Effectiveness of Heterogeneous COVID-19 Policies: County-Level Analyses Using Mathematical Epidemiology Models

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Non-pharmaceutical interventions to COVID-19 included mask mandates, social distancing mandates (banning large gatherings, advising individuals not to socialize outside their households), school closures, lockdowns, and travel restrictions. Different states and counties in the US adopted different degrees of such interventions during the early months of the COVID-19 pandemic. In this project, I study the effects of such heterogeneous interventions on how COVID-19 spread through the populations of these counties. To study the above, I adapt a mathematical model of new product adoption, the Bass Model, to model the spread of COVID-19. Using case data spanning 70 weeks, during which the first strain of COVID-19 virus rapidly spread through the US, I estimate this model at the county-level for each of 3219 counties in the US. I then show that the predictive accuracy of the Bass Model beats that of the popular SIR model. Next, I relate the estimated county-level rates of infectivity to non-pharmaceutical interventions adopted by the counties, while controlling for heterogeneous demographic characteristics (elderly population, median income, average family size etc.) of the counties. The findings from my study will shed light on both the practices that were effective in arresting rapid spread of COVID-19, as well as the ineffective practices. These findings, in turn, will allow national and local policymakers to be better prepared to deal with outbreaks of large-scale epidemics in the future.

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