CAMRI ROUNDTABLE DISCUSSION: MEETING SUMMARY
Now-casting and the Real Time Data Flow

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(This is a meeting summary of the CAMRI Roundtable Discussion led by Lucrezia Reichlin, Professor of Economics at the London Business School, and non-executive director of UniCredit Banking Group and AGEAS Insurance Group. She is the Chair of the Scientific Council at the Brussels based think-tank, Bruegel. Between March 2005 and September 2008 she served as Director General of Research at the European Central Bank (ECB). She is a co-founder and director of Now-Casting Economics Ltd, and a columnist for the Italian national daily Il Corriere della Sera.)

There is a lot of macro data released every day. However, not all information is helpful in understanding the current status of the economy. Is it useful to explore the timeliness of the macro information? The fundamental idea of now-casting is that timely information can be explored to better understand and forecast the economy.

1. Now and then. Why wait?

Figure 1 illustrates the impact of incorporating newly released information in forecasting GDP growth for the Euro Area.

On April 8th, 2014 the GDP growth was forecasted at 1.2% by the IMF. Now-casting model had a very close estimate of 1.15% growth at the same time. From April 8th onwards, new monthly data was released and the forecast revised downward to reflect a pessimistic outlook of the Euro Area economy. The Now-casting model incorporated this new information, and arrived at a revised estimate of GDP growth of 0.69% on July 16th, 2014. However, IMF has still not revised its most recent forecast.
Therefore, by making use of the newly released information, the now-casting model was able to derive a more current view of the economy’s status.

2. What is now-casting and why should we care?

The word “now-casting” comes from meteorology. It is the contraction of the terms Now and Forecasting. Economic now-casting forecasts the near future, the present, and even the recent past.

In the early days, now-casting mainly focused on GDP. GDP data is usually published late, and the frequency of release is usually quarterly. Therefore, now-casting has developed a model to utilize early monthly or even higher frequency information to obtain a timely and accurate estimate of quarterly GDP.

Another motivation of now-casting is that longer horizon forecasts usually depend on the accuracy of the most recent released estimates. For example, Table 1 shows the result of the computed Mean Square Forecast Error (MSFE) relative to the constant growth forecast of GDP. A lower MSFE corresponds to a worse forecast. At time 0, Green Book (or Fed internal forecast) was better than the constant forecasts. But after that, the Survey of Professional Forecasters was better than the Green Book forecasts.
Table 1: How important is now-casting relative to longer horizon forecasting?

<table>
<thead>
<tr>
<th>Horizon</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Book</td>
<td>0.87</td>
<td>1.03</td>
<td>1.17</td>
<td>1.23</td>
<td>1.29</td>
</tr>
<tr>
<td>Survey of Professional Forecasters</td>
<td>0.85</td>
<td>1.03</td>
<td>1.00</td>
<td>1.06</td>
<td>1.06</td>
</tr>
</tbody>
</table>

The concept of now-casting was broadened and a comprehensive framework was defined for reading in a coherent way all the relevant data as they are published in real time. Please refer to Banbura, Giannone, Modugno and Reichlin, *Handbook of Econometrics 2013* for a review. The idea is to mimic market reading of the data flow in a formal model. For example, an investor will form an expectation about the employment report after a recent news release. However, when the actual employment report comes out, the investor will be surprised and when investors are surprised, the market moves.

### 3. The Now-Casting Approach

The objective of now-casting is to track the real time data flow, using a single, coherent framework. In order to link the expectations of the data releases to one another, all relevant and potentially large data are joined together using a parsimonious model. The model is updated every time there is a new data release or whenever there is “news” in the data flow. Now-casting approach is entirely model-based and free of judgment.

#### I. The Now-Casting Platform
II. The Model

Now-casting is basically a multi-factor model, shown in Formula 1. Each of the Observed Variable “x” is a linear function of the common factor and some noise. The variables can be at any frequency. The philosophy of the model is that the forecast is driven by the common dynamics disregarding the noise.

\[
\text{Observed Variable } x_{st} = m_{st}(\text{common factors}) + \text{noise}_{st}
\]

- Variables can be at any frequency
- \( m_{st} \) is a linear function; \( \theta() \) parameters to be estimated
- Common factor unobserved; must be estimated

**Formula 1: Multi-factor Model**
Figure 3 demonstrates the intuition of the model, which is to capture the common factor that drives the co-movements of the economic data in a parsimonious model.

![Figure 3: Co-movements in economic data- The factor: NCI](image)

III. Estimation and Updating

- Step 1: Extract the monthly factors

\[
\text{Est. factors}_t = \text{Proj} [\text{factors}_t \mid \text{Info} (v); m_\theta]
\]

**Formula 2: Extract Factors**

Info (v): vintage of data available at time v; v is the date of a particular data release; v, v+1 are two consecutive data releases (possibly few minutes away)

Characteristics of Info(v): jagged edged, mixed frequency, large

- Step 2: Use monthly factors to forecast each variable x
Formula 3: Forecast Variables

For each variable $x(i,t)$, $i=1, ..., n$ compute the projection each time new information is released according to the calendar.

$$\text{forecast } x_{i,t} = m_{\theta(t)}(\text{factors}_t) = \text{Proj } [x_{i,t} | \text{Info}(v)]$$

Formula 4: Project Variables When New Information Releases

And therefore, there will be “news” or model based surprise as denoted in Formula 5, which is the difference between the data release and the projection.

$$\text{Proj } [x_{i,t} | \text{Info}(v+1)], \text{Proj } [x_{i,t} | \text{Info}(v+2)], ....$$

Formula 5: “News”

To update the projection based on the new information at $v$, a weighted sum of surprised is taken shown in Formula 6. In this way, the factors that drive the changes in the forecasts will always be trackable.

$$x_{1,t} - \text{Proj } [x_{1,t} | \text{Info}(v+1)] = \text{news}(x_{1,v+1})$$
$$x_{2,t} - \text{Proj } [x_{2,t} | \text{Info}(v+1)] = \text{news}(x_{2,v+1})$$
$$\text{...}$$

Formula 6: Update

4. An Example of How Now-Cast Works

Figure 4 is an example of now-casting U.S. GDP growth in 2014 Q2. This is a fixed event forecast and as new data is released, the forecast is updated. At the beginning of the period in January 2014, the GDP growth for the Q2 is projected at 0.8%. Each red dot stands for information release. And the chart moves from April – July (now-cast) to July-September (back-cast).
Figure 4: Evolving Now-Cast of U.S. GDP growth

The following table takes a closer examination of the information release point on June 26.

Table 2: Example of Information Release
On June 26, there was the Kansas City Fed Manufacturing Survey. The actual number was 6.00 for the period of June 2014. Each information release has a weight associated with it. The “News” of -4.16 means the now-cast model was impacted negatively. The impact is a product of the weight and the news, which is -0.60 for the Kansas City Fed Manufacturing Survey. By summing up all three news release impacts, the forecast moved from the previous now-cast of 0.71% to a lower number of 0.67%.

5. Now-Cast Coverage and Performance Results

The now-casting model currently tracks 68% of world GDP. Green labels in Table 3 refer to the countries covered by the current model, while red labels are the ones currently under development.

![Table 3: 20 Largest Countries by Share of World GDP](image)

The NCI (Now-Cast Index) is now released once a month in the Bloomberg calendar. It incorporates all variables including employment, construction, production, surveys, etc. and disregards variable-specific dynamics. Currently, NCI tracks 65% of world GDP, as shown in Table 4. Index values are consistent and comparable among the countries.
Table 4: NCI Geographic Coverage

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Share of world GDP(^a) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>US</td>
<td>21.9</td>
</tr>
<tr>
<td>2</td>
<td>Euro Area</td>
<td>17.0</td>
</tr>
<tr>
<td>3</td>
<td>China</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>Japan</td>
<td>8.3</td>
</tr>
<tr>
<td>7</td>
<td>UK</td>
<td>3.4</td>
</tr>
<tr>
<td>8</td>
<td>Brazil</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Figure 5 demonstrates the consistency of U.S. and Euro Area NCI with NBER and CEPR recessions from January 1991 to January 2014. The recessions are represented by the white shaded area.

Figure 5: U.S. NCI (left) and Euro Area NCI (right) – long history with NBER recessions and CEPR recessions

6. Extension of the Model

I. By Product: News Index

A News Index can be constructed by computing the weighted sum of news normalizing it with respect to one variable – e.g., GDP.

\[
\sum_{i=1}^{n} \sum_{s=0}^{t} weight_{i,GDP} \times news_{i,s}
\]

Formula 7: News Index
The next figure shows the index for the U.S. as constructed in real time starting from 2004Q1 to 2013Q1.

One question that arises from the previous figure is whether macroeconomic news matters for financial variables. Although there are mixed views on this in the literature, research based on surveys to traders shows that macroeconomic news does matter, provided that the high frequency variation is smoothed away.

II. Macro (Bloomberg) News and Bond Returns

The model can be further extended to related research on Bloomberg news and bond returns. Daily change of bond returns at maturity $\tau$ is computed from:

$$\Delta y_t^{\tau} = c + \sum_{i=1}^{n} \beta_i^{\tau} news_{i,t} + \varepsilon_t^{\tau}$$

By aggregating over different time spans and compute $R^2$, the conclusion is that filtering from high frequency dynamics improves the goodness of fit. Therefore, macroeconomic news matters at lower frequency.
The following figure (Altavilla, Giannone and Modugno, 2014) reports the $R^2$ from the regression of the daily, monthly and quarterly change of the yields at different maturities on the daily, monthly and quarterly news indices.

![Figure 7: Regression Results](image)

7. Lessons Learned from Now-Cast and Other Benefits

   I. Timely data matters.

   The precision of the now-cast improves as noise is filtered and more data is included in the model.

   Figure 8 (a) shows the Root Mean Squared Error (RMSE) for China GDP now-casting. F, N and B stand for “fore-cast”, “now-cast” and “back-cast”. The RMSE declines as more data is included in the model. “BB” is the Bloomberg forecast one day before release. “FF” stands for Forex Factory. The same result can be observed in all other countries.
Figure 8(a): China Example

Figure 8(b): RMSE for Other Countries
II. The signal generated from now-cast is automatically produced and updated. It is a signal in continuous time about macroeconomic indicators and macroeconomic surprises, which can be included in quant modelling on a routine basis.

III. Now-casting can be employed as a benchmarking tool to cross check investors’ judgmental views of the state of the economy.

IV. Transparency and coherence: users are able to see why the view moves in relation to surprises of new data publications.

V. Some other benefits are summarized in the following table:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outputs generated entirely by machine</td>
<td>Judgment free. No behavioral biases (herding, caution, competition, political bias)</td>
</tr>
<tr>
<td>Outputs published automatically</td>
<td>High frequency, and therefore timely. Can pick up signals before others</td>
</tr>
<tr>
<td>Input set is large and heterogeneous</td>
<td>Efficient. Extracts maximum information content from the news flow. Processes information the way the market does, not the way professional forecasters do</td>
</tr>
<tr>
<td>Decomposition shows effect of each release</td>
<td>Transparent. Provides a clear, quantitative way of reading the news flow</td>
</tr>
<tr>
<td>Focus on current quarter</td>
<td>Relevant: where we are now matters. Key to identifying turning points … and key to any medium-term analysis</td>
</tr>
<tr>
<td></td>
<td>The current quarter is also the only quarter which we can forecast with any accuracy</td>
</tr>
</tbody>
</table>

Table 5: Now-cast features and benefits