Circuit Breakers
Implementing (partial) Lockdown for 2 weeks over Half-Term

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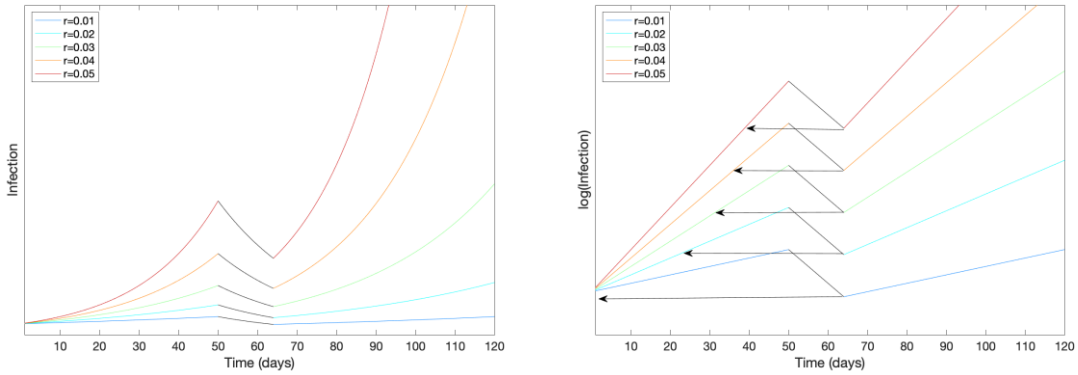
Here we consider the impact of a 2-week "circuit breaker" timed to align with school half terms. Given uncertainty in the future dynamics, we not only integrate over the posterior parameters for each region, but also over a range of potential growth rates (r) from Mid-September onwards.

Simple Analytics

The action of a circuit breaker can be calculated analytically if the dynamics approximate exponential growth and decay. For an exponentially growing outbreak (rate r) and exponentially declining infection during the circuit breaker (rate -s), the dynamics can be approximated as:

$$Cases(t) = \begin{cases} \mathrm{A}_1 \exp(rt) & t < Half\ Term \\ A_2 \exp(-st) & t \in Half\ Term \\ A_3 \exp(rt) & t > Half\ Term \end{cases}$$

where the parameters A_1, A_2 and A_3 are chosen to insure the cases are continuous.



As shown in the two examples above, the action of any circuit-breaker over half term is to reduce the number of cases and effectively resets the number of cases to those at an earlier time. The duration of this "temporal reset" can be estimated from the simple approximation:

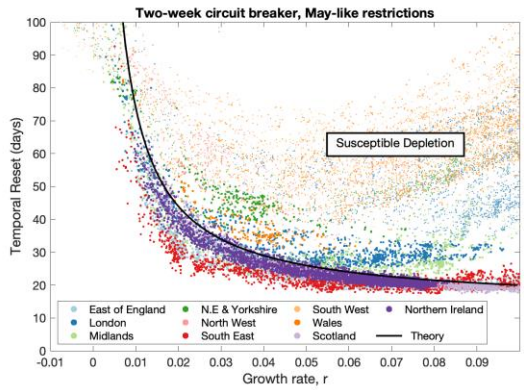
$$\text{Temporal Reset} = \text{Duration of Break} \times \left(1 + \frac{s}{r}\right)$$

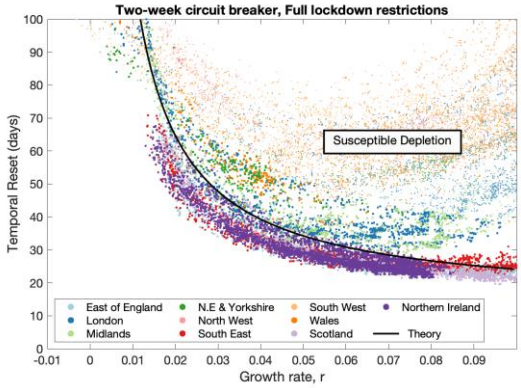
This reset will have a lasting impact on the predicted outbreak size.

Numerical Calculations

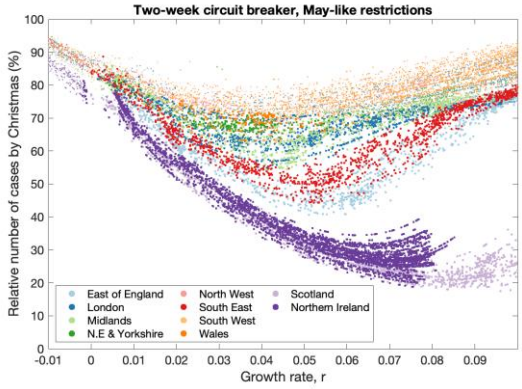
Using the standard Warwick model, we consider different growth rates from Mid-September to the start of Half-Term (24th October 2020) by changing the level of NPIs. We consider two different strengths of circuit breaker over the 2-week half-term period: either full lock-down (s=0.069 (CI 0.055-0.101) or partial (based on late May s=0.042 (CI 0.026-0.71)), with significant regional variation based on observed dynamics.

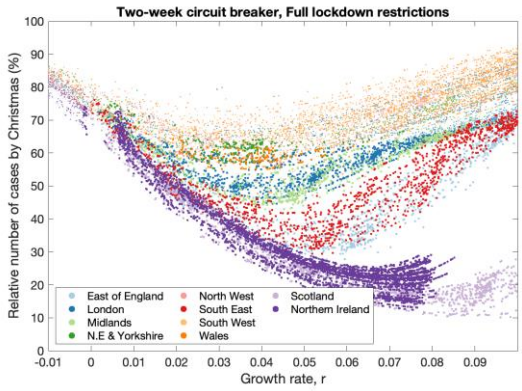
We show below the "temporal reset" based on all 10 regions of the UK, and compare these to theory with an 'average' rate of decline in the half-term. Note paler, smaller dots in the upper-right regions are associated with significant depletion of susceptibles, such that the epidemic deviates from exponential. Any deviation away from the simple theory (black line) is likely due to the complexity of age-structure, meaning that changes in NPI take time to percolate into different age-groups.





We also consider the relative impact that a half-term circuit-breaker would have on the total number of cases between now and Christmas. In all cases, the circuit-breaker generates a substantial reduction cases, which is maximised for intermediate growth rates ($0.03<r<0.08$). Scotland and Northern Ireland see the greatest potential decrease, which is predominantly explained by the more rapid drop in cases observed during lock-down (giving a more negative s).





Conclusions.

A well timed and strong lock-down for a two-week period coinciding with half-term could have a very notable impact on the number of future cases, hospitalisations and deaths. It provides a useful break if cases are rising too rapidly; however, the impact on deaths is often subject to long delays - so deaths may not decline until after the break.