1. Title: Covid and Social Distancing with Heterogenous Population

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3. Extended Abstract

Predictions on the current coronavirus are based on models that do not take into account that (a) individuals make decisions on their own social distancing, which will naturally depend on their health condition/prospects, and that (b) people may respond behaviourally to government interventions that aim at influencing the evolution of the current epidemic. This may be an important shortcoming because the mean contact rate, which is treated as exogenous to the evolution of the epidemic when simulations are run and inform policy makers and the public, might actually change over time or following a change in government policy, with unintended consequences.

We build a model that addresses this shortcoming of existing models, and calibrate it to UK data with the aim of informing the government when they design lockdown policies.

In our model, we also take into account that there is heterogeneity in the population in that some people may develop a serious illness because of the infection and eventually die. Given that we explicitly take into account that people make their own social distancing decisions, we find that these “high-risk” individuals will exercise stricter social distancing than the rest of the population, reaching maximal social distancing before the infection peaks and maintaining maximal social distancing for some time after the infection peaks. On the other hand, the rest of the population — the “low-risk” individuals — will typically exercise less social distancing. As a result, lockdown policies that shut-down non-essential sectors (e.g. services) and thereby increase the minimal level of social distancing will influence largely the behaviour of the “low-risk” part of the population, whereas policies that shut-down some of the less essential sectors (e.g. parts of government services or food industry) and thereby increase the maximal level of social distancing will influence largely the behaviour of the “high-risk” individuals. Therefore, our model highlights that different types of lockdown policies will influence different parts of the population and hence influence different dimensions of the epidemic. For instance, policies that increase the maximal level of social distancing have a relatively stronger impact on the death toll than on the evolution of infections and the level of “herd immunity” than policies that increase the minimal level of social distancing.
Given this previously unrecognised interaction between private decisions, government interventions and the evolution of an epidemic, our calibrated suggests the following predictions.

— By the date of the first reported death (05/03/2020), 0.02% of the UK population would have already been infected with the virus.
— The peak of the mortality rate would have occurred around the second week of April in the absence of government intervention, but with a significant death toll by the end of the epidemic of around 574,000 people.
— Policies that raise significantly the minimal level of social distancing lead to a flattening of the curve during the intervention period but is followed by a significant after-wave due to the behavioural response of low-risk individuals.
— Policies that raise the maximal level of social distancing lead to a significant drop in the death toll but have very little effect on the evolution of infections and herd immunity. As a result, such policies may not be followed by a major after-wave once they are lifted.

4. Data description


5. JEL: C61, C72, C73, H41, I12, I18

6. Keywords

COVID-19, Epidemiology, SIR model, Social Distancing, Externalities

7. URL

https://www.dropbox.com/s/prmqlyyhthr3ud8/COVID_distancing_site_updated.pdf?dl=0