NARODOWY
BANK POLSKI

NBP Working Paper No. 363

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Narodowy Bank Polski
Warsaw 2023

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The views expressed herein are ours and not necessarily those of Narodowy Bank Polski or the Warsaw School of Economics. We would like to thank the participants of the CFE and Money, Macro and Finance conferences as well as the participants of Senamek seminar at the Warsaw School of Economics for helpful comments and discussions. Comments received from an anonymous referee are gratefully acknowledged as well.

Published by:
Narodowy Bank Polski
Education & Publishing Department
ul. Świętokrzyska 11/21
00-919 Warszawa, Poland
nbp.pl

ISSN 2084-624X

Contents

Abstract

The macroeconomic projection is one of the key communication tools of the central bank. We examine how the projection published by Narodowy Bank Polski affects the expectations of the professional forecasters. We focus on the role of uncertainty in explaining the impact of inflation and GDP forecasts released by the central bank on the forecasters' expectations. We find that by disclosing its projection the central bank affects the inflation and GDP forecasts formulated by professional forecasters for all the examined horizons: the current year, the next year and two years ahead. Importantly, our results show that the impact of the NBP projection on the expectations of the professional forecasters is stronger when uncertainty is high, which remains in line with the Woodford (2001) model, in which public information helps private agents to separate signal from noise contained in the data. We also evidence that the coordinating role of the projection for the private sector inflation forecasts is larger in high inflation environment.

JEL: C24, E37, E52, E58

Keywords: Monetary policy, central bank communication, forecasting, inflation expectations, uncertainty.

1 Introduction

Over the last two decades the global economy has been hit by several macroeconomic shocks, which increased the overall uncertainty and made the future less predictable. In particular, the outbreak of the Covid-19 pandemic and the rapid surge in inflation which followed the post-pandemic recovery resulted in alarge increase in forecast errors of both private forecasters and central banks, for which macroeconomic forecasting is one of the main areas of interest.

The central banks which conduct inflation targeting strategy regularly prepare and publish the forecasts of GDP, inflation and other key macroeconomic variables. The motivation of the central banks is twofold. Firstly, as pointed out by Svensson (1997) (see also Goodhart, 2001) due to substantial lags in the monetary transmission mechanism, the central bank should target future inflation rather than current one. Therefore, accurate forecasts of GDP and inflation allow the central bank to pursue a forward-looking monetary policy and react not to current deviations of inflation from the target and the current output gap, which, due to the delays in the monetary policy transmission mechanism, would usually make the central bank's actions belated and reactive, but rather to their expected future values.[1] Secondly, the macroeconomic projection published by the central bank is the main communication tool explaining its decisions and affecting the inflation expectations of private agents (Woodford, 2005). The disclosure of the central bank's macroeconomic forecast influences private agents' expectations, which may shorten the lags in the monetary policy transmission mechanism. Moreover, by publishing accurate forecasts, the central bank may enhance its reputation and credibility, which results in a reduction of the inflation bias (Geraats, 2005).

This paper studies whether private forecasters use the information content from the central bank projection when forming their own forecasts. In particular, we check whether the forecasters adjust their forecasts after the central bank projection is published. In contrast to previous literature, we focus on the role of uncertainty in the adjustment process. Therefore, we examine whether private sector forecasters adjust their forecasts toward the projection to a larger extent when macroeconomic uncertainty is high. We also investigate whether the role of the projection as a potential attractor for private sector forecasts differs in a low and high inflation environment. In our study, we use the unique data for Poland matching the projection published by Narodowy Bank Polski, which pursues inflation targeting strategy with the forecasts of professional forecasters stemming from Refinitiv/Thomson Reuters survey, collected on a monthly basis.

Our research is rooted in the literature on the impact of central bank communication on the expectations of the private sector. This strand of research reflects the trends in central

[1] On the benefits of forward looking monetary policy see more in Rudebusch and Svensson (1998) and Bernanke et al. (1999).

banking in the 1990s and 2000s: the growing transparency of monetary authorities and the disclosure of the macroeconomic forecasts by many central banks. Swanson (2006) shows that the increased transparency of the FOMC since the late 1980s has resulted in higher precision of private sector forecasts of US interest rates in terms of both accuracy and dispersion. Ehrmann et al. (2012) investigate the relationship between the level of transparency of the central bank and the dispersion of the forecasts of key macroeconomic variables formulated by both professional forecasters and households. They analyze data for 12 developed countries and conclude that an increase of transparency diminishes the dispersion of forecasts pursued by professional forecasters.[2]

In this stream of literature some authors focus on the impact of disclosing a quantitative projection of key macroeconomic variables on the formation of private sector expectations. Fujiwara (2005) examines whether inflation and GDP forecasts published by the Bank of Japan affect private sector forecasts and vice versa. He finds that the Bank of Japan, by publishing its inflation forecasts, influences the forecasts formulated by professional forecasters, while the reverse relationship does not hold - the private sector forecasts do not affect the forecasts published by the Bank of Japan. Hattori et al. (2016) also evidence that the projection of Bank of Japan shifts the inflation expectations of the professional forecasters, although the Bank of Japan repeatedly underestimates its inflation target. Hubert (2014) investigates to what extent the FOMC projection influences the dispersion of the forecasts derived by professional forecasters and documents that by disclosing its projection, the FOMC reduces the dispersion of the short-term inflation forecasts – for the current year – while the dispersion of inflation forecasts for the longer horizon (next year) and the dispersion of GDP forecasts remains broadly unaffected. In a similar study for the euro area, Hubert (2015a) finds that the ECB projection affects the inflation forecasts formulated by economists surveyed within the SPF and therefore enables them to interpret correctly and predict ECB policy decisions. Also Łyziak and Paloviita (2017) evidence the growing role of the ECB projection for long-term inflation expectations of the professional forecasters after the global financial crisis.[3]

There are also some papers focused on the coordinating role of the central banks in the emerging economies. Filacek and Saxa (2010) study the impact of the projection published

[2]There is another broad strand in literature, which examines whether the adoption of inflation targeting strategy has resulted in a stronger anchoring of long-run inflation expectations and their lower dispersion. The results are, however, ambiguous. Some authors argue that in the countries in which the central banks adopted the IT strategy, inflation expectations are better anchored (Levin et al., 2004, Gürkaynak et al., 2010). However, the others attribute the lower dispersion of the inflation expectations rather to an overall enhancement of transparency of the central banks than the IT strategy per se (Cecchetti and Hakkio, 2009, Capistrán and Ramos-Francia, 2010).

[3]A comprehensive survey of recent research related to the impact of the communication tools used by the Federal Reserve, the European Central Bank, the Bank of England and the Bank of Canada on private sector expectations can be found in Binder and Sekkel (2023).

by the Czech National Bank (CNB) with an endogenous interest rate and the exchange rate on the disagreement among the forecasts formulated by professional forecasters and find that the forecasters coordinate their forecasts of inflation and interest rates once the projection is released. Kotłowski (2015) documents that the Polish central bank (Narodowy Bank Polski) by disclosing macroeconomic projection decreases the dispersion of individual one-year-ahead GDP forecasts formulated by professional forecasters as well as affects their median. He also shows that the role of the projection release in lowering the dispersion of GDP forecasts varies over the business cycle. By disclosing its projection, Narodowy Bank Polski reduces the disagreement among forecasters, most significantly in the periods when the economy moves from one phase of the business cycle to another. Pedersen (2015) examines whether professional forecasters in Chile adjust their forecasts after the central bank publishes its projection and finds that by publishing the projection, the central bank impacts mostly short-term inflation expectations, while longer-term forecasts remain unaffected. In the same vein, de Mendonça and de Deus (2019) check whether the initial disagreement between the central bank projection and the expectations of the professional forecasters in selected emerging economies: Brasil, Mexico and Poland plays a role in explaining the revisions of their forecasts. They evidence that the central banks in the examined countries affect private sector GDP forecasts but not inflation forecasts.

The relevance of publishing forecasts of the main macroeconomic aggregates by the central banks can also be considered in a broader sense, namely as providing free public information to the private sector. Theoretical models usually point to two main benefits resulting from disclosing public information on the economic situation to private agents. These include the ability to distinguish more precisely the signals coming from the economy from the information noise contained in the data (Woodford, 2001) and reducing the cost of collecting information, which in some cases can be high (Mankiw and Reis, 2002). If the central bank has more complete and precise information on the economy than the private sector, in addition to influencing inflation expectations, it can also play the role of an institution providing additional free information to private agents.

The theoretical framework for the forecasts adjustment by the private sector are the sticky information models proposed by Mankiw and Reis (2001) and Carroll (2003). In these models, the diffusion of information, for example from the central bank to private agents is gradual and results from the assumption that the central bank has additional information that can be used by private sector.

Hubert (2015b) points out why private sector forecasters may adjust their forecasts toward the central bank projection (see also de Mendonça and de Deus, 2019 for discussion). Firstly, the forecasters adjust their forecasts if they believe that the central bank projections are more accurate, for example due to more resources allocated to the forecasting process.

Secondly, the private sector may use the central bank forecasts to correct its own expectations if the forecasters believe that the central bank has some additional data or information, which may be useful to improve the forecasts' accuracy. Romer and Romer (2000) evidence that the FED has an information advantage over the private sector when forming its inflation projections. Thirdly, the central bank's forecasts may contain signals regarding future monetary policy and its impact on the main macroeconomic variables. While forecasting inflation or GDP at a certain level, the central bank has the instruments to bring these variables to the levels disclosed in the projection. Orphanides and Wieland (2008) document that FOMC policy decisions were driven by its macroeconomic projections while Brzoza-Brzezina et al. (2013) evidence that also the Swiss National Bank and Narodowy Bank Polski accounted in their decisions for own inflation forecasts.

Several papers evidence the signaling role of the central bank projection. Jain and Sutherland (2020) examine a panel of 23 countries and find that by publishing the inflation projection, central banks tended to reduce the dispersion and forecast errors of private sector interest rates forecasts. They also document that the more projections the central banks release, the lower the dispersion and standard errors of the private sector inflation forecasts. Hubert (2011) investigates the influence of projections of selected central banks on private sector forecasts and distinguishes between endogenous and exogenous influence, depending on its source. The former type of influence results from the more accurate central bank forecasts than those of private sector and the latter is due to signals on future policy decisions or some not publicly available information that the central banks have. He documents that the macroeconomic projections published by the Swedish central bank (Riksbank), the Bank of England and the Bank of Japan had an statistically significant impact on the private sector forecasts but only in case of the Riksbank the data speak for the accuracy advantage over the private sector. He concludes that for the two other central banks the source of influence was the policy signal. It is worth noting however that the more accurate forecasts do not exclude policy signal channel.

The contribution of our paper to the existing literature is twofold. Firstly, we examine whether the role of the central bank projection in influencing private sector forecasts depends on the level of uncertainty in the economy.[4] If in line with the Woodford (2001) model, private sector forecasters use the public information to separate the signal from noise included in the data then in face of higher uncertainty the usefulness of the projection may be higher. Secondly, we investigate whether in a high inflation environment, when inflation deviates strongly and for longer from the central banks' targets, private sector forecasters are more prone to rely on the central bank projection and read the policy signals contained in the projection. Therefore we check whether the usefulness of the projection for the private sector is different in high and low inflation environment.

[4]Bloom et al. (2012) argue that uncertainty shocks may be one of the key drivers of the business cycles.

Our results show that by publishing its macroeconomic projection, Narodowy Bank Polski affected the inflation and GDP forecasts formulated by the professional forecasters for all examined horizons: the current year, the next year and two years ahead. After disclosing the projection the forecasters adjusted their inflation forecasts to the largest extent for the current and next year while the GDP forecasts were revised most substantially for the next year. We also evidence that the impact of the projection on private sector forecasts is stronger when uncertainty is high, which remains in line with the Woodford (2001) model. Moreover, we document that the forecasters are more willing to use the projection as the focal point for their forecasts in high inflation environment.

The rest of the paper is organized as follows. Section 2 presents the model and data, Section 3 discusses the empirical results while Section 4 offers a number of robustness checks. Section 5 concludes the paper.

2 Data and model

2.1 Central bank projection and private sector forecasts

Narodowy Bank Polski adopted the inflation targeting strategy in 1999. With a view to enhancing the communication framework, NBP started publishing the projection of key macroeconomic variables, including CPI inflation and GDP growth. The first inflation forecast was released in September 2004, while the first GDP forecast was disclosed in June 2005. The projection is owned by the staff and the forecasts are derived using the NECMOD macroeconometric model (see Budnik et al., 2009) under the assumption of constant interest rates. The forecasts usually cover the current and two consecutive years, which results in a varying length of the forecast horizon: from 9 to 12 quarters. The inflation and GDP forecasts are published in the form of a fanchart with a mode as a central path. In our study we refer to the central path of the projection.

The frequency of publishing the macroeconomic projection has varied over time. In 2005 NBP published its macroeconomic projection twice (in August and November) while in 2005, three times (in February, May and August). In the years 2006-2007, the NBP projection was prepared four times a year and released in January, May, August and November. Since 2008, the NBP projection has been released three times a year. In the period 2008-2010, the NBP published its forecasts in February, June and October while since 2011 the projection has been made available to the public in March, July and November. Our sample starts with the projection release in May 2005 and ends with the release in March 2023.

The forecasts of professional forecasters used in our study come from the survey conducted monthly by Refinitiv/Thomson Reuters among economists from commercial banks and other financial institutions.[5] They formulate the forecasts of CPI inflation, GDP, interest rates and other key macroeconomic variables for Poland. The survey participants are asked about expected CPI inflation and GDP growth at various forecast horizons – both fixed and varying. In our research we use the forecasts with varying horizons, formulated for the current year, for the next year and for two years ahead.[6] Therefore, the forecast horizon is consistent with the NBP projection, which covers the current year and the next two years. It has to be emphasized that the forecasters were not asked in every edition of the survey about the full forecast horizon, consistent with the NBP projection. As a result, there are some gaps in the data and length of the available sample is not the same for every forecast horizon.

[5]Since the participants of the survey are mainly the economists from financial institutions who professionally deal with forecasting we use the terms professional forecasters and financial sector analysts interchangeable throughout the text.

[6]In the literature they are classified as fixed event or fixed date forecasts (see Hubert, 2014 for discussion).

In the study we examine to what extent the revisions of inflation and GDP forecasts made by the professional forecasters between the successive rounds of the survey conducted in the months immediately after and before the release of the NBP projection account for the results of the projection. In our model we additionally control for other factors which may influence the forecasts revisions. In particular, we account for inflation and GDP surprises. An inflation surprise is defined as the difference between the latest release of the CPI inflation and the median of individual forecasts formulated for one month ahead in the survey preceding the release. Similarly a GDP surprise is defined as the difference between the release of quarterly GDP growth (y-o-y) and the median forecast of the professional forecasters reported in the preceding survey. We also include in the model the log of the nominal effective exchange rate (from the BIS database) and the index of energy commodity prices published by the World Bank. The detailed description of control variables is contained in Table 1.

2.2 Model

We examine the impact of the NBP projection on the expectations of professional forecasters using the single equation models, which relate the revision of the median forecast of professional forecasters (inflation or GDP) to the discrepancy between the central path of the newly published NBP projection and the median forecast from the survey conducted immediately before the publication of the projection for a given horizon. Our approach is closely linked to the method proposed by Pedersen (2015) and de Mendonça and de Deus (2019). We estimate the models separately for inflation and GDP forecasts as well as separately for different forecast horizons using the LS method with Newey-West correction for potential autocorrelation and heteroscedasticity. The separate estimation of equations for inflation and GDP forecasts is common in the literature (Dovern et al., 2012, Hubert, 2014). We follow this approach, but as a robustness check we estimate the parameters of both equations jointly, allowing for potential cross-correlation of error terms (see Section 4).

More specifically, our baseline model explaining the revision of inflation or GDP median forecast can be written as follows:

$$\Delta X_t^h = \alpha_0 + \beta \left(Y_t^h - X_{t-1}^h\right) + \alpha_1 \Delta X_{t-1}^h + \gamma Z_t + \varepsilon_t \tag{1}$$

where: ΔX_t^h is the change in the median of individual inflation or GDP forecasts in the survey conducted just after the projection release, X_{t-1}^h denotes the median of individual forecasts formulated by professional forecasters in month t - 1 (immediately before the projection release), Y_t^h stands for the central path of the projection released between t and t -1 for the horizon h, ΔX_{t-1}^h is the revision of median forecast in the previous survey and Z_t represent a vector of control variables (inflation and GDP surprises, nominal effective exchange rate,

energy price index). If the central path of the projection is higher than the median forecast from the previous survey forecasters would revise their forecasts up. Therefore we expect a positive relationship between the revision ΔX_t^h and the discrepancy between projection and median forecast from previous survey $\left(Y_t^h - X_{t-1}^h\right)$. We include a lagged dependent variable ΔX_{t-1}^h on the right hand side of (1) to account for the persistence of the forecast revisions.[7]

Equation (1) is a starting point for further analysis. In the next step we focus on the role of uncertainty in explaining the influence of the projection on private sector forecasts. We extend our baseline model (1) to account for the varying impact of the projection on professional forecasters' expectations in respect to the level of uncertainty in the economy. We use two different measures of uncertainty: internal and external. We associate the internal uncertainty among forecasters with the dispersion of their individual inflation or GDP forecasts for the respective horizon. Our measure of dispersion is the interquartile range, which is more robust to the presence of outliers than the standard deviation. As the external measure of uncertainty we adopt the Economic Policy Uncertainty Index proposed by Baker et al. (2016) based on newspaper articles regarding economic policy uncertainty. Since there is no specific index available for Poland, we use the index calculated for Europe, which covers newspapers from five major European economies: Germany. France, Spain, Italy and the UK. The European EPU Index is the closest to Poland both geographically and economically.

We investigate the relevance of uncertainty for the coordinating role of the central bank projection by using interaction variables. We calculate interaction variables as the product of selected uncertainty measure and the discrepancy between projection and median forecast from previous survey $\left(Y_t^h - X_{t-1}^h\right)$. For the internal uncertainty measure the extended model takes a form:

$$\Delta X_t^h = \alpha_0 + \beta_1 \left(Y_t^h - X_{t-1}^h\right) + \beta_2 IQR_t^h \left(Y_t^h - X_{t-1}^h\right) + \alpha_1 \Delta X_{t-1}^h + \gamma Z_t + \varepsilon_t \qquad (2)$$

where IQR_t^h denotes the dispersion (interquartile range) of inflation or GDP growth forecasts for horizon h.

The model with the external uncertainty measure is:

$$\Delta X_t^h = \alpha_0 + \beta_1 \left(Y_t^h - X_{t-1}^h\right) + \beta_2 EPU_t \left(Y_t^h - X_{t-1}^h\right) + \alpha_1 \Delta X_{t-1}^h + \gamma Z_t + \varepsilon_t \qquad (3)$$

[7] We additionally include a COVID dummy variable in the set of explanatory variables. This variable takes the value of one in March 2020 and zero otherwise. It is related to the fact that the NBP projection was published at the beginning of March 2020 and its central path, to which we refer in our study did not account for the COVID pandemic. Just after the release of the projection the Polish government announced a long-lasting lockdown in Poland, which was incorporated by the professional forecasters in the new forecasts reported in the survey conducted in March after the projection release.

where EPU_t is Economic Policy Uncertainty Index for Europe. If higher uncertainty strengthens the coordinating role of the central bank projection, β_2 in models (2) and (3) should be statistically significant and positive.

In the same vein, we examine whether high inflation environment strengthens the impact of the projection on the revisions of private sector forecasts. Mankiw et al. (2004) study US data and argue that the disagreement among forecasters is positively related to the level and volatility of inflation. In this strand of research d'Amico and Orphanides (2008) using SPF data, find that dispersion of US inflation forecasts is positively correlated with the expected level of inflation. If uncertainty is related to the level of inflation, the current or expected inflation rate would matter for the role of the projection as a focal point for professional forecasters.

We verify the relevance of the inflation rate for the coordinating role of central bank projection by interacting the level of inflation with the discrepancy between the central path of projection and median of individual forecasts from the previous survey. Our model can be then written as follows:

$$\Delta X_t^h = \alpha_0 + \beta_1 \left(Y_t^h - X_{t-1}^h\right) + \beta_2 CPI_t \left(Y_t^h - X_{t-1}^h\right) + \alpha_1 \Delta X_{t-1}^h + \gamma Z_t + \varepsilon_t \qquad (4)$$

where CPI_t denotes the monthly CPI inflation (y-o-y) available at the moment when the survey among the forecasters is carried out. If higher inflation increases the relevance of the central bank projection for private sector forecasts, β_2 should be also significant and positive.

The marginal effect of discrepancy between the central path of the projection and the median of individual forecasts reported by the professional forecasters in the survey preceding the release of the projection $\left(Y_t^h - X_{t-1}^h\right)$ on the revision of their median forecast ΔX_t^h in the interaction models (2), (3) and (4) is varying and depends on the value of the interacted variable. This effect is calculated as:

$$\frac{\partial \Delta X_t^h}{\partial \left(Y_t^h - X_{t-1}^h\right)} = \beta_1 + \beta_2 H_t \qquad (5)$$

where $H_t = \left\{IQR_t^h,\, EPU_t,\, CPI_t\right\}$ for models (2), (3) and (4) respectively. In the next Section we discuss the empirical results.

3 Results

Baseline model

We start with our baseline model (1). We estimate the model separately for inflation and GDP forecasts and for three different forecast horizons: current year, next year and two years ahead. Therefore we examine six variants of the model.

We discuss the impact of the central bank projection on inflation forecasts first. We find that professional forecasters revise inflation forecasts after the release of the NBP projection toward the central path of the projection (Table 2). They adjust the forecasts for all examined horizons: current year, next year and two years ahead - the impact of the NBP projection for all horizons is positive and statistically significant. The forecasters revise their forecasts to a larger extent for the current year and the next year. The discrepancy of 1 pp. between the central bank projection and the median of the individual inflation forecasts stemming from the survey preceding the publication of the NBP projection leads to a revision of the median forecast by 0.44 pp. for the current year and by 0.37 pp. for the next year, respectively. It means that the forecasters reduce the distance to the projection by 44% and 37% depending on the forecast horizon. The revision for two years ahead is weaker, but still statistically significant (at 10 percent significance level). The difference of 1 pp. between the NBP projection and the median of individual forecasts from the previous survey results in a revision of the median forecast by 0.13 pp. One of the explanations of the weaker response of the longer-term private sector forecasts to the NBP projection is the role of central bank inflation target in anchoring inflation expectations. Łyziak and Paloviita (2017) evidence that in the euro area the relative importance of the inflation target as compared with the ECB inflation projection increases with the length of the expectations horizon. Also in Poland the longer term inflation expectations of the professional forecasters may be anchored at the NBP inflation target (2.5+/-1%) stronger than the short-term expectations. NBP underlines the medium-term nature of the inflation target (NBP, 2003) and argues that “due to macroeconomic and financial shocks, inflation may temporarily deviate from the target and even run outside the band for deviations from the target” (NBP, 2022). Therefore, taking into account the lags in the monetary transmission mechanism, the persistence of the shocks affecting the economy, the central bank communication as well as the maximum horizon of the central bank projection, private sector forecasters may associate the medium term with the two-three year horizon and they stick to the target more closely at this horizon. It should also be emphasized that the central bank projection is prepared with the assumption of the constant interest rates, while the forecasters formulate the forecasts assuming the market interest rates scenario.

Apart from the projection we also identify other factors affecting the revision of the inflation forecasts by professional forecasters. The forecasters adjust inflation expectations if the latest CPI inflation release deviates from their forecasts formulated for one month ahead in the survey preceding the release. It is worth noting however, that they correct only the inflation expectations for the current year, leaving longer-term forecasts unchanged. They adjust the average inflation for the current year by half of the inflation surprise. The forecasters also revise inflation expectations because of changes in energy prices represented in our model by the World Bank Energy Price Index (see Section 2.1). They adjust the forecasts due to this factor mostly for the longer term forecast horizon: next year and two years ahead. In turn, the changes in the nominal exchange rate entail only the revisions of the two years ahead forecasts. Thus the forecasters believe that fluctuations of the exchange rate transmit into inflation dynamics with a lag.

Next we move to GDP forecasts. The projection disclosed by the central bank affects the private sector GDP forecasts formulated for all horizons: current year, next year and two years ahead (Table 3). The impact of the projection on the next-year GDP forecasts is stronger than on the forecasts formulated for two years ahead and for the current year as measured by the estimates of the respective parameter in model (1). The initial discrepancy between the central path of the NBP projection and the median of individual GDP forecasts by 1 pp. results in the adjustment of the median forecast by 0.43 pp. for the next year, by 0.18 pp. for two years ahead and by 0.11 pp for the current year.

Surprises in the GDP release, unlike inflation surprises, affect not only the forecasts for the current year but also the GDP forecasts for the next year. This finding may be explained by the carry over effect contained in the GDP data: the change in expected q-o-q GDP growth for the respective quarter - in particular in the second half of the year - by construction affects also y-o-y forecast for the next year. We cannot find any support for the hypothesis that the changes in energy prices contribute to revisions of GDP forecasts. It may result from the mixed nature of the shocks to the energy prices over the examined sample. The increase in energy prices may be related to demand or supply shocks. Demand shocks are followed by an increase of GDP growth and lead to upward revisions of GDP forecasts. The expected relationship between energy prices and GDP growth forecasts should be then positive. The negative supply side shocks (like in years 2021-2022) lead simultaneously to an increase of energy prices and contraction in current and expected GDP growth. In this case the impact of energy prices on GDP forecasts should be negative. We believe that in our sample these two effects balance out, resulting in an insignificant effect of energy prices on GDP forecasts. Therefore we report the results for the GDP forecasts in Table 3 without accounting for this variable. In the summary, the influence of the central bank projection on inflation and GDP forecasts of the private sector is the strongest for one year ahead for both variables.

The role of uncertainty

In the next step we examine how uncertainty affects the role of the central bank projection as a focal point for private sector forecasts. If the information provided by the public institution helps private agents to separate signal from noise contained in the data as argued by Woodford (2001) the impact of the projection on the expectations of the professional forecasters should be stronger when uncertainty is high. We verify this hypothesis and extend our baseline model by introducing on the right hand side of (1) the interaction variable, which makes the influence of the projection dependent on the level of uncertainty. As discussed in Section 2.2 we use two different uncertainty measures associated with internal and external uncertainty, respectively.

The results for the model (2) with internal uncertainty measured by the dispersion of individual inflation and GDP forecasts are collected in Table 4 and Table 5. Our findings allow the conclusion that a rise in uncertainty strengthens the impact of the projection on professional forecasters expectations. This result holds mostly for the longer-term horizons. The interaction variable constructed as a product of the uncertainty measure and the difference between the central path of the projection and the median of individual forecasts reported in the preceding survey is statistically significant with a positive coefficient for the next-year and two years ahead horizons for both inflation and GDP forecasts. The uncertainty does not affect the coordinating role of the projection for the current year's inflation and GDP private sector forecasts.

When uncertainty is measured by the Economic Policy Uncertainty Index (external uncertainty) as proposed in equation (3) the results are to large extent similar (Table 6 and Table 7). Uncertainty enhances the role of the projection as an attractor for the private sector inflation forecasts formulated for the next year and two years ahead and for GDP forecasts derived for the next year. Uncertainty is irrelevant when assessing the impact of the projection on the private sector inflation and GDP forecasts for the current year. The p-value referring to the respective interaction variable in the model for the GDP forecasts formulated for two years ahead amounts to 0.15.

Figure 1 and Figure 2 plot the marginal effect of the difference between the newly published central bank projection and the median of individual inflation and GDP forecasts stemming from the preceding survey on the revision of the median forecast of professional forecasters relative to the percentiles of the respective uncertainty measure. We present the results only for the next-year and two years ahead forecast horizons, for which the results in Tables 4-7 point to the significance of the interaction variable measuring the impact of the uncertainty. The marginal effect in the model (2) with internal uncertainty measure approximated by the dispersion of individual forecasts grows steadily for both inflation and GDP forecasts and for both examined forecasts horizons up to 90th percentile of the dis-

persion range and rises sharply since then (Figure 1). The pace of growth of the marginal effect is, however, heterogeneous across the variables and forecast horizons. The growth in the marginal effect due to increase in uncertainty is the strongest for the inflation forecasts formulated for two-year horizon. For low uncertainty as measured by the 10th percentile of the individual forecasts dispersion the impact of the central bank projection on the revision of the financial analysts' forecasts is negligible and statistically insignificant. However, the role of the projection increases with the growth of uncertainty and for the 90 percentile of the dispersion range the coefficient measuring the strength of private sector forecasts adjustment to the projection amounts to 0.16, turning out to be statistically significant. The difference between the strength of the adjustment to the NBP projection for low and high uncertainty is smaller for the inflation forecasts formulated for the next year. In the case of GDP forecasts the marginal effect of the difference between the projection and the median of individual forecasts reported by the forecasters in the previous survey on the revision of their median forecast rises between 10th and 90th percentile of dispersion range by 2 up to 2.4 times for the next-year and two years ahead forecast horizon respectively.

When measuring uncertainty with the Economic Policy Uncertainty Index (external uncertainty - Figure 2) the changes in the marginal effect relative to the uncertainty level do not differ much from the pattern reported for internal uncertainty. External uncertainty matters the most for the impact of the central bank projection on the revision of professional forecasters' expectations for inflation forecasts formulated for a two-year horizon. Again, for low uncertainty (10th percentile of the EPU index range) the parameter measuring the strength of the adjustment of the private sector median forecast to the central bank projection is insignificant while it grows to 0.32 when uncertainty is high (90th percentile). The increase in external uncertainty also changes the role of the central bank projection for the revisions of private sector inflation forecasts formulated for the next year. In a high uncertainty environment the forecasters adjust their inflation forecasts by 48% of the initial discrepancy between the projection and their previous forecasts, while for the low uncertainty the coordinating role of the central bank for the forecasts revision in negligible. In turn, the marginal effect for GDP forecasts conditional on the level of external uncertainty is growing between 10th and 90th percentile of uncertainty range quite similarly as for internal uncertainty for the next-year horizon while stronger for two years ahead.

All in all the general conclusion stemming from this part of the study confirms that an increase in uncertainty strengthens the impact of the projection on forecasts with a longer horizon (next year and two years ahead), which usually are characterized by higher uncertainty. It is worth noting that in models (2) and (3) extended by uncertainty measures, the other factors contributing to the revisions of the forecasts remain broadly unchanged. The forecasts adjustment depends on GDP and inflation surprises as well as in case of inflation forecasts on the changes in energy prices.

High and low inflation environment

Finally, we examine whether the coordinating role of the central bank projection depends on the inflation level. We believe that the impact of the projection on private sector forecasts may be stronger in a high inflation environment for at least two reasons. Firstly, higher inflation may translate to enhanced forecasts uncertainty. Several authors find positive correlation between the level and the dispersion of inflation forecasts (see Mankiw et al., 2004 and d'Amico and Orphanides, 2008 among others). Secondly, in the face of high inflation, the role of the inflation target as the anchor for private sector inflation forecasts may weaken. That is why we investigate whether the impact of the central bank projection on private sector inflation expectations depends on the inflation level.

We extend our baseline model with the interaction variable constructed as the product of current inflation and the difference between the central path of the projection and the median of individual inflation forecasts from the survey preceding the projection release as proposed by equation (4). We confirm that higher inflation strengthens the role of the projection as a focal point for private sector forecasts formulated for the next year and for two years ahead (Table 8). The respective interaction variables are statistically significant with positive coefficients. Figure 3 presents the changes in the marginal effect of the difference between the central bank projection and the median forecast of the professional forecasters on the revision of the latter relative to the percentiles of the inflation rate studied in the sample. We find that the level of inflation affects the coordinating role of the projection to larger extent when the forecasts are formed for the two-year horizon than for the next year. For very low inflation (10th percentile of the examined inflation range) the impact of the central bank projection on the revision of private sector two years ahead forecasts is negligible. It grows, however, with the increase of inflation, and for high inflation (90th percentile) forecasters adjust the forecasts to the central path of the projection by 21%. The discrepancy between the strength of the adjustment to the projection in low and high inflation environment for the next-year inflation forecasts is less prominent but still significant. The marginal effect increases from 0.23 for the 10th percentile of inflation to 0.33 for the 90th percentile of the inflation range in the sample, which means that in high inflation environment the forecasters reduce the distance of their forecasts to the projection by 1/3.

4 Robustness check

We conduct a number of robustness checks to assess the sensitivity of our results to adopted assumptions. Firstly, we check to what extent the different assumptions on interest rates included in the NBP projection and in the forecasts of the professional forecasters affect the coordinating role of the projection. The NBP projection is derived under the assumption of constant interest rates over the whole projection horizon. On the other hand, private sector forecasters formulate their forecasts of inflation, GDP and other key macroeconomic variables assuming the most likely path of the interest rates over the forecast horizon consistent with the dynamics of the other variables. We examine the effect of different interest rates scenarios and include into the model an additional variable defined as the difference between the constant interest rate assumed in the NBP projection and the private sector expectations about the future central bank interest rate. The results presented in Table 9 and Table 10 do not differ much from the findings for the baseline model reported in Table 2 and Table 3. Our main explanatory variable, which is the difference between the central path of the projection and the median of individual forecasts from the preceding survey is statistically significant for both inflation and GDP forecasts for all examined horizons as in our baseline model. Also, the coefficients measuring the impact of the projection on the revision of the private sector median forecast are almost identical to the numbers reported for the baseline model. The discrepancy between the constant and market interest rates path is statistically significant only in the model for the GDP forecasts formulated for the next year and in the model for inflation forecasts for the two-year horizon. It is worth noting that in the latter model accounting for the discrepancy in interest rate scenarios assumed in the projection and by the market analysts substantially reduces the standard error for the main explanatory variable - the difference between the central path of the NBP projection and the median of private sector individual inflation forecasts from the preceding survey. The interpretation of this result may be that professional forecasters are aware of the lags in monetary transmission mechanism and tend to adjust partially the results from the NBP projection to their own interest rates scenarios for longest forecast horizon.

The second robustness check validates the assumption about the separate estimation of the equations for inflation and GDP forecasts proposed in our baseline approach. We repeal this assumption and estimate the equations explaining the revisions of inflation and GDP forecasts for the same horizon simultaneously using the Seemingly Unrelated Regression (SUR) method, where the error term is allowed to be cross-correlated. The estimation results are collected in Table 9 for inflation forecasts and in Table 10 for GDP forecasts respectively. The findings are consistent with the conclusions drawn for the baseline model. The impact of the projection on the revision of the private sector forecasts is statistically significant for

all examined models. Also the coefficients measuring the scale of revision due to projection release are close to the respective numbers for the equations estimated separately.

Finally we check whether changes in inflation volatility affect the coordinating role of the projection for private sector inflation forecasts. As discussed in Section 2.3 some authors evidence that not only the level of inflation but also its volatility may have an impact on the dispersion of the inflation forecasts. Therefore, we substitute the level of inflation by its volatility as the interacting variable in equation (4). We calculate inflation volatility as the conditional variance from GARCH(1,1) model for monthly CPI inflation. The results presented in Table 11 evidence that an increase in inflation volatility strengthens the impact of the projection on the revision of private sector inflation forecasts formulated for the next year and for two years ahead similar as the increase in the inflation level does. The respective interaction variables are statistically significant with the positive coefficient. These findings support our previous results that changes in the inflation environment affect the role of the projection as a focal point for the private sector forecasts.

5 Conclusions

The macroeconomic projection is one of the key communication instruments of the central bank. It may affect the expectations of the private sector and therefore shorten the lags in the monetary transmission mechanism. In our study we examine the role of the projection published by Narodowy Bank Polski in the formation of professional forecasters' expectations. We also investigate whether the relevance of the projection depends on the uncertainty level in the economy. We find that the central bank by disclosing its own projection affects the inflation and GDP forecasts formulated by the professional forecasters for all examined horizons: current year, next year and two years ahead. We document that the forecasters revise their inflation forecasts to the largest extent for the current and the next year while the impact on the GDP forecasts is the strongest for the next-year horizon. We also evidence that the impact of the NBP projection on the expectations of professional forecasters is stronger when uncertainty is high. In particular, uncertainty strengthens the coordinating role of the projection for the next-year and two years ahead forecasts leaving the impact on the current year forecasts unchanged. This result holds for two proposed measures of uncertainty: internal uncertainty measured with the dispersion of individual forecasts and the external uncertainty represented by the Economic Policy Uncertainty Index. In this sense our findings remain in line with the Woodford (2001) model, in which public information helps private agents to separate signal from noise contained in the data. Finally we evidence that the impact of the projection on private sector inflation forecasts increases with the level of inflation. Once the dispersion of the individual inflation forecasts is widely documented to be positively correlated with the level of inflation, this result strengthens our findings that the increase in uncertainty enhances the role of the projection as a focal point for private sector forecasts.

References

Baker, Scott, Nicholas Bloom, and Steven Davis (2016) 'Measuring economic policy uncertainty.' *The Quarterly Journal of Economics* 131(4), 1593–1636

Bernanke, B.S., T. Labauch, and F.S. Mishkin (1999) *Inflation targeting: lessons from the international experience* (Princeton University Press, Princeton)

Binder, Carola Conces, and Rodrigo Sekkel (2023) 'Central Bank Forecasting: A Survey.' Staff Working Papers 23-18, Bank of Canada, March

Bloom, Nicholas, Max Floetotto, Nir Jaimovich, Itay Saporta-Eksten, and Stephen J Terry (2012) 'Really uncertain business cycles.' Working Paper 18245, National Bureau of Economic Research, July

Brzoza-Brzezina, Michał, Jacek Kotłowski, and Agata Miśkowiec (2013) 'How forward-looking are central banks? Some evidence from their forecasts.' *Applied Economics Letters* 20(2), 142–146

Budnik, Katarzyna, Michał Greszta, Michał Hulej, Marcin Kolasa, Karol Murawski, Michał Rot, Bartosz Rybaczyk, and Magdalena Tarnicka (2009) 'The new macroeconometric model of the Polish economy.' National Bank of Poland Working Papers 62, National Bank of Poland, Economic Institute

Capistrán, Carlos, and Manuel Ramos-Francia (2010) 'Does Inflation Targeting Affect the Dispersion of Inflation Expectations?' *Journal of Money, Credit and Banking* 42(1), 113–134

Carroll, Christopher D. (2003) 'Macroeconomic expectations of households and professional forecasters.' *The Quarterly Journal of Economics* 118(1), 269–298

Cecchetti, Stephen G., and Craig Hakkio (2009) 'Inflation targeting and private sector forecasts.' NBER Working Papers 15424, National Bureau of Economic Research, Inc, October

d'Amico, Stefania, and Athanasios Orphanides (2008) 'Uncertainty and disagreement in economic forecasting.' *Board of Governors of the Federal Reserve System (U.S.), Finance and Economics Discussion Series*

de Mendonça, Helder Ferreira, and Joseph David Barroso Vasconcelos de Deus (2019) 'Central bank forecasts and private expectations: An empirical assessment from three emerging economies.' *Economic Modelling* 83(C), 234–244

Dovern, Jonas, Ulrich Fritsche, and Jiri Slacalek (2012) 'Disagreement Among Forecasters in G7 Countries.' *The Review of Economics and Statistics* 94(4), 1081–1096

Ehrmann, Michael, Sylvester Eijffinger, and Marcel Fratzscher (2012) 'The Role of Central Bank Transparency for Guiding Private Sector Forecasts.' *Scandinavian Journal of Economics* 114(3), 1018–1052

Filacek, Jan, and Branislav Saxa (2010) 'Central Bank Forecasts as a Coordination Device.' Working Papers 2010/13, Czech National Bank, December

Fujiwara, Ippei (2005) 'Is the central bank's publication of economic forecasts influential?' *Economics Letters* 89(3), 255–261

Geraats, Petra (2005) 'Transparency and reputation: The publication of central bank forecasts.' *The B.E. Journal of Macroeconomics* 5(1), 1–28

Goodhart, Charles A.E. (2001) 'Monetary transmission lags and the formulation of the policy decision on interest rates.' *Review* (Jul), 165–186

Gürkaynak, Refet S, Andrew Levin, and Eric Swanson (2010) 'Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK, and Sweden.' *Journal of the European Economic Association* 8(6), 1208–1242

Hattori, Masazumi, Steven Kong, Frank Packer, and Toshitaka Sekine (2016) 'The effects of a central bank's inflation forecasts on private sector forecasts: Recent evidence from Japan.' BIS Working Papers 585, Bank for International Settlements, September

Hubert, Paul (2011) 'Do central banks forecast influence private agents? Forecasting performance vs. signals.' Documents de Travail de l'OFCE 2011-20, Observatoire Francais des Conjonctures Economiques (OFCE), October

_ (2014) 'FOMC Forecasts as a Focal Point for Private Expectations.' *Journal of Money, Credit and Banking* 46(7), 1381–1420

_ (2015a) 'ECB Projections as a Tool for Understanding Policy Decisions.' *Journal of Forecasting* 34(7), 574–587

_ (2015b) 'The Influence and Policy Signalling Role of FOMC Forecasts.' *Oxford Bulletin of Economics and Statistics* 77(5), 655–680

Jain, Monica, and Christopher S. Sutherland (2020) 'How Do Central Bank Projections and Forward Guidance Influence Private-Sector Forecasts?' *International Journal of Central Banking* 16(5), 179–218

Kotłowski, Jacek (2015) 'Do Central Bank Forecasts Matter for Professional Forecasters?' *Czech Journal of Economics and Finance (Finance a uver)* 65(6), 432–454

Levin, Andrew, Jeremy Piger, and Fabio M. Natalucci (2004) 'Explicit inflation objectives and macroeconomic outcomes.' Working Paper Series 383, European Central Bank

Łyziak, Tomasz, and Maritta Paloviita (2017) 'Anchoring of inflation expectations in the euro area: Recent evidence based on survey data.' *European Journal of Political Economy* 46(C), 52–73

Mankiw, N. Gregory, and Ricardo Reis (2001) 'Sticky Information: A Model of Monetary Nonneutrality and Structural Slumps.' NBER Working Papers 8614, National Bureau of Economic Research, Inc, December

Mankiw, N. Gregory, and Ricardo Reis (2002) 'Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve.' *The Quarterly Journal of Economics* 117(4), 1295–1328

Mankiw, N. Gregory, Ricardo Reis, and Justin Wolfers (2004) 'Disagreement about Inflation Expectations.' In 'NBER Macroeconomics Annual 2003, Volume 18' NBER Chapters (National Bureau of Economic Research, Inc) pp. 209–270

NBP (2003) 'Monetary Policy Strategy beyond 2003.' Technical Report, Narodowy Bank Polski

_ (2022) 'Monetary Policy Guidelines for 2022.' Technical Report, Narodowy Bank Polski

Orphanides, Athanasios, and Volker W. Wieland (2008) 'Economic projections and rules of thumb for monetary policy.' *Review* 90(Jul), 307–324

Pedersen, Michael (2015) 'What affects the predictions of private forecasters? The role of central bank forecasts in Chile.' *International Journal of Forecasting* 31(4), 1043–1055

Romer, Christina D., and David H. Romer (2000) 'Federal Reserve Information and the Behavior of Interest Rates.' *American Economic Review* 90(3), 429–457

Rudebusch, Glenn D., and Lars E. O. Svensson (1998) 'Policy Rules for Inflation Targeting.' NBER Working Papers 6512, National Bureau of Economic Research, Inc, April

Svensson, Lars E. O. (1997) 'Inflation forecast targeting: Implementing and monitoring inflation targets.' *European Economic Review* 41(6), 1111–1146

Swanson, Eric T. (2006) 'Have Increases in Federal Reserve Transparency Improved Private Sector Interest Rate Forecasts?' *Journal of Money, Credit and Banking* 38(3), 791–819

Woodford, Michael (2001) 'Imperfect Common Knowledge and the Effects of Monetary Policy.' NBER Working Papers 8673, National Bureau of Economic Research, Inc, December

Woodford, Michael (2005) 'Central bank communication and policy effectiveness.' NBER Working Papers 11898, National Bureau of Economic Research, Inc

Tables and Figures

Table 1: List of the control variables

Variable	Description	Source
SURP_CPI	Ex post error of the one month ahead CPI inflation forecasts (y-o-y) reported by professional forecasters in the survey carried out immediately before the disclosure of the projection	Refinitiv/ Statistics Poland
SURP_GDP	Ex post error of the quarterly GDP growth (y-o-y) forecasts reported by professional forecasters in the survey carried out immediately before the disclosure of the projection	Refinitiv/ Statistics Poland
ENERGY	World Bank Energy Price Index including crude oil, coal and natural gas (log dif)	World Bank
NEER	Nominal effective exchange rate (log)	BIS
EPU	Economic Policy Uncertainty Index for Europe	Economic Policy Uncertainty

Table 2: Revisions of CPI inflation forecasts - baseline model

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.034	-0.0002	**-0.595*** **
	(0.077)	(0.296)	(0.130)
$(Y^h_t - X^h_{t-1})$	**0.443*** **	**0.365*** **	**0.133***
	(0.046)	(0.090)	(0.065)
SURP_CPI	**-0.459*** **	0.001	-0.192
	(0.116)	(0.197)	(0.144)
ENERGY	0.243	**1.399** **	**1.117*** **
	(0.154)	(0.678)	(0.369)
NEER	1.402	-2.992	**-5.561*** **
	(1.432)	(3.268)	(1.779)
COVID	**-0.254*** **	0.306	**0.311** **
	(0.056)	(0.296)	(0.142)
Const	0.016	0.044	0.031
	(0.016)	(0.037)	(0.026)
R2	0.91	0.66	0.77
No. of obs.	41	45	30

Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Revisions of GDP forecasts - baseline model

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	0.113	-0.020	**-0.404****
	(0.109)	(0.198)	(0.156)
$(Y^h_t - X^h_{t-1})$	**0.109*****	**0.428*****	**0.178*****
	(0.039)	(0.110)	(0.028)
SURP_GDP	**-0.096****	**-0.398****	0.038
	(0.041)	(0.160)	(0.170)
COVID	**-2.525*****	**0.437*****	**0.064****
	(0.027)	(0.042)	(0.024)
Const	-0.014	-0.039	**0.058*****
	(0.026)	(0.039)	(0.016)
R2	0.84	0.59	0.60
No. of obs.	52	43	33

Note: The dependent variable is the revision of the median GDP forecast of professional forecasters. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Revisions of CPI inflation forecasts - conditional on internal uncertainty (dispersion of individual forecasts)

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.040	-0.014	**-0.315*****
	(0.072)	(0.307)	(0.105)
$(Y^h_t - X^h_{t-1})$	**0.423*****	**0.267****	0.008
	(0.094)	(0.116)	(0.058)
$IQR^h_t \times (Y^h_t - X^h_{t-1})$	0.029	**0.102****	**0.184*****
	(0.097)	(0.048)	(0.042)
SURP_CPI	**-0.462*****	-0.054	-0.118
	(0.122)	(0.189)	(0.139)
ENERGY	0.210	**1.442****	**1.025*****
	(0.218)	(0.635)	(0.224)
NEER	1.472	-2.565	**-4.384***
	(1.604)	(3.282)	(2.226)
COVID	**-0.264*****	0.330	**0.280****
	(0.078)	(0.265)	(0.101)
Const	0.016	0.043	0.053
	(0.016)	(0.037)	(0.032)
R2	0.91	0.68	0.83
No. of obs.	41	45	30

Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Revisions of GDP forecasts - conditional on internal uncertainty (dispersion of individual forecasts)

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	0.111	0.066	**-0.494*** **
	(0.111)	(0.261)	(0.129)
$(Y^h_t - X^h_{t-1})$	**0.246** **	0.078	0.042
	(0.101)	(0.199)	(0.055)
$IQR^h_t \times (Y^h_t - X^h_{t-1})$	**-0.207** **	**0.451** **	**0.186*** **
	(0.096)	(0.191)	(0.054)
SURP_GDP	**-0.097** **	**-0.449*** **	0.063
	(0.039)	(0.103)	(0.154)
COVID	**-2.522*** **	**0.454*** **	**0.057** **
	(0.029)	(0.041)	(0.021)
Const	-0.022	-0.048	**0.050*** **
	(0.028)	(0.035)	(0.014)
R2	0.84	0.71	0.67
No. of obs.	52	43	33

Note: The dependent variable is the revision of the median GDP forecast of professional forecasters. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Revisions of CPI inflation forecasts - conditional on external uncertainty (EPU)

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.044	-0.061	**-0.511*** **
	(0.080)	(0.286)	(0.080)
$(Y^h_t - X^h_{t-1})$	**0.413*** **	-0.124	-0.192
	(0.144)	(0.192)	(0.156)
$EPU_t \times (Y^h_t - X^h_{t-1})$	0.0001	**0.0017*** **	**0.0013** **
	(0.0005)	(0.0005)	(0.0005)
SURP_CPI	**-0.463*** **	-0.006	-0.186
	(0.128)	(0.178)	(0.118)
ENERGY	0.216	0.462	**0.905*** **
	(0.224)	(0.613)	(0.314)
NEER	1.520	0.872	**-5.596*** **
	(1.809)	(3.313)	(1.904)
COVID	**-0.261*** **	-0.052	0.231
	(0.075)	(0.240)	(0.146)
Const	0.015	0.022	0.032
	(0.018)	(0.037)	(0.029)
R2	0.91	0.72	0.83
No. of obs.	41	45	30

Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. External uncertainty is measured with Economic Policy Uncertainty Index for Europe (see Baker et al., 2016). HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Revisions of GDP forecasts - conditional on external uncertainty (EPU)

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	0.111	-0.062	**-0.421*** **
	(0.109)	(0.247)	(0.138)
$(Y^h_t - X^h_{t-1})$	0.028	-0.159	0.028
	(0.092)	(0.280)	(0.114)
$EPU_t \times (Y^h_t - X^h_{t-1})$	0.0004	**0.0025** **	0.0005
	(0.0006)	(0.0009)	(0.0004)
SURP_GDP	**-0.097** **	-0.234	0.050
	(0.043)	(0.185)	(0.173)
COVID	**-2.536*** **	**0.411*** **	**0.050** *
	(0.036)	(0.031)	(0.028)
Const	-0.011	-0.017	**0.064*** **
	(0.029)	(0.028)	(0.018)
R2	0.84	0.73	0.63
No. of obs.	52	43	33

Note: The dependent variable is the revision of the median GDP forecast of professional forecasters. External uncertainty is measured with Economic Policy Uncertainty Index for Europe (see Baker et al., 2016). HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Revisions of CPI inflation forecasts - conditional on inflation rate

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.016	-0.025	**-0.395*** **
	(0.095)	(0.305)	(0.101)
$(Y^h_t - X^h_{t-1})$	**0.466*** **	**0.240** *	0.059
	(0.092)	(0.118)	(0.067)
$CPI_t \times (Y^h_t - X^h_{t-1})$	-0.004	**0.017** *	**0.016*** **
	(0.013)	(0.008)	(0.005)
SURP_CPI	**-0.446*** **	-0.024	-0.176
	(0.144)	(0.187)	(0.133)
ENERGY	0.274	**1.149** *	**1.089*** **
	(0.212)	(0.585)	(0.263)
NEER	1.203	-1.290	**-5.131** *
	(1.868)	(3.234)	(2.193)
COVID	**-0.249*** **	0.241	**0.301** *
	(0.068)	(0.250)	(0.110)
Const	0.019	0.035	0.042
	(0.020)	(0.040)	(0.030)
R2	0.91	0.68	0.82
No. of obs.	41	45	30

Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Revisions of CPI inflation forecasts - robustness check

	Interest rates discrepancy			Joint estimation		
	Current year	Next year	Two years ahead	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.042	-0.031	**-0.554*** **	-0.035	-0.030	**-0.599*** **
	(0.073)	(0.279)	(0.108)	(0.058)	(0.124)	(0.134)
$(Y^h_t - X^h_{t-1})$	**0.445*** **	**0.359*** **	**0.157*** **	**0.438*** **	**0.341*** **	**0.131** **
	(0.043)	(0.093)	(0.038)	(0.039)	(0.068)	(0.053)
DIF_IR	-0.020	-0.095	**0.142** **	-	-	-
	(0.020)	(0.078)	(0.060)	-	-	-
SURP_CPI	**-0.452*** **	0.123	**-0.261***	**-0.466*** **	-0.021	-0.176
	(0.122)	(0.240)	(0.131)	(0.075)	(0.173)	(0.150)
ENERGY	0.243	**1.394** **	**1.178*** **	0.190	**1.378*** **	**1.114*** **
	(0.158)	(0.582)	(0.383)	(0.227)	(0.500)	(0.381)
NEER	1.815	-1.375	**-7.307** **	1.580	-2.501	**-5.583*** **
	(1.606)	(4.051)	(2.657)	(0.960)	(3.060)	(2.047)
COVID	**-0.250*** **	0.327	**0.297** **	**-0.276** **	0.300	0.313
	(0.057)	(0.251)	(0.139)	(0.136)	(0.323)	(0.236)
Const	0.024	**0.088***	0.020	0.017	0.049	0.031
	(0.020)	(0.052)	(0.028)	(0.014)	(0.040)	(0.030)
R2	0.92	0.68	0.80	0.91	0.66	0.77
No. of obs.	41	45	30	41	45	30

Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. DIF_IR stands for the difference between the level of constant interest rate assumed in the NBP projection and the private sector expectations about the central bank interest rate. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Revisions of GDP forecasts - robustness check

	Interest rates discrepancy			Joint estimation		
	Current year	Next year	Two years ahead	Current year	Next year	Two years ahead
ΔX^h_{t-1}	0.138	0.005	**-0.399** **	0.121	-0.034	**-0.407*** **
	(0.115)	(0.246)	(0.153)	(0.120)	(0.192)	(0.105)
$(Y^h_t - X^h_{t-1})$	**0.108** **	**0.439*** **	**0.177*** **	**0.112***	**0.422*** **	**0.180*** **
	(0.043)	(0.096)	(0.026)	(0.058)	(0.058)	(0.026)
DIF_IR	0.027	**0.158***	-0.008	-	-	-
	(0.046)	(0.087)	(0.037)	-	-	-
SURP_GDP	**-0.087***	**-0.201***	0.042	-0.096	**-0.391*** **	0.052
	(0.048)	(0.108)	(0.171)	(0.087)	(0.138)	(0.166)
COVID	**-2.504*** **	**0.485*** **	**0.063** **	**-2.523*** **	**0.436** **	0.063
	(0.056)	(0.057)	(0.024)	(0.160)	(0.217)	(0.100)
Const	-0.029	-0.084	**0.059*** **	-0.014	-0.039	**0.058*** **
	(0.049)	(0.053)	(0.014)	(0.022)	(0.036)	(0.018)
R2	0.84	0.67	0.60	0.84	0.59	0.60
No. of obs.	52	43	33	52	43	33

Note: The dependent variable is the revision of the median GDP forecast of professional forecasters. DIF_IR stands for the difference between the level of constant interest rate assumed in the NBP projection and the private sector expectations about the central bank interest rate. *** p<0.01, ** p<0.05, * p<0.1.

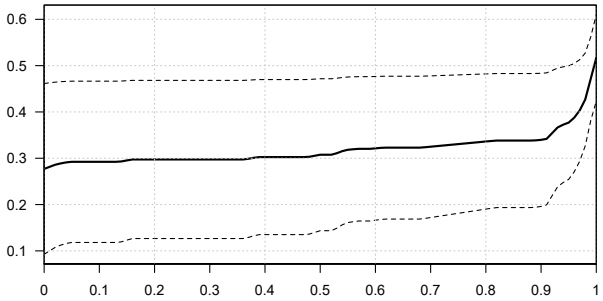
Table 11: Revisions of CPI inflation forecasts - conditional on inflation volatility

	Current year	Next year	Two years ahead
ΔX^h_{t-1}	-0.041	-0.018	**-0.485*** **
	(0.086)	(0.305)	(0.104)
$(Y^h_t - X^h_{t-1})$	**0.436*** **	**0.259** **	0.047
	(0.058)	(0.114)	(0.068)
$CPI\_vol_t \times (Y^h_t - X^h_{t-1})$	0.019	**0.156** **	**0.180*** **
	(0.080)	(0.068)	(0.062)
SURP_CPI	**-0.463*** **	-0.058	-0.201
	(0.131)	(0.187)	(0.139)
ENERGY	0.240	**1.284** **	**1.080*** **
	(0.161)	(0.584)	(0.278)
NEER	1.484	-2.171	**-6.046** **
	(1.715)	(3.273)	(2.313)
COVID	**-0.252*** **	0.277	**0.268** **
	(0.054)	(0.240)	(0.111)
Const	0.015	0.042	0.040
	(0.018)	(0.037)	(0.028)
R2	0.91	0.69	0.81
No. of obs.	41	45	30

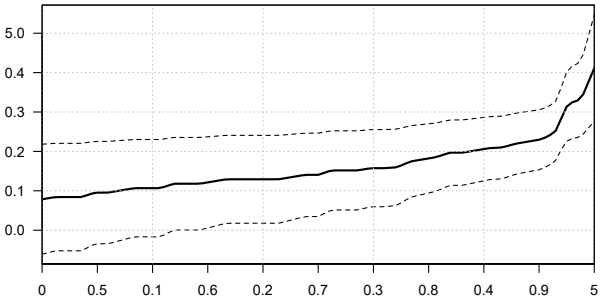
Note: The dependent variable is the revision of the median CPI inflation forecast of professional forecasters. The inflation volatility is calculated as the conditional variance from GARCH(1,1) model for monthly CPI inflation. HAC standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Marginal effect of discrepancy between the central bank's and forecasters' expectations on the forecasts revision - conditional on internal uncertainty (dispersion of individual forecasts).

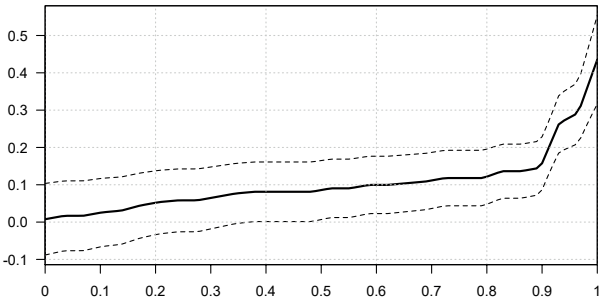
a) CPI inflation: Next year



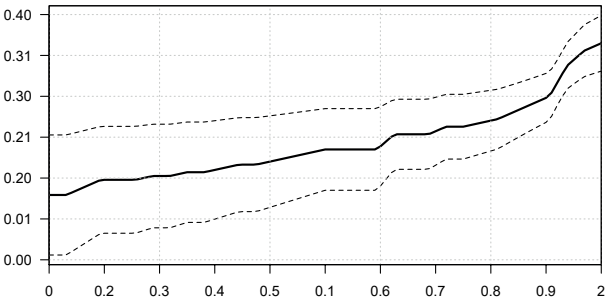
c) GDP: Next year



b) CPI inflation: Two years ahead



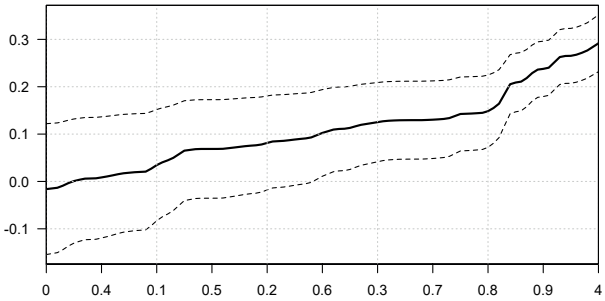
d) GDP: Two years ahead



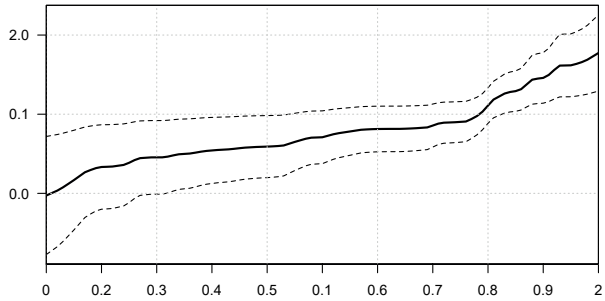
Note: The figures plot the marginal effect of the discrepancy between the central path of the projection and the median of individual CPI inflation or GDP forecasts reported in the preceding survey on the revision of the median forecast by professional forecasters. The values on the horizontal axis are the percentiles of the internal uncertainty measure (dispersion of individual forecasts). The marginal effects is calculated using the formula (5) with the respective estimates from Table 4 and Table 5. The dotted lines represent the 90-percent confidence interval.

Figure 2: Marginal effect of discrepancy between the central bank's and forecasters' expectations on the forecasts revision - conditional on external uncertainty (EPU).

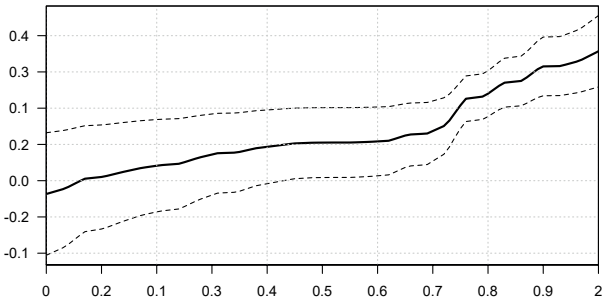
a) CPI inflation: Next year



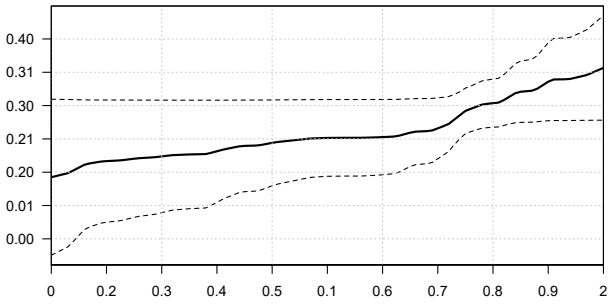
c) GDP: Next year



b) CPI inflation: Two years ahead



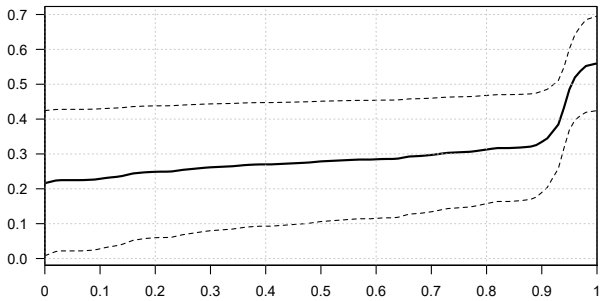
d) GDP: Two years ahead



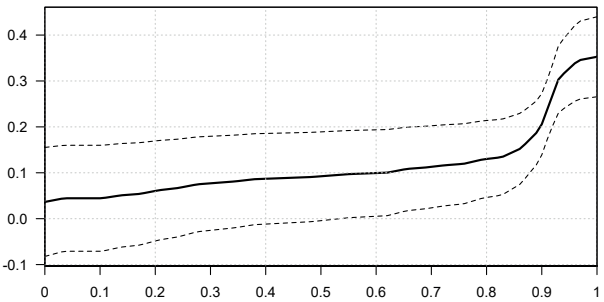
Note: The figures plot the marginal effect of the discrepancy between the central path of the projection and the median of individual CPI inflation or GDP forecasts reported in the preceding survey on the revision of the median forecast by professional forecasters. The values on the horizontal axis are the percentiles of the external uncertainty measure (Economic Policy Uncertainty Index). The marginal effects is calculated using the formula (5) with the respective estimates from Table 6 and Table 7. The dotted lines represent the 90-percent confidence interval.

Figure 3: Marginal effect of discrepancy between the central bank's and forecasters' expectations on the forecasts revision - conditional on inflation rate.

a) CPI inflation: Next year



b) CPI inflation: Two years ahead



Note: The figures plot the marginal effect of the discrepancy between the central path of the projection and the median of individual CPI inflation forecasts reported in the preceding survey on the revision of the median forecast by professional forecasters. The values on the horizontal axis are the percentiles of the CPI inflation in the sample. The marginal effect is calculated using the formula (5) with the respective estimates from Table 8. The dotted lines represent the 90-percent confidence interval.