Shaping Inflation Expectations in the Czech Economy: a Case of Financial Analysts and Corporate Managers

Martin Mandel[1] | *Prague University of Economics and Business, Prague, Czechia*
Jan Vejmělek[2] | *Prague University of Economics and Business, Prague, Czechia*

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Abstract

Inflation expectations play an important role in the transmission mechanism of inflation targeting in the context of the length and costs of the disinflationary process. The objective of our paper is to employ econometric analysis to verify whether financial analysts' and corporate managers' inflation expectations in Czechia (from Q3 1999 to Q2 2024) show basic features of rational expectations and what impact the past YoY CPI inflation rate, the CNB's inflation forecast and the CNB's inflation target have on their expectations. We find that the formation of financial analysts' and corporate managers' yearly inflation expectations with time horizons of one year and three years differs considerably. For corporate managers' inflation expectations, adaptive reasoning plays a more important role. Financial analysts take more account of the CNB's one-year inflation forecasts in forming their yearly expectations, while the inflation target, as an explanatory variable, is statistically significant only for their three-year inflation expectations. Neither group of respondents meets the required criteria for rational expectations in terms of the tests formulated by Pesaran (1987), and Fama (1965 and 1970). In particular, their yearly inflation expectations exhibit systematic errors. Surprisingly, the time series of financial analysts' inflation expectations contain a seasonal component.[3]

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[1] Faculty of Finance and Accounting, Prague University of Economics and Business, W. Churchill Sq. 4, 130 67 Prague 3, Czechia. E-mail: martin.mandel@vse.cz.
[2] Faculty of Finance and Accounting, Prague University of Economics and Business, W. Churchill Sq. 4, 130 67 Prague 3, Czechia.
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INTRODUCTION

Inflation expectations play an important role in the transmission mechanism of inflation targeting, in particular with regard to the length and cost of the disinflationary process. The Czech National Bank (CNB) has been pursuing a monetary policy based on explicit inflation target setting since 1998. From the perspective of the central bank, i.e. in terms of its model framework and the efficacy of its monetary policy, it is important to ascertain the manner in which inflation expectations are shaped in the various groups of market entities.

Simplifying somewhat, inflation expectations can be classified as backward-looking and forward-looking. Backward-looking expectations are typically associated with the hypotheses of adaptive and extrapolative inflation expectations, as proposed by Nerlove (1958 and 1983), and Metzler (1941). Rational inflation expectations (most notably Muth, 1961; and Sargent, 1986) and model-consistent inflation expectations (i.e. expectations that align with a specific inflation targeting model structure) encompass a combination of information about the past (the backward-looking component) and about the future (the forward-looking component).

Rational expectations assume not only the ready availability of the required information but also a perfect capacity to process it. A hard-to-sustain assumption of rational expectations is the notion that fully rational agents form their expectations based on an estimate of future developments, having knowledge of the model structure of the economy.[4] The majority of market entities operate within a relatively narrow economic space with which they have prior experience, acquiring and processing the necessary information within this context. In other areas of economic life, the rationality of market entities is quite bounded. They derive the future from a short-term backward-looking perspective, the psychological make-up of each individual is of great importance, and decision-making is heuristic.[5]

The construction of inflation targeting models usually works with the assumption that one part of the entities is backward-looking and the other part forward-looking consistently with the structure of the formulated inflation targeting model. Each central bank also asks itself to what extent its monetary policy is credible. In terms of inflation expectations, how much influence past inflation, the inflation target and the inflation forecast have on market entities' inflation expectations.

The objective of our paper is to employ statistical and econometric analysis to verify whether or not financial analysts' and corporate managers' inflation expectations show basic features of rational expectations, to what extent their inflation expectations are persistent, and what impact the past YoY CPI inflation rate (i.e. its last known value), the CNB's inflation forecast and the CNB's inflation target have on their expectations. The formation of inflation expectations is likely to differ between the various groups of respondents monitored by the CNB, i.e. managers of non-financial corporations and firms on the one hand and financial analysts on the other. The hypothesis can be formulated that in the above order of entities, there will be a shift from backward-looking to forward-looking expectations. The analysis will be performed on the following time series: a) financial analysts' expectations over one year and three years and b) expectations of non-financial corporations' and firms' managers over one year and three years.

The structure of our paper is as follows. First, an outline of referenced literature and the existing knowledge of inflation expectation analysis; then we describe (in Chapter 2) the basic properties of the time series under review and provide initial insights into the nature of financial analysts' and corporate

[4] "The way expectations are formed depends specifically on the structure of the relevant system describing the economy" (Muth, 1961).

[5] The notion of bounded rationality was developed by A. H. Simon (Simon, 1984) and further elaborated on by representatives of behavioural economics.

managers' inflation expectations. In Chapter 3, we conduct standard (indirect) tests of the rational expectations hypothesis as formulated by, in particular, Pesaran (1987), and Fama (1965 and 1970). In Chapter 4, we then use an econometric model to test how financial analysts' and corporate managers' inflation expectations are formed based on the CNB's database. We then formulate some findings and conclusions for the monetary policy.

1 REVIEW OF LITERATURE

The rational expectations hypothesis (Muth, 1961) posits that expectations are fully rational if all available information has been used in the optimal way. There should not be an alternative prediction model that has less variance in the actual forecast errors and has been built using the same set of available information. Actual forecast errors are random with a mean of zero and are due to random events (shocks) or unsystematic individual errors in individuals' forecasts. Pesaran (1987) formulated econometrically testable conditions for the validity of the rational expectations hypothesis:

1/ test of the unbiased expectation hypothesis,
2/ test of the properties of prediction errors, which should be orthogonal to the agents' information available at the time the prediction is made,
3/ test of the serial uncorrelated prediction error condition,
4/ efficiency test of the prediction, i.e. the prediction error must not be related to the predicted variables from previous periods.

The last mentioned test is most often conducted as a test of weak-form market efficiency (Fama, 1965 and 1970). In this paper, we apply this test, typically used to analyse expectations (predictions) in the capital and foreign exchange markets, to inflation expectations.

Adaptive expectations are formulated, for example, by Nerlove (1958 and 1983). "Purposeful economic agents have incentives to eliminate errors up to a point justified by the costs of obtaining the information necessary to do so... The most readily available and least costly information about the future value of a variable is its past value." (Nerlove, 1983).

In the first wave of interest in the formation of inflation expectations in the Czech literature, Tomšík and Mandel (2004) discuss how inflation expectations are formed on the basis of the adaptive component of expectations, the CNB's inflation forecast and the CNB's inflation target in the context of the credibility of the CNB's monetary policy. Filáček (2005) provides a detailed explanation of the various models of inflation expectations, including the distinction between adaptive expectations, adaptive learning and naive expectations. He then tests the significance of each form of expectations under variant shocks.[6] Vávra (2005) summarises international experience with business cycle-related tests of inflation expectations among households and economic experts. He discusses the statistical methodology of evaluating the results of business cycle-related surveys in Czechia conducted by the Czech Statistical Office (before 2005), which were, however, limited to only determining whether prices would increase, remain unchanged, or decrease.

Some findings can be noticed in international publications, which are important in the context of our subsequent analysis. Carrol (2003) analyzed inflation expectations based on newspaper predictions by professional financial analysts and a dataset collected by the University of Michigan's Survey Research Center on inflation expectations of US households. The author concludes that the model's assumptions about the existence of rational expectations are not entirely relevant, especially in the case of households. People only occasionally pay attention to new information. This inattention creates rigidity and adaptive expectations. The expectations of financial analysts are closer to rationality, which in retrospect can

[6] Options and discussion of the various forms of expectations in modelling, e.g. Brayton et al. (1997).

partially influence the expectations of households as well. Blanchflower and MacCoille (2009), in their extensive empirical analysis using the British population as an example, conclude that inflation expectations are significantly adaptive. They also find that individuals with higher education tend to have lower inflation expectations. Miyajima and Yetman (2018) analyze the characteristics of inflation expectations of households, businesses, financial analysts and trade unions in South Africa over the period 2000 to 2018. They conclude that inflation expectations are more anchored to a band inflation target of 3% to 6% in the case of longer-term predictions. The long-term inflation expectations of financial analysts lie within the range of the central bank's inflation target. Inflation expectations of businesses and unions remain above the upper bound of the official inflation target. Coibion et al. (2018) make an interesting finding that New Zealand firms devote few resources to collecting and processing inflation information, and inflation is not perceived as important for business decisions. However, this conclusion may be influenced by the fact that the Central Bank of New Zealand is successful in meeting its inflation target. Gerlain et al. (2019) conclude in their analysis of the inflation expectations of financial analysts from the Survey of Professional Forecasters database that a hybrid expectations model incorporating adaptive expectations better explains the inflation expectations of the surveyed group of respondents than a model with strictly rational expectations.

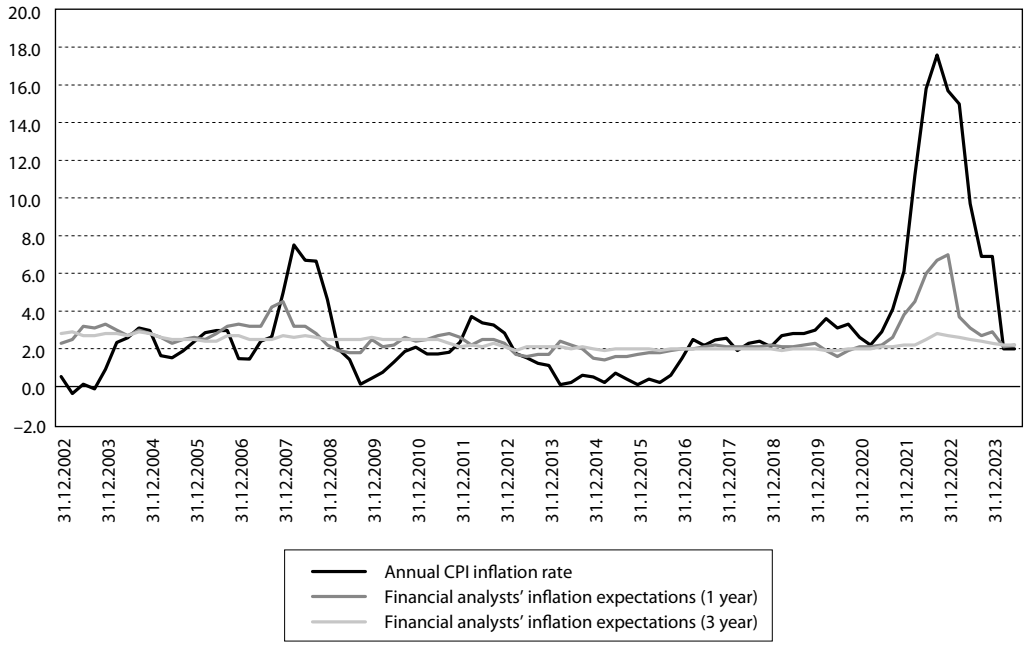
The most recent extensive research on this issue from the perspective of Czech circumstances was carried out by Brázdik et al. (2024). The authors analyse, among other things, the characteristics of inflation expectations in Czechia, highlighting the inflation year 2022. A comparison of financial analysts', non-financial enterprises' and households' inflation expectations shows that the distribution of households' one-year inflation expectations is significantly different (with a higher mean) from financial analysts' inflation expectations. In their analysis, they distinguish between the formation of inflation expectations (the strength of adaptive behaviour) in a low-inflation environment and a high-inflation environment. The authors further conclude that the adaptive expectations mechanism is more significant for one-year inflation expectations and less significant for three-year inflation expectations.

2 DESCRIPTIVE STATISTICS

Our empirical analysis is based on time series with a quarterly frequency (Figures 1 and 2). The basic set covers the period from Q3 1999 to Q2 2024 and comes from the CNB's ARAD database. The time series that enters our analysis is, with one exception, in the form of the YoY CPI inflation rate (π_t) at a quarterly frequency. The response variable in our econometric models is the expected YoY CPI inflation rate ($\pi_t^{e(t+n)}$) with time horizons of one year and three years for periods t to t+4 (time horizon one year) and for periods t+8 to t+12 (time horizon three years). The CNB surveys expected inflation periodically for two groups of entities (Figures 1 and 2): financial analysts (monthly frequency, 16 Czech analysts and 3 international analysts) and managers of firms and corporations (quarterly frequency, 118 enterprises until 2010 and a sample of 250 enterprises since 2011).[7] The CNB's inflation target (π^{T}) is also defined in the form of the YoY CPI inflation rate. The lagging YoY CPI inflation rate is the explanatory variable in the case of adaptive expectations modelling. Another explanatory variable in our econometric models is the CNB's inflation forecast with a time horizon of one year ($\pi_t^{P(t+4)}$). This time series does not take the form of a year-on-year inflation rate as in the previous cases but takes the form of a comparison of the average quarterly price level in the current quarter against the average quarterly price level in the same quarter of the previous year. This is a less commonly used method of calculating the inflation rate, which is not posted on the CZSO's website but is available in the CNB's ARAD database.

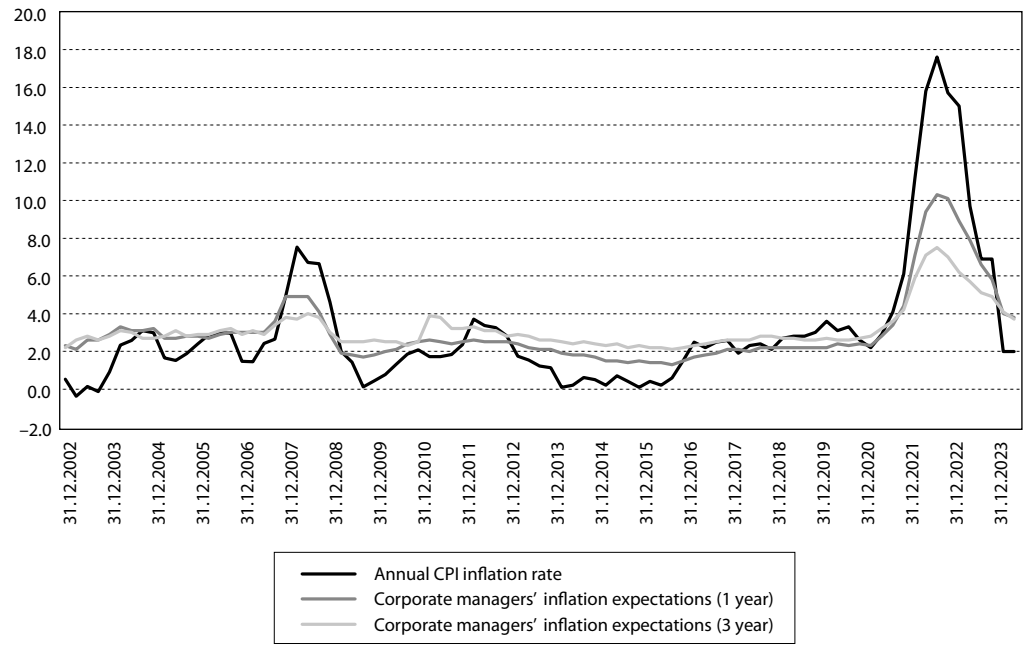
[7] The time series of households' inflation expectations in the CNB's ARAD database ends in 2007, and so we do not include it in our analysis. In general, however, these time series are characterised by large variance of the values obtained from respondents.

Figure 1 Financial analysts' inflation expectations (%)



Source: CZSO, CNB (ARAD), 2024

Figure 2 Corporate managers' inflation expectations (%)



Source: CZSO, CNB (ARAD), 2024

2.1 Tests of the seasonality and stationarity of time series

We used the Census X-12-ARIMA method (F-test, 1% significance level) to test for and then eliminate seasonality. Employing this method, we detected a seasonal component in the time series of the CNB's one-year inflation forecast and in the time series of financial analysts' inflation expectations with a horizon of one year and three years. The seasonal component is positive in Q3 and Q4 and negative in Q1 and Q2. At the same time, the seasonal component of financial analysts' yearly inflation expectation for one year is statistically significantly correlated with the CNB's inflation forecast (0.8638). The seasonal component was not found in the YoY CPI inflation rate published by the Czech Statistical Office (CZSO). This is the first observation indicating the different nature of the time series, i.e., on the one hand, the three time series representing inflation forecasts and inflation expectations and, on the other hand, the actual statistically found YoY CPI inflation rates. This observation is not consistent with the concept of rational expectations.

Unit root tests (Table 1) were performed using the Augmented Dickey-Fuller Test (ADF) and the ADF trend break test. Based on the model with a constant[8] we reject the hypothesis of the existence of a unit root for the time series of financial analysts' and corporate managers' one-year inflation expectations and financial analysts' three-year inflation expectations. Based on the model with a constant and a one-time break, we reject the hypothesis of the existence of a unit root in the case of the time series of year-on-year inflation rates and corporate managers' three-year inflation expectations. In the case of the CNB's inflation target, which gradually declined towards 2% over the period under review, we do not reject the hypothesis of the existence of a unit root at the 5% significance level.

Table 1 Unit root tests: Augmented Dickey-Fuller test (ADF)

Basic time series (Q3/1999–Q2/2024, quarterly frequency)	*t*-statistics (critical value 5%)	Prob.	Lag length, const., break date
YoY CPI inflation rate	–5.0802 (–4.4436)	< 0.01	4, const., Q2 2021
Financial analysts' inflation expectations* (1-year horizon)	–3.0603 (–2.8912)	0.0330	1, const.
Financial analysts' inflation expectations* (3-year horizon)	–3.6361 (–2.8909)	0.0066	0, const.
Corporate managers' inflation expectations (1-year horizon)	–4.0197 (–2.8912)	0.0020	1, const.
Corporate managers' inflation expectations (3-year horizon)	–5.3149 (–4.4436)	< 0.01	1, const., Q3 2021
CNB inflation forecast horizon* (1-year horizon)	–3.6729 (–2.8951)	0.0062	0, const.
CNB inflation target	–2.1629 (–2.8959)	0.2213	0, const.

Note: *seasonally adjusted time series.
Source: Author's calculations

[8] The algorithm for testing models with a trend and with a constant was chosen by Enders (2014).

2.2 Correlation analysis

The results of the correlation analysis in the observation period from Q3/1999 to Q2/2024 (quarterly frequency) suggest some characteristics of the formation of inflation expectations amongst financial analysts and corporate managers, which we will test in the selected models.

In the case of financial analysts, the correlation between the time series of the YoY CPI inflation rate (the last known value when forming expectations) and the expected year-on-year inflation rate with a time horizon of one year and three years is 0.7921 and 0.2588, respectively. However, the correlation of the current YoY CPI inflation rate with its values lagging one year and three years is only 0.3704 and 0.1250, respectively. Financial analysts' inflation expectations with time horizons of one year and three years are moderately strongly correlated at 0.5546. The correlation of the actually observed values of the YoY CPI inflation rate with time horizons of one year and three years is statistically insignificant at a 5% significance level (it is only 0.1223).

In the case of corporate managers, the correlation between the time series of the YoY CPI inflation rate (the last known value when forming expectations) and the expected year-on-year inflation rate with a time horizon of one year and three years is extremely high, i.e. 0.9501 and 0.9341 respectively. The correlation between their expectations of the year-on-year inflation rate with time horizons of one year and three years is also extremely high and amounts to 0.9725.

3 ECONOMETRIC ANALYSIS OF THE RATIONAL EXPECTATIONS HYPOTHESIS

The EViews 13 econometric software was used in the testing. The estimates presented in Tables 2 and 3 were made using the ARMA Generalized Least Squares (Gauss-Newton) method and the estimates of the final model presented in Table 4 use the least squares method.

We verify the problem of autocorrelation of the unsystematic component of individual models using the Durbin-Watson test (test for the existence of autocorrelation of first-order residuals), the results of which we publish. Higher-order autocorrelation was operationally tested using the Breusch-Godfrey autocorrelation test and the Ljung-Box test. The presence of heteroskedasticity was verified by means of the ARCH test.

3.1 Test of the unbiased expectations hypothesis

Under the unbiased expectations hypothesis, the inflation expectations of the tested groups are an unbiased predictor of actual future inflation,

$$\pi_{t+n} = \gamma_0 + \gamma_1 \pi_t^{e(t+n)} + \tau_t\,, \tag{1}$$

where τ is white noise and n is the number of quarters. Null hypotheses have parameters:

$\gamma_0 = 0$ and $\gamma_1 = 1$.

In the case of non-stationary time series, this hypothesis is usually tested using a relationship for the expected change in inflation:

$$\pi_{t+n} - \pi_t = \gamma_0 + \gamma_1 \left(\pi_t^{e(t+n)} - \pi_t \right) + \tau_t, \tag{2}$$

where τ is white noise and n is the number of quarters. Null hypotheses have parameters:

$\gamma_0 = 0$ and $\gamma_1 = 1$.

Table 2 Test of the unbiased expectations hypothesis (response variable: change in the YoY inflation rate $\pi_{t+n} - \pi_t$)

	Constant	Expected change in inflation	D-W stat.	Autocorrelation of higher order residues	*R* sq.
Financial analysts (1-year forecast, Q3/1999–Q1/2023)	0.3465 (0.2778)	1.2583* (8.7996)	1.8448	AR(1) 0.8772* (14.6295) MA(1) 0.414542* (3.6816)	0.8993
Financial analysts (3-year forecast, Q4/2002–Q1/2021)	–0.0616 (–0.0385)	1.0495 (5.7728)	1.8464	AR(1) 0.8774* (15.3030) MA(1) 0.5990* (6.3047)	0.8928
Corporate managers (1-year forecast, Q3/1999–Q1/2023)	–0.3182 (–0.2317)	1.8402* (9.3319)	1.7187	AR(1) 0.8931* (15.7894) MA(1) 0.4015* (3.4888)	0.9045
Corporate managers (3-year forecast Q4/2002–Q1/2021)	0.2829 (0.1793)	0.9328 (4.2831)	1.7461	AR(1) 0.8574* (12.9602) MA(1) 0.5762* (5.2628)	0.8806

Note: We show the values of the estimated parameters in the first row and the t-statistics in parentheses in the second row. *, **, *** denote parameters that are statistically significant at the 1%, 5% and 10% significance levels (constant from zero, expected change in inflation from one).
Source: Author's calculations

The unbiased expectation hypothesis was not confirmed (Table 2), although the regression coefficients before the constant are statistically insignificant, consistent with the unbiased expectation hypothesis. In the case of yearly inflation expectations of both financial analysts and corporate managers, the estimated coefficients for the expected change in inflation are statistically significantly different from one. In all the cases tested, the existence of AR(1) processes was shown at the 1% significance level, which is contrary to the unbiased expectation hypothesis. A statistically significant MA(1) process is consistent with the findings of Pesaran (1987), and Suk-Joong (1997) and is related to the higher frequency of observations (quarterly) compared with the length of inflation expectation (one year).

3.2 Testing the properties of prediction errors

The test of the properties of prediction errors can be based on the test for no serial dependence of prediction errors and the requirements of the hypothesis of weak-form market efficiency.

The test for no serial dependence verifies whether previous errors in expectations are used in the new predictions. In backward observation and testing, prediction errors should not be constant and should not depend on their previous values:

$$\pi_{t+n} - \pi_t^{e(t+n)} = \beta_0 + \sum_{m=1}^{k} \beta_{t-m} (\pi_{t+n-m} - \pi_{t-m}^{e(t+n-m)}) + \omega_{t+n}, \tag{3}$$

where ω_{t+n} is white noise, m is the number of quarterly lags. Null hypotheses have parameters: $\beta_0 = 0$ and $\beta_{\text{t-m}} = 0$.

The autocorrelation test of weak-form market efficiency (Fama, 1965) is based on the decomposition of actually observed changes into an expected part and an unexpected part. In the case of inflation expectations, this is the relationship:

$$\pi_{t+n} - \pi_t = (\pi_t^{e(t+n)} - \pi_t) + \left(\pi_{t+n} - \pi_t^{e(t+n)}\right). \tag{4}$$

Independence from past changes is required only in the case of the unexpected component (Fama, 1965), i.e. in the case of prediction errors. In contrast, an expected change can be correlated with a past change if the previous observed changes are persistent. The tested econometric equation has the following form. We test whether prediction errors can be explained by previous observed changes in inflation:

$$\pi_{t+n} - \pi_t^{e(t+n)} = \alpha_0 + \sum_{l=0}^{k} \alpha_{t-l} (\pi_{t-l} - \pi_{t-l-1}) + \vartheta_{t+n}, \tag{5}$$

where ϑ_{t+n} is white noise, l is the number of quarterly lags. Null hypotheses have parameters: $\alpha_0 = 0$ and $\alpha_{t-l} = 0$.

Based on both approaches for testing prediction errors, we formulate the following econometric equation:

$$\pi_{t+n} - \pi_t^{e(t+n)} = \alpha_0 + \sum_{l=0}^{k} \alpha_{t-l} (\pi_{t-l} - \pi_{t-l-1}) + \sum_{m=1}^{k} \beta_{t-m} (\pi_{t+n-m} - \pi_{t-m}^{e(t+n-m)}) + \varepsilon_{t+n}, \tag{6}$$

where ε_{t+n} is white noise. Null hypotheses have parameters: $\alpha_0 = 0$, $\alpha_{t-l} = 0$ and $\beta_{t-m} = 0$.

Table 3 lists the results of the tests for weak-form efficiency and the absence of serial dependence of errors in expectations. Financial analysts' and corporate managers' one-year and three-year inflation expectations have statistically insignificant coefficients for the constant at the 10% significance level. However, the other findings are not consistent with the required properties of the rational expectations model. Our tests show, at the 1% significance level, that prediction errors are related to prior prediction errors (t–1 and t–2 lags) for both groups of analysed respondents. In the case of one-year inflation

expectations, our next finding is also inconsistent with the rational expectations hypothesis. A change in inflation lagging one period can (at the 1% level of statistical significance) explain some of the prediction errors in the case of financial analysts' as well as corporate managers' expectations. Let us add that the one-period lag of the change in inflation is the observed change in inflation at the time new inflation expectations are being formed.[9]

Table 3 Test for weak-form efficiency and absence of serial dependence (response variable: prediction error $\pi_{t+n} - \pi_t^{e(t+n)}$)

	Constant	Past change in inflation	Lagging prediction error (*t*–1 and *t*–2)	D-W stat.	*R* sq.
Financial analysts (1-year forecast, Q4/1999–Q1/2023)	–0.0512 (–0.5208)	0.5839* (4.5032)	1.3903* (16.990) –0.3828* (–4.2994)	2.0861	0.8931
Financial analysts (3-year forecast, Q4/1999–Q1/2021)	–0.0501 (–0.4317)	0.1451 (0.9038)	1.4276* (14.060) –0.5401* (–5.2881)	2.0215	0.9008
Corporate managers (1-year forecast, Q4/1999–Q1/2023)	–0.4687 (–0.4737)	0.8300* (5.7853)	1.4345* (19.223) –0.3761* (–4.2544)	1.9477	0.8940
Corporate managers (3-year forecast, Q4/1999–Q1/2021)	–0.0182 (–0.1294)	0.1015 (0.5621)	1.4532* (12.992) –0.5747* (–5.0944)	2.0111	0.8904

Note: We show the values of the estimated parameters in the first row and the t-statistics in parentheses in the second row. *, **, *** denote parameters that are statistically significant at the 1%, 5% and 10% significance levels.
Source: Author's calculations

4 SHAPING OF FINANCIAL ANALYSTS' AND CORPORATE MANAGERS' INFLATION EXPECTATIONS

Let us ask: what is the impact of lagging inflation expectations, past inflation (π_{t-m}), and the CNB's year-on-year inflation forecast ($\pi_t^{P(t+4)}$) and the CNB's inflation target (π^T) on the formation of financial analysts' and corporate managers' inflation expectations ($\pi_t^{e(t+n)}$)? We test the econometric model:[10]

[9] The last known value of the inflation rate as the only explanatory variable in the inflation expectations model is called the naive expectation. This is a special case of adaptive expectations.
[10] For comparison, e.g., Mandel (2009), Łyziak and Paloviita (2017), and Brázdik et al. (2024).

$$\pi_t^{e(t+n)} = c_0 + \sum_{l=1}^{k} \alpha_{t-l} \pi_{t-l}^{e(t+n-l)} + \sum_{m=1}^{k} \beta_{t-m} \pi_{t-m} + \vartheta_P \pi_t^{P(t+4)} + \gamma_T \pi_t^{T(t+n)} + \sum_{v=1}^{k} \varphi_{i,t-v} x_{i,t-v} + \epsilon_t \,, \tag{7}$$

where x_i represents the selected control variables[11] and ϵ_t is white noise.

Comparing the factors that inform financial analysts' and corporate managers' inflation expectations (Table 4), we can see considerable differences.

Table 4 Test of determinants of inflation expectations

	Constant	Lagging response variable	Past inflation (*t*–1, *t*–2)	CNB's inflation forecast (4Q)	CNB's inflation target	D-W stat.	*R* sq.
Financial analysts (1-year forecast, Q3/2002–2/2024)	0.2080*** (1.6408)	0.4364* (5.7447)	0.1125* (4.6533) –0.0621** (–2.3252)	0.4281* (7.3135)	Not categorised	1.9097	0.9059
Financial analysts (1-year forecast, Q1/2009–Q2/2024)		0.4997* (6.4346)	0.1305* (4.7922) –0.0800** (–2.6351)	0.4752* (6.9609)		2.0560	0.9236
Financial analysts (3-year forecast, Q3/2002–Q4/2023)	0.1882* (2.7014)	0.8586* (26.4767)		0.0532* (4.3953)	Not categorised	2.0964	0.9214
Financial analysts (3-year forecast, Q1/2007–Q4/2023)		0.8603* (20.8789)		0.0506* (4.0009)	0.0939** (2.1730)	2.0474	0.9002
Corporate managers (1-year forecast, Q3/2002–Q2/2024)		0.7487* (13.8052)	0.3156* (12.7839) –0.1972* (–4.9740)	0.1653* (4.4015)	Not categorised	1.8849	0.9781
Corporate managers (1-year forecast, Q1/2009–Q2/2024)		0.7272* (10.5030)	0.3702* (15.9450) –0.2083* (–4.5776)		0.1496* (3.2430)	2.0019	0.9860
Corporate managers (3-year forecast, Q3/2002–Q4/2023)	0.5503* (2.7967)	0.6869* (7.7809)	0.1862* (6.8203) –0.1021* (–3.1024)	0.0733*** (1.6307)	Not categorised	1.6659	0.9418
Corporate managers (3-year forecast Q1/2007–Q4/2023)		0.7200* (7.4554)	0.2152* (8.1085) –0.1300* (–3.8774)		0.3060* (2.8892)	1.7992	0.9472

Note: We We show the values of the estimated parameters in the first row and the t-statistics in parentheses in the second row. *, **, *** denote parameters that are statistically significant at the 1%, 5% and 10% significance levels. Explanatory variables with statistically insignificant parameters were not included in the estimated model.

Source: Author's calculations

[11] The control variables M2 monetary aggregate, loans to government, loans to residents, the CZK/EUR exchange rate, and the PRIBOR 3M interest rate at various lags were statistically insignificant.

In the case of the one-year horizon, corporate managers' inflation expectations have a significantly longer inertia (persistence) compared with financial analysts' expectations, while past inflation (i.e. the adaptive component of expectations) has a significantly heavier impact. However, the inertia of inflation expectations is partly technical and stems from the statistical properties of the time series of the YoY CPI inflation rate expectations with a quarterly frequency, which also contains nine 'old' values of expected month-on-month inflation in each new quarter.[12]

In contrast, financial analysts take more account of the CNB's one-year inflation forecasts when forming their year-on-year expectations. Larger analytical teams in financial institutions work with modelling approaches similar to those of the CNB in their forecasting, while smaller analytical teams at least regularly evaluate the CNB's inflation forecasts.

Financial analysts no longer take past inflation into account when forming their three-year inflation expectations. In the case of corporate managers, the respective coefficients are 'surprisingly' statistically significant, although the coefficients are lower than for one-year expectations. The coefficients for the lagging response variables, characterising the inertia of inflation expectations, are again high and statistically significant for both analysed groups.

Given that the CNB's inflation target for the period 1999–2023 is declining and thus non-stationary, its impact was tested only on a shortened price series when the CNB adopted the 2% target (i.e. from 2009 and from 2007). The impact of the inflation target on the formation of inflation expectations was not demonstrated only in the case of financial analysts' one-year forecasts. For both groups, the hypothesis that the inflation target has a stronger impact on the formation of three-year expectations than on one-year expectations was confirmed.

4.1 Lessons learned in the monetary policy context

Inflation expectations are not formed solely on the basis of the impact of macroeconomic fundamentals. Monetary policy, the central bank's inflation forecast, and the inflation target are factors that influence both inflation and the formation of inflation expectations. The high credibility of the central bank's inflation target, reaction function and monetary policy can 'anchor' inflation expectations; on the one hand, this is desirable in terms of reducing the monetary policy costs. From another perspective, however, the 'anchoring' of inflation expectations may be a manifestation of market entities' passivity in shaping their inflation expectations. The 'de-anchoring' may then take a larger leap when monetary policy and the inflation target lose credibility.

The adaptive nature of inflation expectations is normally regarded as a phenomenon that forces the central bank to adjust its interest rate policy more restrictively in an effort to 'break' the inflationary development towards the inflation target.[13] In our view, however, this conclusion is not generally valid. It is justified in cases where inflation is persistent in nature, is primarily driven by the central bank's too expansionary monetary policy, and where adaptive expectations have a long lag. In cases of external cost shocks and short lags of adaptive expectations (especially in the case of naive expectations), this simple 'textbook' rule is questionable. The precautionary motive of savings, which responds to the decline in the current real income and expected real income, contributes significantly to the restriction. Adaptive inflation expectations quickly dissipate as the main external cost impetus gradually recedes.[14]

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[12] More detailed technical interpretation of this problem, e.g., Hassler and Demetrescu (2004), and Arlt (2023).

[13] This issue is analysed in terms of different types of shocks by Filáček (2005). In the case of the existence of adaptive inflation expectations, Orphanides and Williams (2003) stress the importance of combining an explicit inflation target with the central bank's active communication.

[14] The main criticism of this 'dovish' approach is usually waged from the perspective of the possibility of 'de-anchoring' inflation expectations, indexation to inflation (including wages), and the smoothing behaviour of households borrowing for consumption in times of falling income (given a higher permanent income).

In the context of the current discussion, Arlt (2023) also points out some important statistical problems associated with the use of the YoY CPI inflation rate. In the CNB's current monetary policy, this form of inflation measurement occurs in the setting of the inflation target and in the monitoring of financial analysts' and corporate managers' inflation expectations. The fact that a one-month shift in this indicator always incorporates the 11 old month-on-month values becomes a real monetary policy problem in the disinflationary process from high inflation towards the inflation target. In a disinflationary process, this inflation indicator creates a perception of long-lasting high inflation in some market entities. This causes political pressure on the central bank in the form of calls for a more restrictive monetary policy than is actually needed. The transition to monthly seasonally adjusted and then annualised inflation is, in theory, an appealing step in the right direction but it runs into the problem of the instability of seasonal coefficients. The central bank will find it difficult to explain to the public that in any given month, seasonally adjusted monthly annualised inflation surges significantly above the inflation target by 'many' percentage points. At the same time, in another month, the opposite deflationary problem will occur. In this case, the CNB has correctly chosen a communication strategy and argumentation using the inflation momentum (Adam and Michl, 2023), i.e. the rolling average of three consecutive annualised seasonally adjusted monthly price changes supplemented by decomposition into the various components of the consumer basket.

The CNB's forecasting model does not work with the YoY CPI inflation rate but with an average year-on-year inflation rate calculated by comparing the average quarterly price level in the current quarter with the average quarterly price level in the same quarter of the previous year. There is therefore an inconsistency between the definition of the CNB's inflation target (year-on-year inflation rate) and the construction of the CNB's forecasting model (average year-on-year inflation rate on a quarterly basis). This inconsistency is largely determined by the quarterly frequency of the national accounting data that enter the CNB's forecasting apparatus. However, it should be noted that the time series of the average year-on-year inflation rate on a quarterly basis is technically bound to lag behind the time series of the YoY CPI inflation rate.

CONCLUSION

Inflation expectations play an important role in the transmission mechanism of inflation targeting in the context of the length and costs of the disinflationary process. The purpose of our paper has been to verify, via econometric analysis, whether the inflation expectations of financial analysts and corporate managers in the Czech Republic (from Q3/1999 to Q2/2024) have the basic features of rational expectations and what influence the past YoY CPI inflation rate, the CNB's inflation forecast, and the CNB's inflation target have on their expectations.

We would like to point out that the CNB's inflation forecast does not take the form of a year-on-year inflation rate, which is the form of the CNB's inflation target and financial analysts' and corporate managers' inflation expectations under review, but takes the form of a comparison of the average quarterly price level in the current quarter against the average quarterly price level in the same quarter of the previous year.

We find that the formation of financial analysts' and corporate managers' yearly inflation expectations with time horizons of one year and three years is quite different. For corporate managers' inflation expectations, adaptive reasoning plays a more important role. Financial analysts take more account of the CNB's one-year inflation forecasts when forming their yearly expectations and the inflation target as an explanatory variable is statistically significant only for their three-year inflation expectations. The hypothesis that the inflation target has a stronger influence on the formation of three-year expectations than on one-year expectations has therefore been confirmed for both groups.

Neither group of the analysed respondents meets the required criteria for rational expectations in terms of the tests formulated by Pesaran (1987), and Fama (1965 and 1970). In particular, their yearly inflation

expectations exhibit systematic errors. The correlations between their one-year and three-year inflation expectations are high and are completely inconsistent with the actually observed properties of time series of the YoY CPI inflation rate. Surprisingly, financial analysts' expectations (for both one year and three years) have a seasonal component, which is again inconsistent with the actually observed properties of time series of the YoY CPI inflation rate. The explanation seems to be the financial analysts' 'copying' of the CNB's yearly inflation forecast, which also contains this seasonal component.

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