Péter Gábriel and Klára Pintér: Whom should we believe? Information content of the yield curve and analysts' expectations

Expectations of market participants play an important role in monetary policy making. The main reason for this is that expectations influence the behaviour of investors and prices in financial markets. In this article, we present two sources of information on the expectations of financial market participants regarding the central bank's policy rate. Both the yields of government securities and the survey of interest rate expectations conducted by Reuters contain information on what the market expects the future path of the policy rate to be, but sometimes these two sources of information convey substantially different messages. Our analysis helps to understand this phenomenon by shedding light on two key factors behind it. On the one hand, forward rates calculated from the yield curve contain a risk premium and exceed the expected value of the future central bank policy rate. On the other hand, analysts in the Reuters' survey report the most likely value of the future central bank policy rate as their forecasts, instead of the average value of all possible scenarios. Finally, we claim that if the information from the two sources is interpreted properly – taking into account the previous factors – both sources contain valuable information for monetary policy making.

INTRODUCTION

The MNB can influence only short-term interest rates directly by setting its policy rate. The maturity of the policy rate is two weeks, but the decisions of economic agents depend on longer-term interest rates. Financial market participants' expectations regarding future central bank rates constitute the link between short-term and long-term interest rates. The better the intentions of the central bank are reflected in these expectations, the greater the harmony between the decisions of firms and individual agents and economic fundamentals. Therefore, for monetary policy to be efficient, the central bank must be able to shape the expectations of market participants. However, the central bank must have some information about these expectations in order to be able to influence them effectively.

As market expectations can not be observed directly, their measurement is far from easy. There are two main approaches to extracting information on the expectations of market participants. A straightforward way of obtaining information about expectations is to ask market participants directly what they think the central bank policy rate will be in the future. Indeed, in practice there are several firms conducting and publishing such surveys. But interpreting the survey results is not straightforward at all, as it is not clear which behaviour and motivations are reflected in the answers. If the analysts surveyed want to give the best possible forecast, they report the expected value of the future central bank rate. However, there is nothing pushing them to do so, and therefore the forecasts can reflect a variety of motivations. For example, analysts might be interested in avoiding large mistakes, or they may try not to deviate much from the other respondents, or they just do not want to change their prognosis too often. In such cases, the survey does not reflect the best available forecast of the future central bank policy rate.

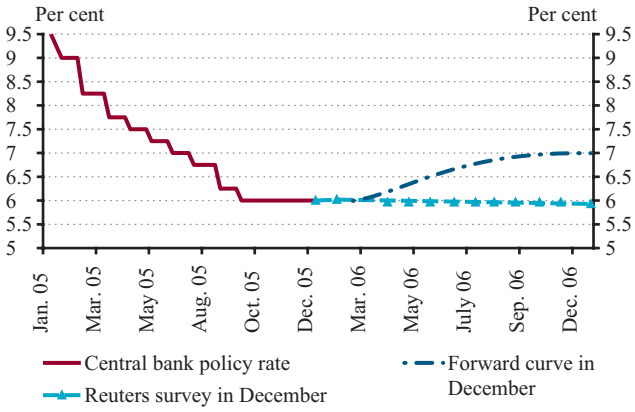
The other possible approach is to measure the expectations of market participants indirectly, using prices observed in financial markets. Various financial asset prices depend on investors' and traders' expectations regarding the future decisions of the central bank. The closer the link between the price of an asset and the central bank interest rates, the better the price reflects market participants' expectations regarding the future path of the central bank policy rate. Moreover, as investors bet their money on their expectations while trading, prices are likely to reflect the best forecast of market participants. The forward rates calculated from the prices of government securities are natural choices for measuring expectations, as the main determinant of government securities prices is the path the central bank rate is expected to follow until the maturity of the assets. However, government securities prices are not determined by the path of the central bank rate exclusively. Therefore, to interpret the expectations reflected in the yield curve, we need to impose assumptions on other factors influencing the yields of government securities.

In practice, central banks use both approaches, as each one has its advantages and disadvantages, and neither is able to completely depict the future path of the central bank policy rate which market participants expect. In this

article, we present a data source for both concepts: the yield curve estimated using government securities prices and the regular survey of market analysts conducted by Reuters. Both sources shed light on the policy rate path which the market participants expect to prevail over a given future period. At the same time, as Chart 1 illustrates, from time to time forward rates and analysts' expectations can differ substantially. Our analysis aims to offer a plausible explanation for this deviation. Furthermore, we argue that it is worthwhile to monitor both sources and to use them as measures of expectations, because despite the inaccuracies both contain valuable information regarding the future path of the central bank policy rate that is not contained in the other. We focus on how accurately we can forecast the future path of the central bank policy rate, therefore for each data source we analyse whether the measured expectations correspond to the expected value of the future central bank rate.

Chart 1

MNB's policy rate and interest rate expectations in December 2005



YIELD CURVE BASED ESTIMATE OF INTEREST RATE EXPECTATIONS

A widely used method to derive expectations regarding the policy rate relies on forward rates calculated from the prices of government securities.[1] The forward rate is equal to the sum of the expected future interest rate and a term premium. To understand this risk premium better, we can separate the duration of the forward contract into two parts:

- The first period starts upon agreeing on the conditions and ends when the security is purchased. When entering into a forward contract, the parties fix the yield, and therefore the investor runs the risk that the interest rates may change before the price of the security must be paid and at this future time he would be able to enter a spot deal under different conditions than the pre-specified.

- The second period starts when the security is purchased and ends upon its maturity. During this period, the risk taken by the investor is the same as the risk of a spot security purchase.

This distinction makes clear that the risk taken in a forward contract is higher than the risk of a spot transaction, due to the uncertainty in the initial period. The risk is mainly determined by the volatility of the spot interest rate during the length of that period, between the date of concluding the forward transaction and the actual purchase of the security. The difference between the two interest rates – the term premium – is the price of this additional risk; it compensates investors for the uncertainty about future interest rates in the first period.

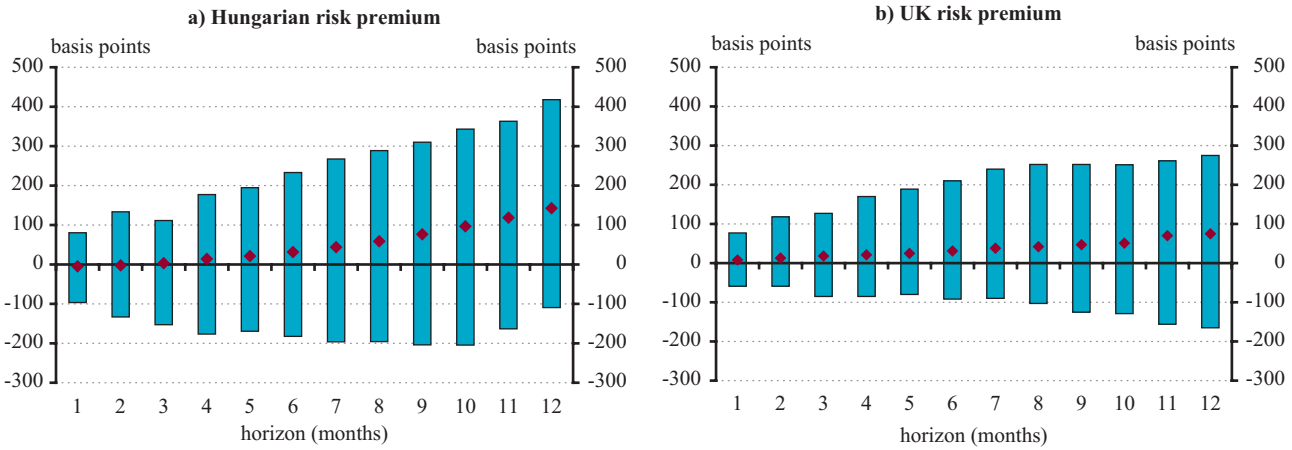
Using the yields in the government securities market we can estimate the risk premium, which enables us to infer the anticipated path of the central bank policy rate. From the yield curve we can directly derive the forward rate, i.e. the sum of the expected future central bank rate and the risk premium. Assuming that the risk premium is constant over time for a given horizon of the forward yield, based on a reasonably long time series of government securities yields both the risk premium and the expected central bank policy rate can be estimated. In this case, the risk premium equals the average difference between the forward rates of a given horizon and the subsequent central bank rate outturns over a sufficiently long period. Once we have obtained the average risk premium, we can calculate the expected central bank policy rate for different horizons at any particular point in time simply as the difference between the forward rate and the estimated risk premium for the corresponding horizon.

Chart 2 shows the risk premium for a range of horizons from 1 to 12 months over the period June 2001 to April 2006. For comparison, we also include the corresponding

[1] In the case of a forward transaction the parties agree in the present time on the conditions of a contract starting at a pre-specified time in the future. For example, a six month ahead three month forward transaction means an agreement concerning a yield, at which one of the parties is to purchase from the other a given security with three-month maturity in six months time. The yield agreed upon is called the forward yield. The time between the date of concluding the forward transaction and the purchase of the security (six months in the previous example) is referred to as the horizon of the forward yield.

Chart 2

Risk premium calculated from forward rates



risk premium for the United Kingdom.[2] Each bar shows the range of the differences between the forward and subsequent spot interest rate outturns, with black diamonds indicating the average risk premium.[3]

The chart shows that although the average risk premium was positive over the analysed time period, there were days when the forward rate was below the subsequent interest rate outturn. This indicates that during the horizon of the forward rate new pieces of information arrive and can lead to changes in the spot interest rates, so that the actual interest rate outcome exceeds the level that was previously expected. Moreover, the range of these differences increases with the horizon, probably reflecting the greater uncertainty as market participants project further out into the future. According to our estimates, the Hungarian risk premium is higher, and the range of the differences is wider than in case of the UK. As mentioned earlier, the reason behind this is probably be the higher volatility of Hungarian interest rates.

Chart 3

Volatility of short-term interest rates

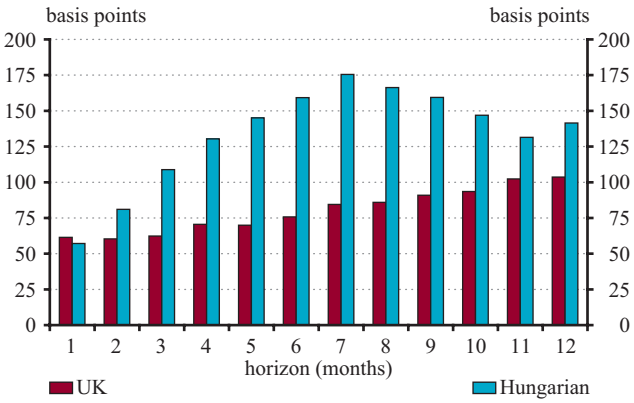


Chart 3 shows the standard deviation of the Hungarian and English short-term interest rate changes in our sample for various horizons between 1 and 12 months. The charts also show that there is a strong link between the estimated risk premium and the volatility of spot interest rates. The standard deviation of the interest rate changes – the measure of the risk taken – increases faster with the horizon in the case of Hungarian yields. Accordingly, at a longer horizon the range of the differences between the forward rate and subsequent spot interest rates widens more in the case of Hungary, and the average risk premium increases faster as well.

Estimating the risk premium involves several problems. First, the time series are relatively short, so the risk premium can only be estimated with considerable uncertainty.[4] Furthermore our model assumes that the risk premium is constant over time. External and internal economic developments and the risk appetite of investors were changing during the period examined, which makes the assumption of a constant risk premium an approximation at best.

[2] The UK risk premiums are estimated using the same method. For a more detailed analysis of market expectations and risk premium in case of the United Kingdom refer to Peacock (2004).

[3] The risk premium for each horizon was estimated as the average difference between the forward rates and the subsequent spot interest rate outturns corresponding to the particular horizon over the period June 2001 to April 2006. We excluded 2003 from the sample, because in this relatively short sample the large central bank rate changes in that year would lead to a significant bias in our estimates.

[4] Before the widening of the exchange rate band and abolishment of capital controls, yields were not determined by the market only, e.g. the MNB intervened more or less continuously on the exchange market. Hence, to estimate the risk premium we do not use yields before 15 June 2001.

In this section we have shown that forward yields calculated from the yield curve cannot be interpreted directly as the expected value of the future central bank policy rate. Forward yields reflect not only expectations, but a risk premium which grows in parallel with the horizon of the forward rate. Therefore, the expected path of the central bank policy rate is below the path drawn by the forward rates.

INFORMATION CONTENT OF THE REUTERS SURVEY

Reuters conducts a survey in the middle of every month, querying financial market economists and research institutions regarding their expectations of the central bank policy rate at various pre-specified future dates (the end of the next month, the end of the current year, end of the next year). If the analysts were to give the best available forecast, they would report the expected value of the central bank policy rate at the specified dates in the survey. However, the motivation of the analysts may differ, and the goal of a respondent may not be to give the most accurate forecast. In this case, it is not straightforward how to interpret the results of the survey, and measuring the analysts' expectations requires a deeper analysis.

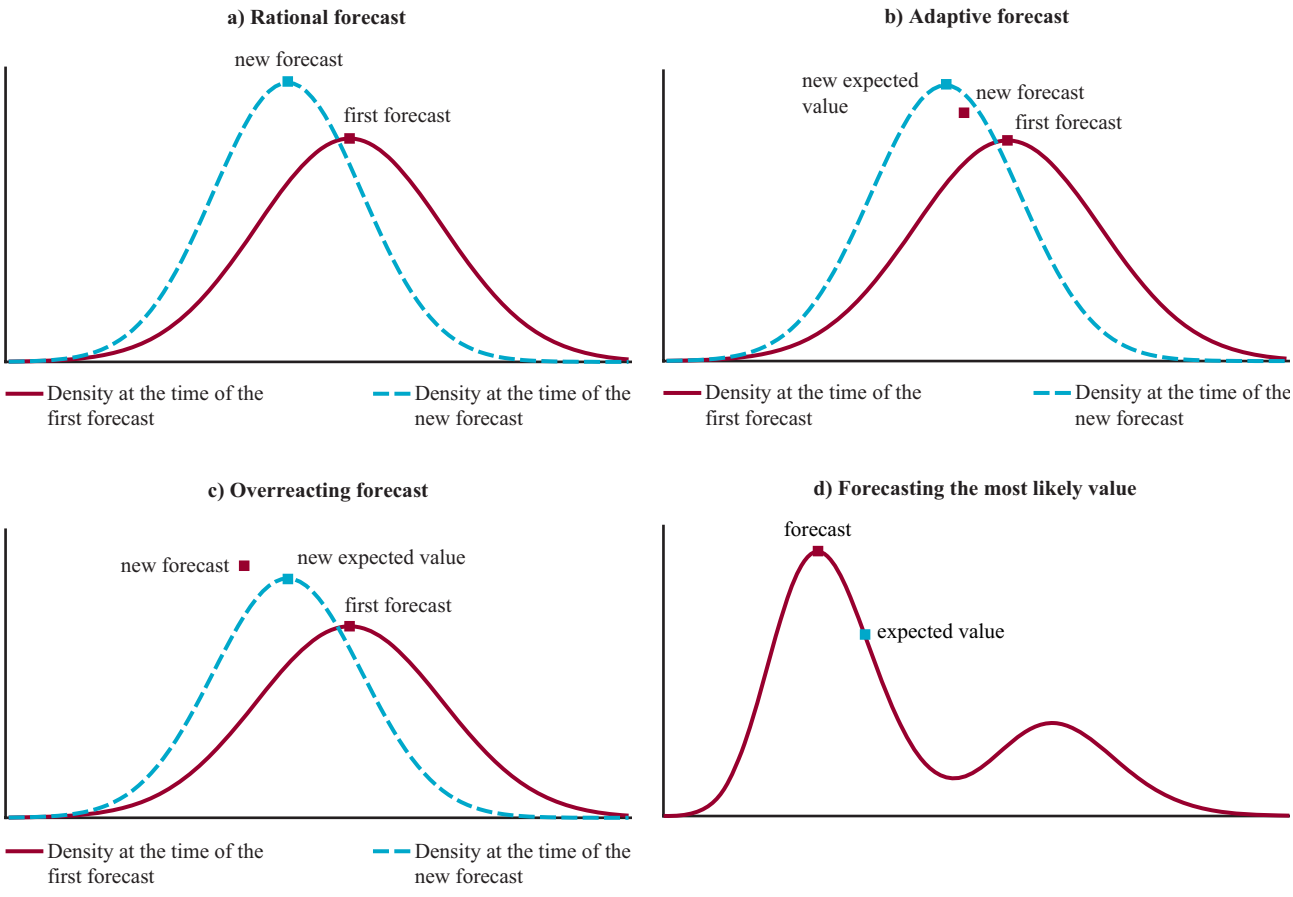
In the first part of this section we present some motives that analysts may have and then we show how these motives can be detected in the survey responses. Finally, we explain how to interpret the forecasts of the analysts if they report the most likely value of the future central bank policy rate instead of its expected value.

FORECASTING STRATEGIES OF ANALYSTS

In addition to reporting the expected value of the future central bank rate in the poll – rational forecasts – we will consider three other possible forecasting strategies: adaptive projections, over-reacting projections and forecasting the most likely value of the future central bank rate.[5]

Chart 4

Forecasting strategies



[5] Frankel and Froot (1985), Bakhshi et al. (2003) provide a more detailed description of these potential behaviours.

The first panel in Chart 4 illustrates the rational forecasts that will serve as a starting point. Forecasting the expected value of the future central bank policy rate will minimize the forecast error, so analysts striving to give the best available prediction will report a rational forecast. If new information arrives and the expected central bank rate changes, the new forecast reflects this change immediately. As new pieces of information arrive randomly and frequently, analysts tend to revise their prognosis quite often in line with changes in the expected future central bank rate.

However, analysts may assume that frequent changes in forecasts jeopardize their reputation, so they attempt to avoid sudden and significant revisions of their forecasts. Panel b) illustrates this type of behaviour, referred to as adaptive forecast. In this case, the projections incorporate new pieces of information gradually, the changes in the expected future interest rate are not fully transmitted into the forecasts. If the previous forecast equalled the expected value, the next forecast will be between the new expected value and the previous forecast. This behaviour results in smoother revisions of the forecasts relative to the rational expectations.

Over-reacting forecasts (Panel (c)) have the opposite effect. In this case market analysts assume that the perceived changes in the expected future path of the central bank rate will continue. Therefore, their revisions will follow the direction of the change in the expected value of the future central bank rate, but the magnitude of the change in forecast will be greater.

Panel d) depicts a case where the density of the future base rate is bimodal. Expectations can take this form, if significantly different scenarios can take place in the forecasting period (e.g. if the central bank decides to raise the interest rate, then the change will be quite large). In this case, however, it is unlikely that the future interest rate outcome will be close to the expected value. Therefore, if analysts report the expected value as their forecast, they will be wrong with a fairly high degree of certainty. To avoid this, analysts will build their forecast in two steps: first they will select the scenario that they favour, and then they will give the expected central bank policy rate corresponding to the chosen scenario as their forecast. Consequently, when analysts strive to maximize the number of relatively accurate forecasts and put less weight on the magnitude of forecasting errors, they will report the most likely value of the future central bank policy rate, instead of its expected value.

TESTING SURVEY EXPECTATIONS[6]

The analysts polled by Reuters are asked to give a forecast each month for the central bank policy rate at various pre-specified future dates. If the analysts intend to minimise their forecast error, i.e. their forecasts are rational, then the forecast of analyst *i* at period *t* for time *t+s* can be written as:

$$forecast^{i}_{t,t+s} = E_i\left(r_{t,t+s}\right) = E\left(r_{t,t+s}\right) + u^{i}_{t,t+s}$$

The analyst's forecast is the sum of the expected value of the future central bank rate and an error term. The latter accounts for the fact that analysts do not know the expected value of the future interest rate precisely.

The subsequent policy rate outturn can be expressed as the sum of its expected value and a random component, where the latter comprises the effect of the shocks which have occurred during the forecast period:

$$r_{t+s} = E\left(r_{t,t+s}\right) + \varepsilon_{t,t+s}$$

Based on the previous two equations, the latter can be transformed as follows:

$$r_{t+s} = forecast^{i}_{t,t+s} + v^{i}_{t,t+s}\ ,\ where$$
$$v^{i}_{t,t+s} = \varepsilon_{t,t+s} - u^{i}_{t,t+s}$$

This equation can be tested using the following regression:

$$r_{t+s} = \alpha^{i} + \beta\, forecast^{i}_{t,t+s} + v^{i}_{t,t+s} \qquad (1)$$

If the forecasts of analysts do not differ systematically from the expected value of the future central bank interest rate, the value of β will be 1. However, the estimated coefficients of equation (1) only show us whether the forecasts of the analysts are rational. If they are not, the equation does not provide any further guidance to decide which strategies or behaviours are reflected in the survey responses. Nevertheless, we can interpret the results of the survey properly only if we knew the type of forecasting behaviour behind them. Projections motivated by the previously presented behaviours except rational expectations have one aspect in common: the forecasts do not equal the expected value of the future interest rate. However, the prognoses reflecting different behaviours are revised differently when new information arrives. Accordingly, looking at the forecast revisions could help us to detect which behaviour applies to the analysts in our data set. To test this we use the following, extended regression:

[6] Bakhshi et al. (2003) provides a detailed description of the methodology we applied.

Table 1

Forecast accuracy of the Reuters survey[7]

	Forecast horizon			
	1-5 months	6-11 months	12-17 months	18-23 months
Variable	Estimated coefficient			
Forecast	0.442 (0.121)	0.657 (0.063)	0.250 (0.107)	0.611 (0.120)
Revision_1	0.627 (0.181)	-0.012 (0.128)	0.394 (0.313)	-0.117 (0.221)
Revision_2	0.367 (0.124)	0.122 (0.070)	0.627 (0.113)	0.188 (0.105)
Constant	0.026 (0.002)	0.029 (0.003)	0.018 (0.002)	0.009 (0.006)

Standard errors are shown in parenthesis below the estimated parameters.

$$r_{t+s} = \alpha^i + \beta forecast^i_{t,t+s} + \gamma\, revision^i_{t-1} + \delta\, revision^i_{t-2} + v^i_{t,t+s} \quad (2)$$

The new variables show the change in the analyst's forecast in period t-1 and t-2. If the forecasts are rational, they are only revised if new information emerges, and the changes in the forecasts will be independent from previous changes. In this case, the coefficient of both new variables will be equal to *0*. If γ or δ is positive, it means that analysts tend to make smaller steps in altering their forecasts. If they change their forecasts, they will do this gradually over several months. The reason for a negative coefficient is that analysts tend to overreact to perceived changes in yields, in other words, their forecasts change more than justified by the factors behind the changes in yields. The results are shown in Table 1 for various forecast horizons.

According to our results analysts typically did not overreact or modify their forecasts in smaller steps (the estimated coefficients for $revision_{t-1}$ and $revision_{t-2}$ are not different from 0).[8] The coefficient of the forecast, however, differs from 1, which indicates that the forecast does not equal the expected value of the future central bank rate, meaning that the assumption of rational expectations is violated.[9]

MODE VS. EXPECTED VALUE

In the previous section we demonstrated that the forecasts in the Reuters survey do not, on average, equal the expected future central bank policy rate. The regressions do not show signs of smooth forecast revisions, nor over-reacting projections.

One plausible explanation for the observed systematic deviation of analysts' prognoses from the actual interest rate outcomes can be that the forecasts are not rational, but rather are based on the scenario with the highest probability. This assumption may be motivated in the Hungarian environment by the fact that expectations often incorporated big changes in interest rate that were likely to occur only with small probability. For example, analysts might expect that in case of an exchange rate crisis the central bank will raise the interest rate significantly; yet the crisis is unlikely to happen, so the central bank's base rate will probably remain unchanged. Accordingly there are two main scenarios, one with a big policy rate increase and another with a constant policy rate. In this case, the expected value of the future policy rate – the weighted average of the central bank base rate corresponding to the individual scenarios- is an interest rate level highly unlikely to occur according to analysts' expectations. If the analysts' objective is to improve their chances to accurately predict the base rate, in terms of the number of precise projections, their prognosis will not be the expected value of policy rate, they will rather forecast the most likely outcome.

The available data does not allow us to test directly whether analysts report in the poll the most likely interest rate outcome. But with the help of simulations we can

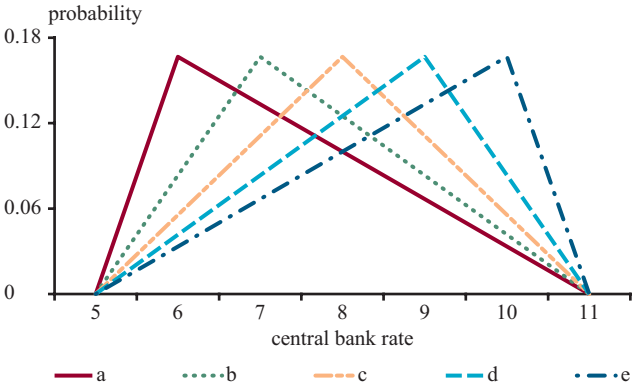
[7] In this section we used the Reuters surveys conducted between December 1995 and January 2006 in our regressions. We omitted the observations which were affected by the exceptional policy rate changes in 2003.

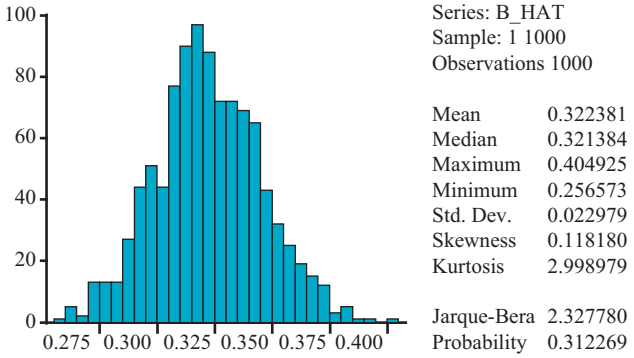
[8] The estimated values of the coefficients γ and δ are very uncertain, therefore the results should be interpreted carefully.

[9] In the estimated equation the explanatory variable and the error term are not independent, since both contain the error made by the analysts in their estimation of the expected value. Hence, our estimate for the β coefficient is smaller than its true value. We have used some other estimation methods to account for this bias, but the results obtained were similar. This means that the coefficient value below 1 is probably not due to the inadequate choice of methodology. For the sake of brevity, we do not report these results here.

Chart 5

Simulating mode-based forecasts





check what coefficients can be estimated in the regression under equation (1), if this is the common analyst behaviour.

The simulations are based on some simple assumptions.

- The economy can be in five states (a, b, c, d and e) with equal probability, for which the future distributions of the base rate are illustrated in the left panel of Chart 5.

- Analysts forecast the level of the base rate with the highest probability in the particular state, which in this case could be 6, 7, 8, 9 and 10.

In the simulation, the estimated value of the coefficient was less than one, on average 0.32 (Chart 5, right panel). This means that the estimated coefficients in our regression could be explained by the fact that analysts' forecasts show the most likely and not the expected value of the future central bank policy rate.[10]

If analysts report the most likely outcome, the forecast may be interpreted as a conditional prognosis. The forecast reflects the expected value of the future central bank base rate in a case when an unlikely extraordinary event (for example an unlikely yet substantial exchange rate depreciation) does not occur.

COMPARISON OF THE FORECASTING PERFORMANCE OF FORWARD RATES AND ANALYSTS' PROGNOSES

In the analysis so far we have argued that there are different factors that drive a wedge between the expected value of the future base rate and both forward rates and the forecasts of analysts. In this section we will discuss whether they contain any useful information concerning the future path of the central bank policy rate. Analysing the two sources together we can assess to what extent they convey the same information. We compare the forecasting performance of the analysts' survey expectations – represented by the average of the individual forecasts – and the forward rates using the following regression:

$$r_{t+s} = \alpha + \beta\, forecast_{t,t+s} + \gamma\, f_{t,t+s} + \delta\, r_t + v_{t,t+s} \qquad (3)$$

The coefficients in the equation indicate how strong the relationship is between each variable and the policy rate. Those variables, which contain information about the expected interest rate path, are correlated with the future central bank interest rate outcome, helping to explain its changes. The coefficients of these variables differ from zero.

The results in Table 2 show that neither the analysts' forecasts nor the forward yields carry all the available information. This follows from the fact that the coefficient of the current base rate differs from zero at all forecast horizons, in other words, the current central bank rate also contains information concerning the future interest rate path in addition to the variables characterising market expectations. At the same time, analysts' forecasts help explain the future base rate at all horizons. At forecast horizons below one year, the forward rates fail to carry any information in addition to the analysts' forecasts and the current level of the base rate, whereas at forecast horizons over one year the coefficients of all variables differ from zero. These results indicate that in analysing market expectations within one

[10] As we could test only indirectly whether analysts indicated the most likely value in their forecast, our argument stands only as far as another alternative – that can be tested indirectly as well – would result a lower coefficient than one in the analysed regression.

Table 2

Forecast accuracy of forward yields and survey expectations

	Forecast horizon			
	1-5 months	6-11 months	12-17 months	18-23 months
Current reference interest rate	-0.434 (0.120)	-0.853 (0.179)	0.433 (0.103)	-0.886 (0.230)
Forecast	1.487 (0.242)	2.245 (0.177)	1.703 (0.082)	2.200 (0.220)
Forward yield	-0.023 (0.120)	-0.139 (0.077)	-0.898 (0.160)	-1.454 (0.147)
Constant	-0.002 (0.000)	-0.016 (0.005)	-0.035 (0.002)	0.139 (0.025)

Standard errors are shown in parenthesis below the estimated parameters.

year the focus should be on the market analysts' forecasts, and at a longer horizon both sources should be considered.[11]

The results, however, do not necessarily mean that forward yields carry no information at all for horizons within one year. On the one hand, the forward yield is the sum of the expected future central bank policy rate and the risk premium, hence it shows the upper limit of interest rate expectations. On the other hand, the difference between the forward yield and the survey expectations can be interpreted as an estimate of the risk premium. The higher this difference, the greater the premium required by investors and the vulnerability of the financial markets.

CONCLUSIONS

In this paper we analysed market expectations concerning the future path of the MNB's policy rate using two sources of information, the yield curve and the Reuters survey of financial market analysts. We found that neither source shows the expected value of future central bank rate directly. The forward rates contain a risk premium which pushes the forward curve above the expected future interest rate path. The analysts' forecasts in the Reuters survey also differ from the expected future policy rate, which in part may be explained by the fact that the respondents report the most likely future interest rate outcome, rather than the expected value. According to our findings, the expected future interest rate path is between the two curves in Chart 1, and it may be closer to the analysts' expectations for forecast horizons of less than one year.

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[11] Nevertheless, for any timeframe over one year the problem remains that our observations are not unbiased since there is an overlap in the forecast periods, which makes the results within this timeframe less reliable.