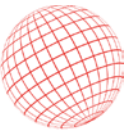# NOW-CASTING AND THE REAL TIME DATA FLOW

Lucrezia Reichlin
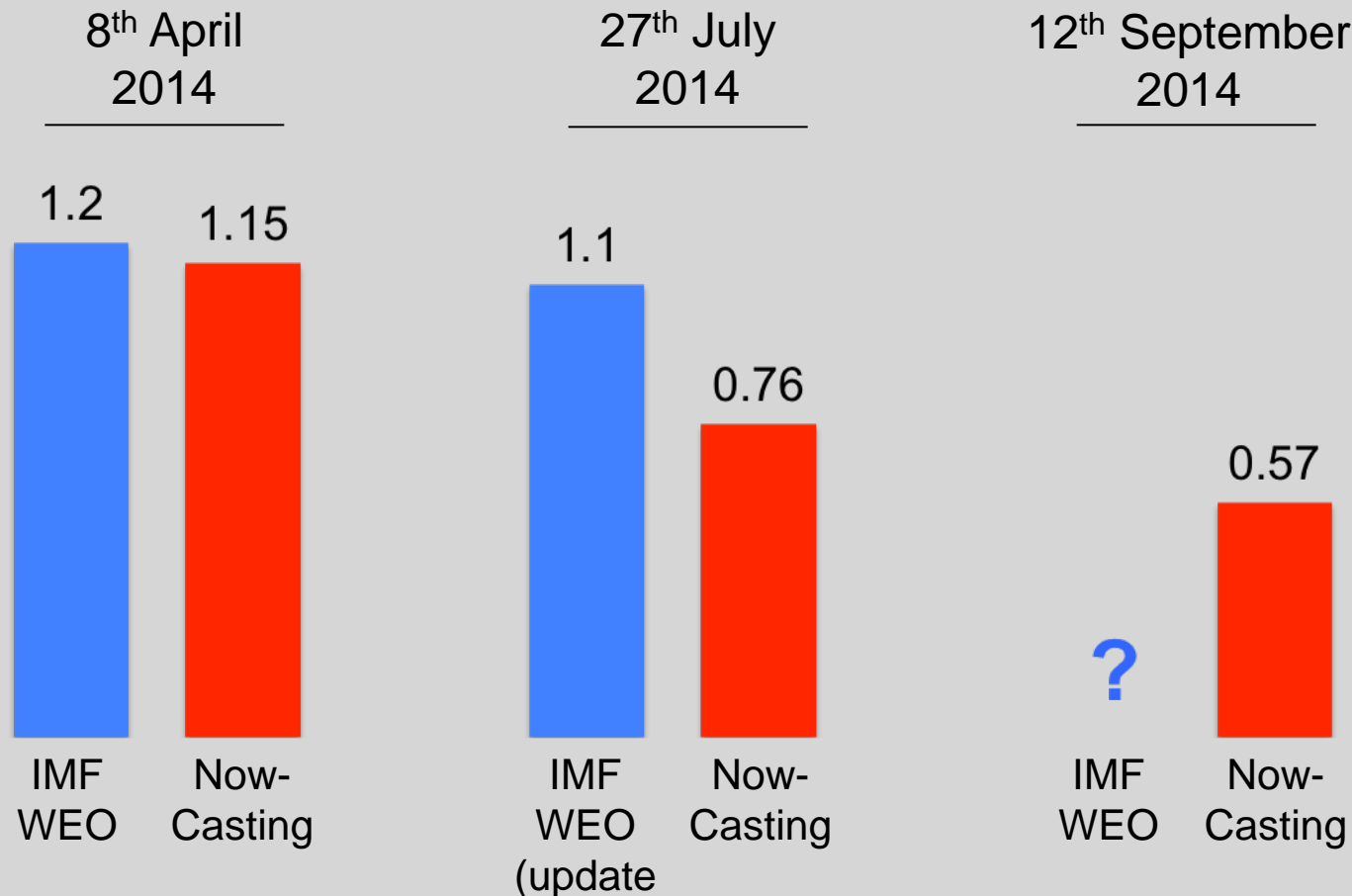London Business School & Now-Casting Economics Ltd

CONFERENCE IN HONOR OF MARCO LIPPI
ROME, 13TH   SEPTEMBER, 2014

NOW AND THEN: WHY WAIT?

Since 8th April: monthly data releases for industrial production, trade, retail sales, employment, PMIs, etc.

Forecast GDP growth for the Euro Area in 2014

What is now-casting and why should we care? (1)

Contraction of the terms *Now* and *Forecasting*

Meteorology Now-casting

forecasting up to 6-12 hours ahead

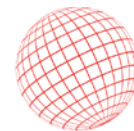long tradition, since 1860

Economic Now-casting

forecasting the near future, the present and even the recent past

In early days focus has mainly been on GDP

- Idea: exploit early monthly or even higher frequency information to obtain a timely estimate of quarterly GDP

- MOTIVATION: GDP data are published late and they are subject to large revisions

Giannone, Reichlin and Small (2008): first to propose a formal framework

How important is nowcasting relative to longer horizon forecasting?

Very !!!!

Forecasting GDP in real time
MSFE relative to constant growth

Horizon	0	1	2	3	4
GB	0.87	1.03	1.16	1.23	1.29
SPF	0.85	1.03	1.00	1.06	1.06

Evaluation sample 1992Q1 through 2001Q4

Since then we have broadened the concept of now-casting and defined a comprehensive framework for reading in a coherent way all the relevant data as they get published in real time

See 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
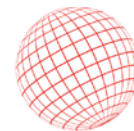
- Our objective is to track the real time data flow, using a single, coherent framework

- We want to model *jointly* all relevant data – potentially many using a parsimonious model

- And we want to update the model every time there is a new data release … or whenever there is 'news' in the data flow …

- The approach is entirely model based – free of judgment

THE NOW-CASTING PLATFORM
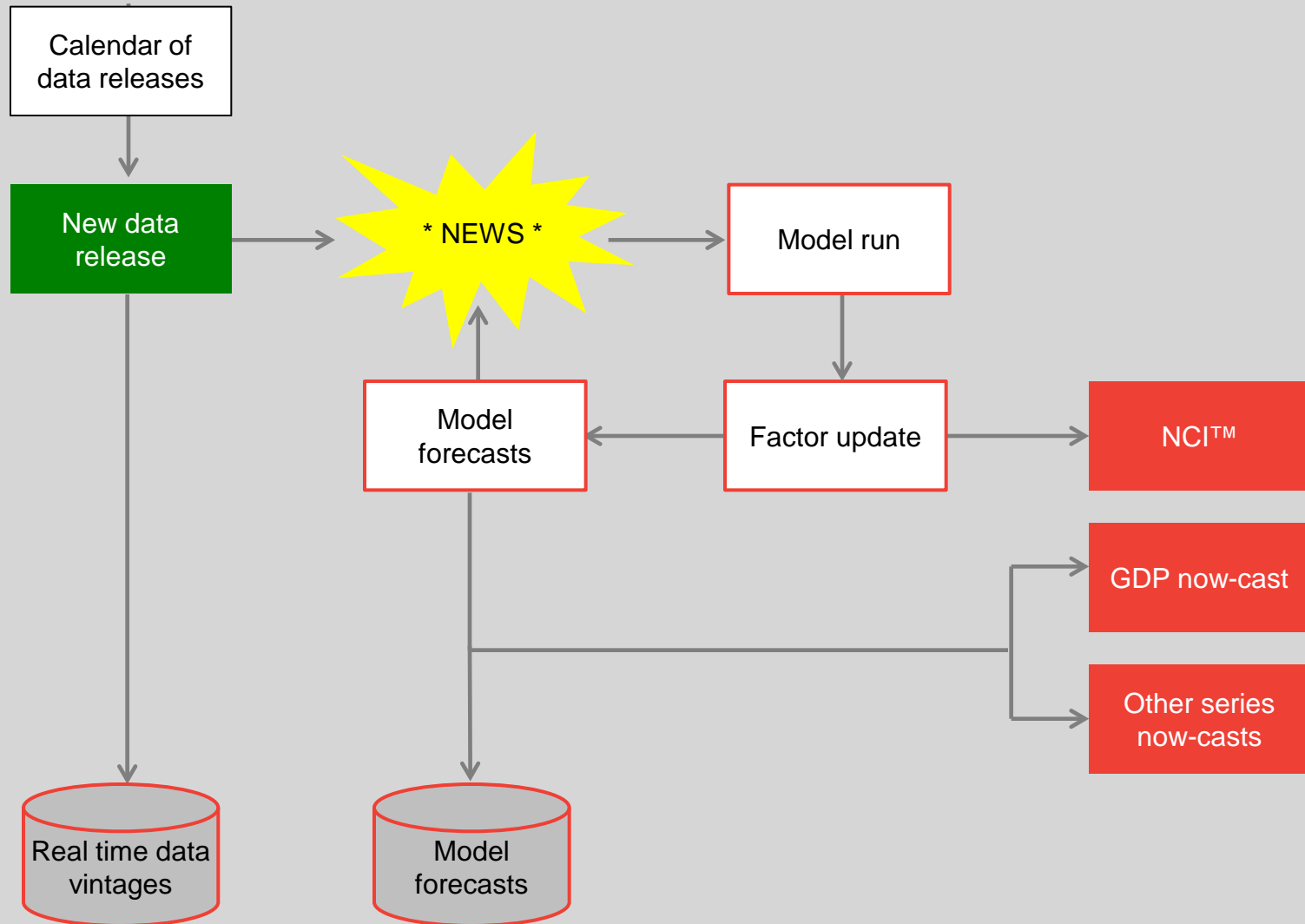
The Model
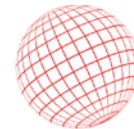
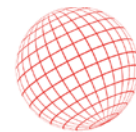*Observed Variable* $x_{i,t} = \boxed{m_{\theta(i)}(\text{common factors}_t)} + noise_{i,t}$

signal

- Variables can be at any frequency
- m_θ: is a linear function; $\theta(i)$ parameters to be estimated
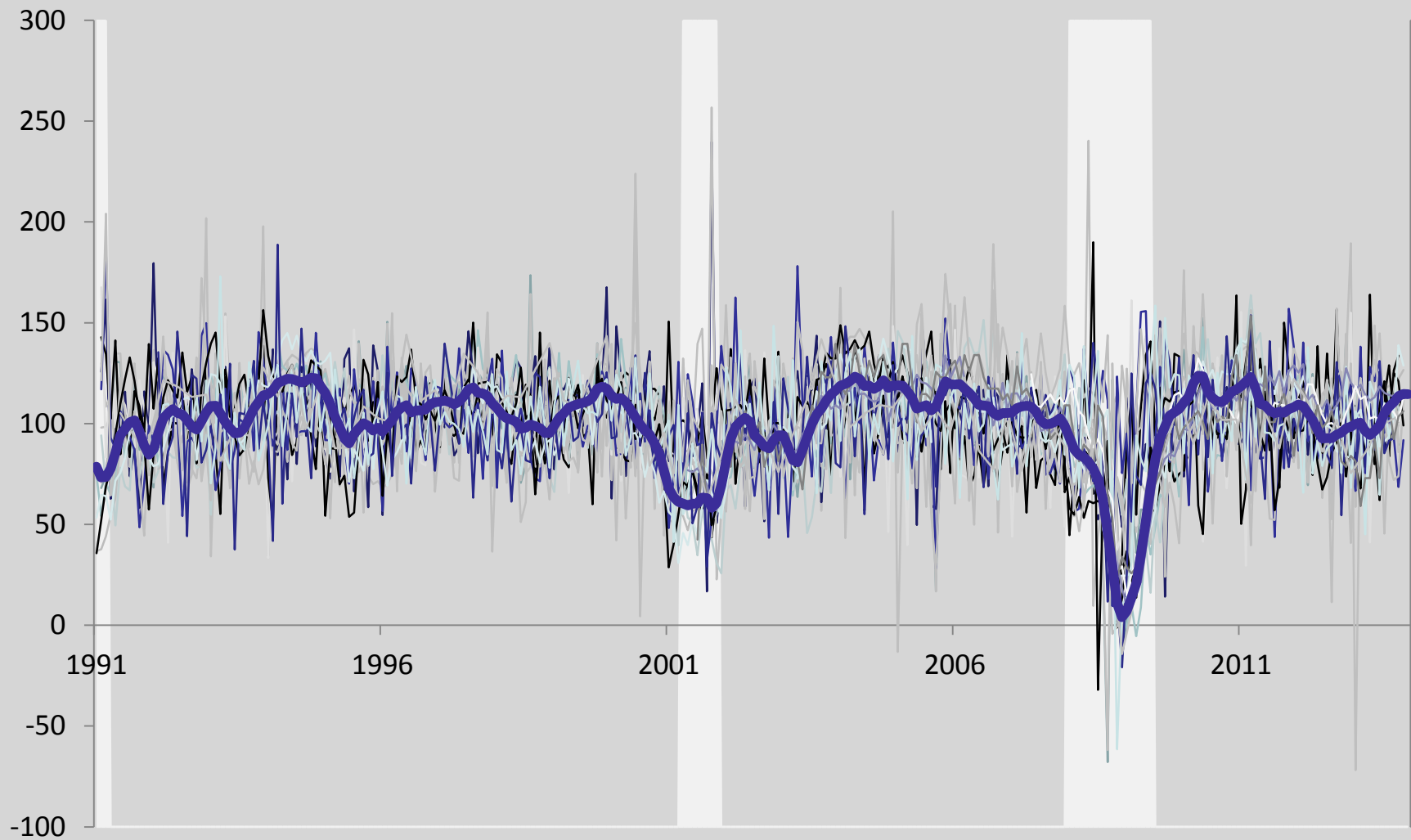- Common factor unobserved; must be estimated

NB: Disregard the noise!

Co-movements in economic data
The factor: NCI^TM

Estimation

Estimate model parameters Ө

Given m_θ and $Info\ (v)$ estimate the factor by Maximum Likelihood

$$Est.\ factors_t = Proj\ [factors_t\ |\ Info\ (v);\ m_\theta\ ]$$

The forecast of each variable $x_{i,t}$ is:

$$forecast\ x_{i,t} = m_{\theta(i)}\ (factors_t\ )$$

$$= Proj\ [\ x_{i,t}\ |\ Info\ (v)\ ]$$

- 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

THREE PAPERS MATTER: Giannone, Reichlin and Small, JME 2008; Doz, Giannone and Reichlin, ReStat 2012; Banbura and Modugno, JofAppEc 2013
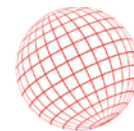
EM algorithm, basic principle

Solution to problems in which latent or missing data yield the likelihood intractable.

Dempster, Laird and Rubin (1977)

Write the likelihood as if all the data were observed:

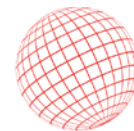in this case in terms of observables *and factors*: $l(Y, F; \theta)$.

Iterate:

- **E-step**: replace the sufficient statistics by their expectations (given the parameters from previous iteration):

$$L(\theta, \theta(j)) = \mathbb{E}_{\theta(j)}\left[l(Y, F; \theta)|\Omega_v\right]$$

- **M-step**: maximise the "expected likelihood":

$$\theta(j+1) = \arg\max_{\theta} L(\theta, \theta(j))$$

EM algorithm for dynamic factor models

EM algorithm: easy to implement, computationally inexpensive

- Watson and Engle (1983) implement EM for a small factor model without missing data
- Shumway and Stoffer (1982) implement EM algorithm for a state space form also with missing data, however only in the case the matrix linking the states and the observables is known
- Doz, Giannone, and Reichlin (2006) show consistency and feasibility for large n and T
- Bańbura and Modugno (2014) generalize the EM steps to the case *with missing data* and *unknown parameters* in the measurement equation and model *serial correlation* in the idiosyncratic component

For the static factor model version see Rubin and Thayer (1982)

Updating and "news"
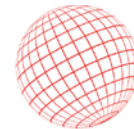
For each variable x(i,t) , i=1, …, n compute the projection each time new information is released according to the calendar

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

NEWS

example of "news" or model based surprise:

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

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

….

UPDATING

Proj [$x_{i,t}$ | Info(v+1)] - Proj [$x_{i,t}$ | Info(v)] =Weighted sum of surprises related to all variables included in the model
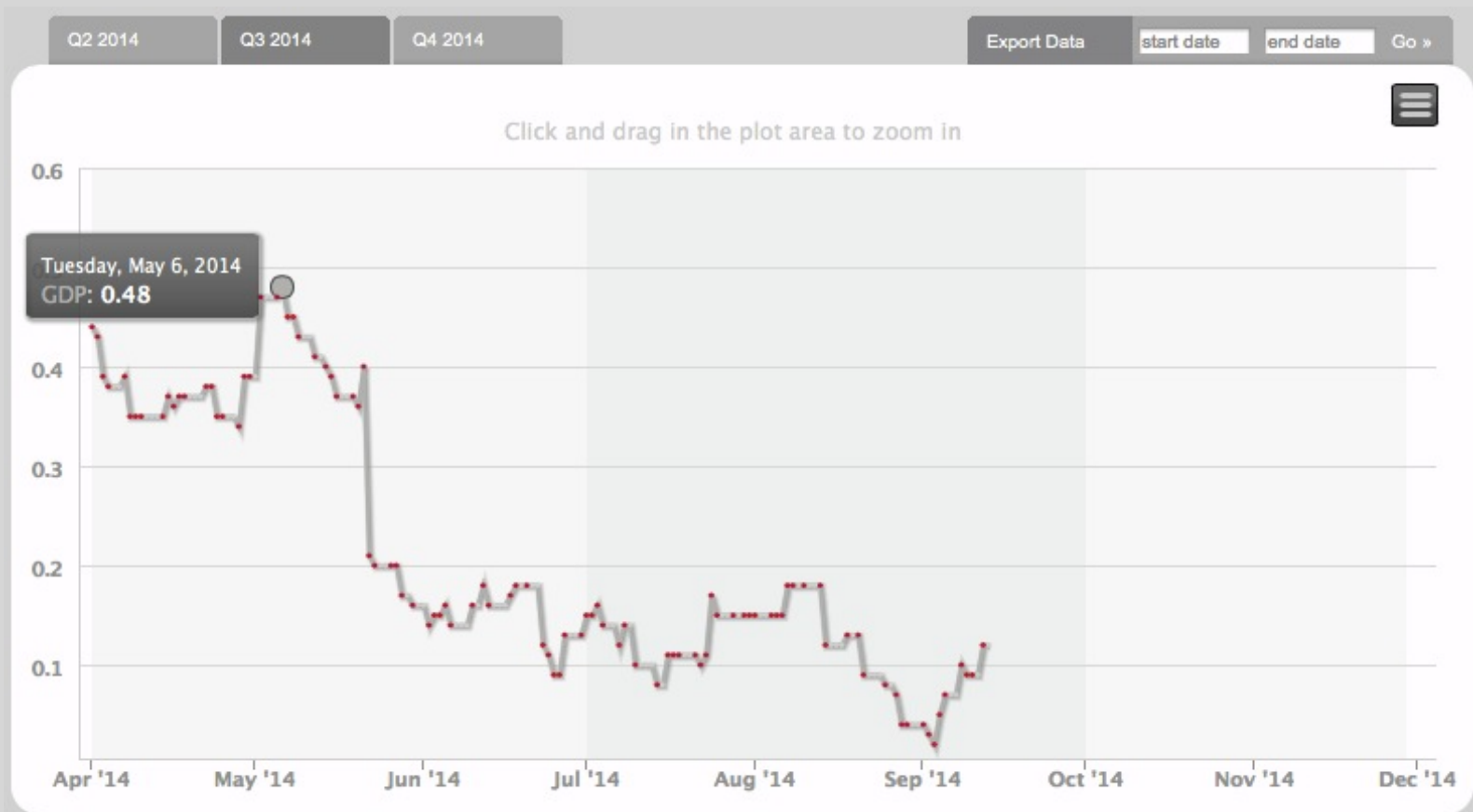
NOT QUITE A BLACK BOX: CAN UNDERSTAND WHAT MOVES THE UPDATE!

The very short run: the slowdown

The model started predicting a decline in early May

Source: Now-Casting Economics Ltd

The first negative signals arrive from IP on May 7th: they refer to March

Now-Casting.com
economics in real time

| Q1 2014 | Q2 2014 | Q3 2014 | | Export Data | start date | end date | Go |

Wednesday, May 7, 2014

Date	Country	Release	Actual	Unit	Period	Weight (x100)	News	Impact (x100)
07 May 07:51	France	Industrial Production Excl Construction	-0.70	MoM %	Mar-14	1.19	-0.55	-0.65
07 May 07:51	France	Construction Output	-0.51	MoM %	Mar-14	0.59	-0.18	-0.11
07 May 07:51	France	Imports	3.44	MoM %	Mar-14	0.46	0.35	0.16
07 May 07:51	France	Exports	0.58	MoM %	Mar-14	0.36	-0.13	-0.05
07 May 07:20	Germany	Orders	-2.81	MoM %	Mar-14	0.42	-3.44	-1.43
07 May 07:20	Germany	Industrial Turnover: Manufacturing	-0.55	MoM %	Mar-14	0.96	-1.52	-1.46

Prior GDP Nowcast	0.44
Revised GDP Nowcast	0.41

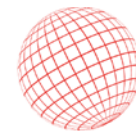Source: Now-Casting Economics Ltd

But it is not only about GDP …

Products:

- Calendar of releases

- News

- Now-cast of all variables

- The now-casting Index (NCI™):

    this is the factor: it weight all variables including employment, construction, production, surveys, … it disregards variable-specific dynamics

20 largest countries by share of world GDP

Now-Casting.com
economics in real time

#	Country	Share of world GDP (%)		#	Country	Share of world GDP (%)
1	US	21.9		11	India	2.5
2	Euro Area	17.0		12	Canada	2.5
3	China	11.5		13	Australia	2.2
4	Japan	8.3		14	Mexico	1.6
5	Germany	4.7		15	South Korea	1.6
6	France	3.6		16	Indonesia	1.2
7	UK	3.4		17	Turkey	1.1
8	Brazil	3.3		18	Saudi Arabia	1.0
9	Russia	2.8		19	Argentina	0.7
10	Italy	2.8		20	South Africa	0.5

🟩 Live on Now-Casting

🟥 In development

Now-Casting currently tracks 68% of world GDP

NCI™ geographic coverage
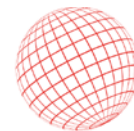
Rank	Country	Share of world GDP* (%)
1	US	21.9
2	Euro Area	17.0
3	China	11.5
4	Japan	8.3
7	UK	3.4
8	Brazil	3.3

- NCI™ tracks 65% of world GDP
- The same model is used for all countries; so index values are consistent and comparable
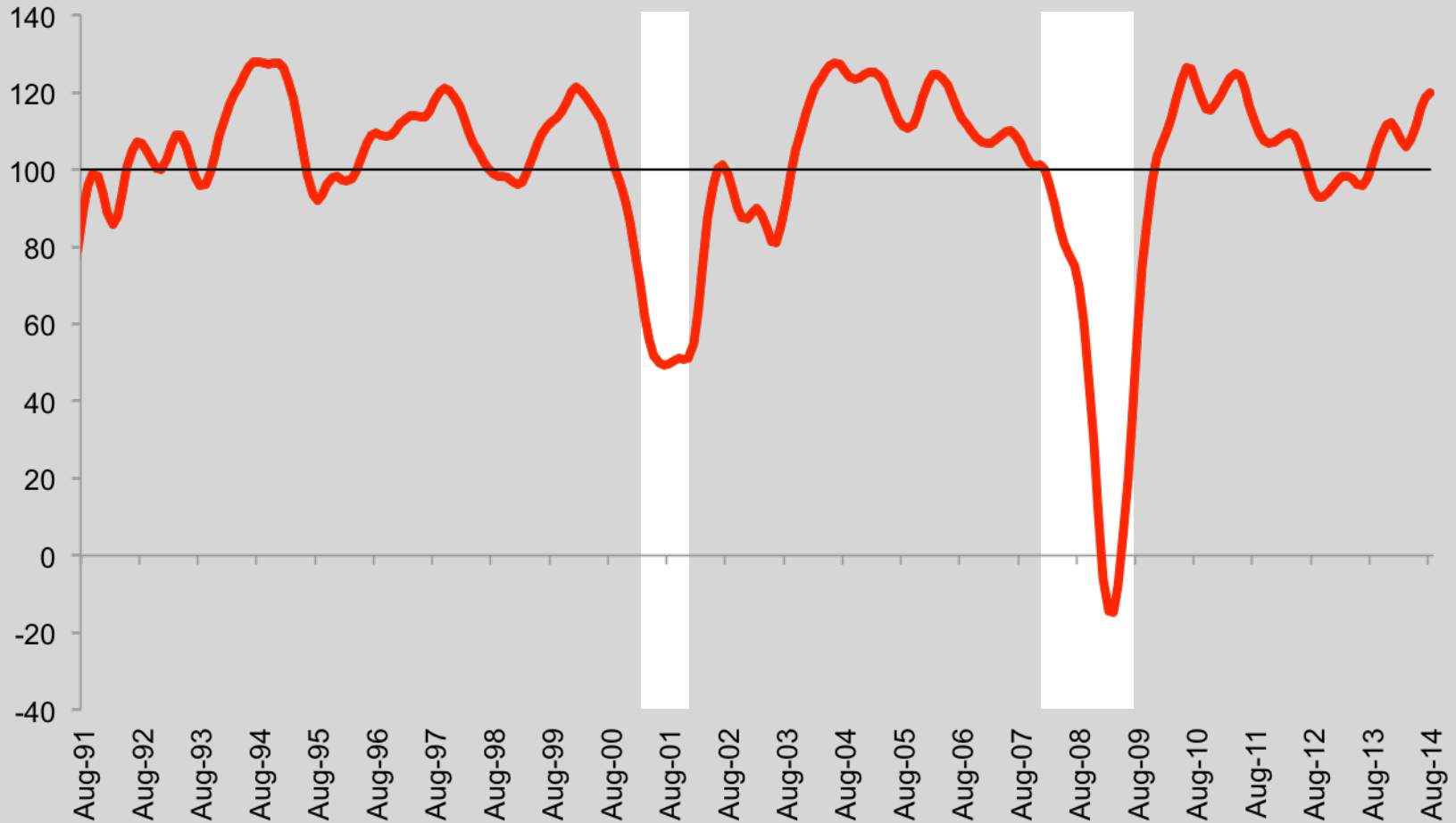
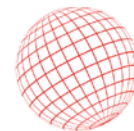# Release calendar – e.g., the US
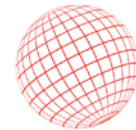
Releases relating to June 2014
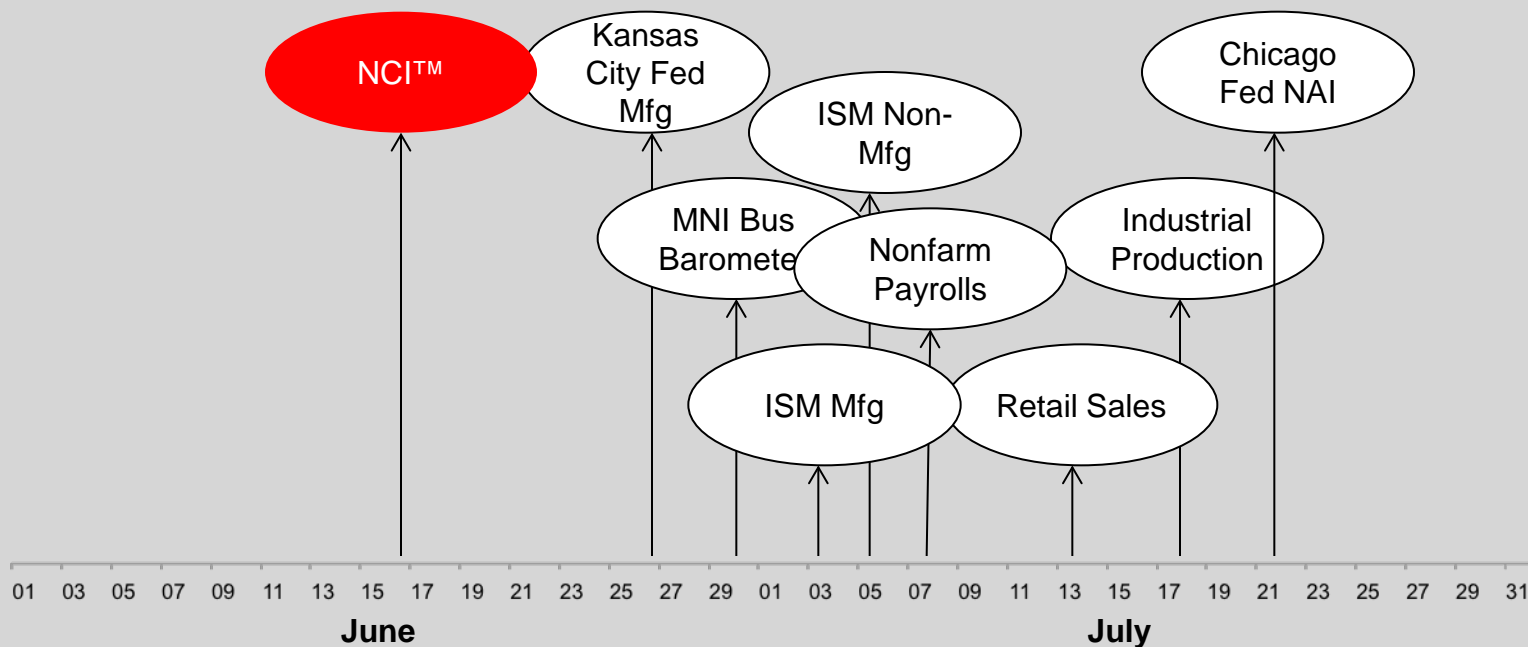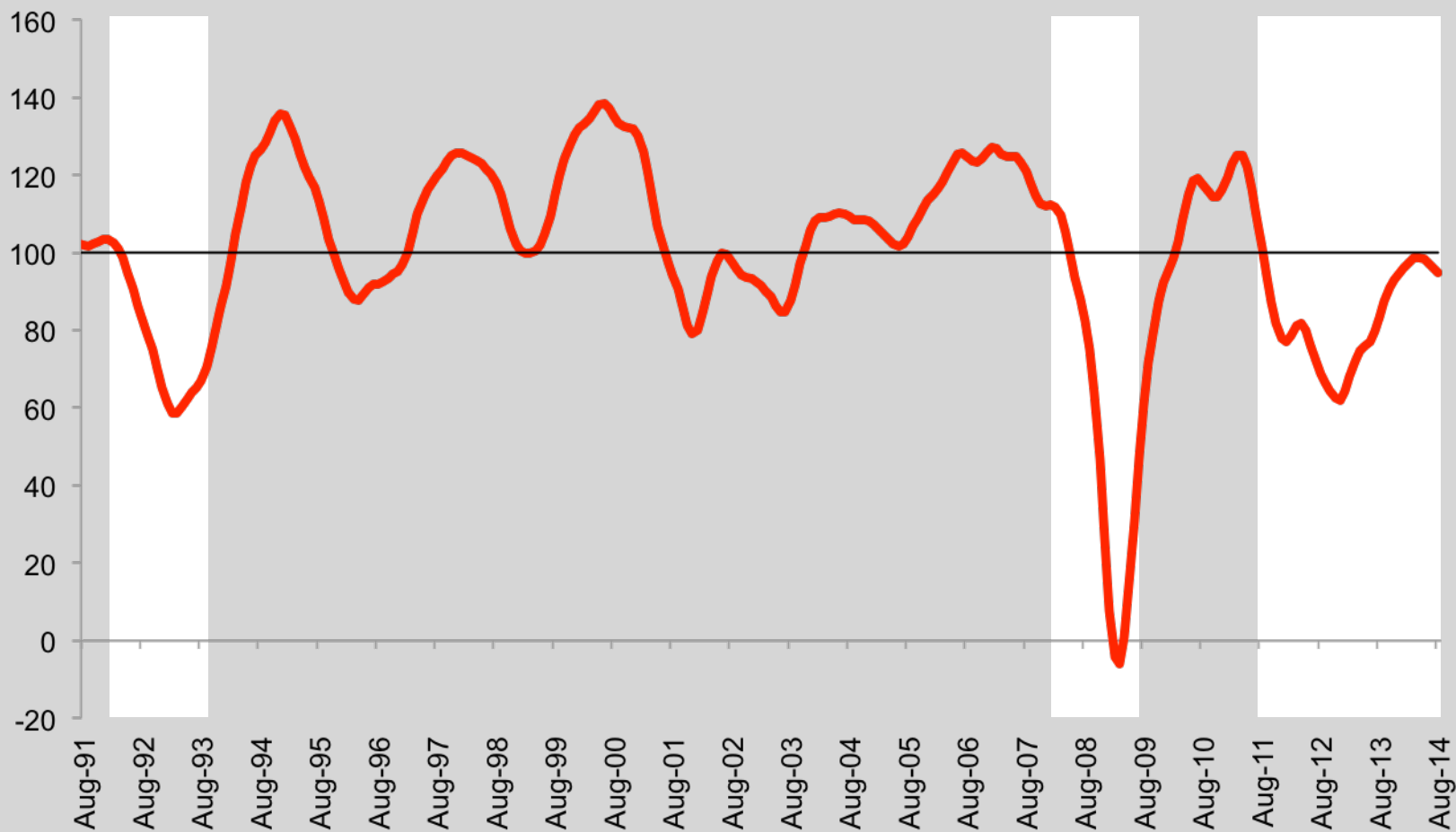
US NCI™ - long history with NBER recessions

Euro Area NCI™ - long history with CEPR recessions

NCIs for the US, euro area and UK
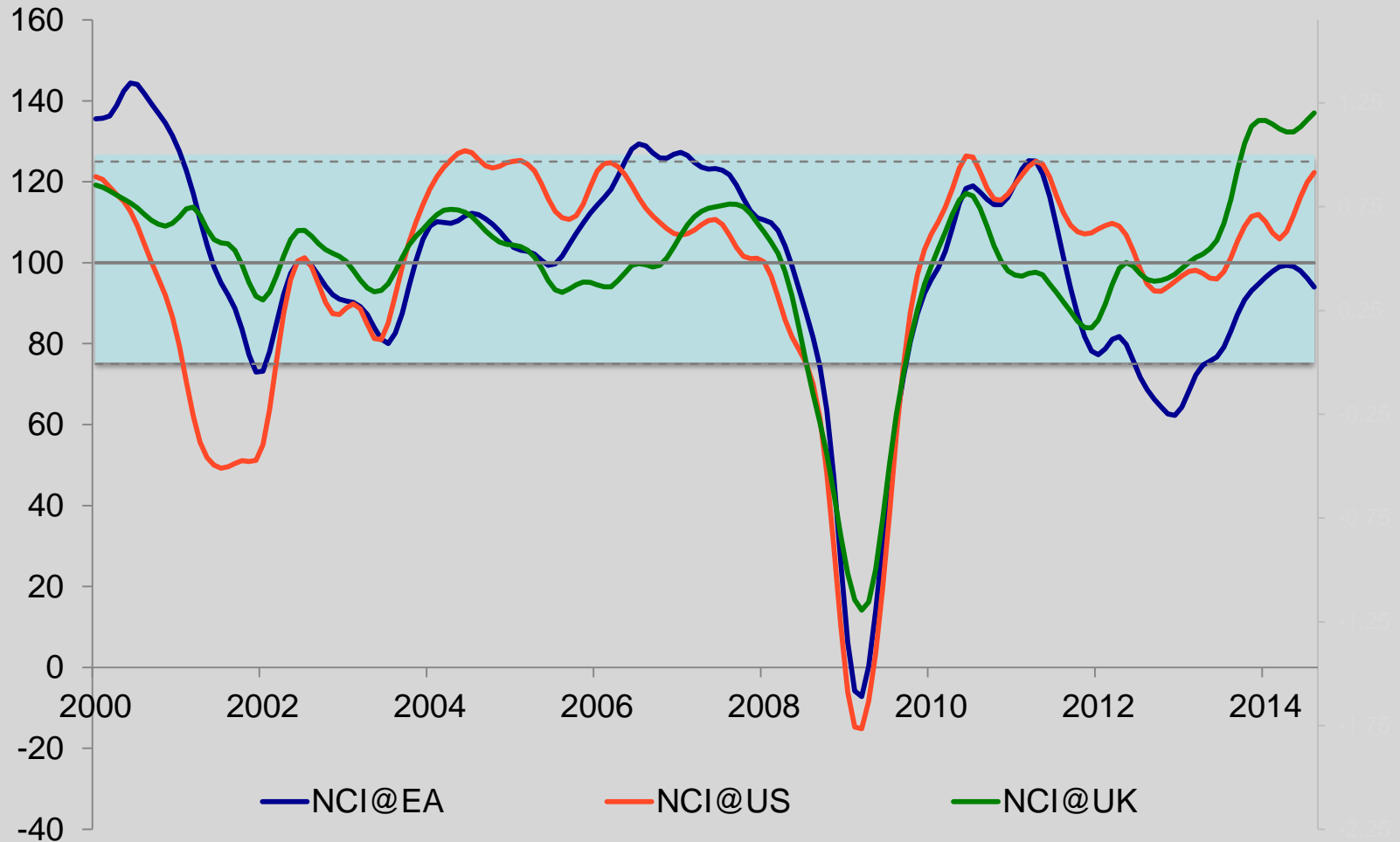
NCIs for the US and Euro Area - recent
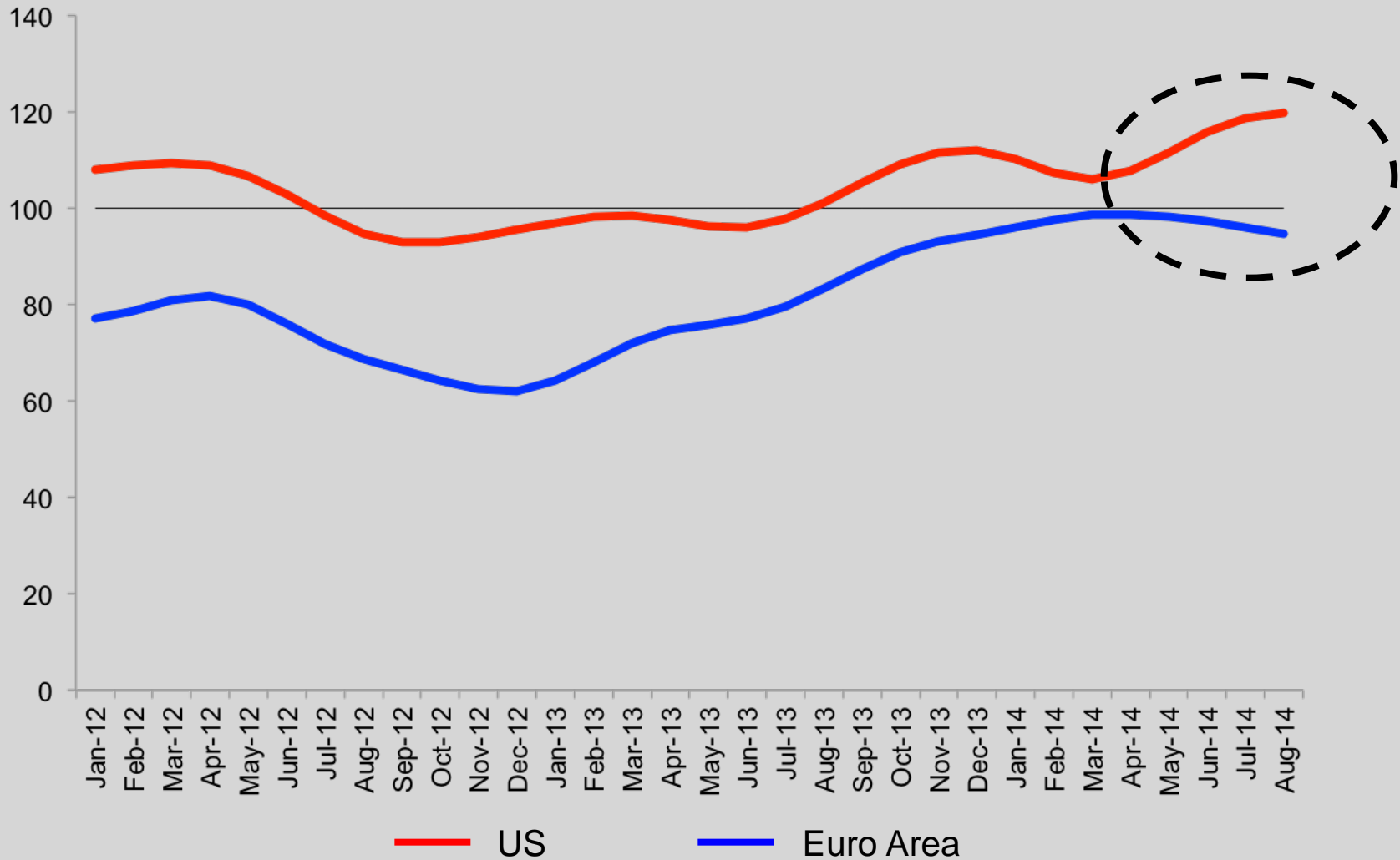
NCI™ Bloomberg tickers
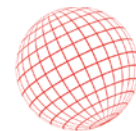
|	
Brazil	NCIXBZ
UK	NCIXUK
Euro Area	NCIXEA
Japan	NCIXJP
China	NCIXCN
US	NCIXUS

Now-Casting.com
economics in real time

- Timely data matter: the precision of the now-cast improves as more data are included in the model

- Surveys are important, but only at the beginning of the quarter

- However they can be forecasted

- On average we do as well as the professional forecasters for GDP and many of the other variables

- Best performing models are relatively simple in the parameterization and include only "real economy" aggregate indicators
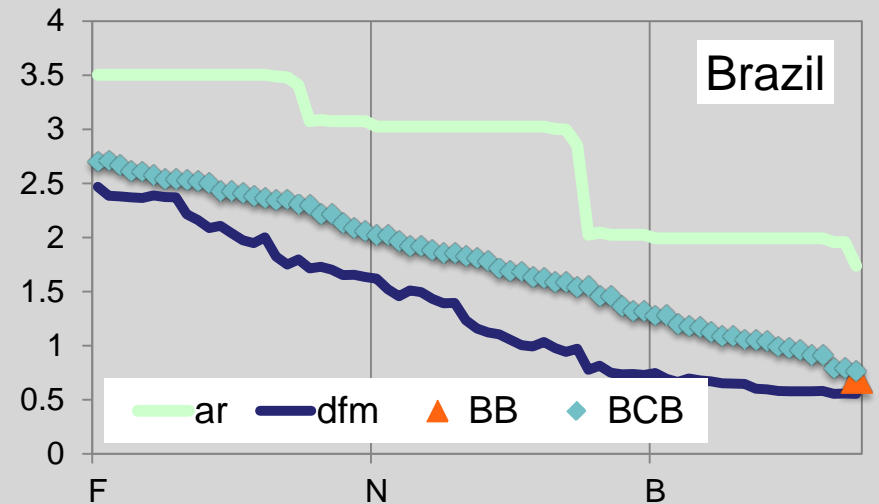
And all other countries …
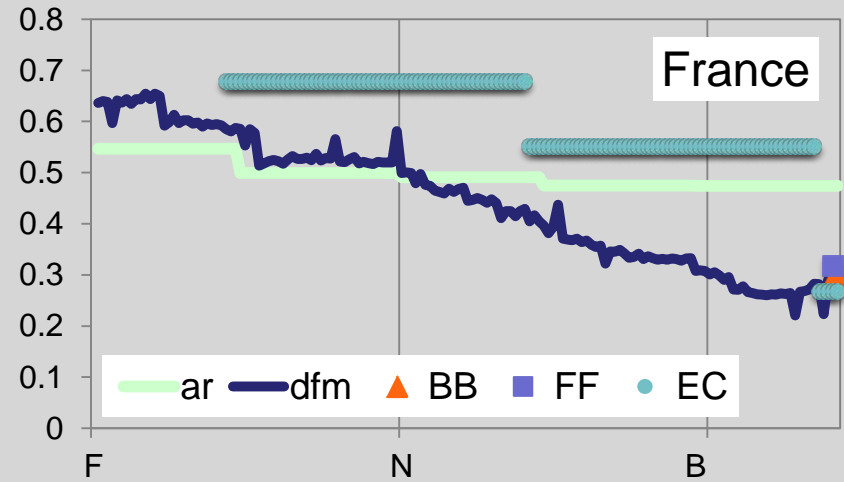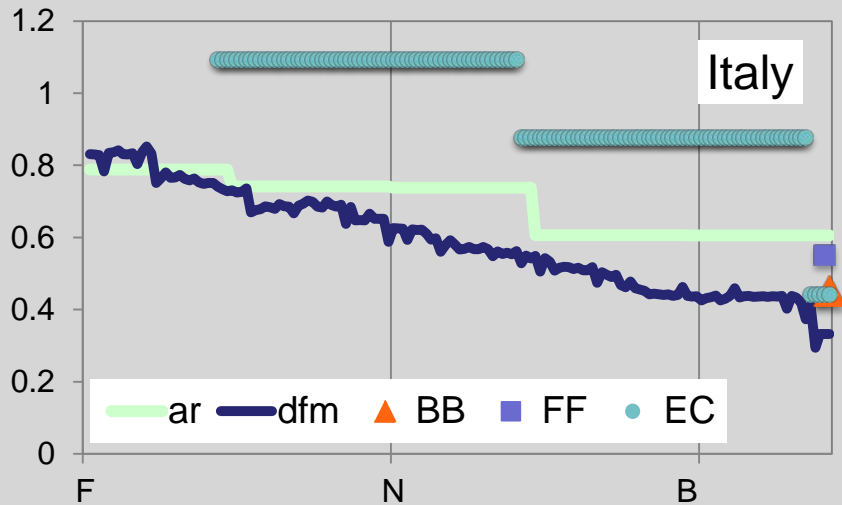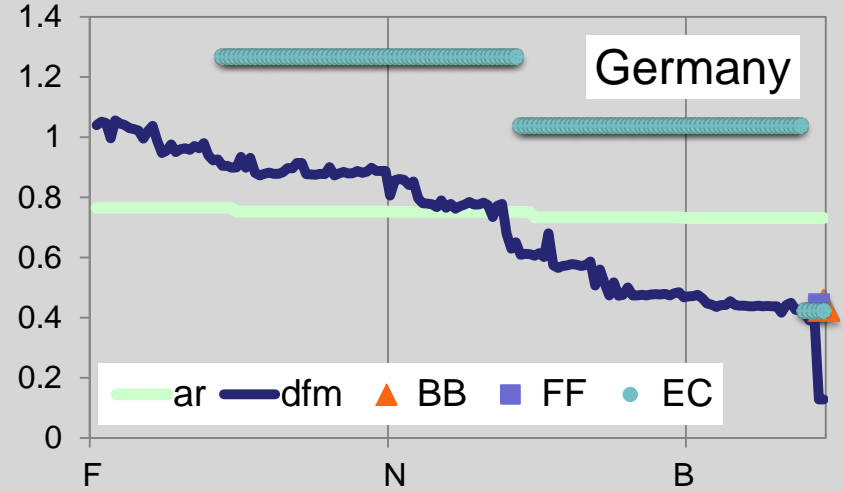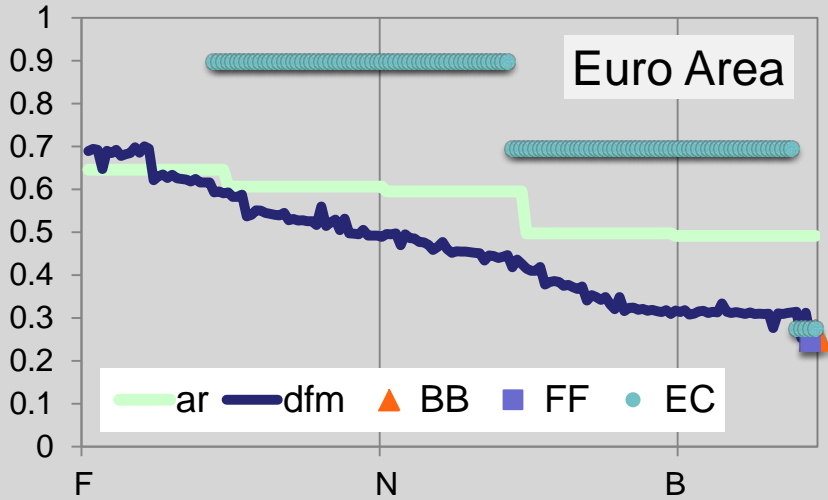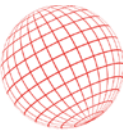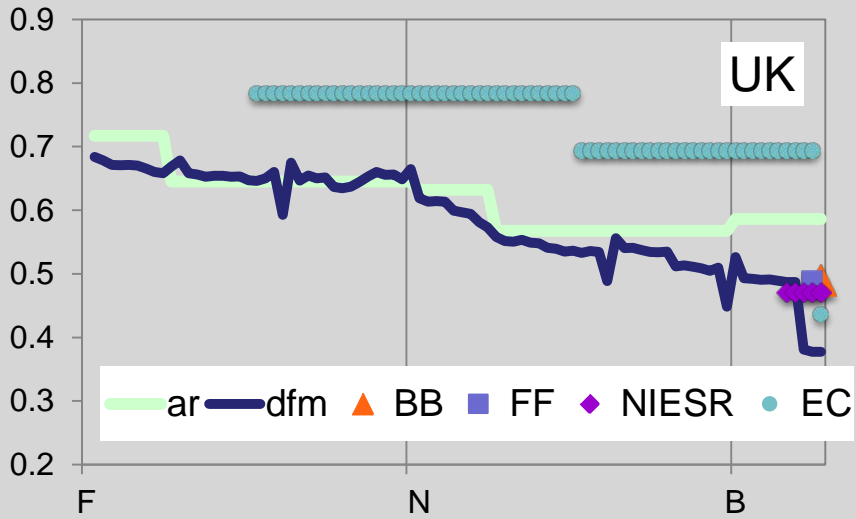
And all other countries ….
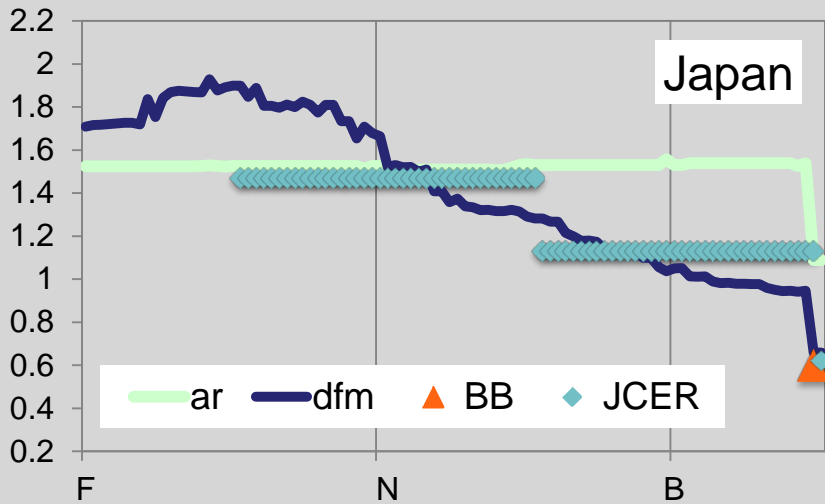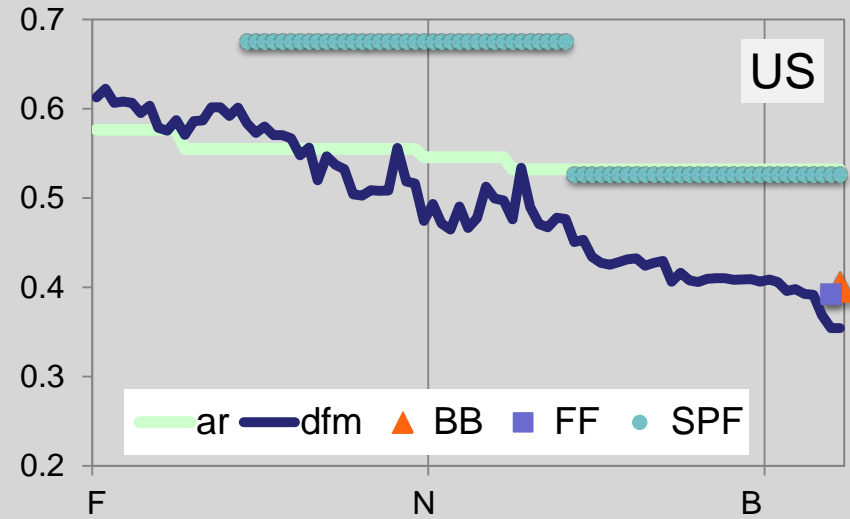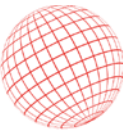
CHINA
The Root Mean Squared Errors (RMSE) in relation to the real time data flow
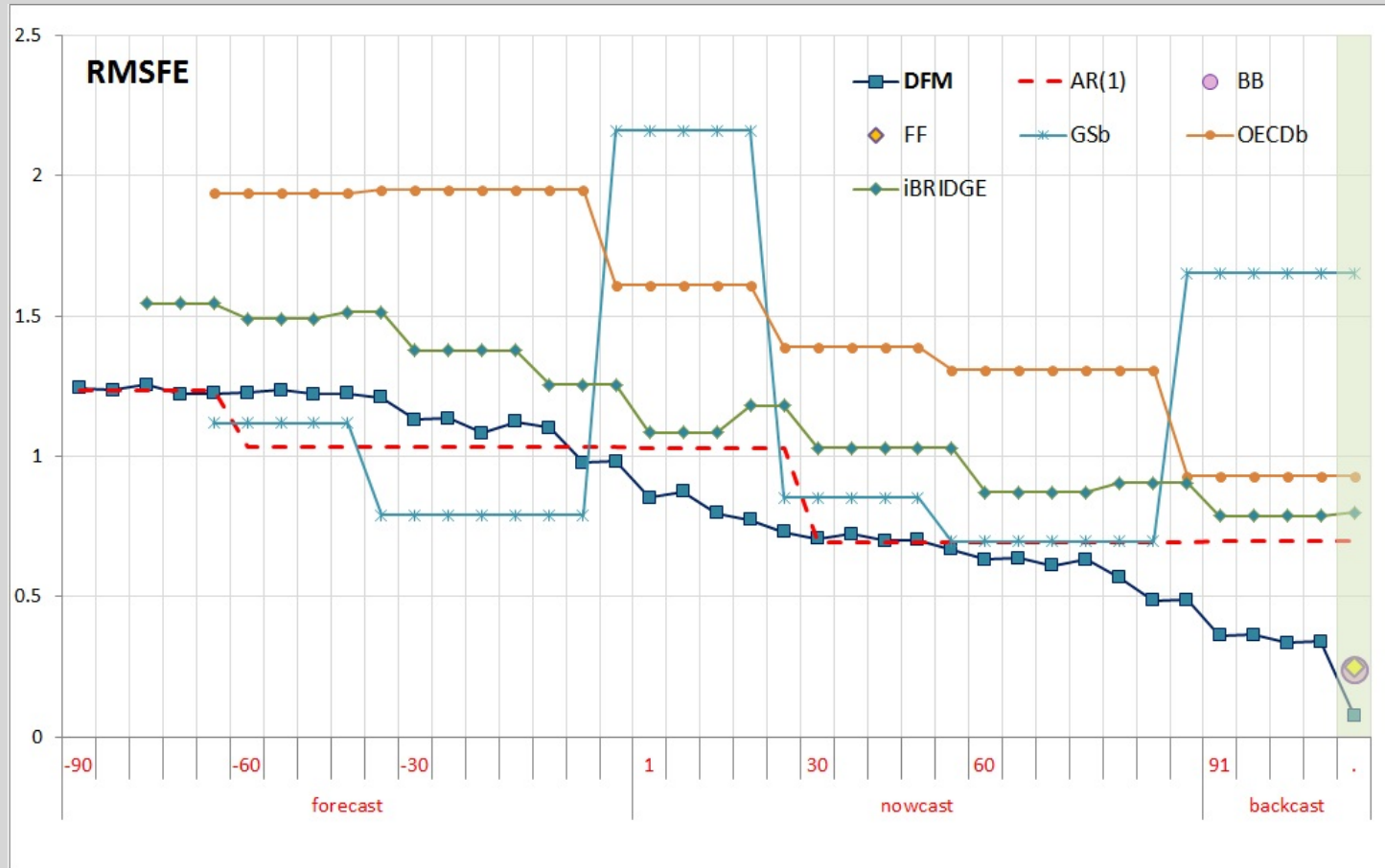
Source: Giannone, Miranda, Modugno 2014

China: historical Performance
Annual Forecasts
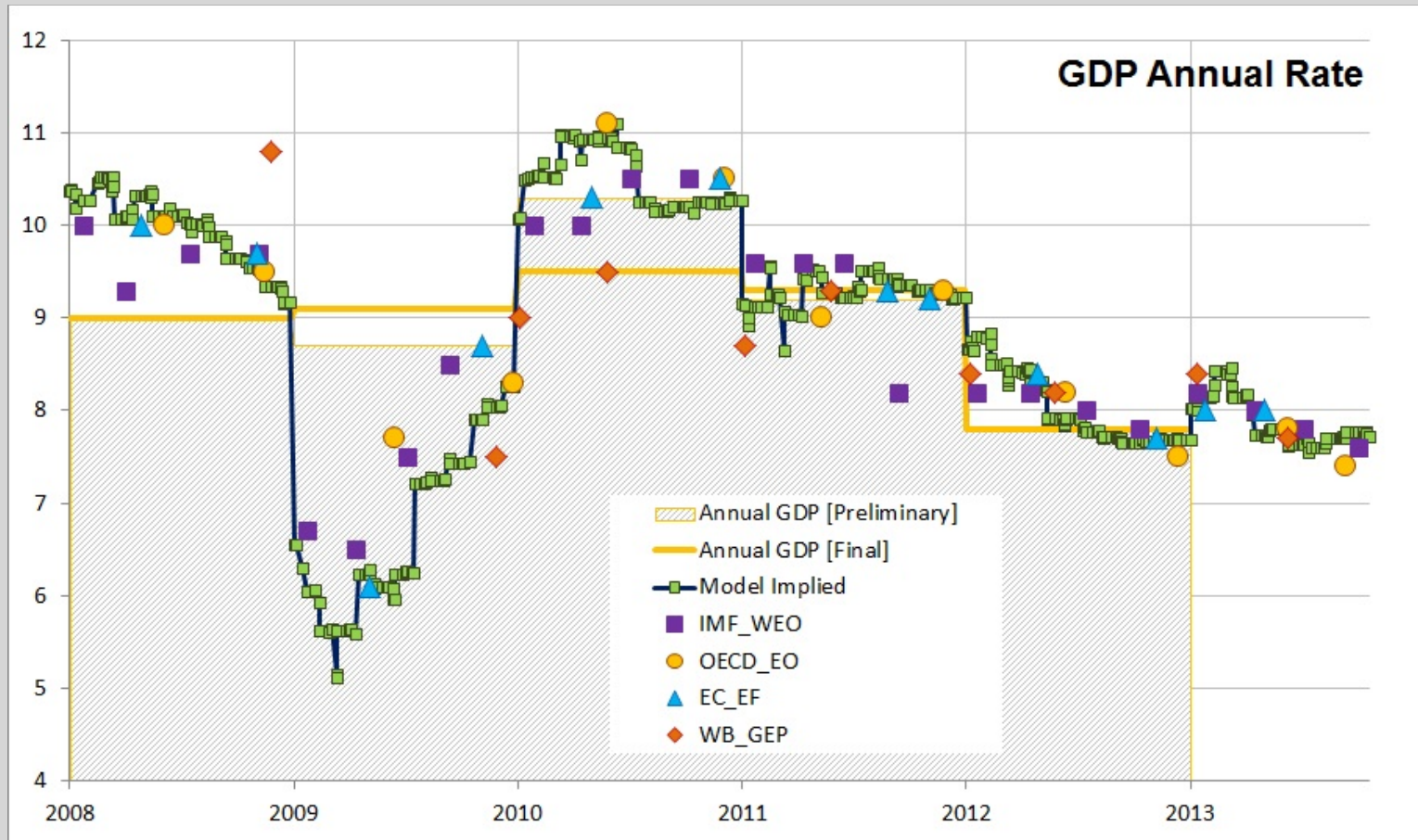
GDP Annual Rate

Legend:
- Annual GDP [Preliminary]
- Annual GDP [Final]
- Model Implied
- IMF_WEO
- OECD_EO
- EC_EF
- WB_GEP

Source: Giannone, Miranda, Modugno 2014

Now-Casting.com
economics in real time

Quarterly GDP - US

Actual GDP — **Now-Casting model** — ◆ Survey of Professional Forecasters

Source: Liebermann (2010) "Real-time nowcasting of GDP: factor model versus professional forecasters", MPRA Paper, University Library of Munich
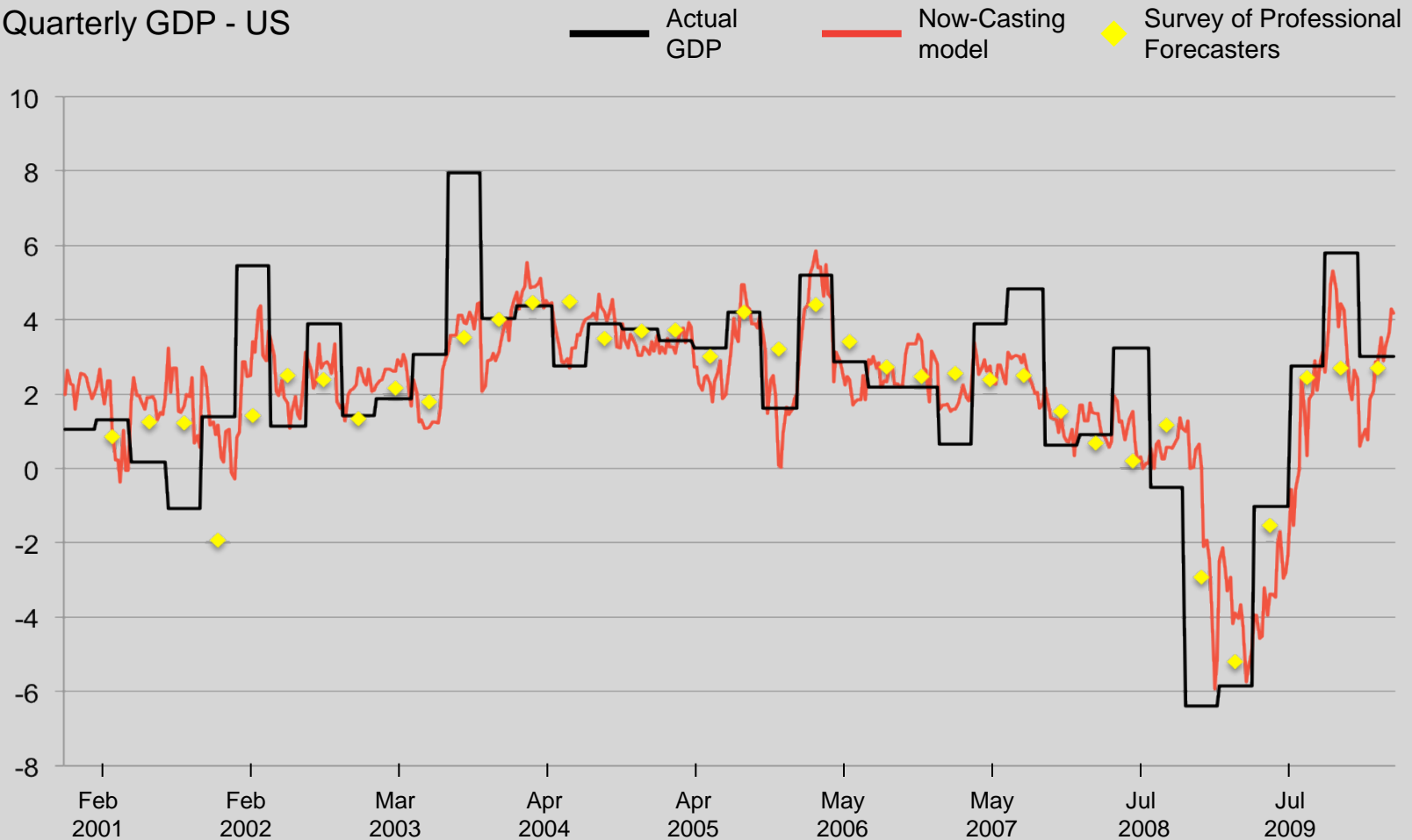
HISTORICAL PERFORMANCE ANALYSIS
Current quarter: root mean squared forecast errors (RMFSE)

Now-Casting.com
economics in real time

US
1996Q1-2005Q4

Bar	Value
N-C OOS	1.87
N-C IS	1.89
AR(2)	2.20
SPF	2.05
GB	2.10

US
1996Q1-2011Q1

Bar	Value
N-C OOS	2.00
N-C IS	1.94
AR(2)	2.39
SPF	2.00

EA
2003Q1-2011Q1

Bar	Value
N-C OOS	0.53
N-C IS	0.43
AR(2)	0.87
EC	0.61

Germany
2003Q1-2011Q1

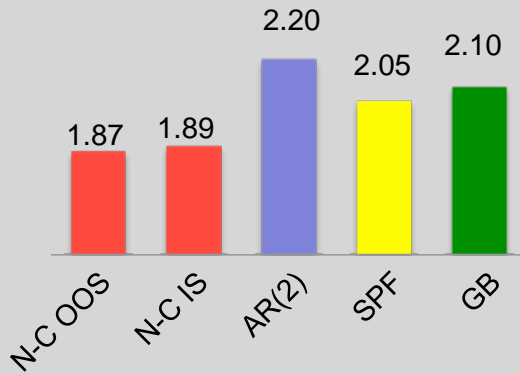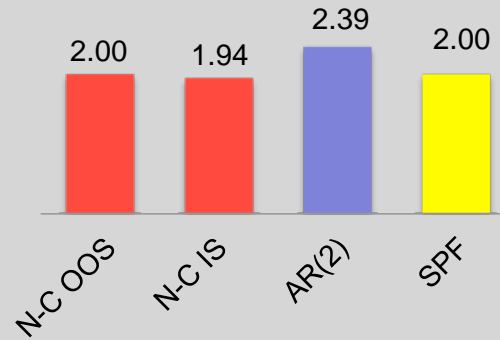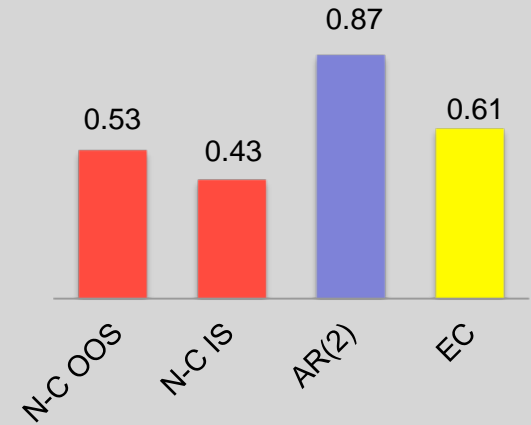| Bar	Value
N-C OOS	0.75
N-C IS	0.63
AR(2)	1.17
EC	0.93

France
2003Q1-2011Q1

Bar	Value
N-C OOS	0.45
N-C IS	0.40
AR(2)	0.60
EC	0.49

Italy
2003Q1-2011Q1

Bar	Value
N-C OOS	0.60
N-C IS	0.48
AR(2)	0.93
EC	0.77
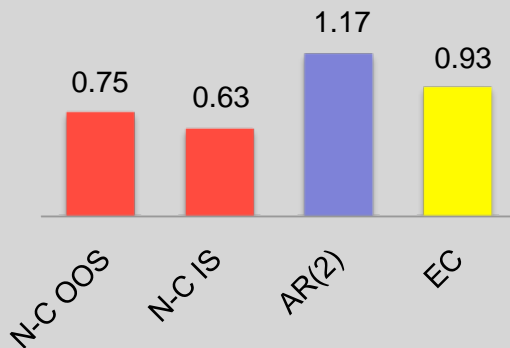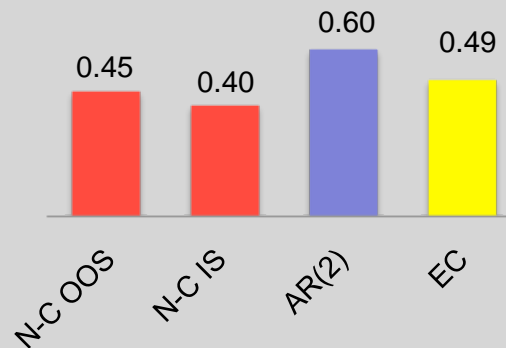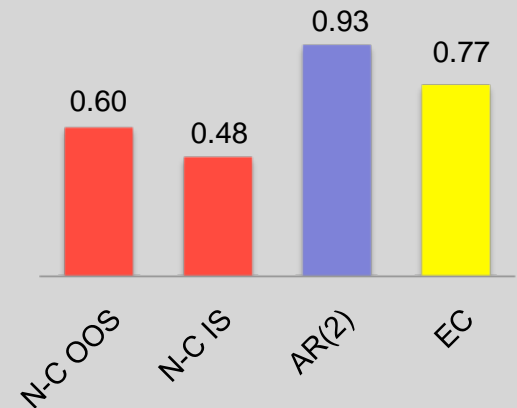
Key: N-C = Now-Casting; OOS = out of sample; IS = in sample; AR(2) = auto regressive projection; SPF = Survey of Professional Forecasters; GB = Federal Reserve 'Green Book'; EC = European Commission

WHY NOW-CASTING: A GOOD PREDICTOR

Now-Casting.com
economics in real time

Using the same model, Now-Casting predicts individual series
Standard deviation of Now-Casting forecast errors; one day before release*

■ NCI™

■ Bloomberg Survey

Euro Area

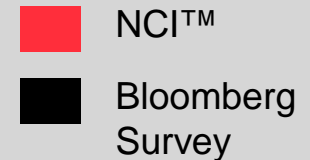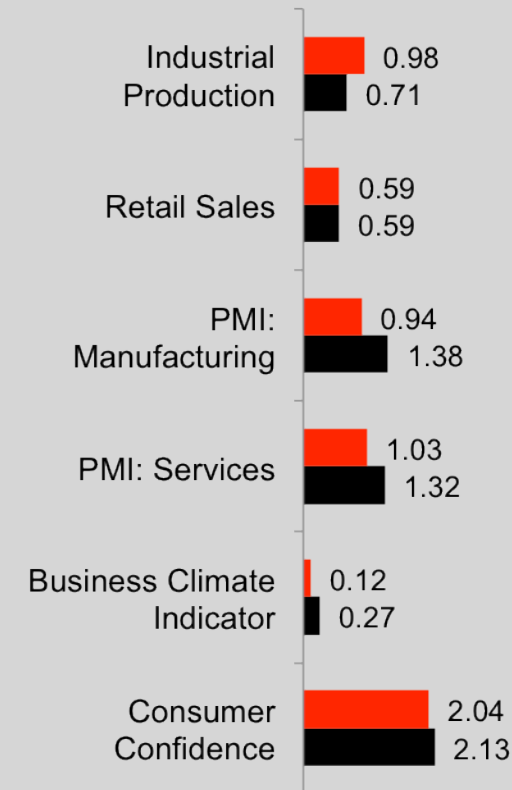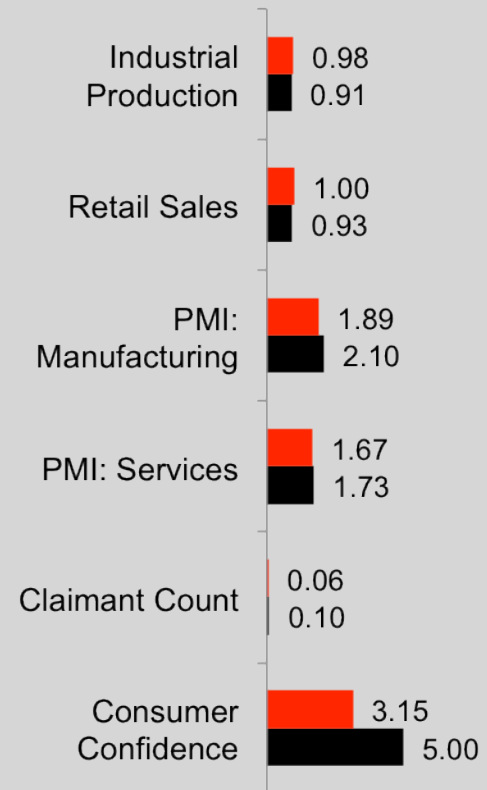| Series	NCI™	Bloomberg
Industrial Production	0.98	0.71
Retail Sales	0.59	0.59
PMI: Manufacturing	0.94	1.38
PMI: Services	1.03	1.32
Business Climate Indicator	0.12	0.27
Consumer Confidence	2.04	2.13

Germany

Series	NCI™	Bloomberg
Industrial Production	1.33	1.41
Retail Sales	1.13	1.15
PMI: Manufacturing	1.76	1.91
PMI: Services	1.76	1.77
Business Climate Indicator	1.26	2.57
Consumer Confidence	0.29	0.43

UK

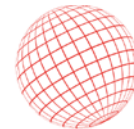| Series	NCI™	Bloomberg
Industrial Production	0.98	0.91
Retail Sales	1.00	0.93
PMI: Manufacturing	1.89	2.10
PMI: Services	1.67	1.73
Claimant Count	0.06	0.10
Consumer Confidence	3.15	5.00

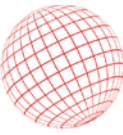* Average performance in historical reconstruction (January 2008 – December 2013), using revised data

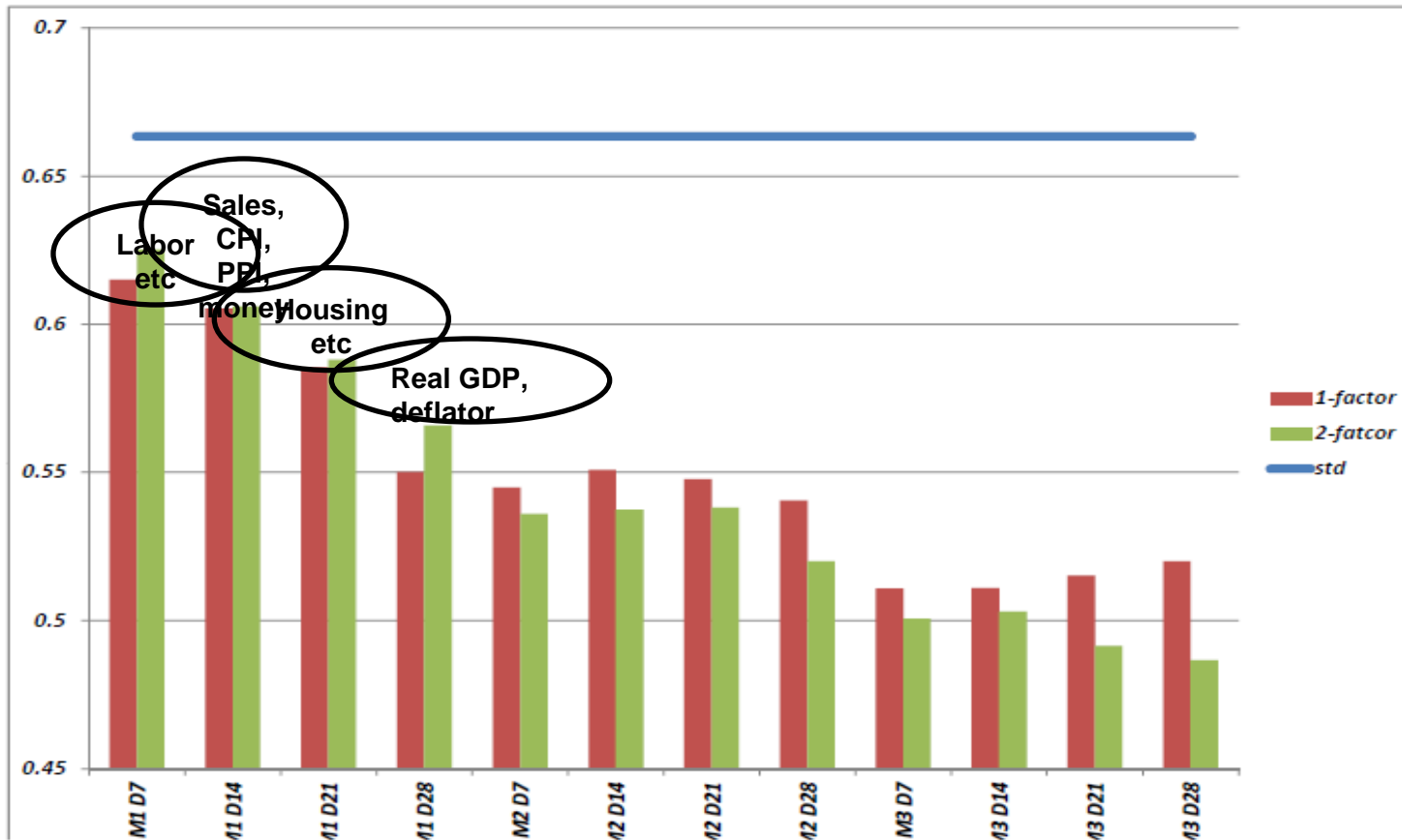- Daily model including quarterly, monthly, weekly and daily data

Why?

Some information on CPI inflation in daily financial variables, exchange rates, yield curve and weekly oil prices
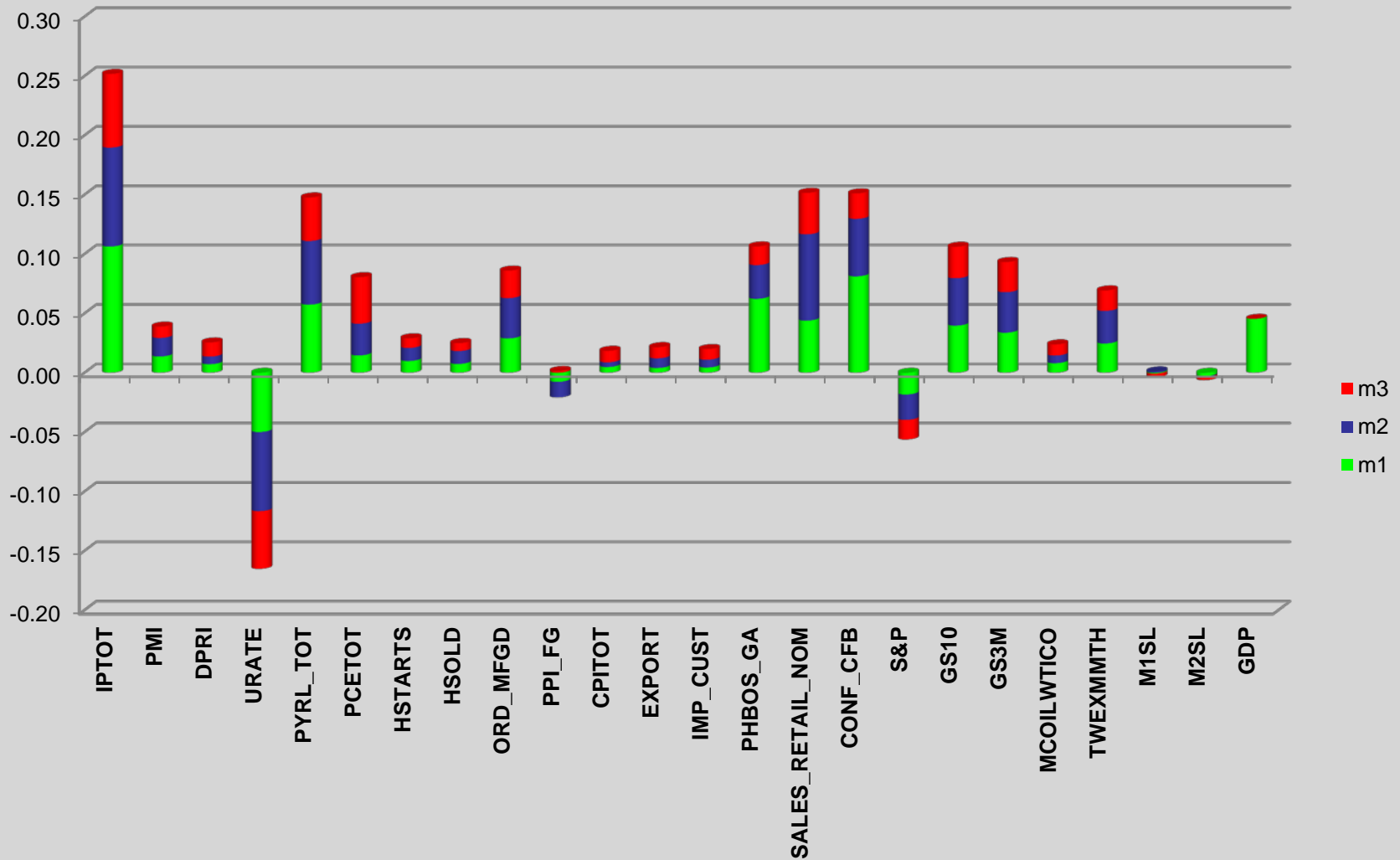
Nominal GDP
Evolution of RMSFE over the quarter

Average impact nominal GDP

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

Next chart shows the index for the US as constructed in real time starting from s = 2004q1 until t = 2013q1

Plain index: $\sum_{i=1}^{n} \sum_{s=0}^{t} weight_{i,GDP} \times news_{i,s}$

We report the three month rolling window

Quarterly rolling news index and quarterly returns of S&P

CORRELATION = 0.487

Figure 11: Corrected quarterly Now-Casting-20 and quarterly returns of the S&P 500

But does macro matter for financial variables?

- Mixed evidence in the literature …. but some people make money

  – Research based on surveys to traders shows that macroeconomic news matter for financial variables provided that high frequency variation is smoothed away

  – See previous chart – quarterly rolling window of news index

  – Research in our team confirms this result

What drives exchange rates?

|	Intraday	Medium Run (up to 6 months)	Long Run (over 6 months)
Bandwagon Effects	51	13	1
Over reaction to news	57	1	0
Speculative Forces	44	42	3
Economic Fundamentals	1	43	80
Technical Trading	18	36	11
Other	3	2	2

Proportion of respondents answering the question: Select the *single* most important factor that determines exchange rate movements in each of the three horizons listed.

Source: Cheung, Chinn and Marsh (NBER WP 7524) 'How do UK based foreign exchange dealers think their market operates?

Aggregating the daily now-cast of GDP to a daily rolling forward quarter
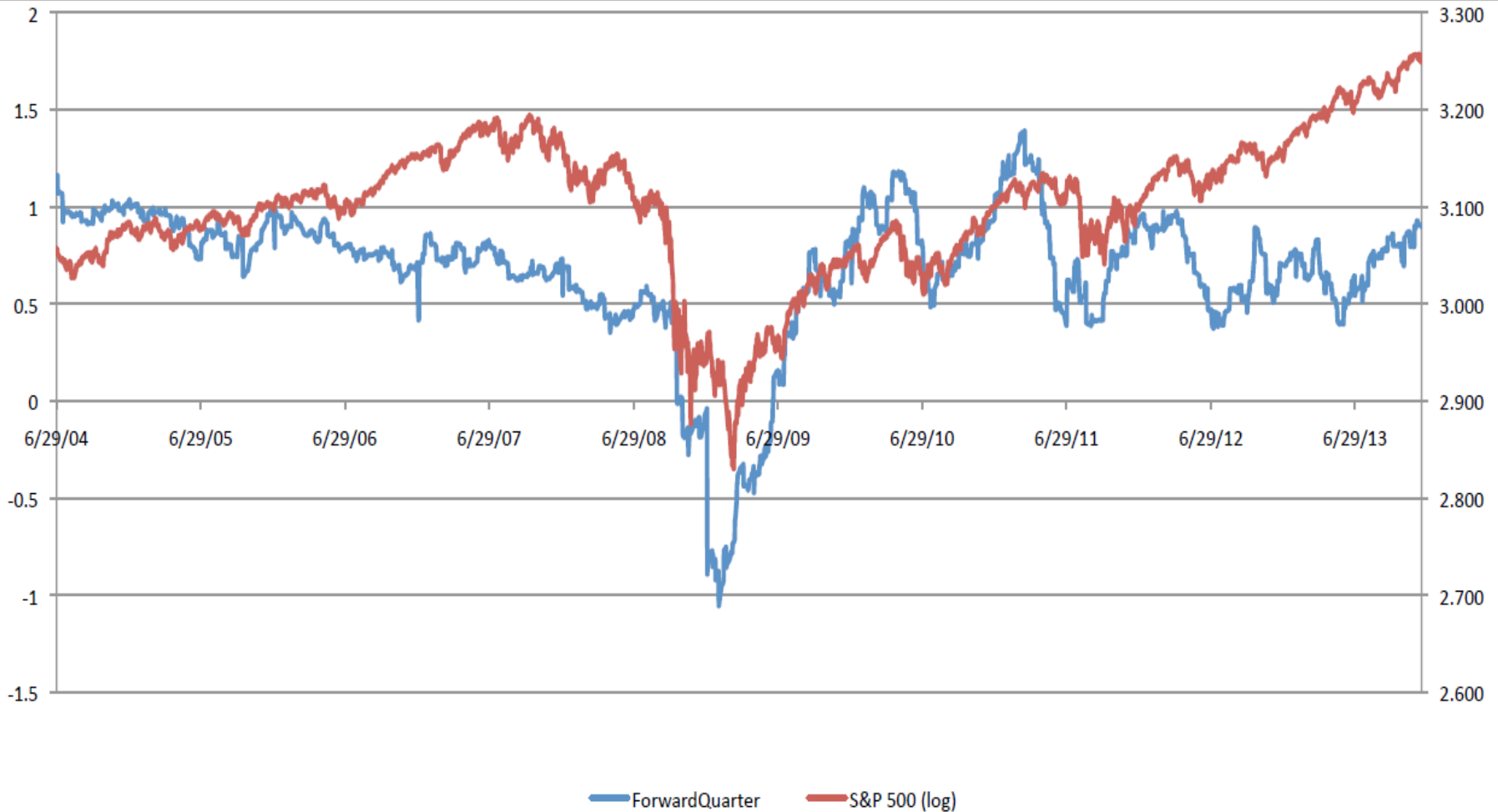
Macro (Bloomberg) news and bond returns

Daily change of bond returns at maturity τ:

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

Aggregate over different time spans and compute R^2

Results: filtering from high frequency dynamics improves the goodness of fit

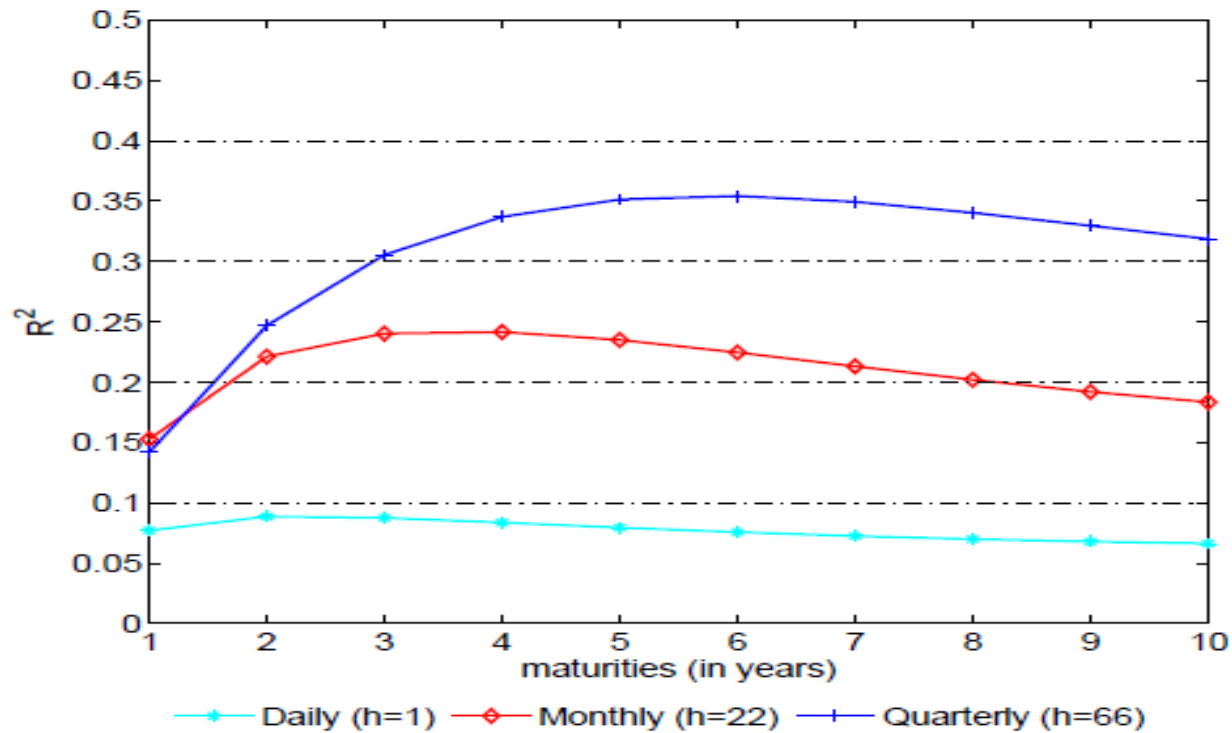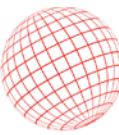Macroeconomic news matters at lower frequency

Figure 2: R^2 for the daily, monthly and quarterly bond yields changes

Notes: The figure reports the R^2 from the regression of the daily, monthly and quarterly change of yields at different maturities on the daily, monthly and quarterly news indexes, as in Equations (1) and (4).
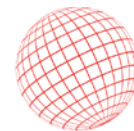
Why should one buy the Now-Casting service?

- Quant – we have a signal in continuous time about macroeconomic indicators and macroeconomic surprises automatically produced and updated → can include in models on a routine basis

- Benchmarking: cross-check with your own judgemental view of the state of the economy

- Transparency and coherence: can see why your view moves in relations to surprises of new data publications

- Don't need a lot of PhD economists – employ them to do something more interesting!

Summary: what is special about Now-Casting?

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

END