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Abstract

The conduct of monetary policy nowadays involves not only interest rate decisions but also central bank communication, aimed at managing the expectations of the private sector. In this paper, we apply epidemiological model to private-sector experts' forecasts regarding interest rates and inflation in Poland—an economy with over 20 years of inflation targeting history. We show that both of these factors affect interest rates and inflation expectations. Our study contributes to the literature by including a wide set of factors affecting expectations with a special focus on central bank decisions, projections and the tone of official documents. In general, the textual content of monetary policy minutes affects experts' expectations more at the shortest horizons (nowcasts and one quarter ahead), while GDP and inflation projections released by the central bank play a larger role for slightly longer horizons (two quarters ahead or longer). As far as monetary policy actions are concerned, a positive interest rate surprise produces an upward shift in the whole path of interest rate expectations and leads to a decrease in one-year-ahead inflation expectations.

JEL: E52, E58.

Keywords: central bank communication, inflation expectations, interest rate expectations, text mining.

1 Introduction

Expectations are a prominent source of economic fluctuations. The role of expectation has been analysed since Knight and Keynes in the 1920 and 1930s (Pesaran, 1996; Laidler, 2010), although including fully endogenous expectations (forward-looking variables) in models only dates from the late 1960s (Lucas, Phelps, Phillips, Rapping), and this feature has become an industry standard in contemporary macroeconomic models. Central banks responded to this paradigm in the 1990s by adopting monetary policy strategies based on "managing expectations", in particular, inflation targeting strategy, and by enhancing communication with the public. The instruments of central bank communication include, among others, announcements of inflation targets, the publication of central bank macroeconomic projections, detailed explanations of monetary policy decisions, and signalling future decisions (forward guidance). Central bank communication has become even more important in the environment of low interest rates as experienced recently (Blinder et al., 2017).

The way central banks affect the expectations of private sector agents nowadays is twofold: through words (communication) and deeds (e.g. interest rate decisions). The main goal of this paper is to empirically assess the role of central bank actions and communication in shaping the expectations of the private sector in Poland. Monetary policy actions are measured either in terms of monetary policy shocks, identified by the narrative approach (Romer and Romer, 2004), or as interest rate surprises, based on survey data. When it comes to central bank communication, we consider its two dimensions, i.e. inflation and GDP projections as well as the tone of central bank documents. The latter is quantified based on minutes from meetings of the NBP Monetary Policy Council (MPC)—the decision-making body in the area of monetary policy—with the use of the dictionary approach. We apply two dictionaries proposed in the literature; one is by Apel and Blix Grimaldi (2014) (the ABG dictionary), and the other is Bennani and Neuenkirch (2017) (the BN dictionary). Both the lexicons were developed with the particular aim to analyse monetary policy documents, but due to distinct linguistic approaches are likely to capture different "shades" of the communication. We examine how interest rate and inflation expectations of private sector experts at various forecast horizons respond to these two forms of communication and interest rate decisions after controlling for a number of variables that represent the macroeconomic and financial market performance.

The Polish economy seems well-suited to this kind of analysis for several of reasons. First, Narodowy Bank Polski (NBP)—the central bank of Poland—adopted an inflation targeting strategy in 1999, and since then, it has significantly developed its set of

communication tools, increasing the degree of central bank transparency (e.g. Dincer and Eichengreen, 2014; Łyziak, 2013; Mackiewicz-Łyziak, 2016). In particular, since 2004, NBP has regularly published macroeconomic projections and since 2007 it has provided the public with minutes that summarise the discussions during the meetings of NBP MPC.[1] Apart from conveying specific information (content), these documents describe the inclination of policymakers, which may also exert an impact on private sector expectations. Second, since March 2015, the headline central bank interest rate (i.e. the NBP reference rate) has remained at a historically low level (1.5%). A long period of stable and predictable central bank interest rate implies a potentially greater role of central bank communication, especially in the environment of CPI inflation persistently below the NBP inflation target (2.5%) combined with fast economic growth. Thirdly, despite the disturbances caused by the global financial crisis (GFC), the monetary policy conducted by the Polish central bank has remained conventional[2], which facilitates the assessment of the role of words and deeds of monetary authorities in managing expectations.

Our paper contributes to the literature that studies the role of central bank communication in affecting private sector forecasts. The first strand of this literature, which is particularly relevant for our study, concerns the role of central bank projections in managing expectations. It has been shown that central bank projections indeed affect forecasts of the private sector in different economies (e.g. Hubert, 2015a,b; Hattori et al., 2016; Łyziak and Paloviita, 2017; Pedersen, 2015) and that they lead to a reduction in the dispersion of private sector forecasts (e.g. Ehrmann and Fratzscher, 2007; Fujiwara, 2005).[3] The second strand of related literature concerns the impact of the textual content of monetary policy communication. Picault and Renault (2017) show that the tone extracted from the wording of monetary policy communiques may help to predict current and future interest rate changes, and it affects both asset prices and volatility. Neuenkirch (2013b) finds that tone affects inflation expectations with similar strength and dynamics to interest rate changes. Bennani (2019) evidences the effect of speeches on stock prices, while Hüning (2019) identifies the

[1] On the top of that, MPC communicates with the public through a number of announcements, press releases and interviews. However, these forms of communication are not provided regularly and are subject to media bias. Furthermore, only the minutes and press releases after the MPC meeting are officially provided by the National Bank of Poland (in contrast to, e.g., the European Central Bank, where all speeches of the board members are archived and provided to the public on the ECB's website).

[2] The only modification introduced in 2013-2014 was forward guidance.

[3] Numerous studies have also shown that monetary policy announcements provide additional information to available macroeconomic data, e.g. the tone of the ECB President's introductory statement at the press conference (Sturm and De Haan, 2011), the dissent of policy-makers' voting helps to predict the course of monetary policy (El-Shagi and Jung, 2015), the public statements of policymakers affect both interest rates and the stock market, and have little or no impact on exchange rates (Gertler and Horváth, 2018), while releases of monetary policy minutes influence the trading volume and volatility of asset prices (Rosa, 2013).

impact on uncertainty in financial markets. Finally, Hubert and Labondance (2017) find that monetary policy sentiment shapes private agents' interest rate expectations and Hansen et al. (2019) documents the impact of monetary policy communication on forward nominal interest rates.

The paper delivers three major novel inputs to the literature. Firstly, to the best of our knowledge, it is the first study that jointly assesses the impact of monetary policy actions and communication, including the tone of documents published by decision-makers, on survey-based measures of interest rate and inflation expectations. The studies closest to ours (i.e. Hubert and Labondance, 2017 and Hansen et al., 2019) examine the impact of the tone of central bank documents on market expectations, while we consider survey-based expectations. The main advantage of surveys as a source of information on expectations—relative to market data—is that they are free from the distortions that result from the time-varying liquidity premium and shifts in market sentiment (Bauer and Rudebusch, 2015; Christensen et al., 2010; Cunningham et al., 2010). Such biases might play a greater role in emerging economies like Poland with relatively shallow financial markets and during periods of financial turmoil. Secondly, in measuring the tone of monetary policy documents, we consider two distinct linguistic approaches (single words vs. phrases) capturing different dimensions of central bank communication. In this way, we are able to identify more potential channels of the impact of central bank communication on private sector forecasts. Thirdly, we investigate the tone of central bank communication in Poland, which has not been analysed in the context of the formation of private sector expectations.

Some aspects of the nexus between central bank communication and private sector expectations have been previously analyzed also in Poland and CEE countries. A large number of these studies focused on determinants (Mackiewicz-Łyziak, 2016) or effects (Neuenkirch, 2012, 2013a) of the transparency of central bank communication. Several papers analysed efficiency of NBP communication, including the credibility of forward guidance policy announcements (Kot and Brzoza-Brzezina, 2008; Baranowski and Gajewski, 2016) or positive effects of communication for trading volume and consequently reduced market volatility (Brzeszczyński and Kutan, 2015). Horváth et al. (2012) and Horváth and Jonášová (2015) examine the forecasting power of voting records and show that voting records are useful for predicting future monetary policy course. The latter study shows the differences in the predictive power of the records in the global financial crisis period. Kotłowski (2015) and de Mendonça and de Deus (2019) find that central bank projections affect private sector expectations of GDP growth, however, this effect is less evident for inflation expectations. On the other hand, the literature on the effects of inflation projections on inflation expectations is ambigous, e.g. Szyszko and Tura (2015) show moderate effects of projections of the Czech National Bank. Rozkrut et al. (2007) analyse the impact of central banks'

verbal communication on interest rate predictability and financial market volatility in the Czech Republic, Hungary, and Poland. Naszodi et al. (2016) show how central bank transparency affects private sector forecasts of several macroeconomic variables (including short-term interest rates). Generally, they report negative effects of transparency on disagreement across individual forecasters and forecast accuracy, though for the interest rates forecast the results are less clear than for the forecasts of real variables. In a recent study, Rybiński (2019) analyses the correlation between the lexical sentiment of NBP policy statements and newspaper articles. He shows that NBP can successfully affect the media discourse when the press discusses topics that fall under the NBP mandate.

Our main finding suggests that NBP communication significantly shapes private sector forecasts. In general, the tone of the MPC minutes affects expectations at the shortest horizons (nowcasts and one quarter ahead), while GDP and inflation projections play a greater role for slightly longer horizons (two quarters ahead or longer). As far as monetary policy actions are concerned, a positive interest rate surprise produces an upward shift in the whole path of interest rate expectations and leads to a decrease in one-year-ahead inflation expectations.

The paper is structured in the following way. Section 2 presents the data used in the paper, in particular, it discusses the measures of central bank communication and monetary policy shocks. Section 3 provides the empirical model used to analyse the formation of expectations and discusses the results. The final section summarises the findings.

2 Data description

In our study, we consider the impact of central bank actions and communication on the expectations of experts. This group of economic agents is the most likely to be affected by monetary policy instruments, in contrast to firms and consumers, who might be less attentive.[4] The data on the tone of central bank communication starts in May 2007, with the beginning of the publication of the minutes after the MPC meetings. However, due to limitations in availability of survey data on private sector expectations, in most cases, the sample begins in 2011, although we do not consider this to be a serious limitation as central bank communication intensified after the global financial crisis. The last observation is for February 2019. We exploit a longer sample, starting in 2005 to estimate the monetary policy shock. To obtain macroeconomic surprises, monetary policy shock and central bank tone shock, we use a wide range of data on private sector forecasts, central bank projections and monetary policy minutes. Details on the data are provided below.

2.1 Private sector expectations

We employ monthly data on private sector forecasts of inflation and interest rate from the Thomson Reuters survey and the Bloomberg survey. Both surveys target the same group of participants, i.e. forecasters from the financial sector; however, they differ slightly in the coverage of variables, forecast horizons and timing of the survey. We measure expectations as the median of individual forecasts.

We consider inflation expected in the current quarter, +1 quarter, +2 quarters, +3 quarters and +4 quarters as well as NBP interest rate expected at the end of the analogous forecast horizons.[5] In general, expectations of private sector are available starting from November 2011. For the longest forecast horizon (+4 quarters) we are able to extend series back to May 2007, if we proxy +4-quarter horizon with +12-month horizon.[6] Variety of horizons allows us to better understand the interplay

[4] Nevertheless, monetary policy might have an indirect impact on the expectations of these agents, namely through expectations of experts that influence expectations of firms and consumers (as suggested by the epidemiological model, see Carroll 2003, 2006).

[5] When modeling expectations that refer to the end of a quarter, the horizon of expectations varies depending on the month of the survey. To control for this effect, we introduce into the model two dummies, which represent second and third months of the quarter.

[6] The horizons +4 quarters and +12 months ahead differ slightly given monthly frequency of our data. For example, in October 2017, the former horizon refers to inflation in 4th quarter 2018 and interest rate at the end of December 2018, while the latter – to inflation in October 2018 and interest rate at the end of October 2018. Nevertheless, we treat both series as homogeneous. Alternatively, we could approximate +12 months forecasts based on forecasts for the current and next year with a method outlined by Dovern and Fritsche (2008) and Dovern et al. (2012); however, such an approach has been questioned recently (Yetman, 2018).

between monetary policy and private sector expectations, as different monetary policy tools might be effective at influencing expectations at different time horizons.

Additionally, for constructing the surprise component of central bank projections, we employ forecasts of annual CPI inflation and GDP growth for the current year and the next two years. If the forecasts at all these horizons are not available, we calculate the surprise in the macroeconomic projection using only one, shorter horizon (CPI inflation in 4-quarters and annual GDP growth in the current year).

Since we are attempting to explain the change in expectations with new information released between the two consecutive survey rounds, we carefully match the timing of the surveys, monetary policy decisions, releases of macroeconomic projections and MPC minutes.[7]

Among the factors potentially shaping expectations, we include data on macroeconomic surprises, gathered from the Bloomberg survey. The baseline set of these series is quite wide and includes CPI inflation, core inflation, the producer price index, retail sales, industrial production, wage growth, the unemployment rate and GDP growth. In the robustness analysis, we also include a surprise in the NBP reference rate as an alternative to Romer and Romer's (2004) monetary policy shock. Macroeconomic surprises (x_t) are defined as the difference between the actual (A_t) and the forecasted value (F_t), and they express an unexpected component of the macroeconomic variable release. In order to facilitate the interpretation and comparison of coefficient estimates across the variables, we normalise the surprise by dividing it by its standard deviation (sd) (e.g., Andersen et al., 2003; Gürkaynak et al., 2005): $x_t = \frac{(A_t - F_t)}{sd}$.

A summary of the data sources and samples is presented in the Appendix (Table A.1).

2.2 Central bank instruments

2.2.1 Monetary policy shock

We construct our main measure of monetary policy shock in the spirit of the narrative approach of Romer and Romer (2004). This approach employs central bank projections and real-time data to remove the systematic component of interest rate movements. The resulting monetary policy shock represents the unpredictable part of

[7] In the Thomson Reuters survey, the timing of questions on interest rates was different than the timing of questions on expected inflation and GDP growth. The former were asked just before the MPC meetings, while this was not always true for the latter. We do not have information on the exact timing of this part of the survey; however, we know the publication date of the results. Therefore we assume that the survey was conducted one day before the publication day. As a general rule, before 2012, the survey was conducted before the MPC meeting in a given month, and in the remaining years – after that date. Similarly, the participants of the Bloomberg survey declared interest rate expectations before the MPC meetings. Inflation forecasts are taken from the end of the month survey declarations.

the interest rate change. It is not related to the current and expected economic conditions and is orthogonal to the information set of the MPC. Cloyne and Hürtgen (2016) mention several advantages of identifying monetary policy shocks with the narrative approach. Firstly, it accounts for the fact that monetary policy is forward-looking and reacts not only to the current developments in the economy but also anticipated ones. Secondly, central bank projections, including nowcasts, reflect the real-time assessment of the economic situation, in contrast to ex-post revised data. Thirdly, projections of inflation and GDP growth embody a wide set of economic indicators, so we treat these projections as representative of the overall macroeconomic situation.

In our application, we modify the original Romer and Romer (2004) approach in line with suggestions by Champagne and Sekkel (2018) and Maule and Hubert (2016) to account for the open character of the Polish economy and for a potentially heterogeneous view on future economic outcomes by policymakers and private sector forecasters. We regress a change in the central bank rate (reference rate) between two consecutive MPC meetings (Δi_m) on the lagged interest rate (i_{m-1}), the inflation projection for the current quarter and for 4 quarters ahead ($\pi_m^{cb,+0}, \pi_m^{cb,+4}$), the GDP growth projection for the current quarter and for 4 quarters ahead ($y_m^{cb,+0}, y_m^{cb,+4}$), revisions of central bank projections, deviation of the private sector forecast of inflation ($\pi_m^{ps,+4}$) and GDP growth ($y_m^{ps,+1}$) from the central bank projections, the most recent known CPI inflation rate (π_m) and industrial production dynamics (ip_m), the interest rate in the euro area at the time of the MPC meeting and the latest change in this rate ($i_m^{ea}, \Delta i_m^{ea}$), and the exchange rate before the meeting and its change between the meetings ($ex_m, \Delta ex_m$). The subscript m refers to the monetary policy meeting since the estimated equation describes the change in the interest rate between two consecutive meetings which do not necessarily occur with regular monthly frequency. In periods when no new central bank projection is prepared, we use the latest available projection.

The model specification is the following:

$$\begin{aligned}\Delta i_m = {} & c + \alpha i_{m-1} + \beta_1 \pi_m^{cb,+0} + \beta_2 \pi_m^{cb,+4} + \beta_3 y_m^{cb,+0} + \beta_4 y_m^{cb,+4} + \beta_5 (\pi_m^{cb,+0} - \pi_{m-1}^{cb,+0}) + \\ & + \beta_6 (\pi_m^{cb,+4} - \pi_{m-1}^{cb,+4}) + \beta_7 (y_m^{cb,+0} - y_{m-1}^{cb,+0}) + \beta_8 (y_m^{cb,+4} - y_{m-1}^{cb,+4}) + \\ & + \gamma_1 (\pi_m^{ps,+4} - \pi_m^{cb,+4}) + \gamma_2 (y_m^{ps,+1} - y_m^{cb,+1}) + \lambda_1 \pi_m + \lambda_2 ip_m + \lambda_3 i_m^{ea} + \lambda_4 \Delta i_m^{ea} + \\ & + \lambda_5 ex_m + \lambda_6 \Delta ex_m + \epsilon_m \end{aligned} \tag{1}$$

Our measure of the monetary policy shock is the residual from equation (1). In order to convert the series of shock from the MPC meeting frequency to the monthly frequency, we assume that in months with no policy meeting, the shock is equal to zero (Champagne and Sekkel, 2018; Cloyne and Hürtgen, 2016; Romer and Romer, 2004). We denote the resulting monetary policy shock measure, used in the remaining

part of the analysis, as $\widetilde{i}_t$. The estimation results of equation (1) and the measure of the monetary policy shock are shown in the Appendix.

2.2.2 Central bank tone shock

The instruments that NBP uses to communicate its policies include, among others, the press releases and press conferences that take place immediately after policy meetings, as well as monetary policy minutes, which are published usually with a delay of 2 weeks after the interest rate decision announcement. Before March 2011, the publication lag was greater, equal to 3-4 weeks. In the current study, we analyse the tone (polarity) of monetary policy minutes. These documents have been published regularly (roughly monthly) since 2007 and describe the course of the discussion at the decision-making session, including discussion on inflation and its determinants. We decided to analyse the texts published by NBP in English in order to avoid potential bias related to the translation of language resources into Polish.[8]

To extract the central bank sentiment from the minutes of the MPC, we employ two dictionaries specifically introduced to measure the tone of monetary policy documents.[9] The ABG dictionary was introduced to measure the tone of the minutes of the Swedish central bank (Sveriges Riksbank), and it provides a list of 55 two-word combinations classified as expressing "hawkish" or "dovish" sentiment. Examples of the expressions inclined toward raising interest rates ("hawkish") include "strong growth", "higher inflation" and "increasing employment", while the list of "dovish" phrases (which herald interest rate reductions) includes "decreasing inflation", "weakening growth" and "low wages". The dictionary was originally developed for the Swedish language. This involves issues related to its conversion into English and may cause a potential bias resulting from inaccurate translations.

The second dictionary, BN, was introduced to extract the tone of the public speeches given by European Central Bank Governing Council members. It delivers single words lists, again expressing the hawkishness and dovishness of the monetary policy course as conveyed by the texts analysed. Examples of hawkish (dovish) keywords include: "accelerat*",[10] "better", "boom*" ("collaps*", "contraction", "dampen*"). The BN dictionary contains 26 entries reflecting hawkish monetary policy and 32 dovish keywords.

[8] Both dictionaries which are used to measure central bank tone of minutes are in English. To the best of our knowledge, there is no corresponding language resource designed for financial purposes available in Polish.

[9] We did not consider the Loughran and McDonald (2011) dictionary since it was developed to capture the tone within a relatively broad financial context. In other words, we expect the tailor-made monetary policy sentiment dictionaries to be better suited to extracting the timbre of the texts analysed.

[10] The asterisk symbol (*) denotes a wildcard representing any possible ending, including an empty one, e.g., "boom*" matches both "boom" and "booming".

In line with the dictionary approach, we search and count the occurrences of single words (BN) or two-word phrases (ABG) and calculate the tone (polarity) of each of the analysed communiques as:

$$s^{dict} = \frac{\#hawkish - \#dovish}{\#hawkish + \#dovish} \tag{2}$$

where ($dict$) denotes dictionary used (ABG or BN) and ($\#hawkish$) and ($\#dovish$) are the counts of words/phrases according to the dictionary employed.[11] Figure 1 shows that both measures of central bank tone generally follow a similar pattern over time and are positively—albeit moderately—correlated with each other (the Pearson correlation coefficient is equal to 0.58).

Like with the monetary policy shock, we compute the central bank tone shock by orthogonalising 'raw' tone of the MPC minutes with respect to macroeconomic conditions and financial market stance. We do so by regressing the sentiment published at time p (s_p) on monthly macroeconomic indicators (CPI and industrial production, π and ip) released in the period since the publication of the previous MPC minutes, the monetary policy shock as well as financial market variables, including the WIBOR overnight and 1-year interbank interest rate (i^{ON} and i^{1Y} respectively) and the Warsaw Stock Exchange index, WIG (WIG). In addition, as Poland is a small, open economy, we also include variables describing the world economy, i.e. the global economic policy uncertainty index (Baker et al. 2016, $EPUI$) and the dynamics of oil price (π^{oil}). To capture the persistence of the tone measure, we supplement the set of explanatory variables with the tone of the previous MPC meeting. We take the values of the right-hand-side variables at the time the minutes were published by NBP, rather than at the time of the interest rate decision. This means that our modelling approach is rather conservative – we include not only all the potential variables that influence the central bank communication at the day of MPC meeting, but we also orthogonalise tone to the information coming between the interest rate decision and the date that the minutes are published. Thus, we estimate the following equation:

$$\begin{aligned} s_p = c + \alpha_1 s_{p-1} + \alpha_2 \pi_p + \alpha_3 ip_p + \alpha_4 EPUI_p + \alpha_5 \widetilde{i}_p + \alpha_6 i_p^{ON} + \alpha_7 i_p^{1Y} + \\ + \alpha_8 WIG_p + \alpha_9 \Delta \pi_p^{oil} + \epsilon_p \end{aligned} \tag{3}$$

Taking residuals from the above equation, denoted as $\widetilde{s}$, we get the component of the tone of the central bank minutes that is independent of the information available on the day the text of the minutes is published. Finally, to facilitate interpretation, we normalise the shock by dividing it by its standard deviation. The estimation results

[11] Since the most commonly used words are useless in capturing the tone, we decided to remove the stopwords before extracting the tone of the texts. We used the list of English stopwords included in the NLTK library.

of equation (3) and the figure showing orthogonalised tone shocks are presented in the Appendix.

2.2.3 Central bank projections

NBP has published CPI inflation and GDP growth projections three or four times a year since 2004. The projections are prepared assuming a constant interest rate over the whole forecasting horizon, which covers the current and two subsequent years. The timing of the publication of the projections has evolved over time, but it was always closely tied to the MPC meetings and the publication of the Inflation Reports.

We consider the surprise component of the NBP projections in the same way as in the case of releases of macroeconomic data. Specifically, we calculate the difference between the most recent expert forecasts of CPI inflation or GDP growth and the newly released central bank projections. In months without a new central bank projection, the surprise is equal to zero.

Our surprise measure in the central bank projections refers to the whole projection horizon, as we take the averages of the expert forecasts and NBP projections for the current year and next two years. There are two exceptions to this rule. Firstly, in the case of interest rate and inflation expectations analysed throughout the sample starting in 2007, we use surprise in the CPI inflation projection for +4 quarters and surprise in the GDP growth projection in the current year. The reason is that the expert forecasts for horizons that correspond to projections start only in 2011. Secondly, in the robustness analysis of the results for inflation expectations, we use the same inflation projection horizon as the horizon of the dependent variable, i.e. we explain inflation expectations in the $+h$ quarter with the surprise in the inflation projection for the $+h$ quarter.

3 Empirical analysis

3.1 Model of expectations formation

Following Maule and Hubert (2016), we model expectations of the private sector experts (F_t^{ps})—either inflation expectations (π_t^{ps}) or NBP reference rate expectations (i_t^{ps})—as a function of past expectations and new information that became available in a given period (Ω_t).

$$F_t^{ps} = \lambda_1 F_{t-1}^{ps} + \lambda_2 \Omega_t \tag{4}$$

This approach is related to the sticky-information framework which assumes that in each period, a fraction of the economic agents update their expectations in line with the new information (Mankiw and Reis, 2002; Carroll, 2003).

Series on expectations are highly persistent; therefore, in the empirical specification, we apply the restriction $\lambda_1 = 1$. As a consequence, we model forecast revisions (changes) rather than levels. A similar strategy was adopted by Pedersen (2015). In our specification, expectations (at the $+h$ horizon) depend on central bank tone shock ($\widetilde{s}$), monetary policy shock ($\widetilde{i}$), central bank projections regarding CPI inflation (π^{cb}) and GDP growth (y^{cb}), as well as macroeconomic surprises based on new information from the economy (x). All right-hand-side variables refer to information released between the two consecutive survey rounds (current and previous, t and *t-1*, accordingly). As a result, we estimate the following model, both for interest rate and inflation expectations:

$$\Delta F_t^{ps,+h} = c + \alpha_1 \widetilde{s}_t + \alpha_2 \widetilde{i}_t + \alpha_3 \left(\pi_t^{ps,+H} - \pi_t^{cb,+H}\right) + \alpha_4 \left(y_t^{ps,+H} - y_t^{cb,+H}\right) + \sum_{j=1}^{k} \beta_j x_{j,t} + e_t \tag{5}$$

Virtually all central bank instruments are endogenous, i.e. they not only influence the economy, but they themselves also depend on the current and expected state of the economy. In the case of central bank tone and interest rate change, we deal with endogeneity by employing shocks that are orthogonal to the current information set—obtained in the spirit of Romer and Romer's (2004) narrative approach—rather than "raw" tone or interest rate change, as explained in sections 2.2.1 and 2.2.2. Alternatively, instead of monetary policy shock, we employ surprises in interest rate decisions based on survey data. In the case of macroeconomic projections prepared by NBP staff, we use their surprise component, defined as a difference between the most recent experts' forecast and newly published inflation or GDP growth projection. We consider the whole paths of forecasts rather than focus on a specific projection horizon; hence, we average the difference between these two forecasts over the current and the next two years ($+H$).

There are other factors, not included in model (5), which could possibly affect private sector expectations. We analyse these extensions in Section 3.3. First of all, central banks—apart from macroeconomic projections and minutes—employ other communication tools aimed at managing expectations. Recently, many central banks have used forward guidance to affect expectations regarding future monetary policy decisions. It has been shown that successful forward guidance reduces interest rate expectations (e.g. Hubert and Labondance, 2018; Andrade et al., 2019) and decreases uncertainty; however, the effectiveness of this communication strategy depends on the form (e.g. Coenen et al., 2017; Ehrmann et al., 2019). Secondly, empirical evidence indicates that inflation expectations react to oil prices. This concerns expectations derived from financial markets (e.g., Sussman and Zohar, 2018), as well as from survey data covering different groups of economic agents, i.e. consumers (e.g. Coibion and Gorodnichenko, 2012, 2015), firms (e.g. Richards and Verstraete, 2016) and experts (ECB, 2017).

3.2 Overview of the main results

The aim of our empirical testing is to verify whether central bank communication, namely changes in the tone of minutes published after the MPC meetings, as well revisions of the central bank projections and interest rate decisions, are relevant in explaining movements in interest rate and inflation forecasts by private sector experts. To answer this question, we estimate model (5), considering private sector forecasts at different horizons—from the current quarter up to 4 quarters ahead—over the period 2011:12-2019:02 as well as 4-quarters ahead forecasts over the extended sample period, 2007:07-2019:02.[12] The estimation results reveal that, in general, NBP's actions and communication exert an influence on private sector forecasts. Interestingly, the tone of the MPC minutes affects expectations more at the shortest horizons (nowcasts and one quarter ahead), while GDP and inflation projections play a greater role for slightly longer horizons (two quarters ahead or longer). In addition, interest rate expectations seem to be affected mainly by monetary policy surprises and the factors related to economic activity (either GDP projections published by the central bank or economic activity surprises), while inflation expectations are driven mainly by inflation surprises and—for selected horizons—by central bank communication (either central bank tone or inflation projections).

[12] In this case, we account for the potential impact of the global financial crisis (GFC) on experts' expectations by introducing a dummy variable for the period from October 2008 to March 2009, which corresponds to the most severe phase of the crisis.

3.2.1 The role of monetary policy actions

Positive monetary policy shocks raise the expected interest rate in the current quarter (Table 1 and 2), while they do not affect inflation expectations at any forecast horizon (Table 3 and 4). However, with the extended sample period, monetary policy shocks seem to influence revisions of interest rate expectations one year ahead. It should also be noted that we find greater sensitivity of expectations to monetary policy decisions if we use interest rate surprise instead of monetary policy shock as a measure of central bank actions (see section 3.3.1). Unresponsiveness of inflation expectations to central bank actions for very short horizons might be explained by lags in monetary policy transmission, as inflation typically reacts to interest rate changes only after several quarters (e.g. Havranek and Rusnak, 2013). The empirical evidence on sensitivity of short-term inflation expectations (one-year ahead) to monetary policy shocks offered in the literature is mixed. For example, Barnett et al. (2010) find no statistically significant reaction of experts inflation forecasts for UK, for the euro area Hubert (2015b) shows that inflation expectations increase after a positive monetary policy shock, while Leduc et al. (2007) and Banerjee and Malik (2012) argue that the response of inflation expectations to policy rate in the US is time-varying, in some periods being negative and in other being insignificant.

3.2.2 The role of central bank macroeconomic projections

As far as the macroeconomic projections of the NBP are concerned, interest rate expectations two and three quarters ahead increase after a positive surprise in the GDP growth projection (Table 1 and 2), while inflation expected four quarters ahead increases after a positive surprise in the NBP inflation projection (Table 3 and 4). A significant impact of central bank inflation projections on the yearly inflation expectations of economic experts is also confirmed in the longer sample. The magnitude of this influence is not large, although not negligible: on average, the NBP inflation projection surprise at the projection horizon (current year and the next two years) of 1 perc. point moves the expected inflation in one year upward by about 0.13 perc. points. The impact of the central bank's GDP growth projection on the expected change in the NBP reference rate seems even larger (the parameter estimates are equal to 0.21-0.26).

The direction of reaction of interest rate expectations to GDP growth forecasts is in line with economic intuition. More optimistic view of policy makers on future economic activity prompts private sector experts to expect monetary policy tightening in the near future. This suggests that private sector experts perceive economic activity as an important driver of monetary policy decisions. In this context it is interesting to observe that experts' interest rate forecasts adjust neither to surprises in the NBP

inflation projection nor to surprises in current CPI inflation. It is probably related to the fact that since early 2015 the NBP monetary policy has become inactive, i.e. despite substantial volatility of inflation, in particular its large negative deviations from the target, the NBP reference rate has stayed at the same level.

Our finding that experts pay attention to inflation projections only while formulating inflation expectations in the 4-quarter horizon, but not in shorter forecast horizons, seems plausible given the delays of the monetary policy transmission mechanism (Kapuściński, 2018). Moreover, in this forecast horizon the NBP inflation projections outperform private sector forecasts (Kowalczyk and Stanisławska, 2016), which could encourage experts to adjust their expectations to the central bank view.

3.2.3 The role of textual content of monetary policy minutes

The results on the importance of the textual content of MPC minutes, measured with the BN and ABG dictionaries, suggest that these lexicons indeed capture slightly different shades of monetary policy communication. Tone shocks based on the ABG dictionary positively affect interest rate expectations for all forecasting horizons, except the 4-quarter ahead horizon on the shorter sample (Table 1). It implies that when the tone of the minutes, analysed with more precise combinations of two or three words, gets more hawkish, experts expect more restrictive monetary policy over the next year. A typical increase in the measure of central bank communication is followed by a rise in NBP reference rate expectations by 0.03-0.05 perc. points. At the same time, the tone measure derived from the BN dictionary, which contains single words, but not explicitly controlling for the context, indicates that expectations at a 4-quarter horizon do react to the central bank communication tone, but we are only able to identify this impact on the longer sample (Table 2). The conclusion that central bank tone affects interest rate expectations at selected forecasting horizons is in line with Hubert and Labondance (2018) who analyzed market based expectations in the US.

Central bank tone seems to affect inflation expectations only at very short horizons, up to 1 quarter, but this result holds only for the tone extracted using BN dictionary (Table 4). The impact of a typical change in central bank tone on inflation expectations is similar to the impact of a typical change in the CPI inflation surprise. The ABG tone is not useful in explaining changes in inflation expectations (Table 3). Our results concerning inflation expectations up to 1 year complement these by Hubert and Labondance (2018). They analyse link between central bank tone and long-term inflation expectations (from 3- to 10-years ahead) derived from financial markets in the US and find that tone of central bank publications affects negatively only inflation expectations in 10-years horizon. We show that monetary policy makers might affect inflation expectations by the tone of its documents also at very short horizons.

As far as detailed results from our analysis are concerned, it might be surprising that the ABG tone affects interest rate expectations but not inflation expectations, while the BN sentiment influences the latter but not the former. We link this observation with the fact that the ABG dictionary was designed to capture the predictive power of monetary policy minutes concerning future monetary policy decisions. Apel and Blix Grimaldi (2014) chose from a list of nouns that particularly *"closely reflect the goals and concerns of the monetary policy maker"* (Apel and Blix Grimaldi, 2014, p. 61) and combined it with a set of adjectives expressing the monetary policy inclination. They confirmed the predictive power of the monetary policy minutes to the future policy rate decisions of the Swedish Riksbank even when controlling for macroeconomic fundamentals and market expectations. This suggests that the minutes convey information that cannot be readily inferred from the current and expected economic conditions. On the other hand, the BN dictionary was developed to measure the tone of public speeches of ECB Governing Council members. This dictionary includes terms which are explicitly related to future monetary decisions as well as words that reflect monetary policy course through the lens of economic conditions. We find that BN tone shock affects inflation expectations (for the shortest horizons), but not interest rate expectation. This result is quite surprising, as the BN dictionary[13] does not contain any specific words related to nominal variables, while 5 out of the 11 nouns used in the ABG dictionary refer to nominal variables[14].

3.2.4 The role of macroeconomic surprises

As far as macroeconomic surprises are concerned, we find that unexpected movements in economic activity—either in GDP growth rate or in retail sales—lead to changes in the expected path of the policy rate (Table 1 and 2), while CPI and PPI inflation surprises make experts adjust inflation forecasts (Table 3 and 4).[15] Interestingly, macroeconomic surprises affect interest rate and inflation expectations of experts at almost all, even relatively long, forecast horizons.[16] Sensitivity of the private sector expectations to macroeconomic news has been documented in many studies, focusing mainly on long-term inflation expectations derived from financial market (e.g. Coffinet and Frappa, 2010; Gürkaynak et al., 2010; Miccoli and Neri, 2019). Evidence similar to ours—that short-term (one-year ahead) inflation expectations of experts react to macroeconomic surprises—is presented in Bauer (2015).

[13] See footnote 9 in Bennani and Neuenkirch (2017).

[14] See Appendix in Apel and Blix Grimaldi (2014).

[15] It is worth mentioning that initially we included among the regressors a larger set of macroeconomic surprises (regarding unemployment rate, wage growth or core inflation); however, they proved not to be statistically significant.

[16] We estimated an analogous model without variables capturing the effects of central bank communication (the results are available on request). The conclusions regarding the impact of macroeconomic surprises and monetary policy decisions on expectation revisions were broadly the same.

3.3 Robustness

3.3.1 An alternative measure of monetary policy actions

As a robustness check, we employ an alternative measure of monetary policy decisions, which is the difference between the NBP reference rate expected by the survey participants (a median forecast) and the actual reference rate after the MPC meeting. The survey is conducted just before the MPC meeting; hence, we expect this measure of monetary policy surprise to be orthogonal to the information set available at the moment of the interest rate decision. Between May 2007 and February 2019, the median forecast correctly predicted the level of the NBP reference rate in 119 out of 132 cases; six times it underestimated it and seven times it overestimated it. Similarly, as in the case of the monetary policy shock, in months with no interest rate decision, the surprise is equal to zero.

The estimation results presented in Tables 5–8 show that our conclusions about the role of communication and macroeconomic surprises are robust to the choice of monetary policy action measure. In particular, they confirm that interest rate expectations for the first three quarters of the forecasting horizon are affected by tone shock measured with the BN dictionary, and interest rate expectations for the second and third quarter are affected by GDP projections. Moreover, inflation expectations for the first two quarters adjust to tone shock measured with the use of the ABG dictionary and inflation expectations in the 4-quarter horizon adjust to the inflation projection of the central bank.

Interestingly, we find monetary policy decisions play a greater role in experts' expectations. A positive interest rate surprise by one standard deviation increases the expected NBP reference rate at all horizons by about 0.05-0.06 perc. points. We also get a statistically significant reaction of inflation expectations in 4 quarters if the model is estimated on a shorter sample. A positive interest rate surprise by one standard deviation is followed by a decrease in expected inflation rate by 0.03 perc. points. Over the longer sample, the parameter estimate on interest rate surprise is also negative, but not statistically significant. The direction of change in inflation expectations, as well as the time horizon (+4 quarters), is in line with the lags of the monetary transmission mechanism in Poland identified in the empirical literature (e.g. Chmielewski et al., 2018; Kapuściński, 2018; Haug et al., 2019), as the strongest reaction of inflation to interest rate change occurs 3 to 7 quarters after the change.

In general, models with this alternative measure of monetary policy action better fit the data, as indicated by higher R^2 statistics and the results of the $F-test$ for statistical significance of all slope parameters.

3.3.2 Forward guidance

NBP used forward guidance in 2013 and 2014 (NBP, 2014). It was unconditional and concerned relatively short horizons – the announced period of constant interest rates did not exceed three quarters. After the press conference in June 2013, the NBP President stated that interest rate should stay unchanged until the end of 2013. In consecutive months, press releases after the MPC meetings confirmed that interest rates would remain at the current level until the end of 2013. This period was later extended to the end of the third quarter of 2014. This communication affected interest rate expectations, diminishing the impact of the exogenous variables on interest rate expectations (Baranowski and Gajewski, 2016; Kapuściński et al., 2016).

We account for the possibility that the NBP forward guidance affected the interest rate expectations of experts by extending our baseline specification with a dummy variable and its interactions with macroeconomic surprises. We find a very limited impact of forward guidance on experts' interest rate expectations (Table A.5 and A.6). It seems that expectations for the current quarter increased after NBP announced the forward guidance. This is consistent with the observed changes in forward-rate agreement (FRA) contracts at that time and might be linked to the fact that forward guidance reduced expectations of further interest rate cuts (NBP, 2014). Our estimation results also suggest that during the forward guidance period, experts reacted less to GDP growth surprises when forming interest rate expectations for longer horizons. The finding that forward guidance had a small impact on expected interest rates is in line with Ehrmann et al. (2019), who show that short-term date-contingent forward guidance, like the one implemented in Poland, is not very effective.

When it comes to assessing the impact of central bank communication on interest rate expectations, accounting for the effects of forward guidance does not change our baseline results.

3.3.3 Oil prices

Inflation expectations might also be affected by oil prices. We do not have data about experts' expectations regarding oil prices at our disposal, so we are not able to add oil price surprise in the regressor set in a similar way as macroeconomic surprises. However, given that oil prices are difficult to predict, if not unpredictable, we overcome this problem by including a monthly change in oil prices (in USD) in our specification.

Tables A.7 and A.8 show that experts slightly increased the 4-quarter ahead expected inflation rate after the rise in oil prices, when longer sample is considered. For shorter forecast horizons and shorter samples, we find no significant impact of oil prices on expected inflation.

3.3.4 Matching horizons of macroeconomic projection

The last exercise consists of checking the sensitivity of our results with respect to the horizon of macroeconomic projection employed as one of the regressors. In the baseline specification, we assume that experts adjust their expectations to a surprise in inflation and GDP growth projections over the whole projection horizon (the current and the next two years), meaning that experts do not concentrate on any specific projection horizon, but rather they pay attention to the whole path of future economic developments. However, in the case of inflation expectations, matching the horizon of the NBP projection with the horizon of inflation expectations also seems plausible. For example, when experts formulate expectations of inflation in +1 quarters, they might pay more attention to inflation and GDP growth projections in +1 quarters than to projections over three years.

The estimation results presented in Tables A.9 and A.10 confirm the previous finding that experts increase inflation expectations 4-quarters ahead (over shorter and longer sample) after a positive surprise in NBP inflation projections, and that they adjust expectations for the nearest two quarters to central bank tone measured with the ABG dictionary. Even after adjusting the macroeconomic projection horizons, we still do not find a meaningful or significant impact of central bank projections on shorter forecast horizons.[17] The results on central bank tone and interest rate change remain valid.

[17] In two cases, for inflation in the current and next quarter, we get an estimate of parameters related to GDP growth or inflation projections that is unintuitive but statistically significant at 10%.

4 Conclusions

The management of expectations is at the core of contemporary monetary policy. Central banks engage in a variety of forms of communication, trying to affect the expectations of different groups of economic agents and augmenting the impact of monetary policy decisions. In this paper, we scrutinise the impact that both monetary policy words (communication) and deeds (interest rate decisions) have on the expectations of private sector experts in inflation targeting economy. We apply two measures of monetary policy actions, i.e. monetary policy shocks identified with Romer and Romer's (2004) narrative approach and survey-based measures of the unexpected component of monetary policy decisions (interest rate surprise). Central bank communication is represented by surprise components of macroeconomic projections (regarding GDP growth and inflation) and the tone of monetary policy minutes, i.e. the extent to which the communication is hawkish or dovish. Quantifying the latter one we apply two dictionaries proposed by Apel and Blix Grimaldi (2014) and Bennani and Neuenkirch (2017). These two dictionaries use distinct linguistic approaches (single words vs. phrases) and as such capture different "shades" of monetary policy communication.

Our empirical findings show that both monetary policy actions and communication do affect interest rate and inflation expectations of the private sector experts in Poland. Unexpected increase in the NBP main interest rate leads to an upward shift in the path of expected interest rate over next year and to a decrease in expected inflation 4 quarters ahead, however this result does not hold if the Romer and Romer's (2004) monetary policy shock is used instead of interest rate surprises. The effects of central bank communication are also non-negligible. Interest rate expectations 2-3 quarters ahead increase after a positive surprise in the central bank GDP projection, while 4-quarter ahead inflation expectations increase after a positive surprise in the central bank inflation projection. The tone of policy documents positively affects interest rate expectations 4 quarters ahead and—albeit only in the case of the measure based on ABG dictionary—in shorter horizons. The tone of central bank documents seems to affect also inflation expectations, but only in very short horizons and using the BN dictionary.

The main novelties of our study are accompanied by some limitations. Firstly, to the best of our knowledge, it is the first study that jointly assesses the impact of monetary policy actions and communication, including the tone of documents published by decision-makers, on survey-based measures of interest rate and inflation expectations. Even if the coverage of central bank tools seems wider than in the existing literature, we still miss some important elements in this respect. For instance, we do not analyse the textual content of Inflation Reports, press releases or irregular communication of the MPC members. Secondly, in measuring the tone of monetary policy documents,

we consider two distinct linguistic approaches (single words vs. phrases) capturing different dimensions of central bank communication and extensively used in the empirical literature. In this way, we are able to identify more potential channels of the impact of central bank communication on private sector forecasts. The constraint we face in this area is the use of English versions of monetary policy documents, which, translated from Polish, do not necessarily fully reflect the MPC intentions as read by market participants from minutes prepared originally in Polish. Despite the above drawbacks, our main results still remain robust to changes in the specification of the estimated model.

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Tables and figures

Figure 1: Tone measures of MPC Minutes

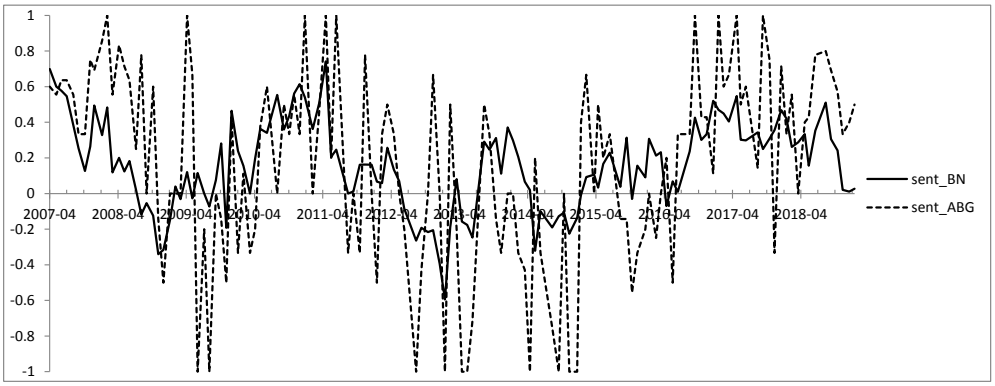


Table 1: Estimation results for interest rate expectations – ABG tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	0.046***	0.018	0.023	0.021	0.020	0.035**
std. error	(0.013)	(0.021)	(0.020)	(0.020)	(0.020)	(0.014)
CB tone	0.044***	0.04**	0.031**	0.033*	0.040	0.041**
std. error	(0.016)	(0.019)	(0.015)	(0.019)	(0.025)	(0.020)
surprise in CB inflation projection	0.024	0.029	-0.115	-0.035	-0.05	-0.038
std. error	(0.043)	(0.070)	(0.076)	(0.102)	(0.101)	(0.055)
surprise in CB GDP projection	0.095	-0.046	0.205***	0.263**	0.108	0.105
std. error	(0.073)	(0.086)	(0.073)	(0.118)	(0.184)	(0.088)
CPI inflation surprise	-0.008	-0.013	-0.004	-0.007	0.024	0.015
std. error	(0.008)	(0.010)	(0.010)	(0.012)	(0.019)	(0.014)
GDP growth surprise	0.019**	0.022**	0.044**	0.018	0.013	-0.015
std. error	(0.008)	(0.011)	(0.018)	(0.015)	(0.016)	(0.013)
retail sale surprise	0.019*	0.015	0.020	0.030*	0.036**	0.048**
std. error	(0.011)	(0.013)	(0.013)	(0.017)	(0.017)	(0.019)
GFC dummy	x	x	x	x	x	-0.383***
std. error						(0.073)
R^2	0.341	0.170	0.179	0.108	0.134	0.282
N	87	87	87	87	87	140
F-test statistics	4.435	1.752	1.870	1.037	1.329	6.421
F-test p-value	0.000	0.092	0.069	0.419	0.236	0.000

Notes: OLS estimates with Newey-West standard errors. F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 2: Estimation results for interest rate expectations – BN tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	0.041***	0.014	0.017	0.015	0.015	0.035**
std. error	(0.014)	(0.022)	(0.020)	(0.020)	(0.022)	(0.015)
CB tone	0.020	0.019	-0.010	-0.008	0.011	0.027*
std. error	(0.014)	(0.014)	(0.019)	(0.022)	(0.022)	(0.016)
surprise in CB inflation projection	0.023	0.029	-0.125*	-0.045	-0.053	-0.044
std. error	(0.045)	(0.068)	(0.070)	(0.10)	(0.095)	(0.058)
surprise in CB GDP projection	0.063	-0.076	0.192**	0.249*	0.081	0.084
std. error	(0.086)	(0.089)	(0.077)	(0.135)	(0.173)	(0.094)
CPI inflation surprise	-0.008	-0.013	-0.002	-0.005	0.024	0.015
std. error	(0.010)	(0.011)	(0.011)	(0.013)	(0.019)	(0.014)
GDP growth surprise	0.015*	0.019	0.043**	0.018	0.011	-0.014
std. error	(0.009)	(0.013)	(0.020)	(0.017)	(0.018)	(0.014)
retail sale surprise	0.013	0.010	0.016	0.026	0.031*	0.046**
std. error	(0.010)	(0.013)	(0.013)	(0.017)	(0.017)	(0.02)
GFC dummy	x	x	x	x	x	-0.368***
std. error						(0.074)
R^2	0.234	0.105	0.139	0.072	0.087	0.261
N	87	87	87	87	87	140
F-test statistics	2.611	1.004	1.384	0.665	0.816	5.770
F-test p-value	0.011	0.444	0.210	0.738	0.603	0.000

Notes: OLS estimates with Newey-West standard errors. F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 3: Estimation results for inflation expectations – ABG tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	-0.012	-0.013	-0.027	0.030	0.010	0.011
std. error	(0.033)	(0.032)	(0.028)	(0.022)	(0.013)	(0.012)
CB tone	0.025	0.038	0.012	0.003	0.001	0.004
std. error	(0.030)	(0.033)	(0.030)	(0.019)	(0.013)	(0.013)
surprise in CB inflation projection	0.157	0.112	0.126	-0.034	0.133*	0.141***
std. error	(0.099)	(0.121)	(0.147)	(0.125)	(0.072)	(0.033)
surprise in CB GDP projection	-0.042	0.096	-0.069	0.295	0.030	-0.029
std. error	(0.185)	(0.578)	(0.429)	(0.280)	(0.135)	(0.093)
CPI inflation surprise	0.076***	0.060	0.054	0.054**	0.033**	0.030***
std. error	(0.023)	(0.037)	(0.044)	(0.024)	(0.013)	(0.009)
PPI inflation surprise	0.138**	0.127**	0.150**	0.061**	0.051**	0.018
std. error	(0.058)	(0.050)	(0.062)	(0.03)	(0.022)	(0.016)
GDP growth surprise	-0.004	0.003	-0.021	-0.015	-0.003	-0.007
std. error	(0.024)	(0.022)	(0.022)	(0.019)	(0.012)	(0.009)
retail sale surprise	0.050	0.013	0.022	0.029	0.038	0.018
std. error	(0.039)	(0.055)	(0.047)	(0.032)	(0.028)	(0.021)
GFC dummy	x	x	x	x	x	-0.245***
std. error						(0.050)
R^2	0.277	0.334	0.272	0.359	0.358	0.285
N	87	87	87	87	87	140
F-test statistics	2.908	3.807	2.842	4.259	4.236	5.751
F-test p-value	0.004	0.000	0.005	0.000	0.000	0.000

Notes: OLS estimates with Newey-West standard errors. F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 4: Estimation results for inflation expectations – BN tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	-0.007	-0.012	-0.030	0.030	0.011	0.011
std. error	(0.033)	(0.031)	(0.029)	(0.022)	(0.012)	(0.012)
CB tone	0.081**	0.069**	-0.017	0.011	-0.012	0.004
std. error	(0.040)	(0.026)	(0.039)	(0.024)	(0.010)	(0.011)
surprise in CB inflation projection	0.200*	0.150	0.118	-0.029	0.119*	0.141***
std. error	(0.102)	(0.121)	(0.138)	(0.129)	(0.072)	(0.036)
surprise in CB GDP projection	-0.130	0.001	-0.072	0.284	0.043	-0.031
std. error	(0.179)	(0.575)	(0.409)	(0.280)	(0.133)	(0.096)
CPI inflation surprise	0.073***	0.058	0.056	0.053**	0.035***	0.030***
std. error	(0.024)	(0.036)	(0.046)	(0.023)	(0.012)	(0.009)
PPI inflation surprise	0.136**	0.128**	0.155**	0.061**	0.051**	0.017
std. error	(0.052)	(0.049)	(0.060)	(0.030)	(0.022)	(0.017)
GDP growth surprise	-0.011	-0.003	-0.020	-0.016	-0.005	-0.007
std. error	(0.024)	(0.025)	(0.022)	(0.020)	(0.012)	(0.009)
retail sale surprise	0.044	0.005	0.020	0.028	0.039	0.019
std. error	(0.038)	(0.052)	(0.045)	(0.031)	(0.029)	(0.021)
GFC dummy	x	x	x	x	x	-0.243***
std. error						(0.050)
R^2	0.317	0.353	0.273	0.36	0.364	0.285
N	87	87	87	87	87	140
F-test statistics	3.532	4.150	2.851	4.282	4.358	5.749
F-test p-value	0.001	0.000	0.005	0.000	0.000	0.000

Notes: OLS estimates with Newey-West standard errors. F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 5: Estimation results for interest rate expectations – alternative monetary policy shock measure, ABG tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q[(1)]	+4q[(2)]
monetary policy surprise	0.054***	0.046**	0.050**	0.054***	0.059***	0.059***
std. error	(0.010)	(0.020)	(0.021)	(0.019)	(0.021)	(0.018)
CB tone	0.038**	0.037**	0.028**	0.030*	0.037*	0.038*
std. error	(0.015)	(0.018)	(0.011)	(0.016)	(0.021)	(0.021)
surprise in CB inflation projection	-0.006	-0.022	-0.168**	-0.097	-0.121	-0.053
std. error	(0.029)	(0.070)	(0.076)	(0.104)	(0.097)	(0.057)
surprise in CB GDP projection	0.114	-0.019	0.233***	0.296**	0.144	0.098
std. error	(0.101)	(0.061)	(0.067)	(0.115)	(0.162)	(0.097)
CPI inflation surprise	0.000	-0.008	0.002	0.000	0.03*	0.013
std. error	(0.007)	(0.008)	(0.010)	(0.011)	(0.016)	(0.012)
GDP growth surprise	0.012*	0.017*	0.038**	0.012	0.007	-0.006
std. error	(0.007)	(0.009)	(0.019)	(0.013)	(0.012)	(0.013)
retail sale surprise	0.016	0.015	0.019*	0.029*	0.036**	0.046**
std. error	(0.010)	(0.010)	(0.010)	(0.015)	(0.015)	(0.018)
GFC dummy	x	x	x	x	x	-0.281***
std. error						(0.07)
R^2	0.429	0.266	0.275	0.203	0.240	0.322
N	87	87	87	87	87	140
F-test statistics	6.439	3.106	3.248	2.183	2.701	7.762
F-test p-value	0.000	0.003	0.002	0.032	0.009	0.000

Notes: OLS estimates with Newey-West standard errors. The F-test refers to test of joint significance of all slope coefficients.[(1)]Estimates on shorter sample (2011:12-2019:02).[(2)]Estimates on longer sample (2007:05-2019:02).

Table 6: Estimation results for interest rate expectations – alternative monetary policy shock measure, BN tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy surprise	0.056***	0.049**	0.05**	0.054***	0.061**	0.060***
std. error	(0.01)	(0.02)	(0.021)	(0.02)	(0.024)	(0.018)
CB tone	0.022	0.023*	-0.006	-0.003	0.017	0.023
std. error	(0.013)	(0.014)	(0.018)	(0.021)	(0.022)	(0.017)
surprise in CB inflation projection	-0.013	-0.028	-0.182**	-0.111	-0.129	-0.060
std. error	(0.034)	(0.072)	(0.078)	(0.109)	(0.098)	(0.061)
surprise in CB GDP projection	0.088	-0.046	0.223***	0.283**	0.120	0.078
std. error	(0.107)	(0.061)	(0.070)	(0.131)	(0.151)	(0.102)
CPI inflation surprise	-0.001	-0.008	0.003	0.001	0.030*	0.013
std. error	(0.008)	(0.009)	(0.010)	(0.011)	(0.015)	(0.013)
GDP growth surprise	0.009	0.014	0.038*	0.012	0.004	-0.006
std. error	(0.007)	(0.010)	(0.020)	(0.015)	(0.014)	(0.014)
retail sale surprise	0.011	0.010	0.016	0.026*	0.031**	0.044**
std. error	(0.009)	(0.010)	(0.010)	(0.014)	(0.015)	(0.018)
GFC dummy	x	x	x	x	x	-0.266***
std. error						(0.072)
R^2	0.359	0.218	0.241	0.172	0.204	0.301
N	87	87	87	87	87	140
F-test statistics	4.785	2.388	2.712	1.777	2.186	7.057
F-test p-value	0.00	0.019	0.008	0.086	0.032	0.000

Notes: OLS estimates with Newey-West standard errors. The F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 7: Estimation results for inflation expectations – alternative monetary policy shock measure, ABG tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy surprise	-0.031	-0.009	-0.006	0.021	-0.032**	-0.017
std. error	(0.038)	(0.032)	(0.028)	(0.017)	(0.014)	(0.011)
CB tone	0.026	0.040	0.015	0.000	0.001	0.006
std. error	(0.031)	(0.031)	(0.030)	(0.018)	(0.011)	(0.012)
surprise in CB inflation projection	0.200**	0.112	0.101	-0.035	0.176***	0.155***
std. error	(0.092)	(0.120)	(0.155)	(0.127)	(0.061)	(0.032)
surprise in CB GDP projection	-0.071	0.095	-0.056	0.299	0.021	-0.038
std. error	(0.191)	(0.584)	(0.429)	(0.275)	(0.131)	(0.083)
CPI inflation surprise	0.072***	0.058	0.052	0.058**	0.036***	0.032***
std. error	(0.021)	(0.038)	(0.044)	(0.023)	(0.012)	(0.009)
PPI inflation surprise	0.145**	0.127**	0.149**	0.059**	0.062***	0.019
std. error	(0.058)	(0.051)	(0.063)	(0.030)	(0.021)	(0.017)
GDP growth surprise	-0.002	0.004	-0.020	-0.017	-0.003	-0.009
std. error	(0.025)	(0.022)	(0.023)	(0.019)	(0.013)	(0.011)
retail sale surprise	0.048	0.014	0.025	0.027	0.023	0.019
std. error	(0.038)	(0.054)	(0.047)	(0.031)	(0.028)	(0.020)
GFC dummy	x	x	x	x	x	-0.291***
std. error						(0.046)
R^2	0.284	0.333	0.268	0.356	0.390	0.289
N	87	87	87	87	87	140
F-test statistics	3.015	3.800	2.787	4.197	4.853	5.864
F-test p-value	0.003	0.000	0.005	0.000	0.000	0.000

Notes: OLS estimates with Newey-West standard errors. The F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Table 8: Estimation results for inflation expectations – alternative monetary policy shock measure, BN tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy surprise	-0.024	-0.004	-0.007	0.022	-0.031**	-0.017
std. error	(0.038)	(0.034)	(0.028)	(0.017)	(0.013)	(0.011)
CB tone	0.079**	0.070***	-0.014	0.010	-0.009	0.006
std. error	(0.038)	(0.025)	(0.039)	(0.024)	(0.009)	(0.011)
surprise in CB inflation projection	0.236**	0.141	0.092	-0.030	0.165***	0.156***
std. error	(0.100)	(0.122)	(0.150)	(0.130)	(0.062)	(0.034)
surprise in CB GDP projection	-0.154	0.004	-0.063	0.293	0.032	-0.04
std. error	(0.191)	(0.581)	(0.411)	(0.274)	(0.129)	(0.087)
CPI inflation surprise	0.070***	0.057	0.053	0.057**	0.036***	0.032***
std. error	(0.022)	(0.037)	(0.045)	(0.023)	(0.011)	(0.009)
PPI inflation surprise	0.141***	0.128**	0.153**	0.058*	0.062***	0.018
std. error	(0.051)	(0.050)	(0.061)	(0.030)	(0.021)	(0.017)
GDP growth surprise	-0.009	-0.003	-0.019	-0.018	-0.005	-0.008
std. error	(0.025)	(0.025)	(0.023)	(0.020)	(0.013)	(0.010)
retail sale surprise	0.042	0.006	0.023	0.027	0.024	0.019
std. error	(0.038)	(0.051)	(0.045)	(0.030)	(0.028)	(0.020)
GFC dummy	x	x	x	x	x	-0.288***
std. error						(0.047)
R^2	0.322	0.352	0.268	0.357	0.393	0.289
N	87	87	87	87	87	140
F-test statistics	3.610	4.135	2.778	4.219	4.928	5.867
F-test p-value	0.001	0.000	0.006	0.000	0.000	0.000

Notes: OLS estimates with Newey-West standard errors. The F-test refers to test of joint significance of all slope coefficients.$^{(1)}$Estimates on shorter sample (2011:12-2019:02).$^{(2)}$Estimates on longer sample (2007:05-2019:02).

Appendix

Data sources

Table A.1: Summary of data on private sector forecasts

Variable	Horizon	Source	Time span	Additional information
Inflation	+4 quarters	Thomson Reuters	2004:01 - 2019:02	+12 months prior to Nov 2011, +4 quarters since then
	current quarter, +1 quarter, +2 quarters, + 3 quarters	Bloomberg	2009:02 - 2019:02	
	current year, next 2 years	Thomson Reuters	2011:12 - 2019:02	annual inflation
Reference rate	+4 quarters	Thomson Reuters	2004:01 - 2019:02	+12 months prior to Nov 2011, +4 quarters since then; value at the end of the period
	current quarter, +1 quarter, +2 quarters, + 3 quarters, +4 quarters	Thomson Reuters	2011:11 - 2019:02	value at the end of the period
	current month	Bloomberg	2004:01 - 2019:02	monetary policy decision in the current month
GDP growth	+1 quarter	Thomson Reuters	2004:01 - 2019:02	
	current year, next 2 years	Thomson Reuters	2010:07 - 2019:02	annual growth; data for current year starts in 2004:01
Macroeconomic surprises	data released in a given month	Bloomberg	2004:01 - 2019:02	actual minus expected value, standardised

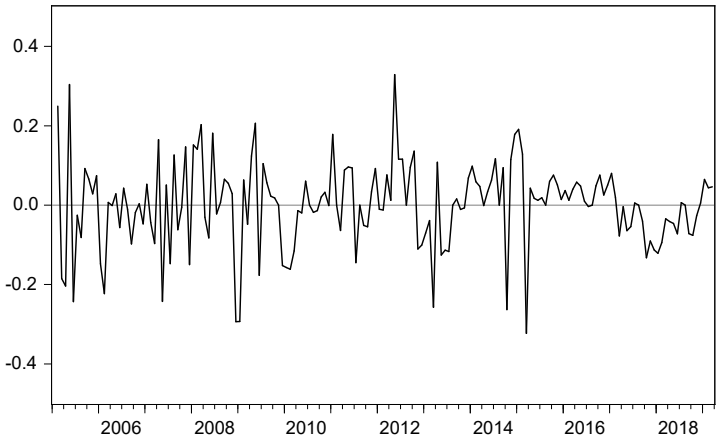
Monetary policy shock

Table A.2: Determinants of the change in the reference rate – estimation results of equation (1)

Variable	Coefficient estimate	Standard error
Constant	-0.673	(0.503)
Initial level of interest rate	-0.090***	(0.022)
Inflation projection		
+0 q	-0.025	(0.020)
+4 q	0.052	(0.046)
Change in inflation projection		
+0 q	0.010	(0.039)
+4 q	0.120**	(0.055)
GDP growth projection		
+0 q	0.045***	(0.016)
+4 q	0.006	(0.027)
Change in GDP growth projection		
+0 q	-0.022	(0.038)
+4 q	-0.017	(0.030)
Inflation forecast by private sector, +4 q (deviation from central bank projection)	0.181***	(0.052)
GDP growth forecast by private sector, +1 q (deviation from central bank projection)	0.075**	(0.03)
Most recent CPI inflation rate	0.055***	(0.02)
Most recent change in industrial production	0.003	(0.002)
Exchange rate (in log, level)	0.338	(0.297)
Exchange rate (in log, change)	-0.002	(0.005)
ECB interest rate (level)	0.050**	(0.02)
ECB interest rate (change)	0.032	(0.096)
N	160	
adj. R^2	0.47	

Notes: Sample: January 2005 – March 2019. OLS estimates with White standard errors.

Figure A.1: Monetary policy shock measure



The monetary policy shock should be orthogonal to the information set available at the time of the monetary policy decision. We check the predictability of the shock with use of the Granger causality test employing 3 and 6 lags of the following macro variables: inflation rate (CPI and core), the unemployment rate, retail sales, industrial production, money supply (M3) and the Warsaw stock exchange index (WIG). Due to the change in the timing of the MPC meetings, from the end of the month to the beginning of the month, we adjust the lags of the macro variables to make sure that all the data were available at the time of the meeting. The results shown in Table A.2 indicate that our measure of monetary policy shock fulfills the condition of orthogonality.

Table A.3: Predictability of the monetary policy shock

Variable	3 lags		6 lags	
	F-stat.	p-value	F-stat.	p-val
CPI inflation (y-o-y)	1.12	0.34	0.38	0.89
Core inflation (y-o-y)	0.81	0.49	1.25	0.28
Unemployment rate (annual change)	0.05	0.98	0.26	0.95
Retail sales (y-o-y)	0.70	0.55	0.29	0.94
Industrial production (y-o-y)	0.38	0.77	1.28	0.27
M3 money supply (y-o-y)	0.18	0.91	0.30	0.93
WIG (y-o-y)	1.76	0.16	1.02	0.42

Notes: The test equations are estimated with the Newey-West standard error.

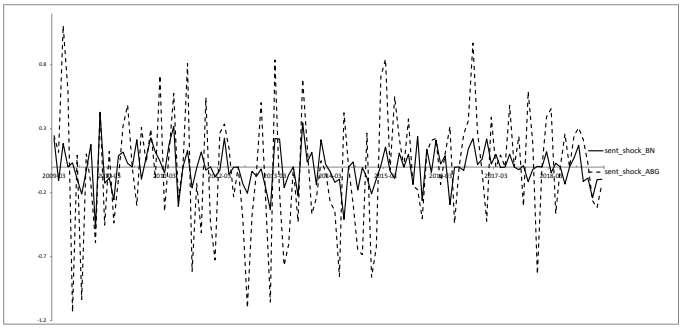
Tone shock

Table A.4: Determinants of the central bank tone – estimation results of equation (3)

Variable	ABG dictionary		BN dictionary	
	Coefficient estimate	Standard error	Coefficient estimate	Standard error
Constant	-4.057	(4.91)	-1.186	(1.498)
Previous meeting tone	0.222**	(0.079)	0.543***	(0.088)
Most recent CPI inflation rate	0.026	(0.048)	0.012	(0.015)
Most recent industrial production dynamics (y-on-y)	-0.082	(1.031)	0.645*	(0.363)
Monetary policy shock	0.265	(0.410)	0.219*	(0.127)
Global economic policy uncertainty index	0.002***	(0.0008)	-0.0002	(0.0003)
WIBOR ON	-0.110	(0.113)	-0.086***	(0.031)
WIBOR 1Y	0.191*	(0.102)	0.049	(0.032)
WIG	0.00002***	(0.000)	0.000002	(0.000002)
Dynamics of oil price	0.068	(0.154)	0.052	(0.054)
N	132		132	
adj. R^2	0.248		0.584	
R^2	0.300		0.613	
F-test statistics	5.80		21.46	
F-test p-value	0.000		0.000	

Notes: Sample: June 2007 - February 2019. OLS estimates with Newey-West standard errors.

Figure A.2: Tone shocks of MPC Minutes



Estimation results with forward guidance

Table A.5: Estimation results for interest rate expectations accounting for forward guidance – BN tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	0.039**	0.013	0.017	0.015	0.013	0.037**
std. error	(0.015)	(0.023)	(0.021)	(0.021)	(0.023)	(0.016)
CB tone	0.021	0.02	-0.011	-0.01	0.011	0.027*
std. error	(0.014)	(0.014)	(0.019)	(0.022)	(0.021)	(0.016)
surprise in CB inflation projection	0.035	0.033	-0.15*	-0.08	-0.084	-0.058
std. error	(0.044)	(0.079)	(0.078)	(0.1)	(0.083)	(0.06)
surprise in CB GDP projection	0.048	-0.081	0.227***	0.285**	0.128	0.077
std. error	(0.093)	(0.102)	(0.079)	(0.138)	(0.175)	(0.096)
CPI inflation surprise	-0.008	-0.014	0.001	-0.01	0.029	0.015
std. error	(0.012)	(0.013)	(0.014)	(0.013)	(0.021)	(0.016)
GDP growth surprise	0.016	0.021	0.049**	0.033**	0.023	-0.009
std. error	(0.01)	(0.014)	(0.022)	(0.015)	(0.017)	(0.015)
retail sale surprise	0.014	0.01	0.016	0.024	0.033**	0.047**
std. error	(0.011)	(0.014)	(0.014)	(0.018)	(0.016)	(0.021)
GFC dummy	x	x	x	x	x	-0.359***
std. error						(0.077)
FG ×CPI inflation surprise	0.001	0.002	-0.012	0.01	-0.021	-0.001
std. error	(0.011)	(0.024)	(0.023)	(0.024)	(0.034)	(0.031)
FG ×GDP growth surprise	-0.026	-0.028	-0.063**	-0.161***	-0.145*	-0.138
std. error	(0.023)	(0.027)	(0.026)	(0.045)	(0.082)	(0.084)
FG ×GDP retail sales surprise	-0.008	-0.004	0.002	0.021	-0.011	-0.04
std. error	(0.018)	(0.021)	(0.018)	(0.042)	(0.059)	(0.072)
FG dummy	0.035	0.023	-0.002	0.036	0.035	-0.022
std. error	(0.023)	(0.031)	(0.03)	(0.054)	(0.06)	(0.057)
R^2	0.247	0.111	0.156	0.158	0.149	0.214
N	87	87	87	87	87	140
F-test statistics	0.578	0.673	1.649	5.002	0.97	0.844
F-test p-value	0.68	0.613	0.171	0.001	0.429	0.472

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors. The F-test refers to the test of the joint significance of all slope coefficients.

Table A.6: Estimation results for interest rate expectations accounting for forward guidance – ABG tone

	Interest rate expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	0.044***	0.017	0.022	0.019	0.016	0.037**
std. error	(0.014)	(0.022)	(0.021)	(0.021)	(0.022)	(0.015)
CB tone	0.045**	0.04**	0.029*	0.024	0.033	0.037*
std. error	(0.017)	(0.02)	(0.016)	(0.019)	(0.023)	(0.02)
surprise in CB inflation projection	0.047	0.044	-0.131	-0.064	-0.073	-0.05
std. error	(0.047)	(0.081)	(0.088)	(0.105)	(0.088)	(0.056)
surprise in CB GDP projection	0.067	-0.064	0.226***	0.284**	0.14	0.097
std. error	(0.081)	(0.101)	(0.081)	(0.121)	(0.187)	(0.09)
CPI inflation surprise	-0.008	-0.014	-0.002	-0.012	0.029	0.014
std. error	(0.011)	(0.012)	(0.013)	(0.013)	(0.022)	(0.016)
GDP growth surprise	0.017*	0.022*	0.048**	0.031**	0.023	-0.011
std. error	(0.009)	(0.012)	(0.02)	(0.014)	(0.015)	(0.014)
retail sale surprise	0.018	0.014	0.02	0.027	0.036**	0.048**
std. error	(0.012)	(0.014)	(0.015)	(0.019)	(0.017)	(0.02)
GFC dummy	x	x	x	x	x	-0.376***
std. error						(0.076)
FG ×CPI inflation surprise	0	0.001	-0.01	0.012	-0.021	0
std. error	(0.008)	(0.021)	(0.026)	(0.026)	(0.033)	(0.027)
FG ×GDP growth surprise	0.004	-0.001	-0.043	-0.144***	-0.123	-0.108
std. error	(0.014)	(0.026)	(0.027)	(0.043)	(0.076)	(0.081)
FG ×GDP retail sales surprise	0.004	0.007	-0.002	0.017	-0.004	-0.022
std. error	(0.016)	(0.017)	(0.022)	(0.045)	(0.058)	(0.067)
FG dummy	0.038*	0.026	0.001	0.038	0.038	-0.018
std. error	(0.02)	(0.029)	(0.028)	(0.05)	(0.054)	(0.051)
R^2	0.355	0.174	0.187	0.174	0.178	0.294
N	87	87	87	87	87	140
F-test statistics	1.073	0.266	0.724	4.162	0.938	0.558
F-test p-value	0.376	0.899	0.578	0.004	0.447	0.644

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors. The F-test refers to the test of the joint significance of all slope coefficients.

Estimation results with oil prices

Table A.7: Estimation results for inflation expectations – with oil prices, BN tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	-0.008	0.000	-0.028	0.036	0.010	0.010
std. error	(0.034)	(0.032)	(0.028)	(0.023)	(0.013)	(0.011)
CB tone	0.081**	0.069***	-0.016	0.011	-0.012	0.007
std. error	(0.04)	(0.026)	(0.039)	(0.024)	(0.01)	(0.011)
surprise in CB inflation projection	0.200*	0.170	0.123	-0.019	0.121	0.134***
std. error	(0.105)	(0.127)	(0.139)	(0.128)	(0.074)	(0.037)
surprise in CB GDP projection	-0.130	-0.003	-0.073	0.282	0.036	-0.042
std. error	(0.18)	(0.581)	(0.41)	(0.284)	(0.137)	(0.084)
CPI inflation surprise	0.073***	0.052	0.055	0.051**	0.034***	0.030***
std. error	(0.024)	(0.037)	(0.047)	(0.024)	(0.012)	(0.009)
PPI inflation surprise	0.136**	0.117**	0.152**	0.055*	0.052**	0.017
std. error	(0.053)	(0.05)	(0.063)	(0.031)	(0.022)	(0.020)
GDP growth surprise	-0.011	-0.002	-0.02	-0.015	-0.003	-0.003
std. error	(0.025)	(0.022)	(0.023)	(0.018)	(0.012)	(0.008)
retail sale surprise	0.044	0.011	0.021	0.031	0.039	0.020
std. error	(0.038)	(0.050)	(0.046)	(0.032)	(0.030)	(0.021)
GFC dummy	x	x	x	x	x	-0.217***
std. error						(0.048)
oil prices	0.000	0.010	0.002	0.005	0.001	0.002**
std. error	(0.005)	(0.007)	(0.007)	(0.004)	(0.001)	(0.001)
R^2	0.317	0.365	0.273	0.365	0.369	0.334
N	87	87	87	87	87	140

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors.

Table A.8: Estimation results for inflation expectations – with oil prices ABG tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	-0.008	0.00	-0.028	0.036	0.009	0.011
std. error	(0.034)	(0.032)	(0.028)	(0.023)	(0.013)	(0.011)
CB tone	0.081**	0.069***	-0.016	0.011	0.001	0.005
std. error	(0.04)	(0.026)	(0.039)	(0.024)	(0.013)	(0.012)
surprise in CB inflation projection	0.200*	0.170	0.123	-0.019	0.134*	0.15***
std. error	(0.105)	(0.127)	(0.139)	(0.128)	(0.074)	(0.034)
surprise in CB GDP projection	-0.130	-0.003	-0.073	0.282	0.023	-0.021
std. error	(0.180)	(0.581)	(0.410)	(0.284)	(0.139)	(0.091)
CPI inflation surprise	0.073***	0.052	0.055	0.051**	0.033**	0.028***
std. error	(0.024)	(0.037)	(0.047)	(0.024)	(0.013)	(0.009)
PPI inflation surprise	0.136**	0.117**	0.152**	0.055*	0.052**	0.015
std. error	(0.053)	(0.05)	(0.063)	(0.031)	(0.022)	(0.017)
GDP growth surprise	-0.011	-0.002	-0.02	-0.015	-0.001	-0.005
std. error	(0.025)	(0.022)	(0.023)	(0.018)	(0.013)	(0.009)
retail sale surprise	0.044	0.011	0.021	0.031	0.037	0.019
std. error	(0.038)	(0.05)	(0.046)	(0.032)	(0.029)	(0.021)
GFC dummy	x	x	x	x	x	-0.215***
std. error						(0.043)
oil prices	0.00	0.01	0.002	0.005	0.001	0.002*
std. error	(0.005)	(0.007)	(0.007)	(0.004)	(0.001)	(0.001)
R^2	0.317	0.365	0.273	0.365	0.364	0.301
N	87	87	87	87	87	140

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors.

Estimation results with matching forecast horizons

Table A.9: Estimation results for inflation expectations – matching projection horizons, BN tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	0.001	-0.005	-0.02	0.034	0.012	0.012
std. error	(0.032)	(0.033)	(0.033)	(0.022)	(0.012)	(0.011)
CB tone	0.082**	0.073**	-0.022	0.012	-0.01	0.004
std. error	(0.04)	(0.029)	(0.039)	(0.024)	(0.011)	(0.011)
surprise in CB inflation projection	0.051	-0.371	-0.129	-0.075	0.117**	0.154***
std. error	(0.163)	(0.225)	(0.189)	(0.08)	(0.049)	(0.037)
surprise in CB GDP projection	-0.243*	-0.366	0.1	-0.062	-0.054	0.029
std. error	(0.134)	(0.235)	(0.264)	(0.153)	(0.061)	(0.043)
CPI inflation surprise	0.08***	0.065*	0.066	0.048**	0.031**	0.029***
std. error	(0.024)	(0.036)	(0.041)	(0.022)	(0.012)	(0.009)
PPI inflation surprise	0.115**	0.085	0.137**	0.066**	0.052**	0.017
std. error	(0.053)	(0.052)	(0.053)	(0.032)	(0.023)	(0.016)
GDP growth surprise	0.008	0.023	-0.008	-0.017	-0.004	-0.008
std. error	(0.029)	(0.031)	(0.025)	(0.02)	(0.011)	(0.009)
retail sale surprise	0.054	0.022	0.037	0.028	0.039	0.017
std. error	(0.036)	(0.048)	(0.048)	(0.029)	(0.03)	(0.021)
GFC dummy						-0.239***
std. error						(0.05)
R^2	0.318	0.387	0.279	0.356	0.381	0.236
N	87	87	87	87	87	140

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors.

Table A.10: Estimation results for inflation expectations – matching projection horizons, ABG tone

	Inflation expectations					
	+0q	+1q	+2q	+3q	+4q$^{(1)}$	+4q$^{(2)}$
monetary policy shock	-0.005	-0.006	-0.015	0.033	0.012	0.012
std. error	(0.032)	(0.034)	(0.033)	(0.022)	(0.013)	(0.011)
CB tone	0.028	0.043	0.015	0	0	0.004
std. error	(0.03)	(0.033)	(0.029)	(0.019)	(0.014)	(0.013)
surprise in CB inflation projection	0.015	-0.39*	-0.133	-0.077	0.125**	0.154***
std. error	(0.165)	(0.216)	(0.192)	(0.079)	(0.049)	(0.036)
surprise in CB GDP projection	-0.213	-0.338	0.087	-0.056	-0.055	0.029
std. error	(0.16)	(0.251)	(0.266)	(0.152)	(0.064)	(0.043)
CPI inflation surprise	0.081***	0.064*	0.064	0.049**	0.03**	0.029***
std. error	(0.024)	(0.037)	(0.039)	(0.023)	(0.012)	(0.009)
PPI inflation surprise	0.121*	0.087	0.131**	0.067**	0.052**	0.018
std. error	(0.063)	(0.054)	(0.054)	(0.032)	(0.023)	(0.016)
GDP growth surprise	0.012	0.028	-0.01	-0.016	-0.003	-0.008
std. error	(0.029)	(0.029)	(0.024)	(0.019)	(0.012)	(0.009)
retail sale surprise	0.058	0.027	0.039	0.028	0.038	0.017
std. error	(0.038)	(0.05)	(0.05)	(0.03)	(0.03)	(0.021)
GFC dummy						-0.241***
std. error						(0.05)
R^2	0.278	0.367	0.278	0.355	0.376	0.236
N	87	87	87	87	87	140

Notes: $^{(1)}$ Estimates on shorter sample (2011-2019); $^{(2)}$ Estimates on longer sample (2007-2019). OLS estimates with Newey-West standard errors.

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