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THE EVALUATION OF FORECASTS UNCERTAINTY FOR RATE OF INFLATION USING A FAN CHART

Abstract. *For an inflation targeting Central Bank, like The National Bank of Romania, the transparency of the target regime, the credibility of the policies based on it and the inflation forecasts uncertainty are very important objectives that could be accomplished using a fan chart. The methodology for this graphical representation was developed by Bank of England. This type of graphic was built also for quarterly rate of inflation in Romania in 2009-2011, noticing a descending tendency of the macroeconomic indicator. In contrast to the simple BNR methodology, based on an aggregate indicator of error type, the fan chart facilitates the establishment of monetary policy, taking into account the probabilities that the rate of inflation fall in some specific intervals in each period of the forecasting horizon.*

Keywords*:* *fan chart, BoE methodology, two piece normal density, degree of uncertainty, balance of risk*

JEL Classification: E37, C54.

1. Introduction

The evaluation of forecasts uncertainty for key macroeconomic indicators is important for many types of economic agents, particularly for central banks. However, only later the methodology for evaluating this uncertainty began to develop due to inflation targeting by national banks. Global output (GDP), inflation and interest rate are variables for which the forecasts uncertainty is mostly evaluated. Since 1996, the Bank of England presented the inflation forecast as a probability distribution called ''fan chart. ''

2. Literature review

An introduction to forecasts uncertainty in macroeconomic modeling is realized by Ericsson (Ericsson, 2001), that establishes the definition of forecast uncertainty, the main measures of evaluation and its consequences. [1]

[1] Ericsson N. (2001) shows that although the literature uses the expression ''forecast uncertainty'', the correct one is ''the uncertainty of forecasting errors'', because

(Ericsson, 2001) defines uncertainty as the variance different results registered for certain indicators with respect to predicted values. In other words, the uncertainty reflects the difference between the actual recorded values and the projected ones.

Only recently, in the last 20 years, the literature in forecasts domain has begun to pay particular attention to density forecasts (Vega, 2003). Given the asymmetry of risk, it was considered necessary the pass from point forecasts to a complete representation of the probability distribution.

A first measurement of uncertainty was achieved by the Bank of England in 1996 by publishing estimates for the probability distribution of expected values for inflation and GDP (Novo, Pinheiro, 2003). After Bank of England initiative, many central banks represent the density forecast using a graphic called "width chart'' or ''fan chart''. Basically, fan chart shows the probability distribution of the forecasted variable or many prediction intervals determined for different probabilities. Descriptions of statistical methods used by the Bank of England (BoE- Bank of England) and Sweden to build fan charts are made by (Britton, Fisher, Whitley, 1998) and (Blix, Sellin, 1998).

For a future moment from the forecast horizon, the measure of probability for density function for the different results is represented by the depth of the shadow. The darkest portion of the band covers about 10% of probability, including the central projection. In time the uncertainty increases and the band widens. Each successive pair of bands must cover about 10% of probability, in aggregate not exceeding 90% of probability.

For building densities some parametric methods are used, the measure of risk or uncertainty being given by the value of the density forecast parameters. The problem of measuring risk and uncertainty was most approached in the context of inflation targeted by central banks. In this case, the risk is associated with the probability that forecasted inflation be higher or lower than three reference measures: core forecast, targeted inflation, targeted inflation approximations.

Since the introduction of fan charts in 1996 in inflation report by the Bank of England, these were studied by many authors. Wallis and Hatch made detailed researches about fan chart and the Bank of England forecasts.

Cogley, Morozov and Sargent used the minimum entropy method to obtain essential information in predicting inflation and they compared densities forecasts with the fan charts made by the Bank of England. They started from the forecast densities generated using a BVAR model with stochastic variances and coefficients of deviation (Cogley, Morozov and Sargent, 2003). Then, these densities are modified by introducing additional information obtained using a relative entropy method.

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certain values for a future phenomenon are given, but we do not know what the error associated with predictions is.

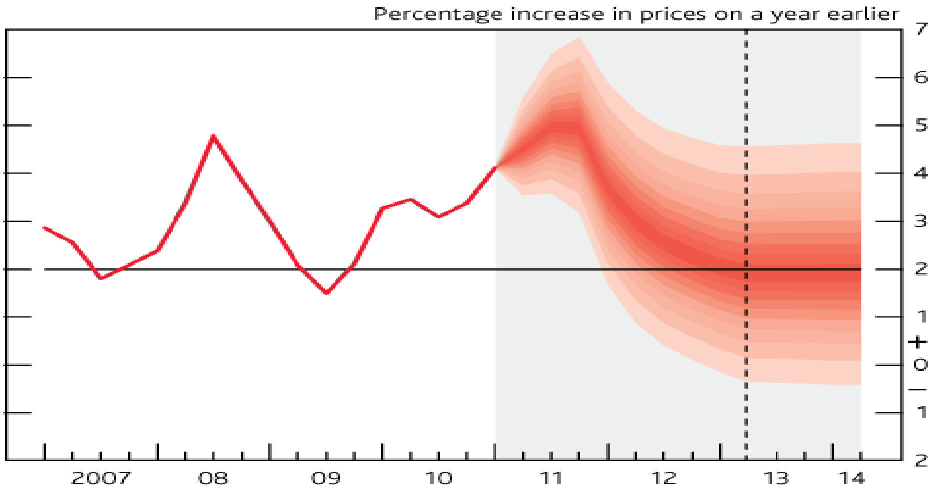

Figure 1. Fan chart for the consumer price index forecasts made by the Bank of England in 2011[2]

(Garratt, Lee, Pesaran, Shin, 2000) calculated, using a small macroeconometric model, the densities forecast for England's inflation and output.

The method used to build a fan chart developed by the Bank of Sweden, Riskbank, is based on a non-diagonal covariance matrix. Between conditioning variables linear correlations appear which do not influence the asymmetry of predicted variables distributions. Later, for small dimensions it was considered the case when the correlation influence influences the asymmetry. (Novo, Pinheiro, 2003) made two key changes in the assumptions of BoE methodology, showing two deficiencies: linear combination of modal values of input variables is a poor approximation of forecast errors mode, when the initial distribution is asymmetric and the hypothesis of independence of errors is too restrictive.

(Wallis, 2004) evaluated the density for the forecasts of the Bank of England, as well as for those of the National Institute of Economic and Social Research. The author concludes that for both institutions the forecasts central tendency is biased and forecasts density overestimates their uncertainty.

If a forecast horizon has only a year, the probability for high inflation rate is overestimated. (Elder, Kapetanios, Taylor, Yates, 2005) showed that this probability was overestimated for GDP even if the horizons

[2] Targeted inflation is defined by the Bank of English as RPIX inflation (Retail Prices Index). *Data source: Bank of England* http://www.bankofengland.co.uk/publications/inflationreport/irfanch.htm

are smaller than a year. Furthermore, from their research resulted an overestimation of the variance of forecasted GDP. In literature many authors observed an overestimation of uncertainty. (Dowd, 2008) analyzed the fan charts built for GDP and concluded that for a short forecast horizon the risk is less captured. Since 2008, the European Central Bank represents its inflation using fan charts. (Osterholm, 2008) built a VAR model for the Swedish economy, parameters estimation being based on Bayesian technique in order to formalize the prediction uncertainty. The major advantage of Bayesian approach is given by the fact that the posterior forecast density interpretation is equivalent to that of a fan chart.

(Galbraith, van Norden, 2011) evaluated the forecasts probabilities using the densities published by the Bank of England and they made their graphical representation, measuring how much they exceeded a threshold. The authors evaluated their resolution and calibration, showing the relative performance of forecasts using also the low resolution for output (GDP) predictions.

Important contributions in the literature related to the fan charts are brought in the demography these graphs being built for longevity or life expectancy. Beyond the frame of inflation evaluation, fan charts are used to describe the probability density for future survival rates for men.

3. The Bank of England (BoE) approach for fan charts

For variables that must be forecasted, variables called ''input variables'' we determine the probability distribution, which will be aggregated. Two types of errors are measured, errors which (Novo, Pinheiro, 2003) classify as:

- Errors of conditioning variables (rate of inflation, interest rate, consumption etc.).

- Pure errors occurring in variables (they are calculated eliminating the first category of errors from the all measured errors).

The assumptions on which the BoE approach is based are:

- The representation of error prediction as a linear combination of the variables to forecast;
- Input variables are independent;
- Marginal probability distributions of input variables consist in two parts normally distributed, aspect described in literature by the expression " two-piece normal distribution "(tpn) or split normal distribution;
- tpn distribution has three parameters: mode (μ) and two standard deviations, to the right and left (σ_1 *şi* σ_2).

Since inflation rates are not symmetrically distributed around the most probable value, (Britton, Fisher, Whitley, 1998) justify the need of split normal distribution (tpn), which shows that the prediction error actions only in one way.

In order to build the forecast distributions the specification of 3 parameters is necessary: a measure of central tendency, an estimate of degree of uncertainty, a presentation of the balance of risk.

a) an appropriate measure of central tendency

The modal value is often chosen, because it is the most likely value to maximize the probability density. However, the mode uses only a part of the information contained in the database and it does not have the average asymptotic significance, fact that generates problems in achieving the inference when the sample distribution is not known. When there are multiple modal values, only one of these will be chosen, which limits the efficiency in using the mode.

b) the use of dispersion to quantify the degree of uncertainty (how different the forecasted values are from the central value) at the expense of average absolute error or interquartile deviation.

c) The risk can be symmetrically distributed around the central tendency or it can be unbalanced, when the mode and the average differ.

In the following the methodology proposed by the BoE we will analyzed and described also by (Novo, Pinheiro, 2003), following two directions: the linear combinations and the tpn aggregation.

A. *Linear combinations from BoE approach*

If y is the variable for which the forecast is realised, then the forecasting horizon (H), the forecast value will be denoted with y_{t+H} . The vectors of (1xK) dimension for different paths of the conditioning variables are: x_{t+H} , h=1,2,...,H. Central forecast for 0 version is: $\hat{y}(x^0_{t+1}, x^0_{t+2},..., x^0_{t+H})$. This prediction results from a variety of econometric models. A local linear approximation is influenced by changes in conditioning variables:

$$\begin{aligned}\tilde{y}(x^1_{t+H},\ldots x^1_{t+1}) &= \hat{y}(x^0_{t+H},\ldots x^0_{t+1}) + \beta_0^{'}(x^1_{t+H} - x^0_{t+H}) + \\ &+ \beta_1^{'}(x^1_{t+H-1} - x^0_{t+H-1}) + \ldots + \beta_{H-1}^{'}(x^1_{t+1} - x^0_{t+1})\end{aligned}$$

where $\{x^1_{t+1}, x^1_{t+2},..., x^1_{t+H}\}$ is an alternative to conditional variances. The estimated effects of y_{t+h} to the change of different factors included in x_{t+h-i} are called interim multipliers denoted with β_i , $i = 0,..., H-1$. The pure forecast error is $\varepsilon_{t+H} = y_{t+H} - \tilde{y}(x_{t+H,} x_{t+H-1,...,} x_{t+1})$. This error aggregates the following components:

- Estimated Errors interim multipliers;
- Errors generated by the approximation of a nonlinear model with a linear one;

- Errors of misspecification;
- Economic shocks in forecasting horizon.

Taking into account the first relation, the total forecast error is:

$$e_{t+H} = y_{t+H} - \hat{y}(x_{t+H}, x_{t+H-1,...,} x_{t+1}) = \beta_0^{'}(x_{t+H}^1 - x_{t+H}^0) +$$
$$+ \beta_1^{'}(x_{t+H-1}^1 - x_{t+H-1}^0) + \ldots + \beta_{H-1}^{'}(x_{t+1}^1 - x_{t+1}^0) + \varepsilon_{t+H}$$

If y_{t+h} is a vector of independent variables, then the first relation is written (Γ_i is the matrix of coefficients of final form linear combinations):

$$\tilde{y}(x_{t+H}^1, \ldots x_{t+1}^1) = \hat{y}(x_{t+H}^0, \ldots x_{t+1}^0) + \Gamma_0 (x_{t+H}^1 - x_{t+H}^0) +$$
$$+ \Gamma_1 (x_{t+H-1}^1 - x_{t+H-1}^0) + \ldots + \Gamma_{H-1}(x_{t+1}^1 - x_{t+1}^0)$$

Using a similar reasoning we obtain:

$$e_{t+H} = y_{t+H} - \hat{y}(x_{t+H}, x_{t+H-1,...,} x_{t+1}) = \Gamma_0 (x_{t+H}^1 - x_{t+H}^0) +$$
$$+ \Gamma_1 (x_{t+H-1}^1 - x_{t+H-1}^0) + \ldots + \Gamma_{H-1}(x_{t+1}^1 - x_{t+1}^0) + \varepsilon_{t+H}$$

If we consider a dynamic model with simultaneous equations in structural form, the residual vector, u_{t+H}, is an approximation of the central forecast. As a consequence of the shocks appeared in resudual variable after ''i'' periods, the predictors modify, their effects or reactions being the elements of ψ_i matrix. In these conditions, the vector of pure errors can be written : $\varepsilon_{t+H} = \psi_0 u_{t+H} + \psi_1 u_{t+H-1} + ... + \psi_{H-1} u_{t+1}$.

Finally, we reach the following relation, which is crucial from the perspective that it breaks down the total error in the error of conditioning variables and the pure error:

$$e_{t+H} = \psi_0 u_{t+H} + \psi_1 u_{t+H-1} + \ldots + \psi_{H-1} u_{t+1} + \Gamma_0 (x_{t+H}^1 - x_{t+H}^0) +$$
$$+ \Gamma_1 (x_{t+H-1}^1 - x_{t+H-1}^0) + \ldots + \Gamma_{H-1}(x_{t+1}^1 - x_{t+1}^0) + \varepsilon_{t+H}$$

The importance of these linear equations is determined by the fact that on their bases, marginal probability distributions are determined and fan charts and confidence bands are drawn.

B. Tpn aggregation in BoE methodology

A random variable, ***z***, has a two-piece normal distribution(tpn) with parameters $(\mu, \sigma_1, \sigma_2)$.If its probability density function exists, it checks: $f(z) = \alpha_1 \phi(z/\mu, \sigma_1^2),\ z \leq \mu$, where $\phi(z/\mu, \sigma_i^2)$ is the probability density of a normal distribution with parameters (μ, σ_i) and $\alpha_i = \dfrac{\sigma_i}{\sigma_1 + \sigma_2}$. The following relations for average, variance and the moment of order 3:

$$E(z) = \mu + (\sigma_2 - \sigma_1)\sqrt{\frac{2}{\pi}}, Var(z) = (1 - \frac{2}{\pi})(\sigma_2 - \sigma_1)^2 + \sigma_1\sigma_2, M_3 =$$
$$= (\sigma_2 - \sigma_1)\sqrt{\frac{2}{\pi}}[(\frac{4}{\pi} - 1)(\sigma_2 - \sigma_1)^2 + \sigma_1\sigma_2] \quad (1)$$

If the standard deviations are different, the distribution is asymmetrical, and in case of equal deviations classical normal distribution results, which is symmetric.

In vectorial terms, if ***e*** is the total error, z the vector of input variables and ***a*** the vector of coefficients, we can write the linear combination using the relation: ***e* = *az***.Modal values of input variables are zero.

We consider the variance and the mode quantile, denoted, $Var(z_n)$ respectively $P(z_n \leq Mo(z_n)$. In order to calculate the average of input variables it is necessary to determine the standard deviations, which are obtained by solving the following equations system:
After solving the above equations system we can determine the mean of the input variables: $E(z_n) = (\sigma_{2n} - \sigma_{1n})\sqrt{\frac{2}{\pi}}$.

The total forecast error mean is zero. Given the assumption of independence, the variance of error e is obtained by summing the weighted variances of the input variables. We approximate error distribution by TPN, the values of standard deviations being determined by solving the following system:

$$\sum_n a_n E(z_n) = (\sigma_2 - \sigma_1)\sqrt{\frac{2}{\pi}} \tag{2}$$

$$\sum_n a_n^2 Var(z_n) = (\sigma_2 - \sigma_1)^2 (1 - \frac{2}{\pi}) + \sigma_1 \cdot \sigma_2 \tag{3}$$

There are several parameterizations of the split normal distribution (tpn). (Banerjee, Das, 2011) proposed two equivalent parameterizations. In a first variant of parameterization, the probability is calculated as:

$$P(li \leq x \leq ls) = \frac{2\sigma_1}{\sigma_1 + \sigma_2}\left[\phi\left(\frac{ls-\mu}{\sigma_1}\right) - \phi\left(\frac{li-\mu}{\sigma_1}\right)\right],\ pentru\ li < ls \leq \mu$$

$$P(li \leq x \leq ls) = \frac{2\sigma_1}{\sigma_1 + \sigma_2}\left[\phi\left(\frac{ls-\mu}{\sigma_2}\right) - \phi\left(\frac{li-\mu}{\sigma_2}\right)\right],\ pentru\ \mu \leq li < ls \tag{4}$$

$$P(li \leq x \leq ls) = \frac{2\sigma_1}{\sigma_1 + \sigma_2}\left[\sigma_2 \cdot \phi\left(\frac{ls-\mu}{\sigma_2}\right) - \sigma_1 \cdot \phi\left(\frac{li-\mu}{\sigma_1}\right) + \frac{\sigma_1 - \sigma_2}{2}\right],\ pentru\ li \leq \mu < ls$$

We will specify the version of parameterization proposed by (Johnson, Kotz and Balakrishnan, 1994), in which the distribution has three parameters: the mode (Mo), the uncertainty or the standard deviation (σ)

and the skewness or asymmetry (Y).The probability density has the following form:

$$f_X(x; Mo, \sigma, \Upsilon) = \frac{A}{\sigma\sqrt{2\pi}} e^{-\frac{1-\gamma}{2\sigma^2}(x-Mo)^2}, x \leq Mo$$
$$f_X(x; Mo, \sigma, \Upsilon) = \frac{A}{\sigma\sqrt{2\pi}} e^{-\frac{1+\gamma}{2\sigma^2}(x-Mo)^2}, x > Mo \quad (5)$$

-1< Y <1 is the inverse of the skewness coefficient, and A is a normalization constant. The formulas to calculate the standard deviations of a split normal distribution are given by: $\sigma_1 = \sqrt{\frac{\sigma^2}{1-\gamma}}$ *and* $\sigma_2 = \sqrt{\frac{\sigma^2}{1+\gamma}}$.

1. *Dacă* $\Upsilon > 0, \sigma_1 > \sigma_2$ => *biased to the left distribution*
2. *Dacă* $\Upsilon < 0, \sigma_1 < \sigma_2$ => *biased to the right distribution*
3. *Dacă* $\Upsilon = 0, \sigma_1 = \sigma_2$ => *normal distribution*

$$\textit{The balance of risk}: p = \frac{\sigma_1}{\sigma_1+\sigma_2} = \frac{\frac{\sigma}{\sqrt{1-\gamma}}}{\frac{\sigma}{\sqrt{1-\gamma}}+\frac{\sigma}{\sqrt{1+\gamma}}} = \frac{1}{1+\sqrt{\frac{1-\gamma}{1+\gamma}}} \Rightarrow$$

$$\frac{1}{p} = 1+\sqrt{\frac{1-\gamma}{1+\gamma}} \Rightarrow 1+\frac{1-\gamma}{1+\gamma} = \frac{(1-p)^2}{p^2}+1 \Rightarrow \frac{2}{1+\gamma} = \frac{1-2p+2p^2}{p^2} \Rightarrow$$

$\gamma = \frac{2p-1}{2p^2-2p+1}$. ξ *is the skewness indicator.*

$$\textit{Thus}, \xi = \overline{Mo} - Mo = (\sigma_2-\sigma_1)\sqrt{\frac{2}{\pi}} = \left(\sqrt{\frac{\sigma^2}{1+\gamma}} - \sqrt{\frac{\sigma^2}{1-\gamma}}\right)\cdot\sqrt{\frac{2}{\pi}}, \beta = \xi^2\frac{\pi}{2\sigma^2}.$$

$$\gamma = -\sqrt{1-\left(\frac{-1+\sqrt{1+2\beta}}{\beta}\right)^2}, \textit{ for } \xi > 0$$
$$\gamma = \sqrt{1-\left(\frac{-1+\sqrt{1+2\beta}}{\beta}\right)^2}, \textit{ for } \xi < 0 \quad (6)$$

There are some limits of the BoE methodology for fan charts: the chose of the mode implies a too restrictive loss function, building confidence intervals around the mode asymmetry affects the method used to determinate the skewness of the distribution.

These include the fact that the fan charts are used to evaluate the risk and the uncertainty in the economy, that will be taken into account in establishing the economic policies. The banks' activity of forecasting is based on this graphical representation. Economic analysis will take into account the possible shocks that may occur in the economy. In making predictions, knowledge of uncertainty and of risk balance is essential.

4. A fan chart to assess the uncertainty for inflation rate forecasts in Romania

In order to build a Fan Chart, we departed form the NBR (National Bank of Romania) inflation report. We used the data from 2005:Q3-2008:Q4 and we made forecasts for 2009:Q1-2011:Q1.

We used the following notations while computing the fan chart :

Table 1. Notations used to build the fan chart

Current No.	Notation	Significance
1.	H	Forecast horizon
2.	X_t^i	Factor that affects the inflation rate
3.	μ_t^i	More likely value for the i-th factor at time t
4.	p_t^i	Balance of risk for the i-th factor at time t
5.	σ_t^i	Forecast error standard deviation for the i-th factor at time t
6.	n2	Number of factors for which p_t^i=0,5
7.	π_t^i	Inflation rate at time t
8.	μ_t^π	More likely inflation rate at time t
9.	p_t^π	Balance of risk for the inflation rate at time t
10.	σ_t^π	Forecast error standard deviation for the inflation rate at time t
11.	ϕ_j^i	Response of π_{t+j} to an impulse in X_t^i
12.	ξ_t^i	Bias indicator of i-th factor at time t
13.	ξ_t^π	Bias indicator of the inflation rate at time t
14.	γ_t^i	Inverse bias indicator of i-th factor at time t
15.	γ_t^π	Inverse bias indicator of the inflation rate at time t

To compute the fan chart we have to determine $(\mu_{t+h|t}^\pi, \sigma_{1,t+h|t}^\pi, \sigma_{2,t+h|t}^\pi)$, where h=1,2,..,9. To calculate this triplet, we have to follow 2 steps:

1. Determination of more likely inflation forecast path $(\mu^{\pi}_{t+h|t})$;

2. Computation of fan chart, which supposes the determination of $(\sigma^{\pi}_{1,t+h|t}, \sigma^{\pi}_{2,t+h|t})$.

1. Inflation rate forecast

- We identify the factors that may affect the inflation rate (X^i_t) over the forecasting horizon and we determine their more likely path $(\mu^{\pi}_{t+h|t})$;

-we compute the more likely short term inflation prediction knowing the factors paths and the data series for inflation up to time t. In this case we use some different models;

- We compute the forecast error standard deviation of the inflation rate, which is the sum of two components: historical forecast error standard deviation estimation and an uncertainty multiplier.

2. Fan chart computation

- we classify the factors according to the balance of risks and we select only those factors for which $p^i_{t+h|h} \neq 0{,}5$ for al least one point in time in the forecast horizon;
- we compute the forecast error standard deviation of the factors and the response of the inflation rate to one unit impulse in each factor ϕ^i_{h-1};
- we transform the forecast error standard deviation and the factors balance of risks into skewness indicators using the formulas;
- The factors' skewness indicators are transformed into inflation rate skewness indicators by using the impulse response function;
- The inflation rate forecast error standard deviation and its skewness indicators are transformed into left and right standard deviations using some formulas above;
- we compute the percentiles of the inflation forecast;
- we compute the probability table, the expected forecasts and the median.

The program used to build the fan chart is developed using MS Office Excel 2003 in Visual Basic.

A VAR model with two variables, the yearly rate of inflation and the yearly rate of devaluation measured quarterly was estimated. The response of inflation to the rate of devaluation is positive, short lived, and statistically significant.

The responses correspond to one SD innovation so we will have to change units to responses to 1 percentage point. The whole response of the inflation rate was divided to an innovation on the rate of devaluation by the standard error of the devaluation rate and the latest as the response on impact of the devaluation to the devaluation.

For the factor uncertainty, the smoothed forecast RMSE of the devaluation rate that arises from the forecasts of the VAR was introduced.

The historical prediction errors for the exchange rate are computed by rolling the estimation of the same VAR model and forecasting the exchange rate nine quarters ahead each time a quarter is added. Finally, the forecast of the model for the next nine quarters is compared to the outlook and by a rule of thumb the balance of risks for these factors is determined.

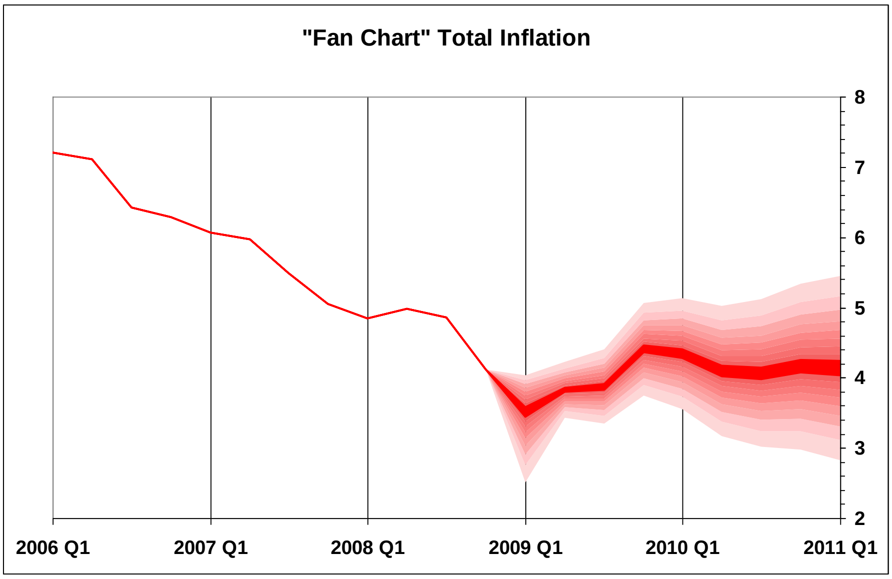

Figure 2. Fan chart for projected rates of inflation in Romania (Q1 2009-Q1 2011)

Providing an evaluation of uncertainty is related to the effectiveness with which an institution fails to influence the economic activity. The methodology used by BNR is a simple one, like measure of global medium uncertainty for the rate on inflation based on its macroeconomic short-term forecast model is used the mean absolute error (MAE-mean absolute error). This synthetic indicator includes all effects of unanticipated past shocks that led the deviation of the expected values from the registered ones. Based on this type of error prediction, forecasting intervals are built, BNR numbering several advantages of its methodology:

- it considers all the previous shocks that have affected the rate of inflation;

- it determines a classification of the deviations from the actual values in the history of projections: deviations that determined an overestimation of the projected inflation and deviations that generated an underestimation;
- the methodology excludes any arbitrary assumption about the action of individual risk factors;
- it allows the adjustment of intervals of uncertainty, so that they reflect the assessments of different agents regarding the magnitude of the future uncertainty in relation with the one of previous periods.

The interval of uncertainty built by BNR is a very simple one, far from the complex methodology proposed by the BoE. This aspect can be noticed from the chart below. Unlike the fan chart, where the shadow depth is assessed, the BNR chart makes no distinction between degrees of uncertainty and it does not consider the forecast distribution. It does not consider the uncertainty in terms of probabilities, but it evaluates only an indicator of prediction accuracy. As a synthetic indicator, the MAE is not able to identify the most important factors in the forecasting horizon. Some methodological notes are necessary in building the interval of uncertainty:

- prediction errors are calculated as the difference between predicted values based on the forecasting model and actual values on medium term of the rate of inflation rate for forecasting horizons of 1 to 8 quarters;
- values of the inflations are the mean quarterly ones;
- the obtained values were logarithmically adjusted to eliminate the irregular trend of concentration of uncertainty at different forecasting horizons, but also to smooth the intervals limits.

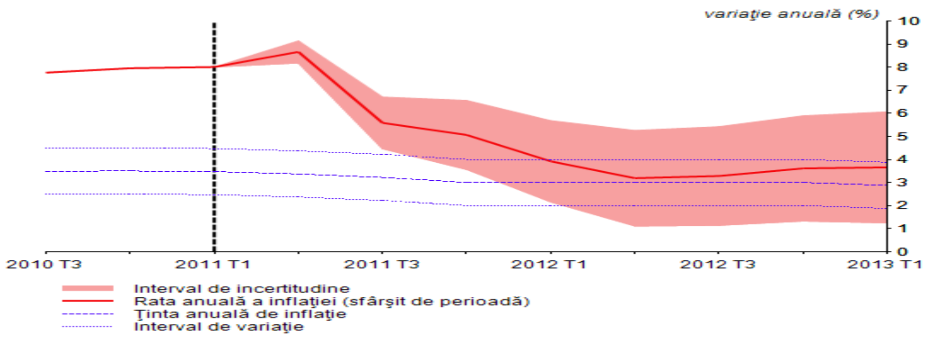

Figure 3. The interval of uncertainty for projections of inflation rate in Romania (from 2011-Q1 2013)

Unlike the RMSE indicator, the indicator for forecasting error MAE is less sensitive to large prediction errors. If the dataset is small MAE is recommended, but the most institutions use RMSE as its unit of measurement is the same as the one of the indicator which is calculated.

RMSE is always at least equal to the MAE. Equality occurs if the errors have the same magnitude. The difference between the MAE and the RMSE is higher, the greater the variability of the data series. RMSE is affected by generalized variance, the interpolation, the errors in the phase and by the presence of outliers.

6. Conclusions

One of the suggestive ways to evaluate the macroeconomic forecasts uncertainty based on the models is to build fan charts, best known methodology being the one of the Bank of England. Although scientists have pointed certain weaknesses of it, fan chart continues to be used by the more central banks, some researchers bringing improvements to the assumptions used in building this type of graphic.

The methodology used by the NBR to build the interval of uncertainty for inflation is very simple and it could be improved or replaced with the methodology of building fan charts, because it is not based on probabilistic approach, but only on mean absolute error.

In conclusion, the fan chart is a good measure of highlighting the inflation forecast uncertainty, being very useful for the establishment of the monetary policy of central banks.

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