THE ECONOMIC CONSEQUENCES OF THE DIFFERENT ATTITUDES OF A POLICY MAKER: A COMBINED EPIDEMIOLOGICAL-ECONOMETRIC STUDY

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ABSTRACT

Within a standard compartmental model for the description of the dynamic of an epidemics (Susceptible-Infectious-Recovered-Dead), we considered a policy-maker (PM) that impose stochastically three types of lock-down with increasing force. The probability by which the PM apply the lock-down reflects the different attitudes of a PM to face an epidemics (e.g. *laissez-faire* vs very strict): thus depending on this probabilistic-parameter different scenario were simulated. For each of them we predicted a selected set of economic impacts by using parameters estimated via econometric techniques (Difference-in -Difference) on the microeconomic data of Italy. The comparison of the different impacts provide a bird's-eye view on the socio-economic consequences of the PM attitude

"It was then that, in a moment, I saw what I must have been harboring in my hidden thoughts for a considerable time. On the one hand, Trantor possessed an extraordinarily complex social system, being a populous world made up of eight hundred smaller worlds. It was in itself a system complex enough to make psychohistory meaningful and yet it was simple enough, compared to the Empire as a whole, to make psychohistory perhaps practical"
I.Asimov, Prelude to foundation

1 INTRODUCTION

The recent pandemic due to the spread of SARS-CoV-2 virus, opened a highly debated issue about what it would be the best approach of the policy maker to face the epidemics. Differently from the pandemics of the past and in particular of the XX century (e.g. Spanish Flu, Asiatic Flu and Hong Kong Flu), for this pandemic a very large amount of data are easily accessible. As consequence not only the modelling of the virus diffusion, but also the effect on socio-economic texture for the different countries can be investigated with a finer resolution. Among the different scientific challenges that can come up in this context, a interesting one involves the socio-economic effects of the attitude of the policy-maker (PM) to block the circulation of people (lock-down) in order to reduce the contagion rate (more formally the reproduction number, as described in Supporting Infomation). Indeed the policy maker can adopt, at a first approximation, a linear combination between these two extreme approaches: forcing all people to stay at home or to *laissez-faire*. In the first extreme, the spread of virus is, of course, stopped but, on the other side, the toll for such approach is that not only the economic activity (and so the income of people/firms) but also that the furniture of the primary goods are stopped. On the other side, if no lock-down measures are taken by the policy-maker, the toll to be paid will be not only the high number of deaths but also the economic damage produced by the very high number of deaths [1, 2]. In practice the PM can adopt intermediate approaches that shut down activities that contribute much more to diffusion with respect to other (for this purpose a very fine analysis was provided by Li et al. in [3] and by Brauner et al. in [4]): as consequence the lock-down efficacy, within certain limits, can be tuned. In the literature different scholars [5, 6] challenged the issue of finding the optimal lock-down policy for minimizing the economic impact as well as the deaths. In particular for the model in Ref. [5] it is assumed that the policy-maker know perfectly the consequences of her choices and that she can act without delay to impose the optimal choice; finally it is assumed that the PM can impose a continuous factor for the lock-down, while, for different countries such factor seems to be much more discrete. It can be argued that most of these drawbacks of this last formidable research, are entangled with the fact that a deterministic approach was considered for the activation of the lock-downs by the policy maker. On this basis we would propose here an alternative way to model the decision of the policy maker that is based on a stochastic model instead of on a deterministic one. Furthermore, differently with respect to the previous researches, that focused basically on macroeconomic impact, here we modelled the impact of the different lock-down at microeconomic level: in particular, by means of

difference in difference, we evaluated the effect of the different levels of restrictions on the sales for different product types in Italy. Thus the final output of the model will be not only the cumulative deaths, but also the economic damage for each selling sector. Moreover here we also considered that there is not only an economic cost for each death, as done by [5] but there is also average cost for each infected person (referring to Italian data), because a consistent part of them may be recovered or even should take the intensive therapy. In this paper three approaches were simulated that basically shape three different PM: a very careful one, a lazy one that adopts a *laissez-faire* strategy and an intermediate one. For each scenario, we will discuss the result of the simulation and then we will compare them in order to get a general insight.

2 MODEL AND METHODS

The model of the present study is composed by an epidemiological part, that shapes the diffusion of the virus, and then its output is used by the economic model to quantify the damage. Thus we will discuss the epidemiological part and then the economic one

2.1 Epidemiological model

Among the very large number of compartmental model that are available in the literature [7], we considered as the core-engine of the simulations the simplest one: the Susceptible-Infectious-Recovered-Dead (SIRD). A review about the dynamics of this model will be provided in the Supporting Info of the present paper. Our choice is motivated by the fact that this relative simple model provide the gross features of an epidemic [8, 9] with a relative small number of parameters. Thus, because the final goal of the present article is an insight on the effects of the PM care of pandemic, an not a fine grained description of the epidemics due to COVID-19, such model is suitable for our proposes[1])

1 One in principle can consider a SIRD model,in which the parameters that are time-dependent, as done by Ferrari et al. in Ref. [10] for the description of Italian situation. On the other side it is possible to increase the complexity of the model with other compartments as done in the following paper [11] by Giordano et al. Note that in this last case the resolution of 9 differential equation is required (accompanied by the estimation of a large number of parameters)

3 DATA DESCRIPTION

4 RESULTS AND DISCUSSION

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