New uncertainty measures for the euro area using survey data

Andreas Reuter

Business and consumer surveys and short-term forecast (ECFIN A4.2)
Structure

- I) **Motivation** for design of new indicators
- II) **Construction methods** of the new indicators
- III) The indicators' **performance**:
  - a) **graphical** inspection
  - b) **VAR models**:
    >>>>impulse-response functions
    >>>>forecast-error variance decomposition
- IV) **Conclusions**
I) Motivation for design of new indicators

a) existing uncertainty indicators

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<tr>
<th>input data:</th>
<th>mathematical operation:</th>
<th>main advantages:</th>
<th>main disadvantages:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>financial:</strong></td>
<td>dispersion</td>
<td>timely available</td>
<td>• financial markets differ from real economy</td>
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<tr>
<td>▪ prices of options with identical maturity-times</td>
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<td><strong>purposefully collected:</strong></td>
<td>frequency</td>
<td>timely available</td>
<td>subjectivity in choosing:</td>
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<tr>
<td>▪ uncertainty-words in newspapers</td>
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<td>• few respondents</td>
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<td><strong>survey data II:</strong></td>
<td>dispersion of forecast errors</td>
<td>original alternative to only considering the dispersion of &quot;raw&quot; responses to the survey</td>
<td>• delayed availability use of micro-data (confidential + require panel)</td>
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<td>▪ question-pairs inquiring expectations &amp; retrospective assessment of concept</td>
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<tr>
<td><strong>extensive panel of real + financial data series</strong></td>
<td>magnitude of error of forecasting model using the data-set</td>
<td>developments in many economic sectors considered</td>
<td>• ex-post measure</td>
</tr>
</tbody>
</table>
I) Motivation for design of new indicators

a) existing uncertainty indicators

assumption: uncertainty can be best derived \textbf{directly} from main economic agents (i.e. consumers, enterprises)

Bachmann et al.'s (2013) uncertainty measures can be improved

Focus of this presentation:

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<td>inquiring expectations &amp;</td>
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<td></td>
<td></td>
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<td>retrospective assessment</td>
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<tr>
<td>of concept</td>
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### b) new uncertainty indicators

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<td>Survey data I:</td>
<td>Dispersion</td>
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<td></td>
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Survey data II:

- Question-pairs inquiring expectations & retrospective assessment of concept
- Dispersion of forecast errors
- Original alternative to only considering the dispersion of "raw" responses to the survey
- Delayed availability
- Use of micro-data (confidential + require panel)
- Use of macro-data (accessible to anyone + no panel structure required)

**NEW:** Survey data III:

- Based on all survey-questions
- Dispersion (but: across, rather than within questions)
- New kind of dispersion considered; possibly complementing existing measures
II) Construction methods of the new indicators

a) uncertainty measure based on expectation-questions:

data used:

- all forward-looking survey question of the Joint Harmonised EU BCS Programme:
  - industry (future production / selling prices / employment / (export) order books)
  - services (future demand / employment / prices charged)
  - retail trade (future orders placed with suppliers / sales / employment / prices charged)
  - construction (future employment / prices charged)
  - consumers (future financial situation / economic situation in country / prices / unemployment / spending on major purchases)

- 18 questions (from 4 sectors + consumers)
- questions refer to euro area level
calculation method:

separately for each survey question:

\[ \sqrt{\text{%age } POS_t + \text{%age } NEG_t} - (\text{%age } POS_t - \text{%age } NEG_t)^2 \]

If more respondents give POS/NEG answer (rather than NEUTRAL), uncertainty increases.

cross-sectional standard deviation (for every point in time t)

If difference between POS and NEG drops, uncertainty increases.

opposing opinions interpreted as uncertainty-indication

across all questions:

standardisation of question-specific time-series

averaging of time-series

+ rescaling so that resulting time-series has average 100 and standard deviation 10
b) ex-post uncertainty measure based on respondents’ forecast errors: \[\text{UNC2}\]

data used:
- all questions of EU BCS programme existing in "pairs" (forward- and backward-looking version)

- INDU: production
- SERV: turnover
- SERV: firm's employment
- RETA: sales

- CONS: financial situation
- CONS: macro situation
- CONS: prices
**calculation method:**

**Bachmann:** for a given point in time \( t \), e.g. Jan 2007:

| January 2007 |  |
|--------------|--
| respondent   | INDU: prod. next 3 months |
| A            | + 1 |
| B            | + 1 |
| C            | - 1 |
| D            | 0   |

**absolute difference**

| April 2007  |  |
|-------------|--
| respondent  | INDU: prod. past 3 months |
| A           | + 1 |
| B           | - 1 |
| C           | 0   |
| D           | 0   |

calculation of standard deviation

\[
\begin{bmatrix}
0 \\
-2 \\
-1 \\
0 \\
\end{bmatrix}
\]

= uncertainty in January 2007

repetition over all subsequent months gives uncertainty time-series
# New calculation method (developed by DG ECFIN):

- no use of micro-data (ensuring feasibility of indicator for everyone)
  >> individuals' forecast errors remain unknown
  >> distribution of forecast errors unknown

**Solution**: **Indirect derivation** of forecast error dispersion

**Step 1)** separately for each survey question: **Cross-sectional standard deviation**

\[
\sqrt{\%age\ POS_t + \%age\ NEG_t - (\%age\ POS_t - \%age\ NEG_t)^2}
\]

<table>
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<tr>
<th>Time</th>
<th>Industry production:</th>
<th>Services turnover:</th>
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<tr>
<td></td>
<td>next 3 months</td>
<td>past 3 months</td>
</tr>
<tr>
<td>01/07</td>
<td>0,65</td>
<td>0,50</td>
</tr>
<tr>
<td>02/07</td>
<td>0,50</td>
<td>0,50</td>
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<tr>
<td>03/07</td>
<td>0,35</td>
<td>0,30</td>
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<tr>
<td>04/07</td>
<td>0,35</td>
<td>0,30</td>
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<tr>
<td>05/07</td>
<td>0,55</td>
<td>0,40</td>
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<tr>
<td>06/07</td>
<td>0,55</td>
<td>0,45</td>
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<tr>
<td>07/07</td>
<td>0,45</td>
<td>0,50</td>
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<td>...</td>
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Dispersion reflects...

(i) ...differences in production expectations across respondents

(ii) ...**Degree of uncertainty** (higher uncertainty leads to higher dispersion)

Dispersion reflects...

...differences in production across respondents (over past 3 months)

"**True**" dispersion, free of any uncertainty effects
# new calculation method (developed by DG ECFIN):

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**Step 2)** for every question "pair":

\[
dispersion_t = \ln\left( \frac{\text{dispersion (question on future)}_{t-3}}{\text{dispersion (question on past)}_t} \right)
\]

repetition over subsequent months produces uncertainty time-series

**Standardisation** of all time-series

**Step 3)** average across all time-series produces uncertainty series

rescaling so that resulting time-series has average 100 and st. deviation 10
c) uncertainty measure based on inter-question dispersion:

rationale:

- commonality of previous uncertainty indicators:
  - uncertainty derived from dispersion at level of individual questions

UNC1 / UNC2:
- look at individual survey questions
- derive cross-sectional st. deviation from the share of pos. & neg. answers

UNC1:
- average across (expectations) questions

UNC2:
- make ratio of st. deviations for each question "pair"
- average ratios across question "pairs"
c) uncertainty measure based on inter-question dispersion:

**rationale:**

- commonality of previous uncertainty indicators:
  - uncertainty derived from dispersion **at level of individual questions**
- **new approach:**
  - uncertainty derived from dispersion **across questions**

- consider the balance scores (i.e. %POS - %NEG) for each question
- calculate the dispersion of balance scores **across questions**

- **assumption:**
  - **in times of high certainty** (e.g. during downswing): assessments change in uniform way (**"everything gets worse"**)  
  - **in times of high un-certainty** (e.g. when approaching a trough): assessments change into different directions:
    - e.g. consumers more positive on future financial situation, but…
    - …**due to remaining doubt**, (still) hesitant to increase their likelihood of making major purchases
data used:

- all questions of the Joint Harmonised EU BCS Programme:
  no restrictions: (i.e. questions on past / present / future & across all 5 surveyed sectors)
  35 questions

calculation method:

- transformation of monthly balances into changes vs. 3 months ago
- standardisation of all time-series
- for each point in time t, calculation of standard deviation across questions
- rescaling of indicator to have 100 mean and standard deviation 10
III) The indicators’ performance: a) graphical inspection

- **financial crisis:**
  - Lehman Brothers bankruptcy in 2008q3
  - economic downturn, culminating in 2009q2 (EA q-o-q GDP growth at -3.0%)

- **2002q4:**
  - discussions about **Iraq invasion**
    (which materialised in March 2003)

- **2002q1:**
  - peak resulting from 3 subsequent sharp rises (starting in 2001q3 where World Trade Center was attacked)

- **2003q3:**
  - Iraq war ongoing
  - August 2003: press unveiling DE / FR / IT having entered recession
b) VAR models: impulse-response functions:

- aim: quantifying the independent impact of a variable A on a variable B, but:
  - allowing for causal links between the variables, which run in both directions (from A to B & from B to A)
  - controlling for the effect of other variables potentially related to variable A and/or B
  - identifying the impact over time, taking account of the dynamic links between the variables

b) VAR models:

impulse-response functions:

- variable of interest 1: **uncertainty** (proxied by three new indicators)
  - GDP - appropriate, since new indicators capture uncertainty throughout entire economy (variables derived from industry/services/etc. questions)

- other variables: similar to selection advocated in Bloom ('09) & Jurado et al. ('15):
  - Economic Sentiment Indicator (ESI)
  - (log of) euro-area employment levels
  - (log of) hours worked
  - (log of) wage level
  - harmonised index of consumer prices
  - nominal short-term interest-rate

system contains 8 variables & a constant

- variables are quarterly (i.e. (i) genuinely quarterly or (ii) quarterly averaged)
- four lags per variable
- estimation period: 1999q1 to 2014q1
- simulation horizon: 20 quarters
impulse-response results by indicator

**UNC 1 (using expectation questions)**
- short persistence
- early trough: \(-0.4\)

**UNC 2 (using forecast errors)**
- long persistence
- late trough: \(-0.7\)

**UNC 3 (using dispersion across questions)**
- medium-long persistence
- medium-early trough: \(-0.3\)

Results robust to various tests: (inclusion of time-trend, dropping constant, dropping variables, adding controls (oil prices), extending estimation period) !!!

**Commonalities:**
- all indicators have negative & significant impact on GDP
- negative impact fades out over time
- no signs of overshooting (as reported in Bloom (2009))

**Differences:**
- magnitude of maximum impact differs
- timing & persistence differ
comparison with impact of other uncertainty indicators

**stock market volatility index**

**Economic Policy Uncertainty Index (Baker et al. (2013))**

**observations:**
- negative impact of shocks is only on brink of statistical significance
- for EPUI:
  - odd positive and significant effect on GDP in quarters 2 / 3 after shock
  - signs of an "overshooting" effect at end of simulation horizon (in line with Bloom (2009))
### forecast-error variance decomposition

- **VAR set-up**
- Focus is not on *absolute* magnitude of the impact of variable A on variable B
- Instead: technique determines *percentage* of variability in variable B, which is caused by the shock to variable A

<table>
<thead>
<tr>
<th>horizon (in quarters):</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>stock market volatility</td>
<td>0.01</td>
<td>0.04</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>Economic Policy Uncertainty Index</td>
<td>0.08</td>
<td>0.12</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>UNC 1 (= based on expectation-questions)</td>
<td>0.11</td>
<td>0.22</td>
<td>0.17</td>
<td>0.14</td>
</tr>
<tr>
<td>UNC 2 (= ex-post measure based on respondents' forecast errors)</td>
<td>0.11</td>
<td>0.10</td>
<td>0.28</td>
<td>0.41</td>
</tr>
<tr>
<td>UNC 3 (= based on inter-question dispersion)</td>
<td>0.06</td>
<td>0.17</td>
<td>0.19</td>
<td>0.11</td>
</tr>
</tbody>
</table>

### observations:
- for every time-horizon:
  - new uncertainty measures account for larger share of GDP variation than "classical" measures
- UNC1 and UNC3 cause – at every horizon – roughly the same percentage of variation
- UNC2 deviates from UNC1 / UNC3: has highest impact in medium term
IV) Conclusions

- 3 new uncertainty measures with several advantages:
  - based on publicly-available survey data (rather than micro-data)
    >>>>>replication for wide range of users possible
  - survey-questions used stretch across different sectors & include consumer survey
    >>>>>lower likelihood of missing important episodes of elevated uncertainty

- new measures show convincing empirical performance:
  - peaks coincide with major uncertainty-enhancing events of the past
  - measures appear counter-cyclical with regard to GDP
  - VAR simulations show shocks to the new indicators having significant negative impact on GDP growth (fading out over time)
  - forecast-error decomposition exercise shows: new indicators account for larger %age of GDP variations than "classical" measures

- practical considerations:
  - UNC1 / UNC3 are particularly useful, since they can be constructed in real time
  - UNC2 (based on respondents' forecast-errors) can only be constructed with delay and is thus less useful in practice