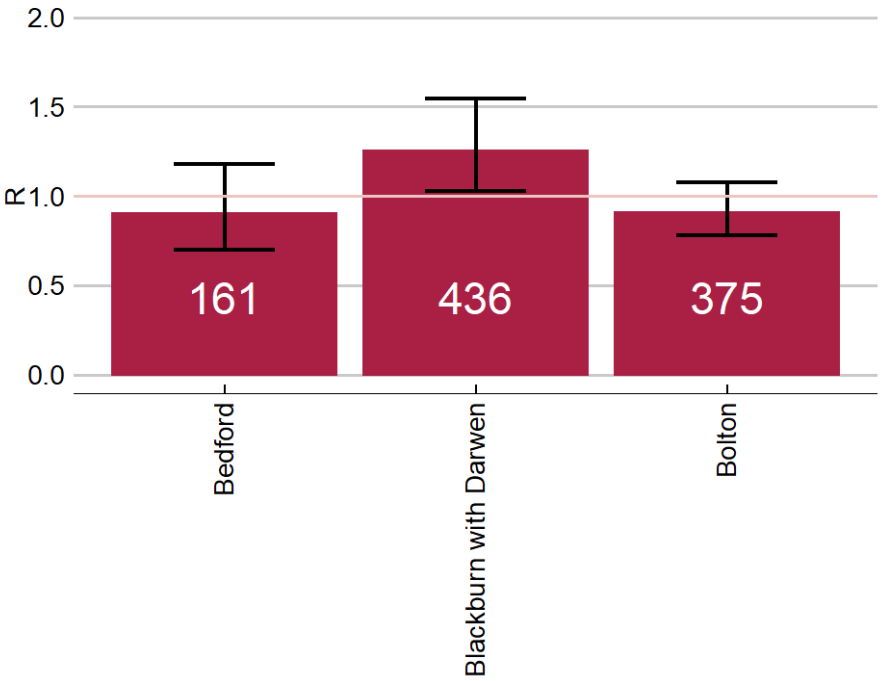
Reproduction Number (R) and Forecasts of New Cases: Waves or Spikes?

Figure 1 – R: Local Authorities in England with high case rates



Bar chart shows point estimates of R and the ± 1 standard deviation confidence intervals.
The numbers in each bar represent the count of cases in the last seven days of the estimation sample per 100,000 population.

Main points

- With this edition we refocus the tracker on local surges in infection to address the question whether sudden increases observed are local spikes or are indicative of the start of a new wave. Given the divergence among local areas in case rates, and surge testing in areas with high case rates, it is less meaningful to monitor the reproduction number at the level of nations or regions. We focus on three local authorities which were the first to experience localised increases in case rates.
- Figure 1 provides R number estimates and the case rates per 100,000 population, for *Bolton*, *Blackburn and Darwen* and *Bedford*, based on specimen date data series released on 1st June 2021. We discard data for the last 3 days due to data revisions in that time window. The estimates reported are to be read in the context of the policy of ***increased testing in local authorities with relatively high case rates.***

- At the end of our estimation sample on 28th May 2021, the R number was in the range 0.80 - 1.00 for Bolton (case rate 375) and 0.75 – 1.10 for Bedford (case rate 161). Blackburn and Darwen (case rate 436) are the only area of concern, with an R number in the range 1.10 - 1.50.
- A sudden surge in infection in any specific location can lead to a sharp increase in the estimated reproduction number. A part of such an increase in R may be due to increased testing in the location. It may also be driven by the fact that the increase is from a low base. If the infection can be contained through vaccination the Reproduction numbers will fall.
- The trajectories of infection in Bedford and Bolton appear to fit this profile. The lower reproduction numbers in these areas may reflect the efficacy of the vaccine in limiting the susceptible population. However, a degree of transmission spill over to surrounding geographical areas in the North West is evident in the data.

"The combination of low case rates with localised outbreaks and associated surge testing make it less meaningful to monitor the reproduction number at the regional and national geographical levels. We consider three local authorities that first experienced the Indian, or Delta, variant. It appears that both Bolton and Bedford are past the peak, whilst cases are still increasing in Blackburn with Darwen.

These findings suggest that localised outbreaks can be locally contained through high vaccination rates and changes in behaviour. But there is more to be done in this regard to prevent local spikes morphing into waves."

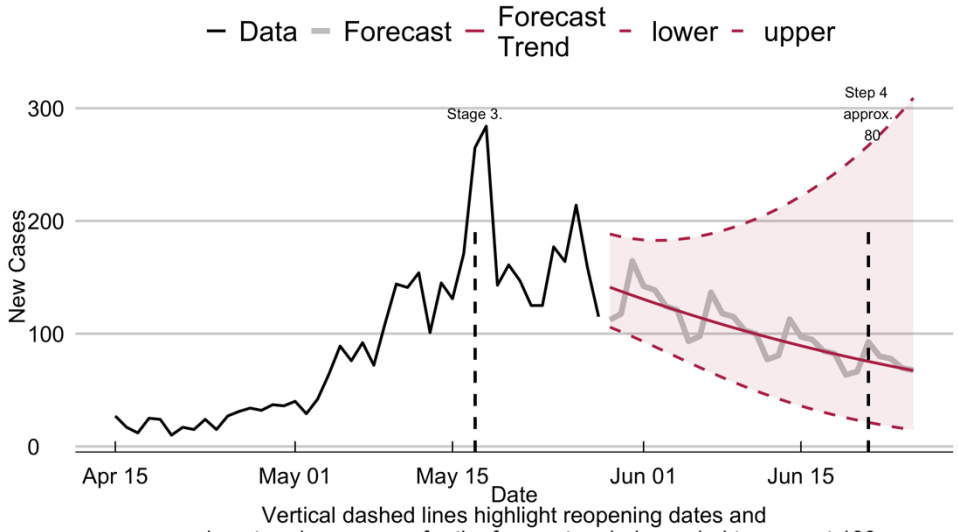
Dr Craig Thamotheram
Senior Economist - Macroeconomic Modelling and Forecasting

Results

Figure 2 provides forecasts of daily cases of Covid-19 for the period until early – July, for the three local authorities that have seen notable flare-ups, and highlights the underlying trend value of new cases to be expected on remaining key dates in the Government's roadmap: step 4 reopening expected on 21st June.

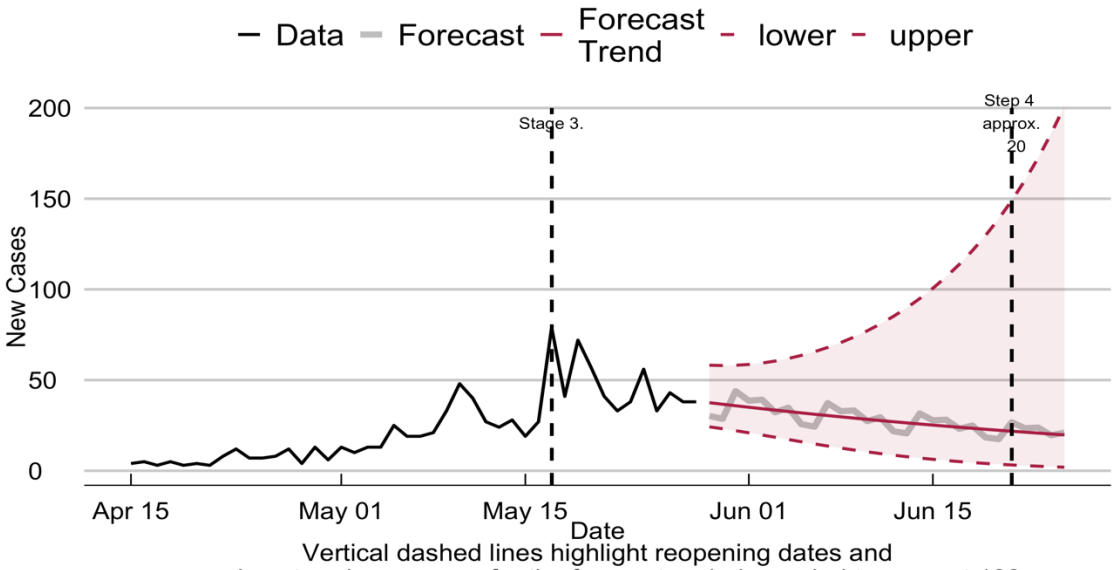
- For Bolton, the trend value of daily cases are forecast to be around 80 by 21st of June.
- For Bedford, the trend value of daily cases are forecast to be around 20 by 21st of June.
- For Blackburn and Darwen, the trend value of daily cases are forecast to be around 570 by 21st of June.

Figure 2a - Bolton forecast of new COVID-19 cases



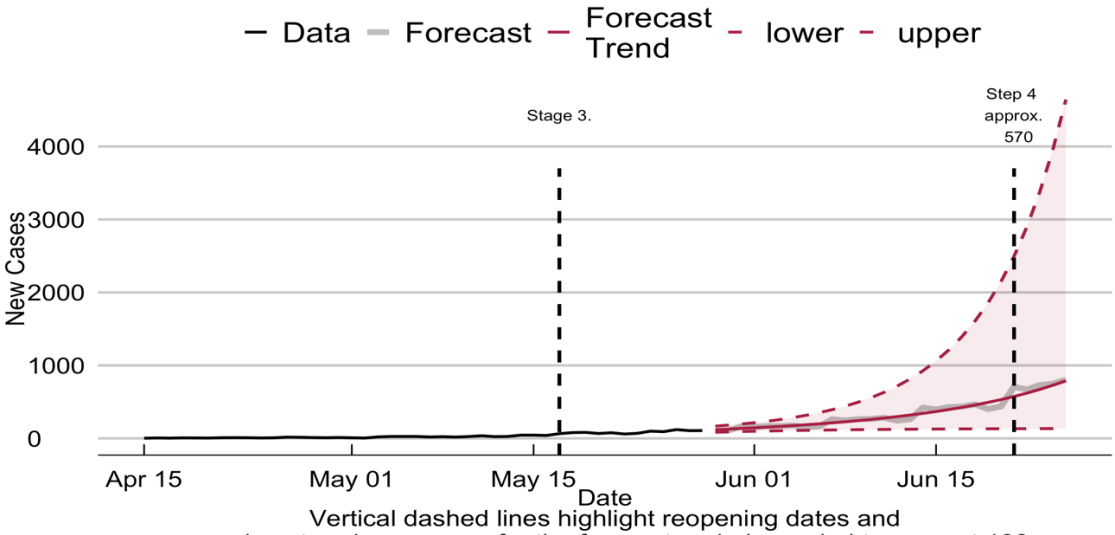
Vertical dashed lines highlight reopening dates and show trend new cases for the forecast period rounded to nearest 100. Specimen case data available on 01 June 2021. Data for the last three days which are subject to revision are discarded, so the estimation sample ends on 28 May 2021.

Figure 2b - Bedford forecast of new COVID-19 cases



Vertical dashed lines highlight reopening dates and show trend new cases for the forecast period rounded to nearest 100. Specimen case data available on 01 June 2021. Data for the last three days which are subject to revision are discarded, so the estimation sample ends on 28 May 2021.

Figure 2c – Blackburn with Darwen forecast of new COVID-19 cases



Vertical dashed lines highlight reopening dates and show trend new cases for the forecast period rounded to nearest 100. Specimen case data available on 01 June 2021. Data for the last three days which are subject to revision are discarded, so the estimation sample ends on 28 May 2021.

Background

NIESR aims to set out projections of the future path of the Covid-19 epidemic in the United Kingdom, its constituent nations and the regions of England, based on current policies.

NIESR has been producing weekly updates on Thursdays, projecting new cases and estimating the R number using a class of time series models developed by Prof. Andrew Harvey and Dr. Paul Kattuman of Cambridge University; see Harvey and Kattuman (2020a). From June 3, 2021 onwards NIESR will be producing fortnightly updates on Thursdays, focusing on monitoring whether sudden increases observed are local spikes or are indicative of the start of a new wave.

The models generate forecasts by extracting changing trends from historical data. They are relatively simple and transparent, and their specifications can be assessed by standard statistical test procedures. The advantage of the time series approach is that it can adapt very quickly to the most recent information and hence produce timely estimates. This flexibility enables the effects of changes in policy, virus mutations and human behaviour to be tracked. The models are data driven and so are different from the structural models used by epidemiologists which rely on assumptions about transmission and behaviour; see Avery et al (2020).

A description of the methods used to produce these estimates and an evaluation of their forecasting performance can be found in Harvey, Kattuman, and Thamotheram (2021).

Data

Data: COVID-19 confirmed cases and deaths data are sourced from
https://coronavirus.data.gov.uk

Data on Covid-19 cases are reported by the government by 'specimen date' and by 'published date'. Specimen cases relate to the date when the sample was taken from the person being tested, while published cases relate to the first date when they are included in the published numbers. At the present time we regard the specimen date data as a more reliable indicator of the trend in new cases. The model based on specimen dated observations has better captured the effect of the sharp increase in testing on the day that schools reopened and also suffers less from data errors or revisions.

On 27 March 2021, 850 historic cases were removed due to a laboratory processing error. This affected specimen date data between 23 and 25 March in local authorities primarily in the North East and Yorkshire. The cumulative total number of people tested positive

was revised down on 27 March 2021. Historic published date totals have not been changed. The downward correction on 27th March is mixed with the positive upward revisions of cases as more test results are returned over time making it impossible to date these corrections accurately. Thus, we cannot back out on which day these corrections were made. For published data, we choose to remove 300, 300 and 250 cases on 24, 25 and 26th of March respectively.

Between 2nd to the 5th April significant disruption to cases and deaths for Wales and Northern Ireland occurred. This was corrected on the 6th April but with a 48-hour reporting period. As the last date in the estimation sample for specimen cases is April 2nd we will decide how to account for this change in next week's forecast. We leave published cases unchanged.

On April 9th rapid LF tests that are confirmed as negative by Polymerase Chain Reaction (PCR) test within 3 days were removed. For published cases, we set 9th April as missing as no correction is applied to the historic data by Public Health England.

Caveat

The model relies on historical data and does not incorporate future outlined changes in the underlying environment. Thus, it is important to read the forecasts in this context. For example, the current forecasts make no assumptions about the effect of reopening non-essential retail on increasing transmissions. On the other hand, the effect of the vaccine program will be in the opposite direction.

Authors

Professor Andrew Harvey is Emeritus Professor of Econometrics at the University of Cambridge and a Fellow of Corpus Christi College. He has published over 100 articles and is the author of four books: *The Econometric Analysis of Time Series* (1981), *Time Series Models* (1981), *Forecasting. Structural Time Series Models and the Kalman Filter* (1989) and *Dynamic models for Volatility and Heavy Tails* (2013). He is a Fellow of the British Academy and the Econometric Society.

Dr Paul Kattuman is a reader in Economics at Cambridge University. He has been a Senior Research Fellow at the University of Cambridge Department of Applied Economics, and a lecturer in economics at Durham. He has held Visiting Professorships at Université Paris 12 and Paris-Est Créteil and was appointed Grupo Santander Visiting Professor at Universidad Complutense de Madrid. He was visiting Faculty Scholar at the Kennedy School of Government, and at the Department of Statistics, both at Harvard University.

Dr Craig Thamotheram is a Senior Economist at NIESR. Prior to joining NIESR, he studied Engineering at Imperial and obtained a PhD in Economics at Warwick. He has work experience as a post-doc in macro and financial econometrics.

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Notes for editors

For further information and to arrange interviews please contact the NIESR Press Office: press@niesr.ac.uk or Luca Pieri on l.pieri@niesr.ac.uk / 07930 544 631

National Institute of Economic and Social Research

2 Dean Trench Street
Smith Square
London, SW1P 3HE
United Kingdom

Switchboard Telephone Number: 020 7222 7665

Website: http://www.niesr.ac.uk