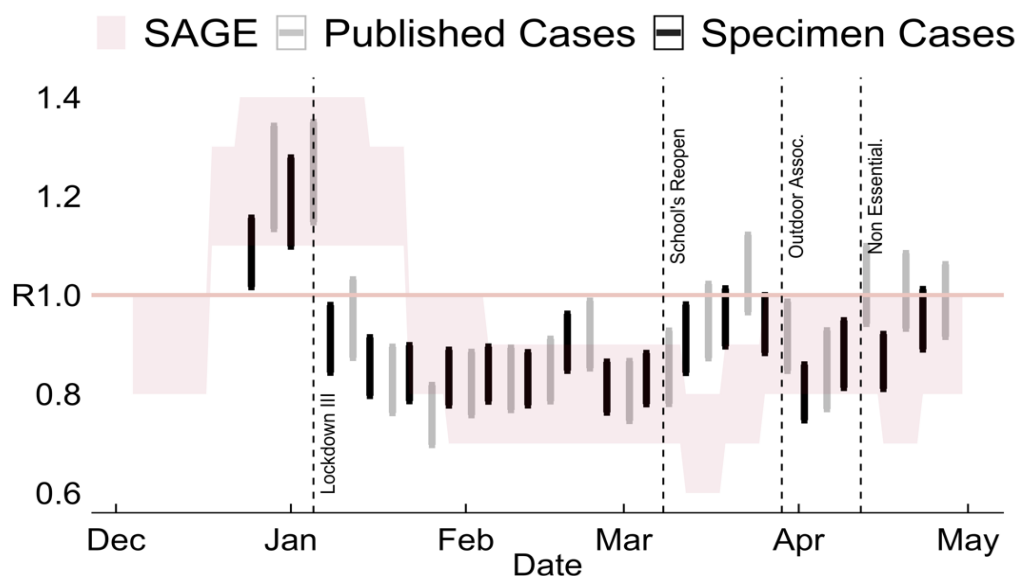


Reproduction Number (R) and Forecasts of New Cases:

R value for England increases towards 1

Figure 1 - England R - NIESR and SAGE



Shaded pink area is SAGE upper and lower bounds (www.gov.uk/guidance/the-r-number-in-the-uk)
NIESR estimates of R show ± 1 standard deviation confidence intervals estimated on published and specimen cases. For specimen cases we discard the last 3 days data.

Main points

- We report estimates of the R number and forecasts for new cases of Covid-19, hospital admissions, and deaths due to Covid-19 using data that was publicly available as of 27th April 2021.
- SAGE has declared that due to the “increasing localised nature to managing the epidemic, particularly between nations” the UK wide estimate is less useful. To enable comparison with SAGE estimates we report our estimates for England and not for the UK as a whole.
- Figure 1 shows that the Reproduction number, R, for England. R is the average number of secondary infections currently generated by an infected individual, and is estimated to be in the range of **0.90 - 1.00** based on specimen date data until 23rd April.

- For Northern Ireland the R number is in the range 0.80 – 0.95; for Wales, 0.80 – 0.95 and for Scotland, 0.90 – 1.00. The regional R number estimates given in Figure 6 show that, currently, the East Midlands has the lowest R number while the South West has the highest value across England's regions.
- Based on our model, by 17th May when step 3 re-opening is due to restart, we expect the trend value of daily cases to be around 1,300; admissions to be below 100, and deaths to be well below 25 (Figures 3-5).
- To the extent that re-opening of the economy increases transmission, these numbers may be exceeded. At the same time, expansion of the vaccination programme can be expected to reduce transmission. The trajectory that nets out these opposing trends could become evident in the weeks to come.

“Based on the latest data on new cases, our estimate of the R number for England lies in the range 0.90 – 1.00, increased relative to last week. This estimate is based on data up to 27th April 2021, including about two week’s data following step 2 of the roadmap out of lockdown. Recent [evidence](#) indicates that the vaccine is effective in reducing transmission of Covid-19. However, there is likely still room for cases to start rising again with increased social mobility from lockdown easing accompanied by the unvaccinated majority of the adult population below 40. Hospital admissions and deaths due to Covid-19 continue their steady decline.”

Dr Craig Thamotheram
Senior Economist - Macroeconomic Modelling and Forecasting

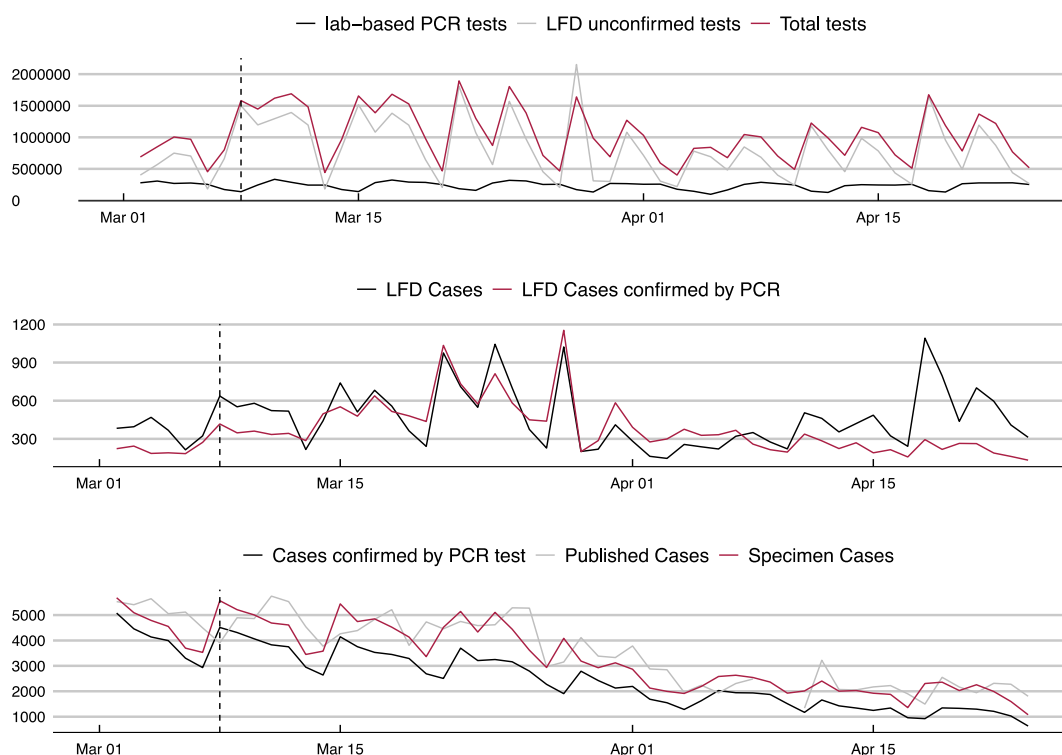
Results

From 10th March, data on cases identified by test type has been available for England. That is, the number of people with at least one positive COVID-19 test result is available by the type of test used in their first positive test. There are three types of tests:

1. Lab-based polymerase chain reaction (PCR).
2. Lateral flow device (LFD) confirmed by a PCR test taken within 3 days.
3. LFD that are unconfirmed by PCR.

Note, specimen cases are the sum of all three types of tests.

Figure 2 - England cases and tests by type



Vertical dashed line on 8th March. The test types are:
 – lab-based polymerase chain reaction (PCR), lateral flow device (LFD) confirmed
 (this means the LFD result has been verified with a positive PCR result taken
 within 3 days), LFD unconfirmed (no positive PCR result taken within 3 days).

- The top panel of Figure 2 shows that the number of PCR tests remained approximately the same after the Easter break while the number of LFD tests decreased significantly.
- The middle panel of Figure 2 shows that this translated into a decrease in LFD cases in the week that followed.
- There has also been a change in reporting from 9th April, whereby cases detected by rapid LF tests that are subsequently confirmed as negative by a Polymerase

Chain Reaction (PCR) test within 3 days, are removed. Thus, rapid LF testing has less of an effect on specimen case numbers than previously.

Figure 3 provides forecasts of daily cases of Covid-19 for the period till end of May and highlights the underlying trend value of new cases to be expected on the key dates in the Government’s roadmap: stage 3 reopening expected on 17th May. Projections include a correction for the increased testing due to the reopening of schools as well as for the reduced testing during the Easter break.

- Trend values of daily cases are forecast to be around 1,300 by 17th of May, up from 600 last week.

Figure 3 - UK forecast of new COVID-19 cases

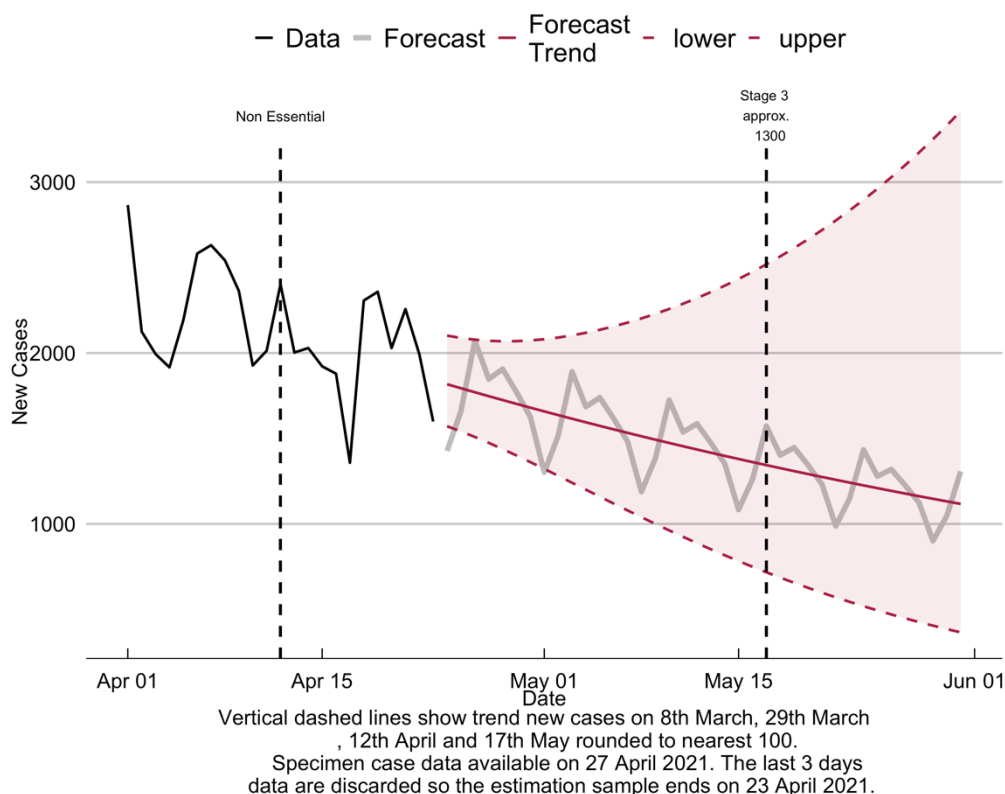


Figure 4 provides forecasts of daily hospital admissions for Covid-19 until end of May and highlights the underlying number of new admissions to be expected on the key dates in the Government’s roadmap: stage 3 reopening expected on 17th May.

- Hospital admissions are forecast to be around 70 by the 17th of May.

Figure 4 – UK forecast of daily Covid-19 hospital admissions

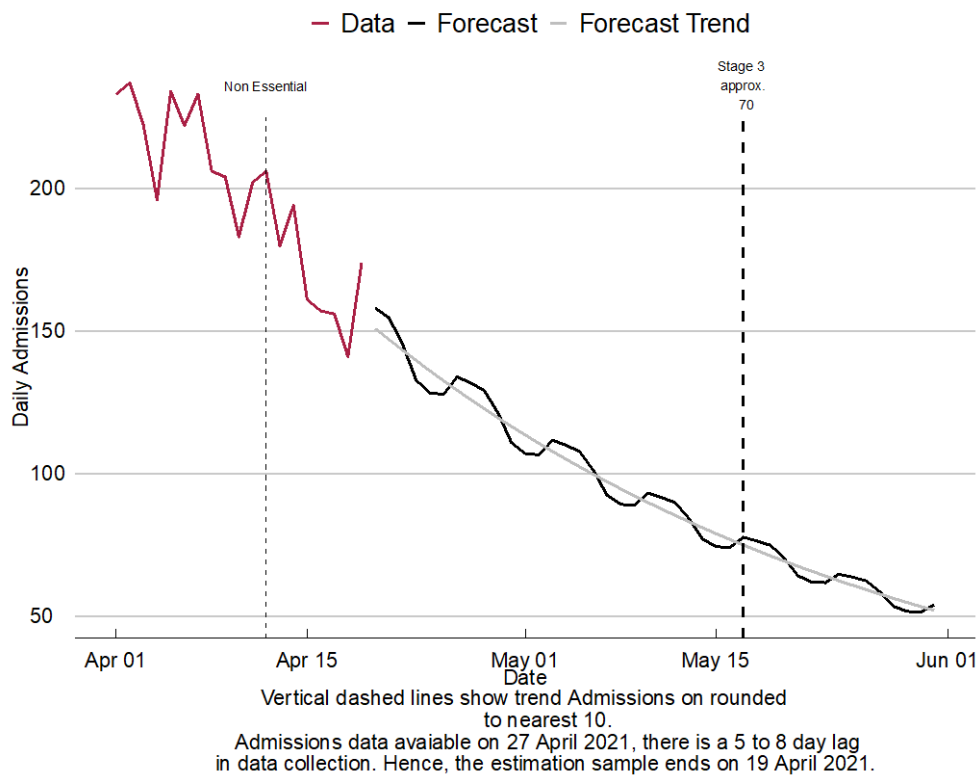
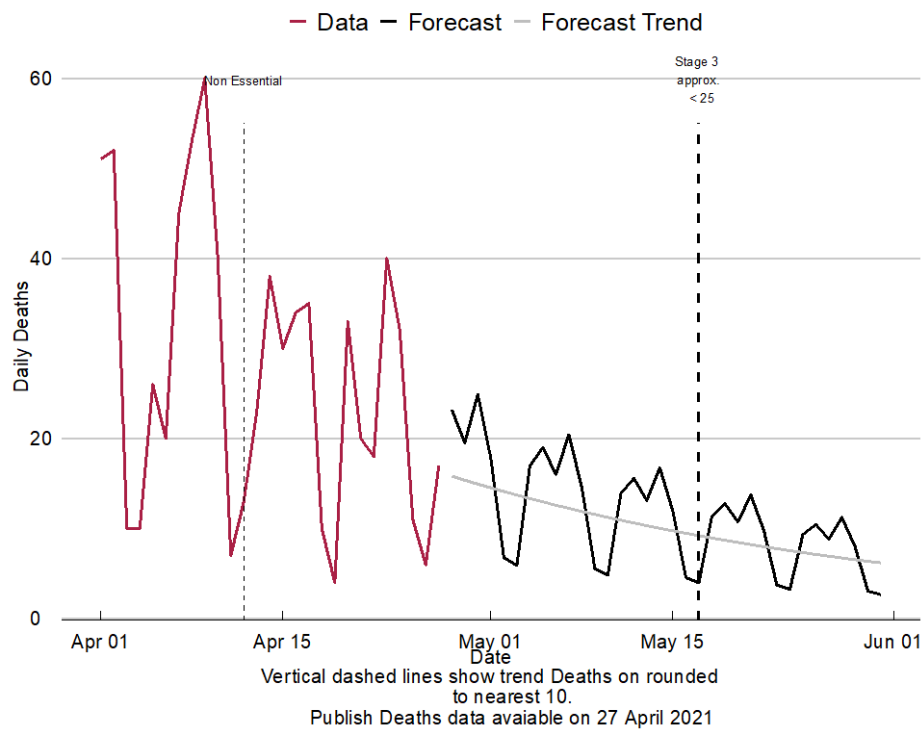


Figure 5 provides forecasts of daily deaths due to Covid-19 till end of May and highlights the underlying number of daily deaths to be expected on the key remaining date in the Government’s roadmap: stage 3 reopening no earlier than 17th May.

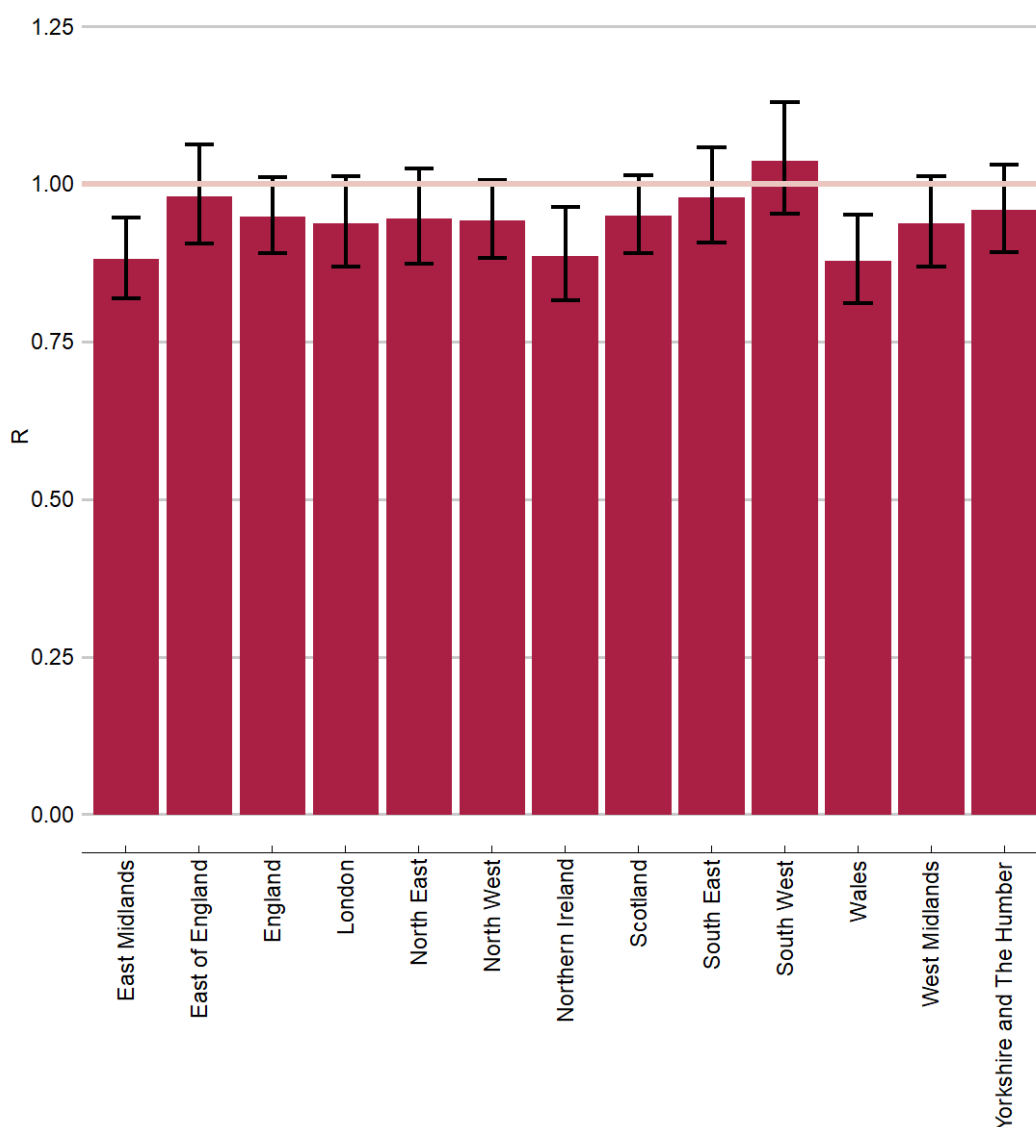
- By 17th May when stage 3 reopening is expected to restart, daily deaths are forecast to be well below 25.

Figure 5 – UK forecast of daily Covid-19 deaths



- Figure 6 provides regional R number estimates based on specimen date data series released on 20th April 2021, controlling for increased testing due to schools reopening. We discard the last 3 days data due to data revisions in that time window. Thus, at the end of our estimation sample on the 23rd April 2021, regional R number estimates are all below 1 apart from the estimate for South West.
- Among nations of the UK, Scotland has the largest R number (0.95) and Wales has the lowest (0.88).
- Among regions of England, the South West has the highest R number (1.04) and the East Midlands has the lowest (0.88).

Figure 6 - UK Regional R



Bar chart shows point estimates of R and the ± 1 standard deviation confidence intervals

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 will be 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 \(2020a\)](#). 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.

Bibliography

Avery, C., W. Bossert, A. Clark, G. Ellison, and S. F. Ellison (2020). An economist's guide to epidemiology models of infectious disease. *Journal of Economic Perspectives* 34(4), 79–104.

Harvey, A. and P. Kattuman (2020a). Time series models based on growth curves with applications to forecasting coronavirus. *Harvard Data Science Review*, Special issue 1 - COVID - 19. <https://hdrs.mitpress.mit.edu/pub/ozgix0yn>

Harvey, A. and P. Kattuman (2020b). A farewell to r: Time series models for tracking and forecasting epidemics. *CEPR working paper*, 51, 7th October. <https://cepr.org/content/covid-economics>

Harvey, A., P. Kattuman, and C. Thamotheram (2021). Tracking the mutant: forecasting and nowcasting COVID-19 in the UK in 2021. *National Institute Economic Review*. Forthcoming.

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>