QUASI EX-ANTE INFLATION FORECAST UNCERTAINTY

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Main findings:

- We propose a concept and measure of *quasi ex-ante* forecast uncertainty, which can be recovered from the *ex-post* forecast errors by removing the monetary policy effects.
- We propose the concept of *uncertainty ratio (UR)*, showing gains and losses of the monetary policy in reducing uncertainty.
- Using this measure, we show that, for inflation targeting countries, the relationship between central banks' independence and strength of monetary policy is in fact nonlinear, depending on the uncertainty regime.
- For UK, US and BRICS countries we show that that the best results of reducing inflation forecast uncertainty are for countries which either conducted systematic and unadjusted inflation targeting (UK, US, South Africa), or did not target inflation (India).

Ex-ante uncertainty for period $t+h$ can be computed on the basis of information available at time t.

For computing *ex-ante* uncertainty, usually data from panels of forecasts (e.g. *Surveys of Professional Forecasters*) are used.

Main critique:

1. Forecasters are *inattentive* e.g. they fail to update their forecasts, disagree when updating, do not learn (Andrade and Le Bihan, 2013).
2. Panel of forecasters often change, often non-randomly (López-Pérez, 2015).
3. Possible psychological bias of probabilistic and interval forecasts (Soll & Klayman, 2004; Hansson & Juslin & Winman, 2008; Clements, 2014).
4. Forecasters seems to look over each other shoulders: correlation of forecasts; bias dominates variance (e.g. Makarova, 2014).
5. Panels of forecasts across countries are often incomplete, or not available, or not comparable.

Ex-post uncertainty: assumptions and interpretation

Ex-post uncertainty (realized risk) is a function of forecast errors made at time t for $t+h$, so that data from time $t+h$ are needed.

- Clements' (JBES, 2014) assertion:

$$\text{`}\textit{ex-post}\text{ uncertainty'} \underset{\textit{in population}}{=} (\text{`}\textit{ex-ante}\text{ uncertainty'} \mid \text{`confidence neutrality'})$$

- We argue that:

  Even if the forecasters are confidence-neutral, in case of inflation and GDP, the *ex-post* and *ex-ante* uncertainties might differ, due to possible policy effects undertaken on the basis of forecasts.

In this presentation:

$$\text{`}\textit{ex-post}\text{ uncertainty'} \underset{\textit{in population}}{=} (\text{`}\textit{ex-ante}\text{ uncertainty'} \mid \text{no <effective> policy})$$

Incorporating policy effects into distribution of *ex-post* forecast errors

U - r. v. which represents h-steps ahead forecasts errors:

$$U = X + \alpha \cdot Y \cdot I_{Y>m} + \beta \cdot Y \cdot I_{Y<k}, \qquad (X,Y) \sim N\left(\begin{bmatrix}0\\0\end{bmatrix},\begin{bmatrix}\sigma^2 & \rho\sigma^2\\ \rho\sigma^2 & \sigma^2\end{bmatrix}\right)$$

where:

X: distribution of forecast errors (relative to trend inflation) in the absence of any effective policy action;

Y: pool of additional forecasts (relative to trend inflation), not observed as available to the decision makers only;

α, β: measure effects of the respective anti-inflationary (α) and pro-inflationary (β) monetary policy on the uncertainty.

The distribution of U is called the *Weighted Skew Normal distribution* (WSN, see Charemza, Díaz and Makarova, 2015). Notation: $U \sim \text{WSN}_\sigma(\alpha, \beta, m, k, \rho)$.

Note: we have only observations on U (point forecast errors relatively to the trend inflation), and not on X and Y.

‘The trick’: approximation of *ex-ante* from *ex-post*

The unpredictable uncertainty, can partially be extracted as:

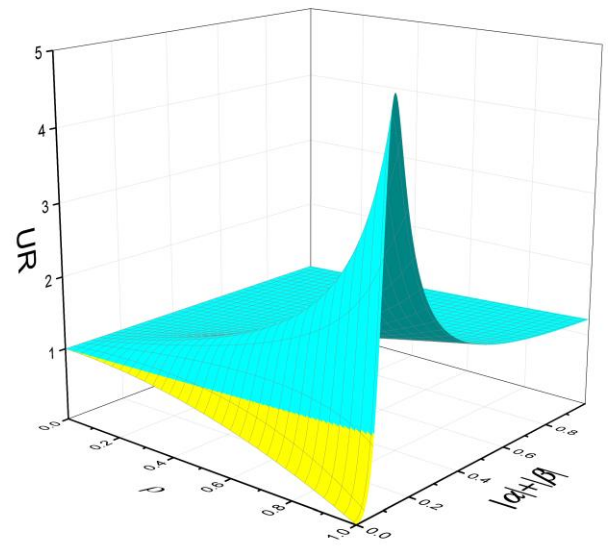
$$V = U - E(X \mid Y) = U - \rho Y = X - \rho Y + \alpha \cdot Y \cdot I_{Y>m} + \beta \cdot Y \cdot I_{Y<k} \quad .$$

Uncertainty Ratio: $\mathrm{UR} = \dfrac{\sigma_V^2}{RMSE_U^2}$

For effective policy we expect that $\mathrm{UR}>1$.

UR for the case where $\sigma^2 = 1$, $\alpha = \beta$, $m = -k = 1$ and for different values of ρ . Values of UR smaller than one are in a lighter shade (yellow).

Compound strength=$|\alpha| + |\beta|$.



Reasons for $\mathrm{UR} < 1$

1 Overreaction to forecast signals (Morris & Shin, AER, 2002; Svensson, AER, 2006).

2. Frequent reaction to irrelevant forecast signals (Charemza and Ladley, IJF, 2016).

The concept of $\mathrm{UR}_{\max}$: $\mathrm{UR}_{\max}(\rho)$ - maximum of UR for a given ρ.

The ratio of $\mathrm{NUR} = \mathrm{UR} / \mathrm{UR}_{\max}$ tells about possibility for policy improvement.

Empirical analysis

Data:

ARMA-GARCH forecast errors for annual CPI inflation (monthly data) for 38 countries:

32 OECD countries,

5 BRICS countries (Brazil, China, Russian Federation, India, and South Africa),

Indonesia.

Data ends at December 2014. The longest series, starting in February 1950 and with 779 observations, is for Canada, and two shortest are 191 observations for Estonia and 252 observations for China.

Sequences of forecast errors are obtained in the *pseudo out-of-sample* way (Stock and Watson, 2007) for forecast horizons h= 1, …,24.

Distributions fitted for each country and each forecast horizon,

(1) WSN;

(2) TPN (two-piece normal)

(3) GB (generalized beta)

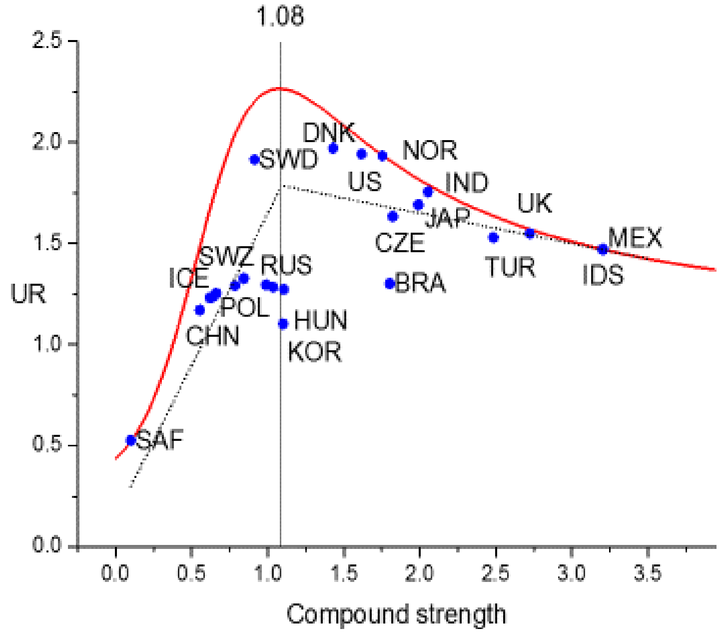
Percentage of cases where WSN fits better than TPN: 85%;

Percentage of cases where WSN fits better than GB: 90%

Criterion of fit: Hellinger twice-squared minimum distance measure.

Theoretical and empirical URs for inflation targeting countries

$$h = 12, \ \rho = 0.75.$$



Red line: slice at $\rho = 0.75$ of the earlier blue-yellow plot (UR: $\sigma^2 = 1, \ \alpha = \beta$, $m = -k = 1$).

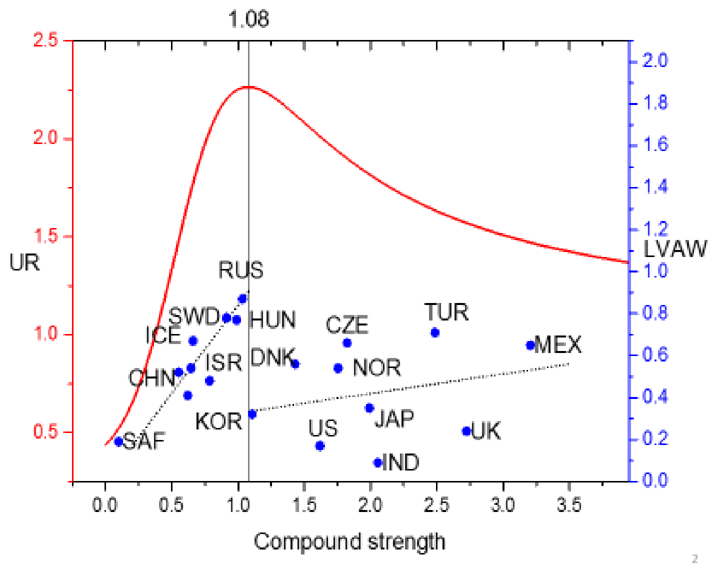
Compound strength=$|\alpha| + |\beta|$.

Distance of empirical points from the red line is due to asymmetry ($\hat{\alpha} \neq \hat{\beta}$).

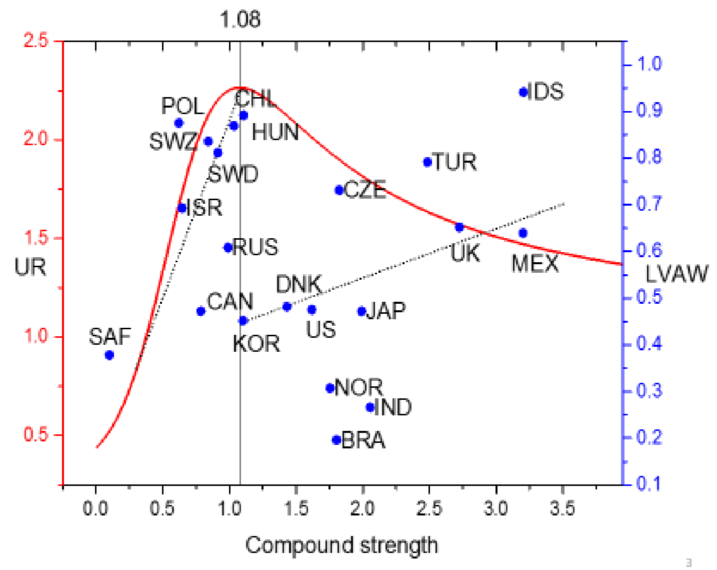
$$\text{UR}_{\max} = 1.08$$

URs and central banks' independence

Dincer and Eichengreen, (IJCB, 2014)



Bodea and Hicks, (IO, 2015)



- It is, overall, a positive relationship between the compound strength of monetary policy and measures of banks' independence.
- However, this relationship is much stronger for $UR < UR_{max}$ than for $UR > UR_{max}$.

Aggregated ***quasi*** *ex-ante* forecast uncertainty measures across horizons

	Short aggregation					Long aggregation				
Country	$RMSE(u)$	σ_V	UR	NUR	$\hat{\sigma}$	$RMSE(u)$	σ_V	UR	NUR	$\hat{\sigma}$
BRA	3.18	3.98	1.18	0.84	0.68	19.4	21.9	**1.02**	**0.82**	2.95
CHN	1.59	1.83	**1.09**	**0.78**	1.46	7.70	8.85	**1.05**	**0.84**	3.82
IND	4.92	6.56	**1.33**	**0.95**	1.40	20.2	23.8	**1.18**	**0.94**	3.55
RUS	3.57	4.40	**1.11**	**0.79**	1.63	19.9	22.3	**0.99**	**0.79**	3.91
SAF	4.11	5.41	1.31	0.93	1.02	5.09	6.16	1.19	0.95	3.49
UK	2.63	3.39	1.27	0.91	0.54	12.7	14.6	1.15	0.93	1.61
US	1.34	1.85	**1.38**	**0.98**	0.57	6.51	7.77	**1.20**	**0.95**	1.45

Conclusions

- We propose the concept of the *quasi ex-ante* forecast uncertainty which is (to a degree) free from effects of economic policy undertaken on the basis of private (non-publicly available) forecast signals.
- Ratio of the *quasi ex-ante* to *the ex-post* uncertainty, called the *uncertainty ratio, UR*, quantifies the effects of economic policy in reducing uncertainty.
- Inflation uncertainty ratio, UR, helps explaining the non-linear relationship between the strength of monetary policy and measures of central banks' independence.
- Our findings reconfirm the consistency and reputation argument of the monetary policy.

Computation of UR using the estimated parameters of WSN:

$$\mathrm{UR} \overset{def}{=} \frac{\sigma_V^2}{RMSE_U^2} = 1 + 2\rho \frac{-(\alpha D_m + \beta D_k) - \rho/2}{RMSE_{U^*}^2} - \frac{\left[E(U^*)\right]^2}{RMSE_{U^*}^2} \quad ,$$

where $U^* \sim \mathrm{WSN}_1(\alpha, \beta, m, k, \rho)$, $m = \bar{m}/\sigma$ and $k = \bar{k}/\sigma$,

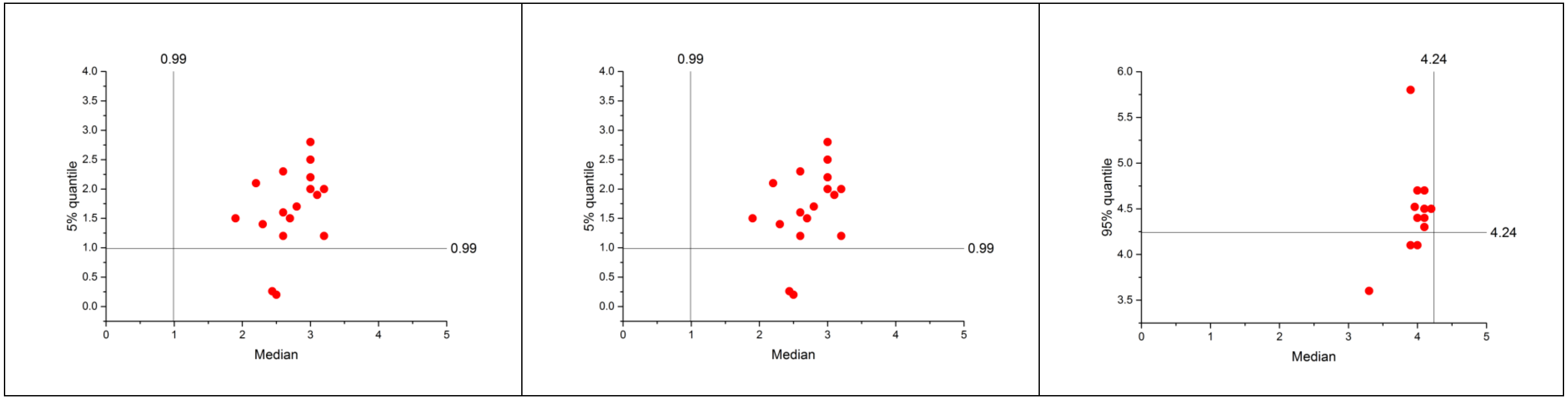
$$E(U^*) = \alpha \cdot \varphi(m) - \beta \cdot \varphi(k), \; D_a = \int_{|a|}^{+\infty} t^2 \varphi(t)dt = 1 - \Phi(|a|) + |a|\varphi(a) \quad .$$

UR is equal to unity, if:

$\rho = 0$ and $bias^2(U) = 0$, or $\rho = -2\left[(\alpha D_m + \beta D_k) + bias^2(U)\right]$.

Note that UR does not depend on σ, but on the ratios $m = \bar{m}/\sigma$ and $k = \bar{k}/\sigma$

Forecasts of annual average inflation and GDP in the 3rd Quarter of 2011 according to the NBP Survey of Professional Forecasters (Poland) and realisations



Further interpretation of parameters of $\mathrm{WSN}_\sigma(\alpha,\beta,m,k,\rho)$:

α,β: measure effects of the respective anti-inflationary (α) and pro-inflationary (β) monetary policy on the uncertainty;

m,k: 'policy thresholds'; if the additional forecast is between the 'thresholds', no policy action is undertaken;

σ^2: variance of the distribution of the uncertainty as if the monetary policy was impotent;

ρ: coefficient explaining the degree of expertise (knowledge) of the additional experts.

If either X totally unpredictable (that is, the uncertainty is fully *ontological*) or if the forecasters producing forecast in Y are fully ignorant, then $\rho=0$. Otherwise, if $0<\rho<1$, the uncertainty is partly *ontological* and partly *epistemic*