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The impact of financial crisis and low inflation environment on short-term inflation expectations in Poland

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Abstract

To what extent financial crisis whose sharp face begun in 2008 and low inflation environment that started in 2013 affect inflation expectations in Poland? Have inflation expectations of the private sector become more forward-looking? Is monetary policy still able to influence expectations as compared with the pre-crisis period? Those are the main questions addressed in this paper. 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 verification of orthogonality of expectational errors with respect to available information leads us to the conclusion that since 2008 inflation expectations of enterprises and financial sector analysts have become more forward-looking, better exploiting available information and more sensitive to interest rate changes and developments in the real economy. At the same time formation of consumer inflation expectations has not been affected significantly.

JEL: D84, E31.

Keywords: Inflation expectations, survey, Poland.

Introduction

> *"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)

This study aims at testing the formation 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 massive increase in macroeconomic uncertainty, faced by economic agents in their decisions. At the same inflation in Poland has deviated significantly from the inflation target set by the National Bank of Poland (NBP) – exceeding it in 2008-2009 and 2011-2012, while being below it since 2013 and 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 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 different studies (e.g. Stanisławska, 2008, Łyziak, 2013). In general, they indicate 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 and Łyziak, 2015), however there are some signs of increasing degree of their forward-lookingness (Łyziak and Mackiewicz-Łyziak, 2014). Inflation expectations of Polish enterprises are found to plan an important role in the price formation (Łyziak, 2016). The impact of forward-looking considerations on enterprises' expectations seems even stronger than in the case of financial sector analysts, whose expectations are anchored to the inflation target of the National Bank of Poland, even in the short-term horizon.[1] Results of adaptive learning models suggest that in setting their expectations financial sector analysts employ information on the NBP inflation target and future inflation to a greater degree than consumers (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 (e.g. Galati et al., 2011, Autrup and Grothe, 2014, Nautz and Strohsal, 2015). There are, however, a few studies discussing formation of

[1] Evolution of long-term inflation expectations in Poland, not analysed in this paper, confirms high degree of central bank credibility in Poland (Kowalczyk et al., 2013).

shorter-term inflation expectations of various groups of economic agents. Gerlach et al. (2011) analyse changes in the formation of short-term inflation expectations based on 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. The study infers 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 – an increase in the degree of forward-lookingness of expectations. In the advanced economies inflation expectational errors have increased, but the degrees of forward-lookingness and macroeconomic 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 these economies have 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 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 is still effective. 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 1 describes survey-based measures of inflation expectations used in the study. Section 2 discusses methods used to answer the questions posed in the Introduction. Section 3 presents empirical results obtained. The final section offers synthetic conclusions.

1 Data

To quantify inflation expectations of Polish consumers we use data from the survey conducted on 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 the National Bank of Poland (NBP's Quick Monitoring). Since 2008Q3 the survey question has been qualitative, while previously (2001Q1-2008Q2) 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 ... [here: the month with the most recent CPI index available] CPI inflation was ...% in annual terms. In your opinion during 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 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.[2]

In the quantification [3] we assume that expected inflation is normally distributed in the population. Currently available CPI inflation, referred to in the survey question, is used as a proxy for inflation perceived by enterprises. 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 services[4] and consumers disregard negative price changes of those items.

[2] 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 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 ... [here: the month with the most recent CPI index available] 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 ... [here: the month with the most recent CPI index available]; (5) fall more slowly than in ... [here: the month with the most recent CPI index available]; (6) fall at a similar rate; (7) fall at faster rate; (8) difficult to say".*

[3] In the period 2000Q1-2008Q2, 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.

[4] 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.

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.[5]

2 Methods

To answer the questions posed in the Introduction 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 and Valev, 2002), with the models used to analyse central bank credibility, which treat inflation expectations as a weighted average of current inflation and the inflation target (Bomfim and Rudebusch, 2000, Rosenblatt-Wisch and 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.:

$$\pi^{e}_{t+12|t} = \alpha^{b}\pi_{t-2} + \alpha^{f}\pi_{t+12} + \left(1-\alpha^{b}-\alpha^{f}\right)\pi^{tar}_{t+12} + \varepsilon_{t} \tag{1}$$

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

Another way of assessing formation of inflation expectations is based on Cerisola and Gelos (2009). Estimating extended hybrid models of expectations in line with their proposal we explain empirical measures of inflation expectations in Poland with lagged inflation, central bank inflation target and a broad set of macroeconomic variables that can influence future inflation. They include: the deviation of the real interest rate from the trend ($\hat{r}$)[6], the deviation of the real effective exchange rate from the trend ($\hat{e^{r}}$), industrial output gap ($\hat{y}$), unemployment gap ($\hat{u}$), real wage gap ($\hat{w}$), the primary fiscal balance for the consolidated public sector (f^{pb}) and the rate of growth of oil prices in international markets (Δp^{o}). The estimated equation is the following:

$$\pi^{e}_{t+12|t} = \alpha^{b}\pi_{t-2} + \alpha^{tar}\pi^{tar}_{t+12} + \alpha^{r}\hat{r}_{t-l^{r}} + \alpha^{e}\hat{e^{r}}_{t-l^{e}} + \alpha^{y}\hat{y}_{t-l^{y}} + \alpha^{u}\hat{u}_{t-l^{u}} + \alpha^{w}\hat{w}_{t-l^{w}} + \alpha^{f}f^{pb}_{t-l^{f}} + \alpha^{o}\Delta p^{o}_{t-l^{o}} + \varepsilon_{t} \tag{2}$$

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

[5] Since November 2000 till December 2010 and in March 2011 the Reuters survey question concerned 11-month horizon.
[6] We use inflation expectations of respective groups of economic agents to calculate real interest rates.

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 set does not however necessarily mean that the use of information is efficient. To address this issue we test orthogonality of expectational errors with respect to available information, that is one of the requirements of the rational expectations hypothesis. More specifically, we verify if expectational errors ($e_t = \pi^e_{t+12|t} - \pi_{t+12}$) are orthogonal with respect to different variables from the information set (Ω) available when inflation expectations are set, including: 3-month interbank interest rate (WIBOR 3M), nominal effective exchange rate (NEER), industrial output, unemployment rate, wages, oil prices and current CPI inflation. For each of the measures of inflation expectations and for each of variables in the information set we estimate the following equation:

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

Due to possible problems with multi-collinearity, which could appear while estimating the above equation in a multivariate context, univariate regressions are run, in which the dependent variable is the year-on-year change in the information variable at the time that the expectations were formed (publication lags taken into account). A statistically significant α_2 suggests that agents failed to take account of the selected information variable in an optimal way in assessing future price developments.[7]

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 pre-crisis period (2001:05-2008:08) and the financial crisis period (2008:09-2015:08).

3 Results

Heterogeneity of inflation expectations among analysed groups of agents in Poland is evident while analysing graphical representation of their developments in 2001-2015 (Figure 2). 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 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 have remained significantly above zero, which results from 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 that seem the most relevant from the macroeconomic perspective, i.e. enterprises' inflation expectations (Łyziak, 2016), have been reduced significantly and remain close to zero. On the one hand it leads to relatively good forecasting properties of those expectations in the recent period, but on the other hand it can explain, at least in a part, persistently negative inflation figures in Poland.

[7] In empirical testing of macroeconomic efficiency past expectational errors are often ignored (e.g. Forsells and Kenny, 2004). Due to strong autocorrelation of those 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 the 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 is confirmed in other studies (e.g. Babecký and Podpiera, 2011, Łyziak, 2013).

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

Simple hybrid models of inflation expectations suggest that the process of formation of inflation expectations differs significantly among analysed groups of agents (Table 1). Similarly as in the previous studies (Łyziak, 2013), it seems that Polish consumers are strongly backward-looking – only 13% of them forms unbiased expectations, while the remaining part sets 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 seems lower with respect to financial sector analysts (17%) and the group of rational agents is higher (35%).

There have been relatively small changes in the formation of consumer inflation expectations in the recent period, i.e. after the collapse of the Lehman Brothers. The share of consumers, whose expectations simply extrapolate the past, has remained stable. At the same time a tiny group of consumers trying to make forward-looking predictions has started using the NBP inflation target instead of unbiased forecasts of future inflation as in the pre-crisis period. In the case of the remaining groups under consideration, i.e. enterprises and financial sector analysts, developments of inflation expectations in the financial crisis period indicate that forward-looking considerations have become statistically significant in the model of expectations' formation and the weight of rational agents increased, respectively, to 31% and 15%. As far as Polish enterprises are concerned, this effect was accompanied by the increase of the share of agents relying on current inflation (from 31% to 59%) and a significant fall of the percentage of agents whose expectations are anchored to the NBP inflation target (from 64% to 10%). 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.

The results presented above suggest that Polish enterprises, whose expectations seem the most relevant for actual price developments, have become more diversified internally, leading to the increase of fractions of both backward-looking and forward-looking agents. Expectations of the remaining groups of agents have changed to a lower extent, although in the case of financial sector analysts we can also observe a significant increase of forward-looking agents.

To understand in a more detailed manner how different pieces of available information influence inflation expectations in the Polish economy we analyse the results of extended hybrid models (Table 2).

The results based on the whole 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 economic 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 in the financial crisis period. In the case of consumers 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, unemployment rate and oil prices. The reaction of enterprises' inflation expectations to the short-term interest rate has become stronger recently. At the same time the role of real wages has become statistically insignificant, while the role of demand factors, represented by the industrial output and unemployment, has increased. Similarly as in the simple hybrid models, the importance of current inflation has increased recently, while the importance of the NBP inflation target – has diminished. In the case of financial sector agents, their expectations have become less dependent on the interest rate, but have started to respond to industrial output, real wages and oil prices. They have become less tied to the current inflation rate and more anchored to the inflation target (which is not suggested by simple hybrid models).

The results described above and decompositions of inflation expectations based on extended hybrid models presented in Annex suggest that the financial crisis period has strengthened abilities of enterprises and financial sector agents to process available information. To check its efficiency we analyse expectational errors and verify one of the crucial requirements of the rational expectations hypothesis, i.e. orthogonality of expectational errors with respect to available information.

Analysis of expectational errors (Table 3) – especially mean absolute errors (MAE) and 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[8], while the errors of inflation expectations of consumers were significantly higher with respect to 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 4). In 2001-2015 only two of seven analysed variables (i.e.: 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.: exchange rate, industrial output, unemployment rate, wages and oil prices) and in the case of financial sector agents all analysed variables except the short-term interest rate were interpreted in the appropriate manner.

Interestingly, after the beginning of the financial crisis expectational errors of enterprises have significantly decreased (similarly as the errors of naive forecasts), while in the case of financial sector analysts they have been reduced to a smaller extent. At the same time the number of variables efficiently processed have increased in the case of all groups under consideration. In particular, expectations of all those groups have become orthogonal with respect to the short-term interest rate and inflation that in the pre-crisis period were statistically significant in explaining forecasts errors.

[8]Naive forecasts are given here by the recent available CPI inflation.

Empirical results presented above suggest that the formation of inflation expectations of the private sector in Poland has considerably changed recently. The environment of high macroeconomic uncertainty and inflation deviating significantly from the inflation target have made economic agents, especially enterprises and financial sector analysts, more forward-looking. In particular, which is important from the point of view of the monetary transmission mechanism, the private sector has 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 for setting inflation expectations by enterprises, whose expectations seem important in analysing inflationary processes in Poland.

Conclusions

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

It seems that changes in the formation of inflation expectations in recent years have been the most noticeable in the case of enterprises, whose expectations matter most for actual price formation. 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 significantly increased. Similar effect can be noted in the case of financial sector agents, whose expectations remain well anchored to the NBP inflation target with a slightly increased fraction of analysts forming unbiased expectations. 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 et al., 2013), monetary policy is still able to manage 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 financial sector analysts inflation expectations, 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 have become more forward-looking and less shaped by the inflation target recently.

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Figures and tables

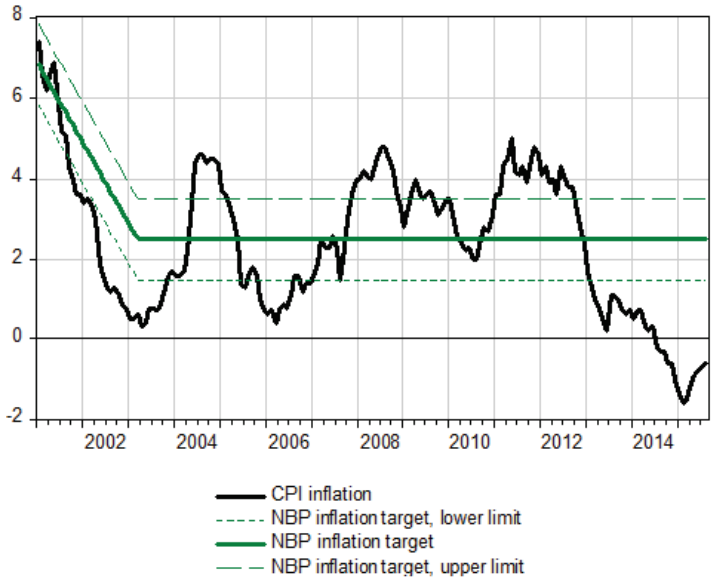


Figure 1: Inflation in Poland, 2001-2015

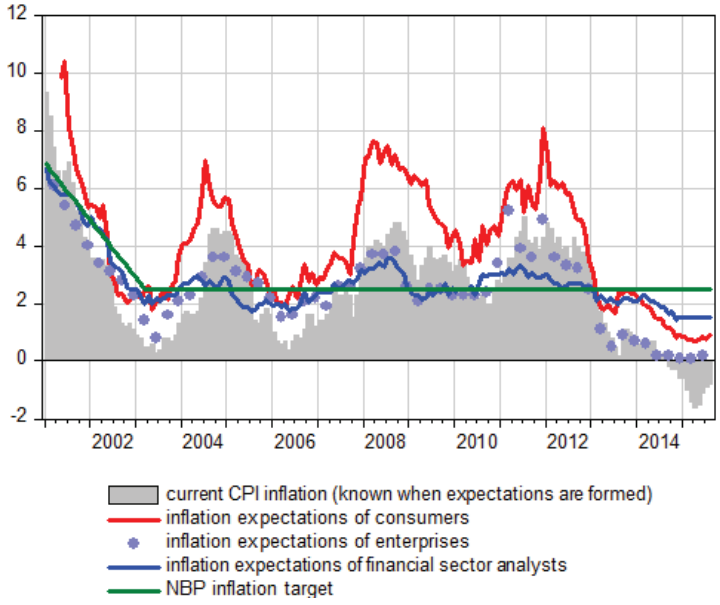


Figure 2: Inflation expectations in Poland, 2001-2015

		Weights of:		
		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	-
	2001:05-2008:08	0.91*** (0.07)	0.09	-
	2008:09-2015:08	0.94*** (0.08)	-	0.06
Enterprises	2001:05-2015:08	0.48*** (0.14)	0.35** (0.17)	0.17
	2001:05-2008:08	0.31*** (0.07)	-	0.64
	2008:09-2015:08	0.59* (0.31)	0.31* (0.18)	0.10
Financial sector analysts	2001:05-2015:08	0.15** (0.07)	0.19* (0.11)	0.66
	2001:05-2008:08	0.13* (0.07)	-	0.87
	2008:09-2015:08	-	0.15*** (0.04)	0.85

Explanations: In the case of consumer inflation expectations lagged CPI inflation is replaced with inflation perception, measured with CPPI index. In the case of enterprises, available with quarterly frequency, we use interpolated 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 both versions of the test equation with constant, twelve lags of current inflation and the NBP inflation target being the instruments (in line with Gerberding, 2001). Numbers in parentheses below estimated coefficients are standard errors. *** denotes significance level at 99 per cent; ** denotes significance level at 95 percent; * denotes significance level 90 per cent.

Table 1: Estimation results of simple hybrid models of inflation expectations

		Coefficients of:								
		lagged inflation (α^b)	inflation target (α^{tar})	interest rate (α^r)	exchange rate (α^e)	industrial output (α^y)	unempl. (α^u)	real wages (α^w)	primary balance (α^{pb})	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*** (0.0265)	-	-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)	-	-	-	-	-	-
	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)

Explanations: In the case of consumer inflation expectations lagged CPI inflation is replaced with inflation perception, measured with CPPI index. In the case of enterprises, available with quarterly frequency, we use interpolated series. Ordinary least squares with Newey-West HAC standard errors. Numbers in parentheses below estimated coefficients are standard errors. *** denotes significance level at 99 per cent; ** denotes significance level at 95 percent; * denotes significance level 90 per cent.

Table 2: Estimation results of extended hybrid models of inflation expectations

		Mesures of errors		
		ME	MAE	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

Explanations: In the case of enterprises, available with quarterly frequency, we use interpolated series.

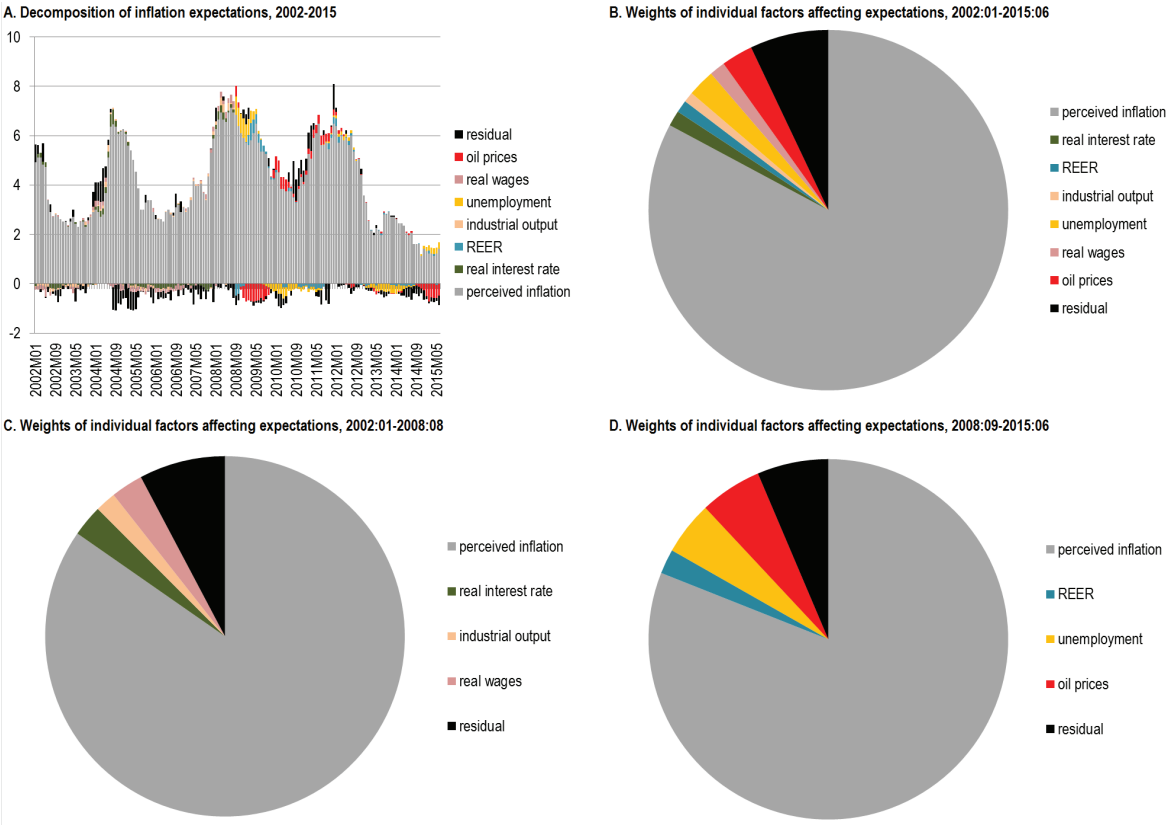
Table 3: Expectational errors

		short-term interest rate	NEER	industrial output	unempl. rate	wage growth	oil price dynamics	CPI inflation
Consumers	2001:05-2015:08	0.060**	-0.007	0.020*	-0.054*	0.036**	0.003	0.039*
		(0.026)	(0.007)	(0.011)	(0.032)	(0.018)	(0.002)	(0.022)
	2001:05-2008:08	0.038*	0.000	0.020*	-0.049	0.031	0.005*	0.052
		(0.022)	(0.016)	(0.012)	(0.040)	(0.022)	(0.003)	(0.026)
	2008:09-2015:08	0.037	-0.011	0.013	-0.131*	(0.049**	0.001	-0.013
		(0.062)	(0.010)	(0.011)	(0.072)	(0.024)	(0.002)	(0.048)
Enterprises	2001:05-2015:08	0.033*	-0.003	0.004	-0.008	0.005	0.000	0.039*
		(0.017)	(0.006)	(0.007)	(0.021)	(0.009)	(0.001)	(0.020)
	2001:05-2008:08	0.039**	0.006	0.025*	-0.007	0.005	0.001	0.056***
		(0.019)	(0.009)	(0.015)	(0.025)	(0.010)	(0.002)	(0.021)
	2008:09-2015:08	0.001	-0.011*	0.004	-0.016	0.006	0.000	-0.008
		(0.049)	(0.006)	(0.010)	(0.054)	(0.016)	(0.002)	(0.040)
Financial sector analysts	2001:05-2015:08	0.031*	0.000	0.002	-0.004	0.003	0.000	0.019
		(0.017)	(0.005)	(0.006)	(0.026)	(0.008)	(0.001)	(0.020)
	2001:05-2008:08	0.035*	0.007	0.001	0.006	0.034*	0.000	0.036*
		(0.018)	(0.007)	(0.008)	(0.027)	(0.018)	(0.002)	(0.021)
	2008:09-2015:08	0.009	-0.006	0.003	-0.016	-0.046**	-0.001	-0.033
		(0.050)	(0.006)	(0.009)	(0.052)	(0.023)	(0.002)	(0.041)

Explanations: In the case of consumer inflation expectations lagged CPI inflation is replaced with inflation perception, measuresd with CPPI index. In the case of enterprises, available with quarterly frequency, we use interpolated series. Ordinary least squares with Newey-West HAC standard errors. Numbers in parentheses below estimated coefficients are standard errors. *** denotes significance level at 99 per cent; ** denotes significance level at 95 percent; * denotes significance level 90 per cent.

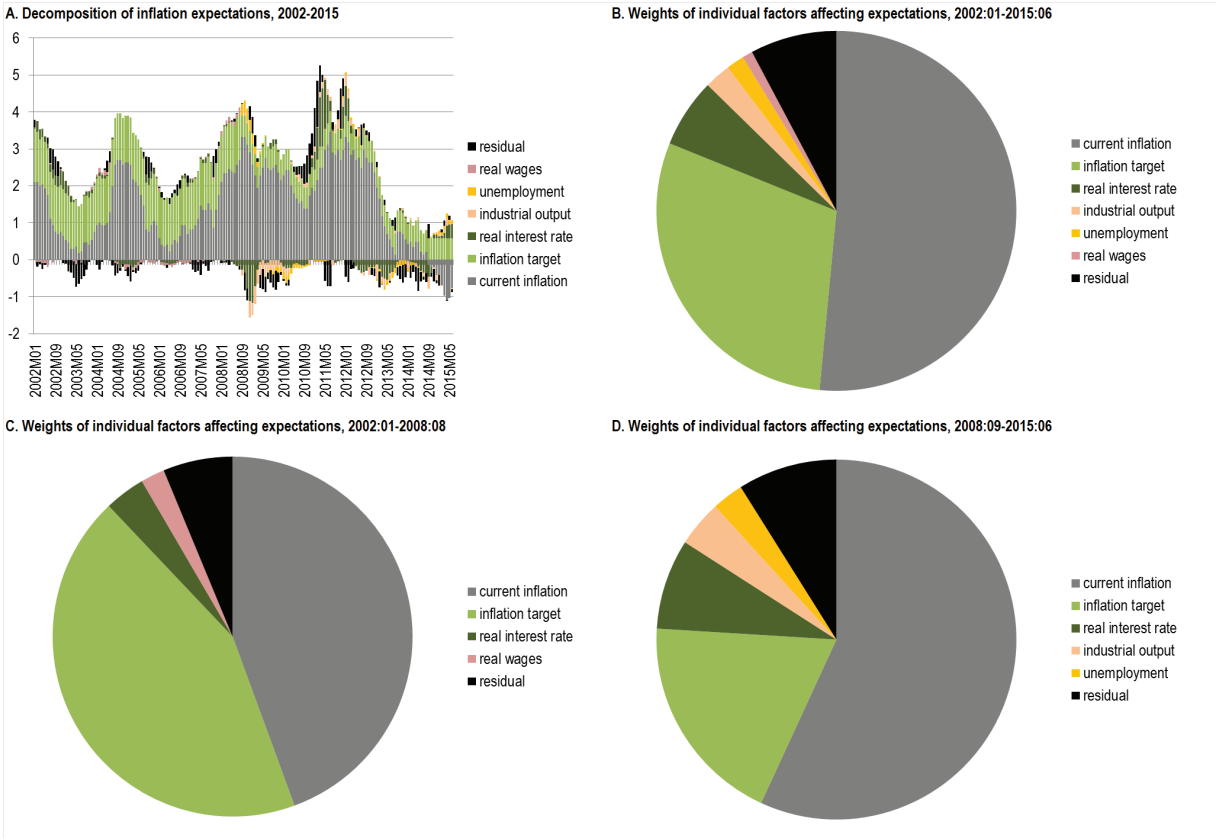
Table 4: Testing orthogonality of expectational errors

Annex: Decompositions of inflation expectations



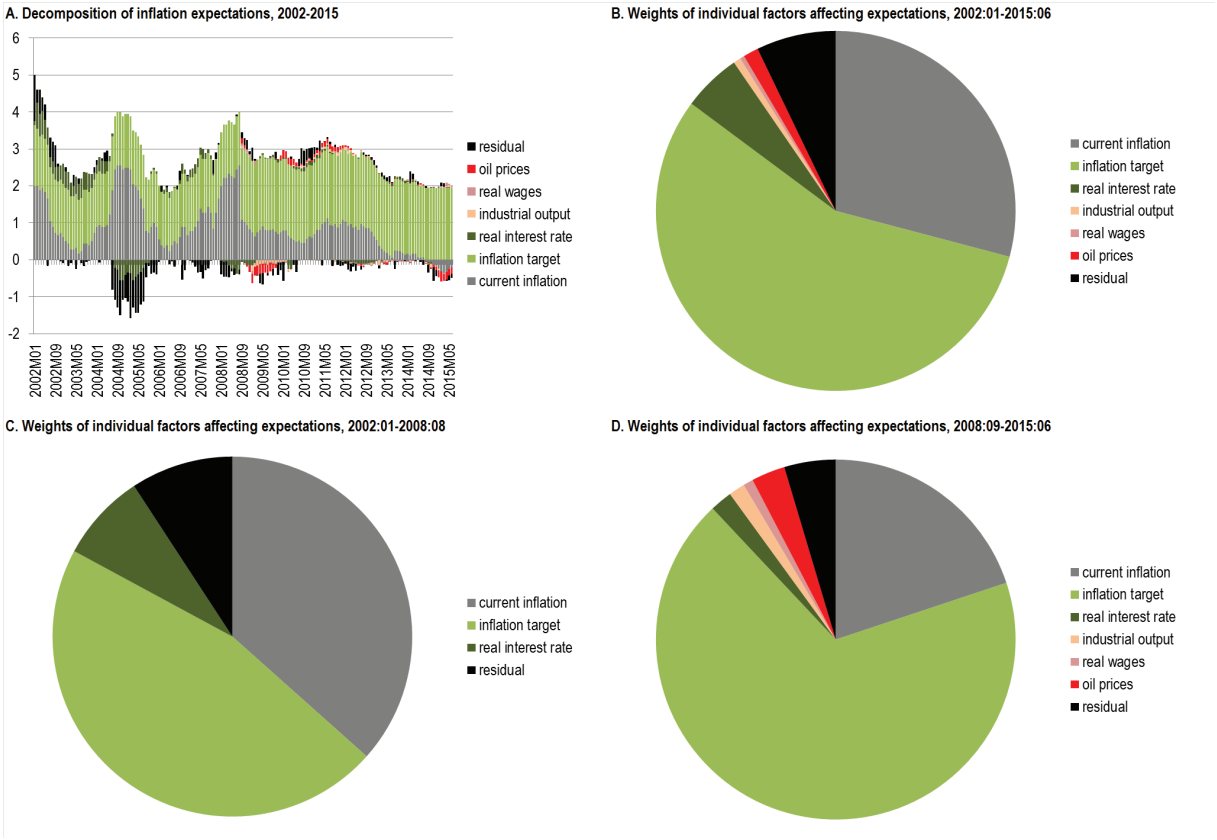
Explanations: Decomposition is base on the extended hybrid models, estimated in sub-periods (pre-crisis and financial crisis samples). Graphs in panels C and D combine the results from the models estimated in those sub-periods.

Figure 3: Decomposition of inflation expectations of consumers based on extended hybrid models



Explanations: Decomposition is base on the extended hybrid models, estimated in sub-periods (pre-crisis and financial crisis samples). Graphs in panels C and D combine the results from the models estimated in those sub-periods.

Figure 4: Decomposition of inflation expectations of enterprises based on extended hybrid models



Explanations: Decomposition is base on the extended hybrid models, estimated in sub-periods (pre-crisis and financial crisis samples). Graphs in panels C and D combine the results from the models estimated in those sub-periods.

Figure 5: Decomposition of inflation expectations of financial sector analysts based on extended hybrid models

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