 2015:Q3).