Impact case study (REF3b)

Institution: *London Business School*.

Unit of Assessment: *C19 — Business and Management Studies*.

Title of case study:

Now-Casting.

1. Summary of the impact

Now-casting is the prediction of the present, the very near future, and the very recent past. It has been developed within a research programme led by Lucrezia Reichlin at LBS. It is relevant because key economic statistics, particularly quarterly measures such as GDP, are available only with a delay. Now-casting exploits information which is published early and at higher frequencies than the target variable and generates early estimates before the official figures become available.

Now-casting has significant influence and impact. The techniques reported in this case study are in widespread use by central banks and policy institutions. Furthermore, this research has achieved successful commercial impact via Now-Casting Economics Limited.

2. Underpinning research

Reichlin and her co-authors have provided a formal statistical framework for the now-casting process described above. During the 2008–13 period (at LBS) she developed and published the key research papers which underpin the commercial now-casting implementation.

Reichlin has developed methods for reading, through the lens of a model, the flow of data releases in real time. A now-casting model involves the monitoring of many data releases, the formation of expectations, and the revision of the assessment of the state of the economy whenever realisations diverge significantly from expectations. A model for quarterly GDP or other key series uses a large and heterogeneous set of “hard” and “soft” predictors; everything from unemployment statistics to consumer surveys. The model uses all of the data that is monitored by market participants plus any other potentially relevant series to extract a signal about the state of the economy.

The estimation procedure exploits the strong co-movement of these data series so that their behaviour can be captured by few factors. All now-casting output series (reported to clients via Now-Casting Economics) are generated by a dynamic factor model developed by Doz, Giannone, and Reichlin and published in the *Review of Economic Statistics* (2012) and the *Journal of Econometrics* (2011). This model copes with the ‘curse of dimensionality’ (large numbers of correlated series) as it involves the estimation of only a limited number of parameters for a large dataset. The model assigns weights to the series and optimally exploits the dynamic relationships among them. The now-cast can be interpreted as that component of GDP growth which is highly correlated with all of the input data series. It disregards idiosyncratic information such as the weather, but it captures common signals given by all macroeconomic data releases including surveys.

The technical details are these. A factor model is written in the state form and the Kalman filter is used to solve problems of missing data due to the non-synchronicity of data release and other problems. The Doz-Giannone-Reichlin research shows convergence properties of the maximum likelihood estimator for the factors and the Kalman filter; it also demonstrates robustness to model misspecification. It explains why the techniques work for the "big data" empirical situation faced by the now-caster. This research is a development of ideas in Forni, Giannone, Lippi and Reichlin published in *Econometric Theory* (2009), as well as other work by Reichlin's team.

The now-casting methodology incorporates comprehensive technical solutions to varying publication lags ("jagged edged" data), to mixed-frequency data, and to missing input data. The model allows the computation of a joint forecast of predictors and the target series and, at each release, the calculation of the surprise component of the published data release (this is the "news"). The revision of the now-cast of quarterly GDP growth can then be described as the product of the weight of each series (estimated using historical data) and the news for each release. This gives a transparent means of reading the flow of data releases.

The research described here and Reichlin's contributions are summarised in two survey papers published in the *Handbook of Econometrics of Forecasting* (2013) and in the *Oxford Handbook of Economic Forecasting* (2011). The surveys are an essential component of the research programme; they provide a conduit for the subsequent impact of the research.

3. References to the research

"A quasi-maximum likelihood approach for large, approximate dynamic factor models," Doz, Giannone, and Reichlin, *Review of Economics and Statistics* 94(4), Nov. 2012, pp. 1014–1024.

doi:10.1162/REST_a_00225

"A two-step estimator for large approximate dynamic factor models based on Kalman filtering." Doz, Giannone, and Reichlin, *Journal of Econometrics* 164(1), Sep. 2011, pp. 188–205.

doi:10.1016/j.jeconom.2011.02.012

"Opening the black box: structural factor models with large cross sections" Forni, Giannone, Lippi, and Reichlin, *Econometric Theory* 25(5), Oct. 2009, pp. 1319–1347.

doi:10.1017/S026646660809052X

"Nowcasting and the real time data flow," Banbura, Giannone, Modugno, and Reichlin, *Handbook of Econometrics of Forecasting*, v. 2A, ed. by Elliott and Timmermann. Elsevier (2013).

ISBN: 9780444536839 (print) and 9780444536846 (eBook)

"Nowcasting," Banbura, Giannone, and Reichlin, Ch. 7 of *Oxford Handbook of Economic Forecasting*, ed. by Clements and Hendry. Oxford University Press (2011).

ISBN: 9780195398649

Evidence of quality. The *Review of Economics and Statistics* is the leading applied economics journal; the *Journal of Econometrics* and *Econometric Theory* are top field journals in econometrics. In the Combes-Linnemer ranking, these outlets are ranked at positions 8, 11, and 38. In the ESRC-RES benchmarking review of UK economics, these three journals were rated as $4\star$, $4\star$, and $3\star$. The North Holland (Elsevier) Handbook and Oxford Handbook are from established and prestigious publishing houses. The research has been cited extensively.

4. Details of the impact

Context. Key statistics on the present state of the economy are available with a delay, and so now-casting is directly relevant for anyone who needs to act on those statistics. For example, the first official estimates of quarterly Gross Domestic Product (GDP) in the UK and USA are published approximately one month after the reference quarter; in the Euro area the lag is 2–3 weeks longer.

Relevant research. The relevant findings is the entire now-casting methodology developed in the underpinning research publications. Thus the outputs that have impact are the statistic modelling techniques and the automated implementation of the techniques.

Beneficiaries. Two key groups of beneficiaries are (a) central banks and policy institutions; and (b) private enterprises, especially hedge funds and investment banks.

Within category (a), most central banks and other financial institutions around the world have now adopted the now-casting methodology on a routine basis. Examples of these beneficiaries include: (i) the Euro system of central banks; (ii) the International Monetary Fund (IMF); (iii) the Reserve Bank of New Zealand; (iv) Norges Bank; (v) the French treasury; and (vi) the Hong Kong Institute for Monetary Research. Members of sub-category (i) include Deutsche Bundesbank, Banque de France, Netherlands Central Bank, and the Central Bank of Ireland.

Within category (b), private clients, particularly hedge funds, extensively use web-based automated now-casting services provided via the research-derived now-casting model.

Nature and process of the impact on category (a). In policy institutions from category (a), including central banks, it is important to have a timely view of the state of the economy. The now-casting methodology helps them to update in real time and analyze a large quantity of data in a coherent way. This is a step forward with respect to judgemental procedures. The beneficiaries directly use the methodology developed by the underpinning research. This process has been facilitated by the publication and dissemination of those methods via the handbook chapter surveys documented in the list of underpinning research. It also facilitated by the direct involvement of Reichlin with these institutions; for example, on the research advisory committee for the Norges Bank.

Nature and process of the impact on category (b). Turning to category (b), private clients often lack the direct expertise to employ directly the now-casting methods which are reported in the underpinning research. To enable the wider impact of the research, Reichlin and her collaborators founded a commercial venture. This is central to this impact case study.

Now-Casting Economics Limited (see www.now-casting.com/about-us) is based upon the underpinning research of Reichlin and her team. It publishes automated "now-casts" of current quarter GDP growth in major economies (USA, Japan, China, the Euro Area, Germany, France, Italy, Spain, UK, and Canada) in real time. This service is built upon the state-of-the-art econometric models from the underpinning research. It gives professional investors and others a snapshot of "where we are today" and a transparent framework for reading the flow of economic news.

Extensive back-testing analysis shows that, for assessing current quarter GDP, Now-Casting Economics is at least as accurate as the best professional forecasters, but significantly more timely. Significant changes in the macroeconomic environment are picked up earlier. Clients can see the impact that every relevant data release has on GDP—again, in real time. Subscribers also have access to a history of input data series and to the continually revised GDP now-cast, via graphs, calendars, and pages of detail on specific data releases.

Now-Casting Economics is successful. It supports a team of six contributing researchers and operators, and has built up a large portfolio of clients. Clear evidence of impact is provided by the fact that such clients pay significant fees for automated now-casts. Private commercial details are not included here, but are available via the supplementary "sources to corroborate the impact."

5. Sources to corroborate the impact

(a) Central banks and policy institutions have made extensive use of the now-casting methodology. Working papers and official reports from all of the institutions mentioned refer to Reichlin's work. The REF evaluators are also welcome to contact directly key central bank and policy institution personnel to verify the active use of the underpinning research described in this case study. The supplemental corroboration sources include specific named personnel at the International Monetary Fund, the European Central Bank, and the Federal Reserve. They are able to confirm that the underpinning research reported here is directly used in those institutions.

(b) www.now-casting.com/countries/euro-area gives tabular and graphical illustrations of the final product available to subscribers. A demonstration username and password for an account on the Now-Casting is available for auditing purposes. The Now-Casting team can also verify the scale of operations, describe the profile of the client base, and report key financial indicators. Contact details for these corroboration methods are contained with the supplement to this study.

Now-Casting Economics and its impact have also been reported in the media:

- Articles in the *Financial Times* by Ralph Atkins: "'Virtual standstill' forecast for EU growth" 15 September 2011; "German slowdown likely to lead to eurozone recession" 7 November 2011; "Sharp fall in eurozone industrial output" 14 November 2011.
- Forecasts from Now-Casting Economics and communicated by the *Economist* newspaper; see www.economist.com/blogs/freeexchange/2012/11/business-cycles.
- The now-casting research and the work of Now-Casting Economics have achieved popular impact via TEDx: www.tedxwarwick.com/talks/talk.php?year=2013&id=8