

Financial crisis, low inflation environment and short-term inflation expectations in Poland

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Abstract

To what extent the financial crisis, whose sharp phase began in 2008, and low inflation environment that started in 2013 have affected inflation expectations in Poland? Have inflation expectations of the private sector become more forward-looking? Is monetary policy still able to influence those expectations as compared with the pre-crisis period? These are the main questions addressed in this study. To answer them we analyse survey-based measures of inflation expectations of consumers, enterprises and financial sector analysts.

Estimation of simple and extended hybrid models of inflation expectations combined with the verification of the orthogonality of expectational errors with respect to available information leads us to the conclusion that since 2008 the share of enterprises and financial sector analysts making improved use of available information and producing forward-looking forecasts has increased. Their expectations have become more sensitive to interest rate changes and developments in the real economy. However, at the same time enterprises' inflation expectations have become less influenced by the NBP inflation target and more responsive to current inflation. The formation of consumer inflation expectations has not been affected significantly.

Keywords: inflation expectations, survey data, financial crisis

JEL: D84, E31

“For long periods expectations, like any other form of acquired behavior, may be routine, habitual, until something happens that creates a crossroad situation, a problem, and thus a need for reorganizing one’s frame of reference.”

(Katona, 1946, p. 53)

1. Introduction

This study aims at testing the formation of inflation expectations of private sector agents in Poland. We use survey-based measures of short-term inflation expectations of consumers, enterprises and financial sector analysts. A special attention in the study is paid to recent developments in the way, in which economic agents under consideration form their expectations. As we are interested in the performance of inflation expectations of different groups of agents, data availability constrains our analysis to short-term expectations, formed in the 12-month horizon. The sample period begins in May 2001 and ends in August 2015.

The beginning of the sharp phase of the financial crisis in September 2008 led to a large increase in macroeconomic uncertainty faced by economic agents in their decisions. Since then inflation in Poland has deviated significantly from the inflation target set by Narodowy Bank Polski (NBP) – exceeding it in 2008–2009 and 2011–2012, while developing below target since 2013 and becoming negative since mid-2014 (Figure 1). Both these factors are likely to affect the formation of inflation expectations. Therefore it is interesting to assess empirically to what extent the financial crisis and the low inflation environment have affected the formation of inflation expectations in Poland. Has private sector agents become more forward-looking? Is monetary policy able to influence expectations?

Formation of inflation expectations in Poland was analysed in various studies. In general, they indicate the heterogeneity of the models of expectations formation across different groups of agents and the ongoing evolution in this respect. Polish consumers seem strongly backward-looking, with their inflation perceptions depending on price increases of a relatively broad group of frequently purchased goods and services (Hałka, Łyziak 2015), however there are some signs of an increasing degree of their forward-lookingness in the post-crisis period (Łyziak, Mackiewicz-Łyziak 2014). The forward-looking component of inflation expectations seems similar in the case of enterprises and financial sector analysts. Expectations of the latter group of agents used to be firmly anchored to the inflation target of Narodowy Bank Polski, even in the short-term horizon (Łyziak 2013).¹ Results of adaptive learning models confirm that in setting their expectations financial sector analysts employ information on the NBP inflation target and future inflation to a greater degree than consumers do (Stanisławska 2008).

Studies related to the impact of the financial crisis on the formation of inflation expectations in different economies have been so far focused mainly on the anchoring of long-term inflation expectations, measured either on the basis of financial market data or on the basis of survey data (Galati, Poelhekke, Zhou 2011; Autrup, Grothe 2014; Nautz, Strohsal 2015). Only a few studies have discussed the formation of shorter-term inflation expectations among various groups of economic agents.

¹ Evolution of long-term inflation expectations in Poland, not analysed in this paper, confirms high degree of anchoring of professional forecasters’ inflation expectations (Kowalczyk, Łyziak, Stanisławska 2013).

Gerlach, Hördahl and Moessner (2011) analyse changes in the formation of short-term inflation expectations on the basis of Consensus Economics data from 25 economies. The authors conclude that in the crisis period the forecasters either have started to view inflation as less sluggish than before the crisis or they now rely more on new economic information when forming inflation expectations and less on their past forecasts. Łyziak and Mackiewicz-Łyziak (2014) analyse consumer inflation expectations in the European Union economies, inferring that the global financial crisis has influenced the formation of consumer inflation, but its impact has been slightly different in advanced and transition economies. Taking into account all economies under consideration a deterioration of forecasting accuracy of consumer inflation expectations and less efficient use of available information can be observed on the one hand, while on the other hand – there is an increase in the degree of forward-lookingness of expectations, i.e. in the share of economic agents forming unbiased expectations, consistent with unbiasedness requirement of the rational expectations hypothesis. It is probably due to the fact that in the environment of high uncertainty and significant changes in the level of inflation, consumers had stronger incentives to collect and interpret available information (more detailed interpretation in: Łyziak, Mackiewicz-Łyziak 2014, p. 17). In the advanced economies inflation forecasting accuracy of analysed measures of expectations has decreased in the post-crisis period, but the degrees of forward-lookingness and efficiency of inflation expectations have slightly increased. Transition economies have faced a significant increase in the degree of forward-lookingness of inflation expectations and improvement in their forecasting accuracy, however the use of available information by consumers in those economies has become somewhat less efficient. Łyziak and Paloviita (2016) analyse long-, medium and short-term inflation expectations of professional forecasters and short-term consumer inflation expectations in the euro area. Their results suggest that since the onset of the financial crisis, the role of the inflation target for long-term expectations of professional forecasters has not diminished and the implicit anchors for medium- and long-term expectations have remained consistent with the ECB price stability objective. As regards the post-crisis period, however, they find some evidence of the increased sensitivity of longer-term inflation forecasts to shorter-term forecasts and to actual HICP inflation. The ECB inflation projections have recently become more important for professional forecasters, as they provide benchmarks for their short- and medium-term inflation expectations. At the same time the role of the ECB inflation target for those expectations has diminished.

The above studies suggest that the formation of inflation expectations has changed to some extent since the beginning of the financial crisis. Interestingly, a majority of the results point out that in the environment of elevated uncertainty and low inflation, inflation expectations have become more forward-looking and monetary policy management of expectations, even if weakened, is still possible. The next parts of the paper will verify if this conclusion holds in the case of the short-term inflation expectations of consumers, enterprises and financial sector agents in Poland.

The paper is organised in a standard manner. Section 2 describes survey-based measures of inflation expectations used in the study. Section 3 discusses methods used to answer the questions posed in the Introduction. Section 4 presents empirical results obtained. The final section offers synthetic conclusions.

2. Data

To quantify inflation expectations of Polish consumers we use data from the survey conducted on a monthly basis by the Polish Central Statistical Office (GUS). The question on expected price changes is qualitative and makes the respondents expecting price increases declare its magnitude relative to their perception of current price changes:

“By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will: (1) increase more rapidly; (2) increase at the same rate; (3) increase at a slower rate; (4) stay about the same; (5) fall; (6) don’t know”.

Inflation expectations of enterprises are measured on the basis of quarterly surveys conducted by Narodowy Bank Polski (NBP’s Quick Monitoring). Since 2008 Q3 the survey question has been qualitative, while previously (2001 Q1–2008 Q2) it was quantitative. In comparison with a similar question in the GUS consumer survey, the Quick Monitoring question provides the respondents with the most recent CPI inflation figure:

“In ... CPI inflation was ...% in annual terms. In your opinion during the next 12 months prices will: (1) rise faster than at present, (2) rise at the same rate, (3) rise more slowly, (4) stay at their present level, (5) go down, (6) difficult to say”.

To quantify consumer and producer inflation expectations in Poland we use the probability method, proposed originally by Carlson and Parkin (1975) and then extended by Batchelor and Orr (1988). In line with the construction of the survey question, the quantified distribution of expected inflation, including its mean, depends both on the responses to the survey question and on the perceived rate of inflation. It should be pointed out that since CPI inflation in Poland reached negative territory (mid-2014), the business survey question on expected price developments has been changed, but still allows the quantification of expected inflation with the use of the probability method. The present form of this question is the following:

“In June 2014 CPI inflation was 0.3% on annual basis. In the following months it has remained negative and in ... it was minus ...%. In your opinion during next 12 months prices will: (1) rise faster than by 0.3%; (2) rise at a rate of 0.3%; (3) rise more slowly than by 0.3%; (4) remain unchanged with respect to ...; (5) fall more slowly than in ...; (6) fall at a similar rate; (7) fall at faster rate; (8) difficult to say”.

In the process of quantification we assume that at each point of time the expected inflation is normally distributed in the population, which is a typical assumption in probability methods.² In the period 2000 Q1–2008 Q2, when the business survey question on expected price developments was quantitative, quantitative expectations of individual enterprises are translated into implied (individual) responses to the qualitative survey question, and then they are aggregated and used to quantify inflation expectations with the probability method (see Łyziak 2012 for details). However, being aware of the fact that the results of our analysis can be affected by the change in the survey question, whose timing coincided with the beginning of the financial crisis, to check the robustness of those results, we applied an alternative measure of enterprises’ inflation expectations. It combines the results based on quantitative

² In their seminal article Carlson and Parkin (1975) argue that survey respondents have similar information sets, containing publicly available professional forecasts, so a unimodal distribution of their expectations around the consensus can be expected. If individual distributions are independent across respondents, have a common form and finite first and second moments, the survey results can be interpreted as a sampling from some aggregate distribution, which under the central limit theorem is normally distributed.

(till 2008 Q2) and qualitative (since 2008 Q3) survey questions. The results of empirical tests, presented in Section 4, are qualitatively the same, independently of the way of measuring enterprises' inflation expectations (they are available from the author on request). The currently available CPI inflation, which is displayed in the survey question, is used as a reference value, allowing enterprises expecting an increase in prices to assess if they will increase faster, at the same rate or at a slower rate. In the case of consumers, the Consumer Perceived Price Index (CPPI) – the measure developed by Hałka and Łyziak (2015) to reflect consumers' perceptions – is used as a scaling factor. It is significantly and systematically higher than CPI inflation, which is due to the fact that the perception of price changes by consumers is based on a sub-basket of frequently bought goods and services³ and consumers disregard negative price changes of those items.

Financial sector analysts are the third group of agents, whose inflation expectations we analyse in this study. We use monthly data on 12-month inflation expectations obtained from the surveys by Reuters.

3. Methods

To answer the questions concerning the formation of inflation expectations in Poland and changes in this respect since 2008, we first estimate two different versions of hybrid models of inflation expectations formation.

The first specification combines standard hybrid models of expectations, in which a part of economic agents is assumed to form rational (forward-looking) expectations and the remaining part forms expectations in the extrapolative (backward-looking) manner (Roberts 1998; Carlson, Valev 2002), with models used to analyse central bank credibility, which treat inflation expectations as a weighted average of the current inflation and the inflation target (Bomfim, Rudebusch 2000; Rosenblatt-Wisch, Scheufele 2015). As a result, we estimate simple hybrid models, in which we identify three groups of agents: those forming their expectations on the basis of lagged CPI inflation (perceived inflation in the case of consumers), those having rational (unbiased) expectations and those, whose expectations are consistent with the central bank inflation target, i.e.:

$$\pi_{t+12|t}^e = \alpha^b \pi_{t-2} + \alpha^f \pi_{t+12} + (1 - \alpha^b - \alpha^f) \pi_{t+12}^{tar} + \varepsilon_t \quad (1)$$

where $\pi_{t+12|t}^e$ denotes 12-month-ahead inflation expectations, π stands for inflation, while π^{tar} is the central bank inflation target.⁴

Another way of assessing the formation of inflation expectations is based on Cerisola and Gelos (2009). Estimating extended hybrid models of expectations in line with their proposal we explain the empirical measures of inflation expectations in Poland with lagged inflation, the central bank inflation target and a broad set of macroeconomic variables that can influence future inflation. The latter include:

³ It is relatively broad and includes: food and non-alcoholic beverages, tobacco, housing and energy carriers, medical products, fuels, communication services, newspapers and articles and products for personal care.

⁴ Actual future inflation is used as a measure of rational expectations. As a consequence, the error term of the estimated equation includes the expectational error of rational expectations (Fair 1993). Therefore, the two-stage least squares method (2SLS) is used to estimate the equation.

the deviation of the real interest rate from the trend (\hat{r}),⁵ the deviation of the real effective exchange rate from the trend (\hat{e}^r), the industrial output gap (\hat{y}), the unemployment gap (\hat{u}), the real wage gap (\hat{w}) and the rate of growth of oil prices in international markets ($\Delta\pi^o$).⁶ The estimated equation is the following:

$$\pi_{t+12|t}^e = \alpha^b \pi_{t-2} + \alpha^{tar} \pi_{t+12}^{tar} + \alpha^r \hat{r}_{t-l^r} + \alpha^e \hat{e}^r_{t-l^e} + \alpha^y \hat{y}_{t-l^y} + \alpha^u \hat{u}_{t-l^u} + \alpha^w \hat{w}_{t-l^w} + \alpha^o \Delta\pi_{t-l^o}^o + \varepsilon_t \quad (2)$$

In the case of variables expressed as deviations from trends, the trends are approximated with the Hodrick-Prescott filter, similarly as in Cerisola and Gelos (2009). The choice of lags for independent variables (l) is driven by their public availability at time t and statistical significance.

The above methods allow assessing the importance of forward-looking factors and the role of the central bank inflation target in the formation of inflation expectations. Dependence of inflation expectations on certain pieces of information available when inflation expectations are formed does not, however, necessarily mean that the use of information is efficient. To address this issue we test the orthogonality of expectational errors with respect to available information, which is one of the requirements of the rational expectations hypothesis. More specifically, we verify if expectational errors ($e_t = \pi_{t+12|t}^e - \pi_{t+12}$) are orthogonal with respect to different variables from the information set (Ω) available when inflation expectations are formed, including: the 3-month interbank interest rate (WIBOR 3M), the nominal effective exchange rate (NEER), industrial output, the unemployment rate, wages, oil prices and the current CPI inflation. For each of the measures of inflation expectations and for each of the variables in the information set we estimate the following equation:

$$e_t = \alpha_0 + \alpha_1 e_{t-1} + \alpha_2 \Omega_t + \varepsilon_t \quad (3)$$

A statistically significant suggests that agents failed to take account of the selected information variable in an optimal way in assessing future price developments. In empirical testing of macroeconomic efficiency past expectational errors are often ignored (e.g. Forsells, Kenny 2004). Due to strong autocorrelation of errors – which does not contradict the rational expectations hypothesis given that the horizon of analysed expectations is longer than the frequency of the data – we use the test equation with lagged expectational errors on its right-hand side. This substantially improves the statistical properties of estimation results. Significance of past forecast errors in explaining their current values has been confirmed in other studies (e.g. Babecký, Podpiera 2011; Łyziak 2013).

Forsells and Kenny (2004) indicate multi-collinearity problems, which could appear while estimating the above equation in a multivariate context. Following their approach, we estimate univariate regressions, in which the dependent variable is the year-on-year change in the information variable at the time when the expectations were formed (publication lags taken into account). However, Mehra (2002) underlines that efficiency tests based on including variables one at a time can be subject to biases generated by the omission of other relevant variables. Being aware of this risk, in our testing of inflation expectations we follow Mehra (2002) and test the joint significance of different information variables in addition to analyses based on univariate regressions.

⁵ We use inflation expectations of respective groups of economic agents to calculate real interest rates.

⁶ Following Cerisola and Gelos (2009) we have also included the primary fiscal balance, but it appears insignificant in extended hybrid models of short-term inflation expectations in Poland.

All the above equations are estimated using the whole sample period at the disposal, i.e. 2001:05–2015:08 as well as separately for the periods before the financial crisis (2001:05–2008:08) and after the beginning of its sharp phase (2008:09–2015:08). Inflation expectations of enterprises, available with a quarterly frequency, were interpolated to monthly series using linear interpolation.

4. Results

Developments of inflation expectations of the analysed groups of agents in Poland in 2001–2015 (Figure 2) illustrate their heterogeneity. In terms of their averages, the quantified measure of consumer inflation expectations in the analysed period was significantly above expectations of the remaining groups of economic agents. A relatively low inflation volatility of inflation expectations of financial sector analysts that follow closely the NBP inflation target indicates a high degree of anchoring of those expectations. It is interesting to note that during the period of deflation inflation expectations of consumers and financial sector analysts remained significantly above zero, which is due to the fact that consumers do not notice price reductions, while financial sector analysts attach a relatively high weight to the NBP inflation target. However, expectations of enterprises, which seem relevant in analysing determinants of actual inflation (Łyziak 2016), have been reduced significantly and remained close to zero.

Analysing results based on the models presented in the previous section of the paper, we first discuss the heterogeneity of inflation expectations across analysed groups of economic agents on the basis of entire sample estimates and then we interpret recent changes in their formation.

Simple hybrid models of inflation expectations suggest that the process of formation of inflation expectations differs significantly among the analysed groups of agents (Table 1). Similarly as in the previous studies (Łyziak 2013), our results suggest that Polish consumers are strongly backward-looking – only 13% of them form unbiased expectations, while the remaining part forms their expectations on the basis of recently experienced price dynamics (Consumer Perceived Price Index). Enterprises and financial sector analysts consider current inflation to a smaller extent – its weight in the formation of inflation expectations equals 48% and 15% respectively. Inflation expectations of financial analysts display strong anchoring to the NBP inflation target (66%), being relatively less influenced by future inflation (19%), while in the case of enterprises the role of the NBP inflation target (17%) is lower as compared to financial sector analysts and the group of rational agents is larger (35%).

Changes in the formation of consumer inflation expectations in the recent period, i.e. after the collapse of the Lehman Brothers, have been rather minor. The dominant share of consumers, whose expectations simply extrapolate the past, has remained stable. At the same time the remaining group of consumers has started defining their expectations on the basis of the NBP inflation target instead of making unbiased forecasts of future inflation as in the pre-crisis period. In the case of enterprises and financial sector analysts the forward-looking component of inflation expectations has become statistically significant and its weight has increased, respectively, to 31% and 15%. This effect has been accompanied by the increase of the share of enterprises relying on current inflation (from 31% to 59%) and a significant fall of the percentage of enterprises whose expectations are anchored to the NBP inflation target (from 64% to 10%). In other words, inflation expectations of Polish enterprises have become more diversified internally. At the same time inflation expectations of financial sector analysts

have remained firmly anchored to the NBP inflation target (85%) and the role of current inflation has been reduced to zero.

To understand better how different pieces of available information influence inflation expectations in the Polish economy we analyse the results of extended hybrid models (Table 2, Table 3).

The results based on entire sample estimations confirm the general findings based on simple hybrid models, i.e. strong backward-lookingness of consumer inflation expectations, high degree of anchoring of inflation expectations of financial sector agents to the NBP inflation target and a relatively large group of enterprises forming unbiased predictions. All groups of agents seem to make some use of available information. Inflation expectations of consumers react to the exchange rate movements, industrial output and real wages with signs consistent with macroeconomic theory. Inflation expectations of enterprises are affected by short-term interest rates and industrial output, while expectations of financial sector analysts respond to the former factor only.

The factors affecting inflation expectations have changed since the beginning of the financial crisis. In the case of consumers, the short-term interest rate, industrial output and real wages, significant in explaining inflation expectations in the pre-crisis period have become statistically insignificant after the collapse of the Lehman Brothers and replaced with the exchange rate, the unemployment rate and oil prices. The reaction of enterprises' inflation expectations to the short-term interest rate has recently become stronger. At the same time the role of real wages has become statistically insignificant, while the role of demand factors, represented by industrial output and unemployment, has increased. Similarly as in the simple hybrid models, the importance of current inflation has risen recently, while the importance of the NBP inflation target – has diminished. In the case of financial sector analysts, their expectations have become less reactive to the short-term interest rate, but have started responding to industrial output, real wages and oil prices. They have become less tied to current inflation and more anchored to the NBP inflation target (which is not suggested by simple hybrid models).

The results described above and decompositions of inflation expectations based on the extended hybrid models (Table 3) suggest that since 2008 enterprises and financial sector agents have strengthened their abilities to process selected pieces of available information. To analyse it in a more detailed manner we analyse expectational errors and verify one of the crucial requirements of the rational expectations hypothesis, i.e. the orthogonality of expectational errors with respect to available information.

Analysis of expectational errors (Table 4) – especially the mean absolute errors (MAE) and the root mean squared errors (RMSE) – suggests that in the whole period under consideration inflation expectations of enterprises and financial sector analysts displayed better forecasting properties than naive forecasts,⁷ while the errors of inflation expectations of consumers were significantly larger than the errors of naive forecasts. It is related to a less efficient use of available information by consumers relative to the remaining groups of agents (Table 5). In 2001–2015 only two out of seven analysed variables (i.e. the exchange rate and oil prices) were efficiently processed by consumers, while in the case of enterprises, forecast errors were orthogonal with respect to five variables (i.e. the exchange rate, industrial output, the unemployment rate, wages and oil prices) and in an case of financial sector agents all the information variables except the short-term interest rate were interpreted in an appropriate manner.

Interestingly, after the beginning of the financial crisis expectational errors have significantly decreased in the case of enterprises (similarly as the errors of naive forecasts), while in the case of

⁷ Naive forecasts are given here by the recent available CPI inflation.

financial sector analysts they have been reduced to a smaller extent. At the same time the number of variables efficiently processed has increased for all groups under consideration. In particular, expectational errors have become orthogonal with respect to the short-term interest rate and inflation, which in the pre-crisis period were statistically significant in explaining forecast errors.

The results of testing the joint significance of different variables in the equations explaining forecast errors confirm the improvements of macroeconomic efficiency of expectations formed by enterprises and financial sector analysts in the post-crisis period, however, they suggest a less efficient use of available information by consumers in the recent period.

Empirical results presented above suggest that the formation of inflation expectations in the private sector in Poland has changed recently. The environment of high macroeconomic uncertainty and inflation deviating significantly from the inflation target has made the groups of enterprises and financial sector analysts making forward looking predictions expand. In particular, they have learnt how to interpret changes in the short-term interest rates. It suggests that monetary policy decisions are able to shape inflation expectations in line with central bank intentions. A higher degree of forward-lookingness can compensate for a lower role of the inflation target in setting inflation expectations by enterprises.

5. Conclusions

The results presented in this study offer updated and detailed insights to the formation of inflation expectations by Polish consumers, enterprises and financial sector analysts. The heterogeneity of the models of expectations is tested with the use of a relatively long sample period (2001–2015) and changes in this respect after the beginning of the financial crisis and in the current low inflation environment are in the centre of the conducted analysis.

It seems that changes in the formation of inflation expectations in recent years have been the most evident in the case of enterprises. Even if the role of current inflation has become higher than in the pre-crisis period and the role of the inflation target has decreased, we can observe that the group of forward-looking enterprises, making unbiased predictions and processing available information adequately, has expanded significantly. A similar effect can be observed in the case of financial sector analysts, whose expectations remain well anchored to the NBP inflation target with a slightly increased fraction of analysts forming unbiased expectations in the recent period. Some changes are also observed in the formation of consumer inflation expectations, but in this case simple and extended hybrid models offer slightly different conclusions.

We can conclude that besides its role in anchoring long-term inflation expectations (Kowalczyk, Łyziak, Stanisławska 2013), monetary policy is still able to influence short-term inflation expectations of enterprises and financial sector analysts and – to a small extent – it can also exert influence on consumer inflation expectations in Poland. It does so with different means. The NBP inflation target is the most important benchmark for inflation expectations of financial sector analysts, although they react also to monetary policy decisions (changes in short-term interest rates). The latter factor is more important than the former in the case of enterprises, whose expectations since 2008 have been affected by monetary policy decisions to a higher extent than in the past, being, however, less anchored to the NBP inflation target.

References

- Astrup S.L., Grothe M. (2014), Economic surprises and inflation expectations: Has anchoring of expectations survived the crisis?, *ECB Working Paper*, 1671, European Central Bank.
- Babečỳ J., Podpiera J. (2011), Inflation forecast errors in the Czech Republic: evidence from a panel of institutions, *Eastern European Economics*, 49(1), 72–83.
- Batchelor R.A., Orr A.B. (1988), Inflation expectations revisited, *Economica*, 55(219), 317–331.
- Bomfim A.N., Rudebusch G.D. (2000), Opportunistic and deliberate disinflation under imperfect credibility, *Journal of Money, Credit and Banking*, 32(4), 707–721.
- Carlson J.A., Parkin M. (1975), Inflation expectations, *Economica*, 42(166), 123–138.
- Carlson J.A., Valev N.T. (2002), A disinflation trade-off: speed versus final destination, *Economic Inquiry*, 40(3), 450–456.
- Cerisola M., Gelos G. (2009), What drives inflation expectations in Brazil? An empirical analysis, *Applied Economics*, 41(10), 1215–1227.
- Fair R.C. (1993), Testing the rational expectations hypothesis in macroeconomic models, *Oxford Economic Papers*, 45(2), 169–190.
- Forsells M., Kenny G. (2004), Survey expectations, rationality and the dynamics of euro area inflation, *Journal of Business Cycle Measurement and Analysis*, 1, 13–41.
- Galati G., Poelhekke S., Zhou C. (2011), Did the crisis affect inflation expectations?, *International Journal of Central Banking*, 7(1), 167–207.
- Gerlach P., Hördahl P., Moessner R. (2011), Inflation expectations and the Great Recession, *BIS Quarterly Review*, March, Bank for International Settlements.
- Hałka A., Łyziak T. (2015), How to define the Consumer Perceived Price Index? An application to Polish data, *Eastern European Economics*, 53(1), 39–56.
- Katona G. (1946), Psychological analysis of business decisions and expectations, *American Economic Review*, 36(1), 44–62.
- Kowalczyk H., Łyziak T., Stanisławska E. (2013), *A new approach to probabilistic surveys of professional forecasters and its application in the monetary policy context*, NBP Working Paper, 142, National Bank of Poland.
- Łyziak T. (2012), *Inflation expectations in Poland*, NBP Working Paper, 115, National Bank of Poland.
- Łyziak T. (2013), Formation of inflation expectations by different economic agents: the case of Poland, *Eastern European Economics*, 51(6), 5–33.
- Łyziak T. (2016), Survey measures of inflation expectations in Poland: are they relevant from the macroeconomic perspective?, *Baltic Journal of Economics*, 16(2), 33–52.
- Łyziak T., Mackiewicz-Łyziak J. (2014), Do consumers in Europe anticipate future inflation? Has it changed since the beginning of the financial crisis?, *Eastern European Economics*, 52(3), 5–32.
- Łyziak T., Paloviita M. (2016), *Anchoring of inflation expectations in the euro area: recent evidence based on survey data*, ECB Working Paper Series, European Central Bank, forthcoming.
- Mehra Y. (2002), Survey measures of expected inflation: revisiting the issues of predictive content and rationality, *Federal Reserve Bank of Richmond Economic Quarterly*, 88/3, 17–36.
- Nautz D., Strohsal T. (2015), Are US inflation expectations re-anchored?, *Economics Letters*, 127(C), 6–9.
- Roberts J.M. (1998), *Inflation expectations and the transmission of monetary policy*, Finance and Economics Discussion Series, 98-43, Board of Governors of the Federal Reserve System.

- Rosenblatt-Wisch R., Scheufele R. (2015), Quantification and characteristics of household inflation expectations in Switzerland, *Applied Economics*, 47(26), 2699–2716.
- Stanisławska E. (2008), Do Polish consumers and bank analysts learn how to forecast inflation?, *Bank i Kredyt*, 39(10), 14–23.

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Appendix

Figure 1
Inflation in Poland, 2001–2015

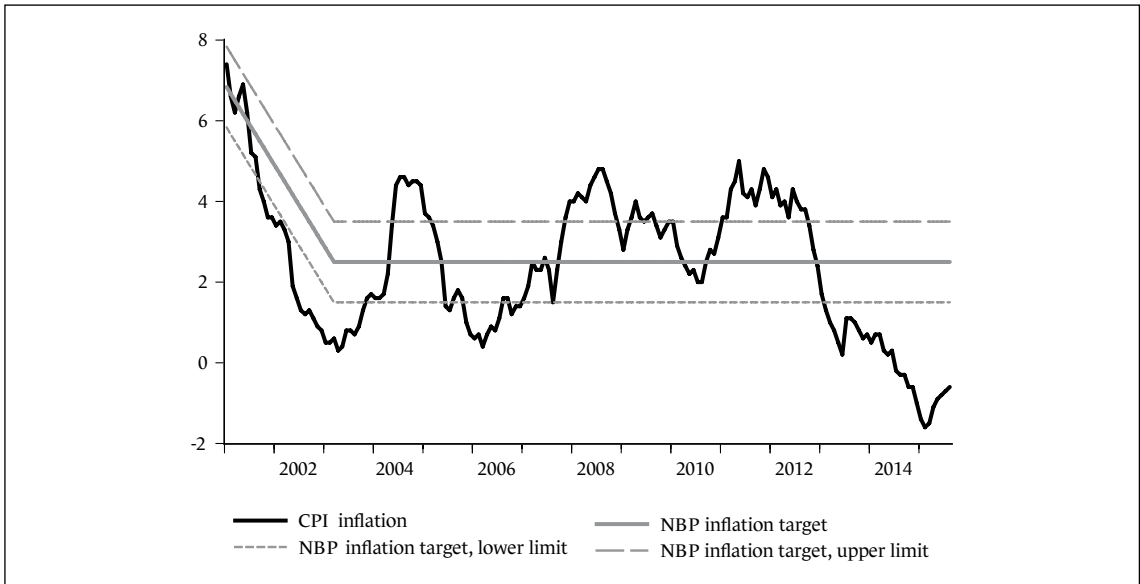


Figure 2
Inflation expectations in Poland, 2001–2015

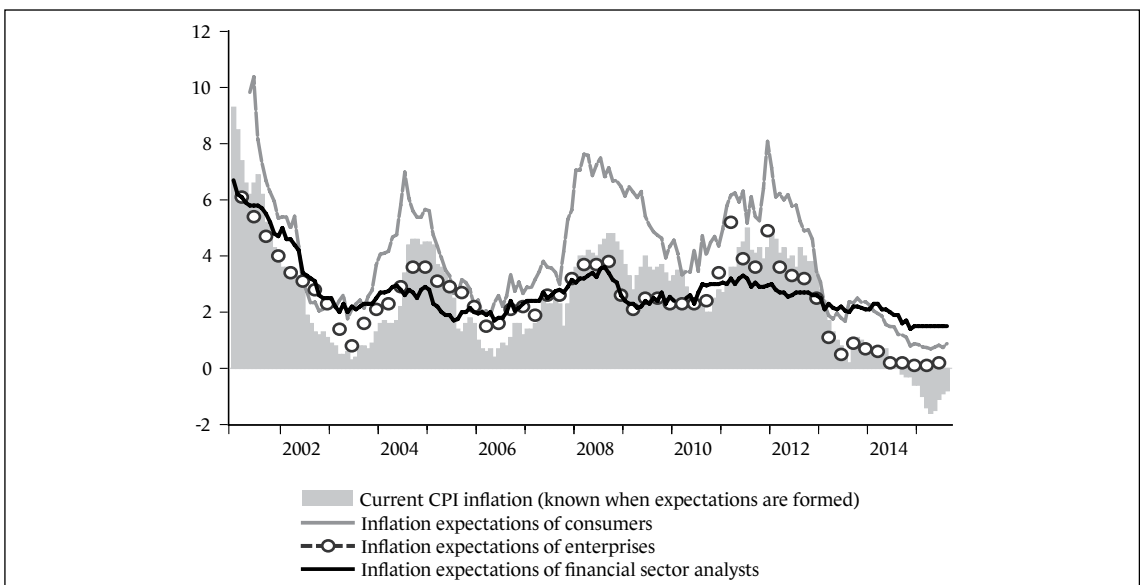


Table 1
Estimation results of simple hybrid models of inflation expectations

		Weights of:			Hansen J-statistic p-value
		lagged inflation (α^b)	future inflation (α^f)	inflation target ($1 - \alpha^b - \alpha^f$)	
Consumers	2001:05–2015:08	0.87*** (0.06)	0.13	–	0.81
	2001:05–2008:08	0.88*** (0.08)	0.12	–	0.15
	2008:09–2015:08	0.94*** (0.08)	–	0.06	0.26
Enterprises	2001:05–2015:08	0.48*** (0.14)	0.35** (0.17)	0.17	0.99
	2001:05–2008:08	0.31*** (0.07)	–	0.64	0.35
	2008:09–2015:08	0.59* (0.31)	0.31* (0.18)	0.10	0.81
Financial sector analysts	2001:05–2015:08	0.15** (0.07)	0.19* (0.11)	0.66	0.14
	2001:05–2008:08	0.13* (0.07)	–	0.87	0.20
	2008:09–2015:08	–	0.15*** (0.04)	0.85	0.80

Notes:

In the case of consumer inflation expectations the lagged CPI inflation is replaced with inflation perception, measured with the CPPI index. In the case of enterprises' expectations, available with a quarterly frequency, we use interpolated monthly series. Actual future inflation is used as a measure of rational expectations. As a consequence, the error term of the estimated equation includes the expectational error of rational expectations (Fair 1993). Therefore, the two-stage least squares method (2SLS) is used to estimate the equation with a constant, twelve lags of current inflation and the NBP inflation target being the instruments.

Numbers in parentheses below the estimated coefficients are standard errors.

*** denotes confidence level at 99%; ** denotes confidence level at 95%; * denotes confidence level at 90%.

Table 2

Estimation results of extended hybrid models of inflation expectations

		Coefficients of:							
		lagged inflation (α^b)	inflation target (α^{lan})	interest rate (α^r)	exchange rate (α^e)	industrial output (α^y)	unem- ployment rate (α^u)	real wages (α^w)	oil prices (α^o)
Consumers	2001:05–2015:08	0.958*** (0.016)	–	–	-0.001** (0.001)	0.031*** (0.012)	–	0.091** (0.050)	–
	2001:05–2008:08	0.965*** (0.026)	–	-0.002* (0.001)	–	0.029** (0.013)	–	0.114* (0.061)	–
	2008:09–2015:08	0.939*** (0.015)	–	–	-0.043*** (0.014)	–	-0.483*** (0.097)	–	0.890*** (0.164)
Enterprises	2001:05–2015:08	0.675*** (0.036)	0.332*** (0.045)	-0.007*** (0.001)	–	0.043*** (0.014)	–	–	–
	2001:05–2008:08	0.584*** (0.040)	0.508*** (0.051)	-0.003*** (0.001)	–	–	–	0.055*** (0.019)	–
	2008:09–2015:08	0.692*** (0.024)	0.230*** (0.030)	-0.007*** (0.001)	–	0.056*** (0.020)	-0.208*** (0.072)	–	–
Financial sector analysts	2001:05–2015:08	0.366*** (0.049)	0.708*** (0.036)	-0.003* (0.002)	–	–	–	–	–
	2001:05–2008:08	0.553*** (0.075)	0.580*** (0.067)	-0.004*** (0.001)	–	1	–	–	–
	2008:09–2015:08	0.224*** (0.014)	0.777*** (0.015)	-0.001* (0.001)	–	0.017* (0.010)	–	0.033* (0.019)	0.320*** (0.089)

Notes:

In the case of consumer inflation expectations the lagged CPI inflation is replaced with inflation perception, measured with the CPPI index. In the case of enterprises' expectations, available with a quarterly frequency, we use interpolated monthly series. Ordinary least squares with Newey-West HAC standard errors is used to estimate the models.

Numbers in parentheses below the estimated coefficients are standard errors.

*** denotes confidence level at 99%; ** denotes confidence level at 95%; * denotes confidence level at 90%.

Table 3

Decomposition of inflation expectations based on extended hybrid models

		Current inflation	NBP inflation target	Real interest rate	REER	Indu- strial output	Unem- plov- ment rate	Real wages	Oil prices	Residual
Consumers	2001:05–2015:08	82.8	0.0	1.4	1.1	0.9	2.4	1.4	2.8	7.1
	2001:05–2008:08	84.7	0.0	2.8	0.0	1.9	0.0	2.9	0.0	7.7
	2008:09–2015:08	81.0	0.0	0.0	2.2	0.0	4.8	0.0	5.6	6.4
Enterprises	2001:05–2015:08	51.5	29.6	6.2	0.0	2.4	1.6	0.9	0.0	7.8
	2001:05–2008:08	44.4	43.5	3.7	0.0	0.0	0.0	2.2	0.0	6.3
	2008:09–2015:08	56.9	19.1	8.1	0.0	4.2	2.8	0.0	0.0	8.9
Financial sector analysts	2001:05–2015:08	29.1	56.1	5.3	0.0	0.7	0.0	0.4	1.4	7.2
	2001:05–2008:08	36.6	46.3	7.9	0.0	0.0	0.0	0.0	0.0	9.2
	2008:09–2015:08	19.9	68.1	2.0	0.0	1.5	0.0	0.9	3.0	4.6

Note: the decomposition is based on extended hybrid models estimated in sub-periods. It presents the percentage of inflation expectations attributable to individual factors.

Table 4

Expectational errors

		Measures of errors:		
		mean error (ME)	mean absolute error (MAE)	root mean squared error (RMSE)
Consumers	2001:05–2015:08	2.10	2.51	3.06
	2001:05–2008:08	1.82	2.45	3.13
	2008:09–2015:08	2.45	2.58	2.97
Enterprises	2001:05–2015:08	0.44	1.53	1.84
	2001:05–2008:08	0.40	1.74	2.06
	2008:09–2015:08	0.50	1.27	1.52
Financial sector analysts	2001:05–2015:08	0.52	1.57	1.96
	2001:05–2008:08	0.51	1.58	2.03
	2008:09–2015:08	0.53	1.55	1.87
Naive forecasts	2001:05–2015:08	0.48	1.85	2.21
	2001:05–2008:08	0.13	2.11	2.49
	2008:09–2015:08	0.90	1.53	1.80

Note: in the case of enterprises' expectations, available with a quarterly frequency, we use interpolated monthly series.

Table 5
Testing the orthogonality of expectational errors

		Short-term interest rate	NEER	Industrial output	Unemploy- ment rate	Wage growth	Oil price dynamics	CPI inflation	Jointly F-stat (prob.)
Consumers	2001:05–2015:08	0.060** (0.026)	-0.007 (0.007)	0.020* (0.011)	-0.054* (0.032)	0.036** (0.018)	0.003 (0.002)	0.039* (0.022)	1.402 (0.218)
	2001:05–2008:08	0.038* (0.022)	0.000 (0.016)	0.020* (0.012)	-0.049 (0.040)	0.031 (0.022)	0.005* (0.003)	0.052 (0.026)	2.199* (0.062)
	2008:09–2015:08	0.037 (0.062)	-0.011 (0.010)	0.013 (0.011)	-0.131* (0.072)	0.049** (0.024)	0.001 (0.002)	-0.013 (0.048)	3.126** (0.014)
Enterprises	2001:05–2015:08	0.033* (0.017)	-0.003 (0.006)	0.004 (0.007)	-0.008 (0.021)	0.005 (0.009)	0.000 (0.001)	0.039* (0.020)	1.635 (0.141)
	2001:05–2008:08	0.039** (0.019)	0.006 (0.009)	0.025* (0.015)	-0.007 (0.025)	0.005 (0.010)	0.001 (0.002)	0.056*** (0.021)	4.114*** (0.002)
	2008:09–2015:08	0.001 (0.049)	-0.011* (0.006)	0.004 (0.010)	-0.016 (0.054)	0.006 (0.016)	0.000 (0.002)	-0.008 (0.040)	0.579 (0.716)
Financial sector analysts	2001:05–2015:08	0.031* (0.017)	0.000 (0.005)	0.002 (0.006)	-0.004 (0.026)	0.003 (0.008)	0.000 (0.001)	0.019 (0.020)	1.575 (0.158)
	2001:05–2008:08	0.035* (0.018)	0.007 (0.007)	0.001 (0.008)	0.006 (0.027)	0.034* (0.018)	0.000 (0.002)	0.036* (0.021)	3.357*** (0.008)
	2008:09–2015:08	0.009 (0.050)	-0.006 (0.006)	0.003 (0.009)	-0.016 (0.052)	-0.046** (0.023)	-0.001 (0.002)	-0.033 (0.041)	1.701 (0.147)

Notes:

In the case of enterprises' expectations, available with a quarterly frequency, we use interpolated monthly series. Ordinary least squares with Newey-West HAC standard errors is used to estimate the models.

Numbers in parentheses below the estimated coefficients are standard errors.

*** denotes confidence level at 99%; ** denotes confidence level at 95%; * denotes confidence level at 90%.

The regressions are estimated including one variable at a time as well as all of them jointly.

The F-statistic in the last column tests all variables which when included jointly are not significant in explaining the forecast error.