The European Commission's Composite Indicators of Business and Consumer Surveys – Ad-hoc- vs. Data-driven Techniques

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The Role of NSOs in the Production of LCS Indicators – UN Geneva, 6-7 July 2017
Structure

- (i) The Joint Harmonised EU Programme of Business and Consumer Surveys
- (ii) Establish**ed** Composite Indicators & their performance
  - a) Confidence Indicators (CIs)
  - b) Economic Sentiment Indicator (ESI)
  - c) Business Climate Indicator (BCI)
- (iii) Motivation for design of **new/alternative indicators**
- (iv) Construction methods of new indicators
- (v) Comparison of **new indicators** & Consumer Confidence Indicator (**CCI**):
  - (a) **graphical** inspection
  - (b) **ability to track** reference series
  - (c) **ability to forecast** expansions/contractions
- (vi) Conclusions
The Joint Harmonised EU Programme of Business and Consumer Surveys: History

since 1962: monthly survey in **Industry**
since 1966: monthly survey in **Construction**
since 1972: monthly survey among **Consumers**
since 1984: monthly survey in **Retail Trade**
since 1996: monthly survey in **Services**
since 2007: monthly survey in **Financial Services**

**additionally:**
since 1966: bi-annual **investment survey** of the manufacturing sector
Geographical scope

i. The Joint Harmonised EU Programme of Business and Consumer Surveys

**EU-28**

+ 

**candidate countries:**
- Turkey (2007)
- FYROM (2008)
- Montenegro (2012)
- Serbia (2013)
- Albania (2016)
## Business Survey questions (monthly)

<table>
<thead>
<tr>
<th></th>
<th>last 3 months</th>
<th>currently</th>
<th>next 3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>production / business situation / business activity</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>demand for firm's services/turnover</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>order books</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>export order books</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>stock of (finished) products</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>prices charged</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>firm's employment</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
<tr>
<td>orders placed with suppliers</td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
<td><img src="image" alt="last 3 months" /> <img src="image" alt="currently" /> <img src="image" alt="next 3 months" /></td>
</tr>
</tbody>
</table>

Factors limiting activity

![Industry](image) = Industry  
![Services (incl. fin.)](image) = Services (incl. fin.)  
![Retail](image) = Retail  
![Construction](image) = Construction
i. The Joint Harmonised EU Programme of Business and Consumer Surveys

**Consumer Survey questions (monthly)**

**Micro questions**
- Development household's financial position

**Macro questions**
- Development general economic situation in MS
- Development consumer prices

**Last 12 months**
- Development household's financial position

**Currently**
- Right moment for people to make major purchases?
- Good moment to save money?
- Household's position (from running into debt to saving a lot)

**Next 12 months**
- Development household's financial position
- Spending more or less on major purchases?
- Household's likelihood of saving money
- Development general economic situation in the MS
- Development consumer prices
- Development unemployment in MS
ii. Composite Indicators & their performance

a) Confidence Indicators (CIs)

**purpose:** summarising overall perceptions and expectations at the individual sector level (industry, services, construction, retail, consumers) in a one-dimensional index

**calculation:** for every sector: arithmetic mean of (seasonally adjusted) balances for specific questions

**selection criteria for questions to be included:**
- relevance
- high correlation of CI with reference series
- smoothness
### Questions included in CIs

<table>
<thead>
<tr>
<th>Industry</th>
<th>Services</th>
<th>Construction</th>
<th>Retail Trade</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>order books - currently</td>
<td>business - last 3 months</td>
<td>order books - currently</td>
<td>business activity (sales) - last 3 months</td>
<td>household's fin. position - next 12 months</td>
</tr>
<tr>
<td>stock of (finished) products - currently</td>
<td>demand for firm's services - last 3 months</td>
<td>firm's employment - next 3 months</td>
<td>volume of stock - currently</td>
<td>econ. situation in MS - next 12 months</td>
</tr>
<tr>
<td>production - next 3 months</td>
<td>demand for firm's services - next 3 months</td>
<td></td>
<td>business activity (sales) - next 3 months</td>
<td>unemploy-ment in MS - next 12 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>likelihood of saving money - next 12 months</td>
</tr>
</tbody>
</table>
ii. Composite Indicators & their Performance – a) Confidence Indicators (CIs)

Performance of the CIs

Industry CI and reference series (y-o-y growth):

Notabene: given substantial publication lead of CIs the coincident correlation is practically a leading correlation.

- Coincident correlation: 0.89
- Correlation leading 1: 0.87
- Correlation leading 2: 0.83
ii. Composite Indicators & their Performance – a) Confidence Indicators (CIs)

Performance of the CIs

Services CI:

Coincident correlation: 0.94
Correlation leading 1: 0.95
Correlation leading 2: 0.94
ii. Composite Indicators & their Performance – a) Confidence Indicators (CIs)

Performance of the CIs

Construction CI:

- Coincident correlation: 0.57
- Correlation leading 1: 0.55
- Correlation leading 2: 0.52
ii. Our Composite Indicators & their Performance – a) Confidence Indicators (CIs)

Performance of the CIs

Retail Trade CI:

Coincident correlation: 0.81
Correlation leading 1: 0.80
Correlation leading 2: 0.78
Performance of the CIs

Consumer CI:

Coincident correlation: 0.87
Correlation leading 1: 0.86
Correlation leading 2: 0.85
b) Economic Sentiment Indicator (ESI)

**Purpose:**

- summarising overall economic developments, in all 5 surveyed sectors
- tracking GDP growth at Member State, EU and euro-area level
ii. Composite Indicators & their Performance – b) ESI

Calculation of the ESI

**components:** 15 balance series of the 5 sectoral CIs

- seasonally adjusted
- standardised

allocating weights per sector:

Industry: 40% ; Services: 30% ; Consumers: 20% ; Construction: 5% ; Retail Trade: 5%

→ individual INDU question has weight of 13.3% (= 40% / 3 questions)

calculation of arithmetic mean of weighted balances

standardisation of the ESI and:

- addition of 100
- multiplication by 10

- values >100 indicate above-average economic sentiment
- 2/3 of observations will be in the interval [90 ; 110] (assuming normality)
Performance of the ESI

Correlations:

<table>
<thead>
<tr>
<th></th>
<th>ESI</th>
<th>EMU CLI</th>
<th>PMI</th>
<th>IFO BCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>coincident</td>
<td>0.92</td>
<td>0.84</td>
<td>0.88</td>
<td>0.50</td>
</tr>
<tr>
<td>leading 1</td>
<td>0.91</td>
<td>0.83</td>
<td>0.91</td>
<td>0.49</td>
</tr>
<tr>
<td>leading 2</td>
<td>0.88</td>
<td>0.80</td>
<td>0.91</td>
<td>0.46</td>
</tr>
<tr>
<td>leading 3</td>
<td>0.84</td>
<td>0.75</td>
<td>0.90</td>
<td>0.42</td>
</tr>
</tbody>
</table>
Purpose:
- timely tracking of IP/gross value added growth in the manufacturing sector
Calculation of the BCI

components: 5 balance series from the industry survey:
- production last 3 months
- production next 3 months
- order books currently
- export order books currently
- stock of finished products currently

conducting factor analysis:
- only one factor retained
  (assumption is: business cycle can be represented by a single variable)
ii. Composite Indicators & their Performance – c) BCI

Performance of the BCI

Correlations:

- coincident
- leading 1
- leading 2
- leading 3

<table>
<thead>
<tr>
<th>Indicator</th>
<th>BCI</th>
<th>INDU COF</th>
</tr>
</thead>
<tbody>
<tr>
<td>coincident</td>
<td>0.89</td>
<td>0.87</td>
</tr>
<tr>
<td>leading 1</td>
<td>0.87</td>
<td>0.85</td>
</tr>
<tr>
<td>leading 2</td>
<td>0.83</td>
<td>0.80</td>
</tr>
<tr>
<td>leading 3</td>
<td>0.76</td>
<td>0.73</td>
</tr>
</tbody>
</table>

*no significant difference...*
(i) new/alternative indicators: Motivation

Example: current Consumer Confidence Indicator (CCI):
- uses 4 out of 12 consumer survey questions
- arithmetic mean of the four questions' balance series
  %age of pos. replies \textit{minus} %age of neg. replies

Advantages:
- easy calculation
  \textit{>>easy communication}
  \textit{>>easy interpretability}

Disadvantages:
- no statistical foundation (\textit{ad-hoc})
  \textit{>>risk of sub-optimal performance}
  (in tracking + forecasting reference series)
(ii) Construction methods of the new indicators

input variables:
"rich" set of time-series, namely: **balance series of all 11 cons. survey questions**

- **household specific questions**
  - financial situation,
  - saving behaviour, etc.
- **macro-economic questions**
  - general economic situation,
  - unemployment

- **past 12 months** and/or
- **currently** and/or
- **next 12 months**

series for 10 EA countries stretching sufficiently far back (to 1985)
(11 questions * 10 countries = **110 time-series**)

reference series:
EA private consumption growth (y-o-y)
aggregation technique:

...straight-forward solution would be: **OLS regression** of ref. series on all survey series (algorithm determining questions' weights)

- OLS estimator fails if number of expl. variables too large for sample size
- inflated variance of estimated parameters (=inaccurate estimates)
  - if predictors are (near) collinear
  - likelihood of collinearity increasing with number of variables

need of genuine "**data-reduction**" methods to generate confidence indicator

- **Principal Component Analysis (PCA):**
  - summarises information in (limited number of) "factors"
  - "factor" reflects tendency shared by several (or all) series
  - "factors" are uncorrelated
  - first "factor" summarises largest share of variables' co-movement

- **Partial Least Squares (PLS):**
  - like PCA, but co-variance of input series with reference series is considered

- **Ridge Regression (RR):**
  - regularised regression (i.e. imposes thresholds on values of coefficients)
  - works even if more regressors than observations
aggregation "issue": combining different frequencies:
- survey series are monthly
- private consumption growth (= ref. series) is quarterly

**solution:** render survey series quarterly… **BUT**
…keep monthly interpretation of survey series (remember: confidence indicator shall be monthly)

### 'blocking approach'

<table>
<thead>
<tr>
<th>Monthly</th>
<th>Question 1</th>
<th>Question 1 (M1)</th>
<th>Question 1 (M2)</th>
<th>Question 2 (M1)</th>
<th>Question 2 (M2)</th>
<th>Question 2 (M3)</th>
<th>Question 3 (M2)</th>
<th>Question 3 (M3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>M1 10.1</td>
<td>M1 10.1</td>
<td>M2 12.3</td>
<td>M1 13.5</td>
<td>M1 18.5</td>
<td>M2 19.2</td>
<td>M3 20.7</td>
<td>…</td>
</tr>
<tr>
<td>Q2</td>
<td>M1 13.5</td>
<td>M2 13.7</td>
<td>M1 14.3</td>
<td>M2 13.7</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Q3</td>
<td>M1 18.5</td>
<td>M2 19.2</td>
<td>M3 20.7</td>
<td>M2 19.2</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

(i) Motivation for design of new indicators (ii) Construction methods of new indicators (iii) Comparison of new indicators & official CCI: (a) graphical inspection (b) ability to track ref. series (c) ability to forecast ref. series (iv) Conclusions
calculation of indicators happens in real time...

To calculate value for January 2015, only data released until 31 January 2015 may be used.

- use only the M1-versions of each survey series
- time-series stop in 2015 Q1
- conduct PCA:
  2015-Q1-value of the first factor
  = confidence indicator's reading in January 2015

- use only the M2-versions of each survey series
- time-series stop in 2015 Q1
- conduct PCA:
  2015-Q1-value of the first factor
  = confidence indicator's reading in February 2015

finally: transform the confidence indicator from first-differences into levels
<table>
<thead>
<tr>
<th>Indicator Value for January 2015</th>
<th>Indicator Value for March 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>use only the <strong>M1-versions</strong> of each survey series</td>
<td>use only the <strong>M3-versions</strong> of each survey series</td>
</tr>
<tr>
<td>time-series stop in 2015 Q1</td>
<td>time-series stop in 2015 Q1</td>
</tr>
<tr>
<td>include quarterly reference series (last value = <strong>2014 Q3</strong>)</td>
<td>include quarterly reference series (last value = <strong>2014 Q4</strong>)</td>
</tr>
<tr>
<td>priv. consumption growth published with 65 days delay</td>
<td></td>
</tr>
<tr>
<td>conduct PLS / Ridge regression:</td>
<td>conduct PLS / Ridge regression:</td>
</tr>
<tr>
<td>result is a <strong>weighting scheme</strong> for the combination of survey series into a confidence indicator</td>
<td></td>
</tr>
<tr>
<td><strong>plug Q1 values</strong> of survey series into equation to produce confidence indicator's value for January 2015</td>
<td><strong>plug Q1 values</strong> of survey series into equation to produce confidence indicator's value for March 2015</td>
</tr>
</tbody>
</table>

**Finally:** transform the confidence indicator from first-differences into **levels**
(iii) Comparison of new indicators & official EA Consumer Confidence Indicator (CCI)

(a) **graphical** inspection

![Graphical comparison of indicators](image)

Indicators very similar!

(b) **tracking** performance: correlation with EA priv. cons. growth (y-o-y)

<table>
<thead>
<tr>
<th></th>
<th>current CCI</th>
<th>PCA-based</th>
<th>PLS-based</th>
<th>RR-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-2015</td>
<td>0.82</td>
<td>0.89</td>
<td>0.86</td>
<td>0.84</td>
</tr>
<tr>
<td>coincident</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Q-lead:</td>
<td>0.79</td>
<td>0.82</td>
<td>0.79</td>
<td>0.76</td>
</tr>
</tbody>
</table>

No significant differences in tracking performance!
(c) ability to forecast reference series

expansions & contractions in EA private consumption

questions:
- Do new CIs contain information additional to that contained in current CCI?
- If yes, is this supplementary info complementary to timely released hard data?

set-up:
- for every new CI, run two probit-models predicting recession probabilities:
  - restricted model: only CI (+ constant) predict probabilities
  - augmented model: CI (+ timely available hard-data) predict probabilities
- out-of-sample period: 2005q2 to 2015q1
- pseudo-real time set-up with assumption that...
  ...forecast of qt is conducted at end of M3 of qt

Motivation for design of new indicators
(ii) Construction methods of new indicators
(iii) Comparison of new indicators & official CCI: (a) graphical inspection (b) ability to track ref. series
(c) ability to forecast ref. series
(iv) Conclusions
results:

Usually: cut-off probability of 0.5 as a recession signal when comparing forecasts

Here: visual inspection of receiver operating characteristic (ROC) curves:

for different cut-off values (0 to 1), plot: false positives rate (x-axis) vs. true positives rate (y-axis)

- good models tend to lie above 45-degree line
  (= higher true positives than false positives rate)
(i) Motivation for design of new indicators  
(ii) Construction methods of new indicators  
(iii) Comparison of new indicators & official CCI:  
(a) graphical inspection  
(b) ability to track ref. series  
(c) ability to forecast ref. series  
(iv) Conclusions

### Conclusions:

- Models tend to be above 45-degrees line
- All cof. indicators contain forecast-relevant info, no matter which cut-off value is used
- Current CCI carries least forecast info
- Hard-data improves models
- Current-CCI model NOT inferior to other models

**Statistical test**

- If new cof.-models are better than current-CCI-model

- **Restricted models**: New cof's make better forecasts
- **Augmented models**: New cof's don't make better forecasts

*New cof's have (a bit) more forecasting-relevant info… **but**: New info largely covered by timely-released hard data

**No added value in realistic forecasting scenarios!**

### Graphical Inspection

- **Restrained models**: Models tend to be above 45-degrees line
- **Augmented models**: All cof. indicators contain forecast-relevant info, no matter which cut-off value is used

### Hard-data Improves Models

- Current CCI carries least forecast info
- Current-CCI model NOT inferior to other models

- **Statistical test** if new cof.-models are better than current-CCI-model

### New Cof's Make Better Forecasts

- **Restricted models**: New cof's make better forecasts
- **Augmented models**: New cof's don't make better forecasts

- New cof's have (a bit) more forecasting-relevant info… **but**: New info largely covered by timely-released hard data

**No added value in realistic forecasting scenarios!**
(iv) Conclusions

current CCI has potential **shortcomings**:

- ad-hoc aggregation method
- just 4 input questions
- not tailored to target-series by design

we addressed all **shortcomings**:

- PCA/PLS/RR
- 110 time-series
- (PLS/RR): tailored to target-series

**results:**

- **only slight improvements in tracking** private consumption growth
- **only slight improvements in forecasting** expansions/contractions in private consumption
  + all improvements fading in realistic forecasting scenario
  (i.e. when timely hard data are included)

**interpretation:**

- more complicated cof. indicators no compelling alternative to current CCI,
  especially since:
  …current CCI easy to communicate
  …upswings / downswings in CCI easily attributable to developments in individual underlying survey questions
Thanks for your attention!