CENTRE FOR MACROECONOMICS

Economic and Social Research Council

An Analytical Model of Covid-19 Lockdowns

CFM-DP2020-29

Łukasz Rachel

Bank of England, Centre For Macroeconomics and LSE

This paper studies the risk-mitigation decisions of individuals and governments faced with a contagious and deadly disease. As is common in the emerging macro-epidemiology literature, the model appends the baseline SIR framework with individuals and policymakers who act to maximize their own or society's welfare. What is new is that the framework enables analytical characterization of these decisions and their impact on the aggregates in a general equilibrium setting. The analytics enable sharp characterization of the results that papers based on simulating macro-SIR models have missed.

I show that individually optimal voluntary behavior delivers a gently declining number of new infections over time in equilibrium, thus leading to a dramatic flattening of the epidemic curve in the aggregate.

The precautionary behavior significantly lowers – but does not minimize – cumulative deaths, as compared to the mechanistic SIR model with no behavioral response. But the epidemic persists for a long-time and so it is economically costly.

I then turn to the analysis of optimal lockdown policy. The optimal strategy for the use of the lockdown policies that cover wide swathes of the population is to get to the herd immunity threshold as fast as possible. This means that the optimal lockdown starts when the level of infections is high – a stark illustration that optimal mitigation policy does not aim to flatten the curve and instead focuses on achieving the lowest cumulative death toll at minimum cost.

Remarkably, the optimal lockdown policy is almost entirely independent of parameters that determine the value of statistical life (VSL).

I discuss the externalities driving the differences between the socially optimal and the equilibrium outcomes. My contribution is to point out that the infection externality present in the behavior of the susceptibles means there is *too much* social distancing in equilibrium relative to the social optimum. The intuition for why the infection externality can work in this direction is that the (external) effects of today's decision to engage in social distancing lower the infection rate in the short-run but raise it further out (by the logic of flattening the curve – the curve is flatter but it is also fatter). Another way to contrast the individuals' vis-a-vis the planner's mitigation strategies is that the individuals focus on the *infection risk at a point in time*, whereas the planner sees through to the end of the epidemic and cares about *cumulative infection risk*.

In the final part of the paper I discuss how some important extensions of the baseline model alter the conclusions.