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THE WORLD CUP EFFECT: A NEW AVENUE OF THOUGHT IN SEARCH OF AN EFFECTIVE DE-CONFINEMENT STRATEGY

By Aomar Ibourk & Karim El Aynaoui

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The World Cup Effect: A New Avenue of Thought in Search of an Effective De-confinement Strategy

Summary:

We explore a new avenue that could contribute to an effective de-confinement in the context of COVID-19. This phenomenon is known as the 'World Cup Effect'. We first define this phenomenon and highlight its existence and its possible amplifying effect with regard to the spread of the pandemic, in light of the number of infected cases recorded at the pandemic's peak, and the duration before reaching its highest level. Based on hypothetical scenarios in terms of the initial conditions at the lockdown exit, we show that under constant probability of infection, the World Cup Effect always results in a higher number of infected cases at peak ($\Delta y>0$), and in a shorter period before the peak is reached ($\Delta x<0$). Finally, we discuss the elements that can contribute to mitigating this effect. Partial or complete lockdown lifting should be accompanied by the maintenance of social-distancing measures and the use of face masks, limitation of contacts, cautious management of population flows and special control, if not closure, of mass gathering places, including 'Moussems', cinemas, stadiums, and schools.

Introduction

As more and more cities, provinces, and regions of the Moroccan Kingdom start to send out signals that the coronavirus health crisis is coming to an end, there is increasing focus on the possible date for lifting the lockdown, and people are wondering how to act properly. This last question—which was highly important when COVID-19 arrived and during its spread—is even more relevant in the context of the gradual easing of the lockdown. The challenges are so broad that Mundell's rules of efficient public policy instruments and Tinbergen's rule of coherence must be given full impetus. Modeling and designing scenarios can be useful, though it is necessary to clearly identify the objectives that need to be targeted and prioritized.

Our essay falls within this approach and sheds light on a spectrum of national debates on the prerequisites for a successful de-confinement and on topics often absent in such discussions. For instance, this paper looks at crowd psychology research, largely observed in practice and documented in the literature, with a particular emphasis on the relationship between place attachment and the rate of congestion during celebrations, festivals and other exceptional events (Tuan, 1974; Stokols & Shumaker, 1981; Proshansky, Fabian & Kanimoff, 1983; Low & Altman, 1992; Wickham & Deborah, 2000), which may likely include lockdown lifting. This is known as the 'World Cup Effect'.

This paper explores this phenomenon and highlights its relevance and its possible amplifying effect with regard to the spread of the pandemic, in light of the duration and number of infected cases recorded at the peak. It also contributes to the discussion of elements required for circumventing it.

I. The World Cup Effect: Theoretical and Empirical Basis

Let us first define the World Cup Effect. The term is used to describe an event leading to mass gatherings in very confined spaces, which are the result of community or individual attachments to a place (or places), often over a short time. This effect occurs, in principle, in cities, not only during events leading to mass gatherings, but also in normal life. A behavior consisting of seeking collective entertainment is also likely to produce such an effect. One of the consequences is increased frequent interactions between people and, therefore, an increased mixing within the population in question. Research informs us that mixture increases with density, but in a non-linear way. At the high density limit, the contact rate fits well with observations from different mass gathering events (Hao et al, 2013). Another consequence is increased risk of the spread of diseases at the geographical level, expressed in principle by an increase in the reproduction number, R_0.

The basic reproduction number, R_0, is defined as the expected number of secondary cases produced by a single (typical) infection in a completely susceptible population. It is important to note that R_0 is a dimensionless number and not a rate, although it is called 'the basic reproduction rate'.

$$R_0 = \tau * \bar{c} * d$$

Where τ is transmissibility (i.e. the likelihood of infection per contact between a susceptible person and an infected person), $\bar{c}$ is the average rate of contact between susceptible persons and infected persons, and **d** is the duration of infectiousness (Jones, 2007).

The experience of some countries suggests that the effect in question may occur in some localities as a result of easing lockdown restrictions. This is perhaps the case in Germany, where the R_0 rose above 1[1], in response to the first de-confinement measures, which involved reopening of shops with surface areas below 800 square meters, and of car and cycle dealers. In order to counteract the R_0 trend, wearing face masks became compulsory in shops.

In Denmark, the trend in the R_0 has also been on the rise since the reopening of schools and kindergartens. According to analyses by Denmark's Infectious Diseases Agency, the reproduction number, R_0, increased from 0.6, around the second week of April, to 0.9 towards the end of the same month. However, with the R_0 still below 1, the trend in the number of infected people remains downward..

1. According to a report by the public health agency (The Robert Koch Institute).

The return of the R_0 to an upward trend, after easing lockdown restrictions, was also noted in Asia, particularly in Hong Kong, Singapore, and Taiwan. A temporary two-week return to lockdown was imposed on residents. The resurgence is fundamentally associated with international travelers.

In Morocco, the first phase of de-confinement, which was triggered on June 10th, and the impact of the reopening on indicators of the spread of COVID-19 can only be assessed 10 days later (average incubation time). The hope is the figures will be reassuring. What is needed is mapping of the risks and measures, while taking into account a possible World Cup Effect.

In what follows, we present the mathematical bases of Susceptible-Infected-Recovered (SIR) modeling, which allows us to assess the evolution of the epidemic by taking into account an initial state and a set of progression rules. We will show that the occurrence of a World Cup Effect would result in a new higher peak reached in a shorter time, than in the case of a peak without a World Cup Effect. This difference resists changes in the initial state and the progression rules.

II. The World Cup Effect: Mathematical Bases

According to our definition of the World Cup Effect, a mathematical approach should take into account a two-stage spread: an initial stage of spread between populations at a gathering (or gatherings), and a second stage of a subsequent increase in the number of infected individuals because of contacts within the local population. This may suggest that the probability of infection (p) or contact rate (c) would tend to increase on days of mass gatherings and during the infectious period (j) associated with the first stage. Another assumption is that the probability of infection, the contact rate, and the duration of the infectious period are the same for all individuals in the second stage.

With such assumptions, we should expect a likely rapid accumulation of infected cases, resulting in peak levels being reached in a shorter period of time compared to a situation in which the World Cup Effect is not present. This is what we will show, later on, in the case of de-confinement without and with protection. To do so, we use a variant of the SIR (Susceptible-Infected-Recovered) model family, which allows us to approach the spread of the pandemic through scenarios, albeit in a simplistic but useful way, or when it comes to understanding the meaning of the gap between two scenarios.

The SIR (Susceptible-Infected-Recovered) model is used to model epidemics under simplistic conditions, namely: a constant population size (N), a constant contact rate, an absence of population dynamics, and a good population mixture. The latter condition means that in a well-mixed population any infected individual is likely to contact any susceptible individual with a fixed average probability over the entire period. This last assumption does not correspond to a World Cup Effect and will therefore be relaxed in the comparison scenarios.

Apart from this last remark, the formulation of the SIR model is made in relation to a closed population of N individuals of which there are S susceptible individuals, I infected, and R post-infection because of death or recovery. To designate the fraction of each, we consider the following notations: s = S/N, i = I/N, r = R/N.

The SIR model is then written as a system of differential equations:

$$\frac{ds}{dt} = -\beta si$$
$$\frac{di}{dt} = \beta si - \gamma i$$
$$\frac{dr}{dt} = \gamma i$$

$\beta = \tau * \bar{c}$: Effective contact rate;

$\gamma = \frac{\beta}{R_0} = \frac{1}{d}$: Removal rate, when assumed to be fixed and s ≈ 1.

Depending on the cases studied, certain assumptions may be relaxed, such as the consideration of spatial segregation and differentiation in the level of exposure according to population categories, etc.

III. The World Cup Effect: An Application

- **Case of de-confinement without protection**

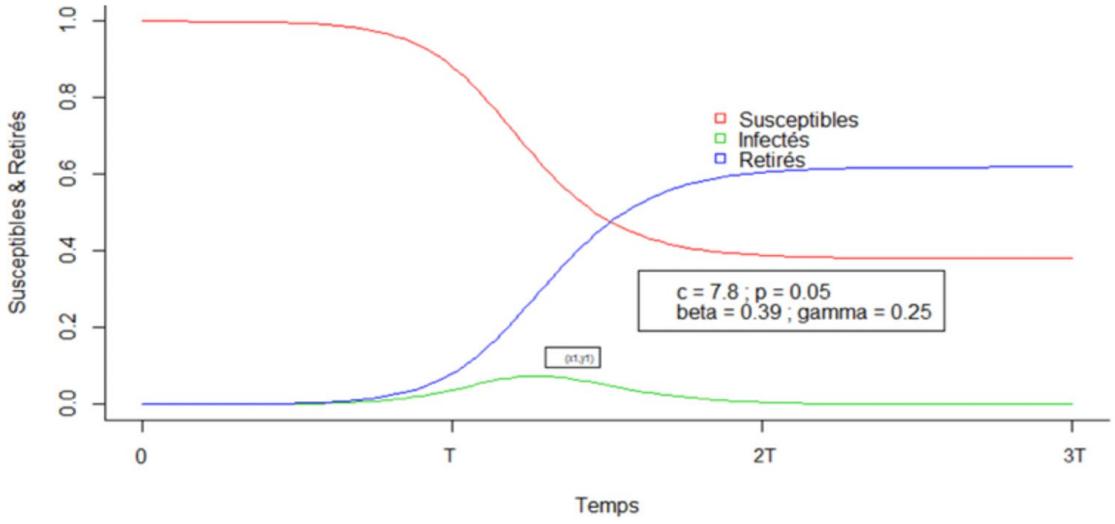
We make the following assumptions:

- As there is a share of persons that have been withdrawn (for reasons of death or recovery), R is therefore positive. The recent situation in Morocco and the upward trend in the number of persons recovered (5605 persons by May 30, 2020), suggests a value of R equal to 2/10,000;
- When the lockdown is lifted, part of the population is still infected. We note this part I, and place it at 0.5/10,000, by referring to the recent situation (May 30, 2020) and the downward trend in the number of people still infected;
- The World Cup Effect would increase the number of contacts that an individual could have per day over a six-day period. We assume a 50% increase in the contact rate;
- The population is well mixed at the selected spatial level. Any infected individual is likely to contact any susceptible individual with a fixed average probability over the entire period. We assume that the probability of being contaminated remains unchanged as a result of the World Cup Effect;

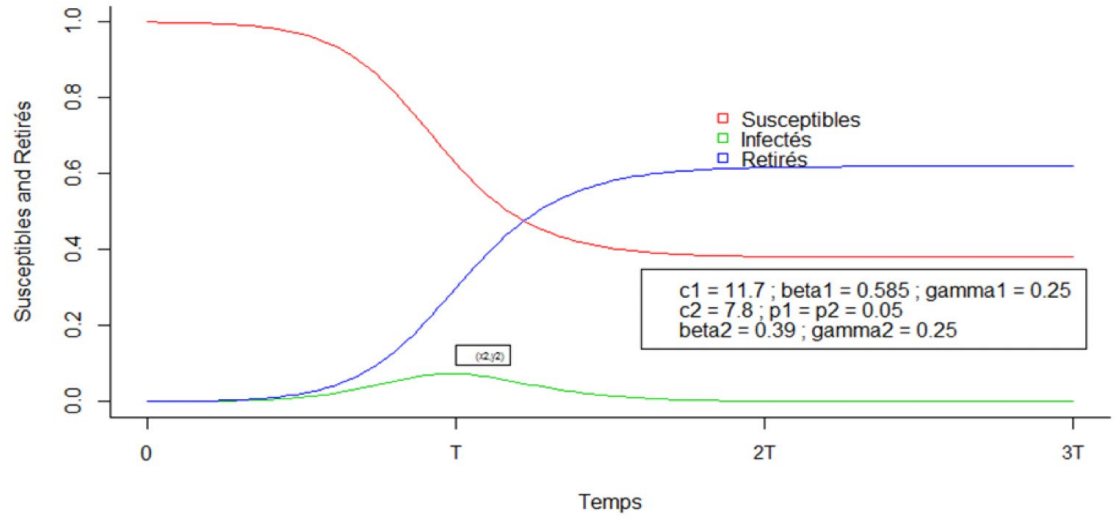
- Modelling parameters are assumed to be constant in the baseline scenario and variable between the first and second stages, for the World Cup scenario.

Based on the above assumptions, our estimates under the World Cup scenario point to a larger peak of infected people, occurring in fewer days compared to the baseline scenario[2]. The latter indicates a peak in the number of infected people at about 1.6/10,000 less than in the World Cup scenario. Also, this peak is reached after another 15 days, reflecting a less flattened curve in the presence of the World Cup Effect.

De-confinement without self-protection



De-confinement without self-protection – World Cup

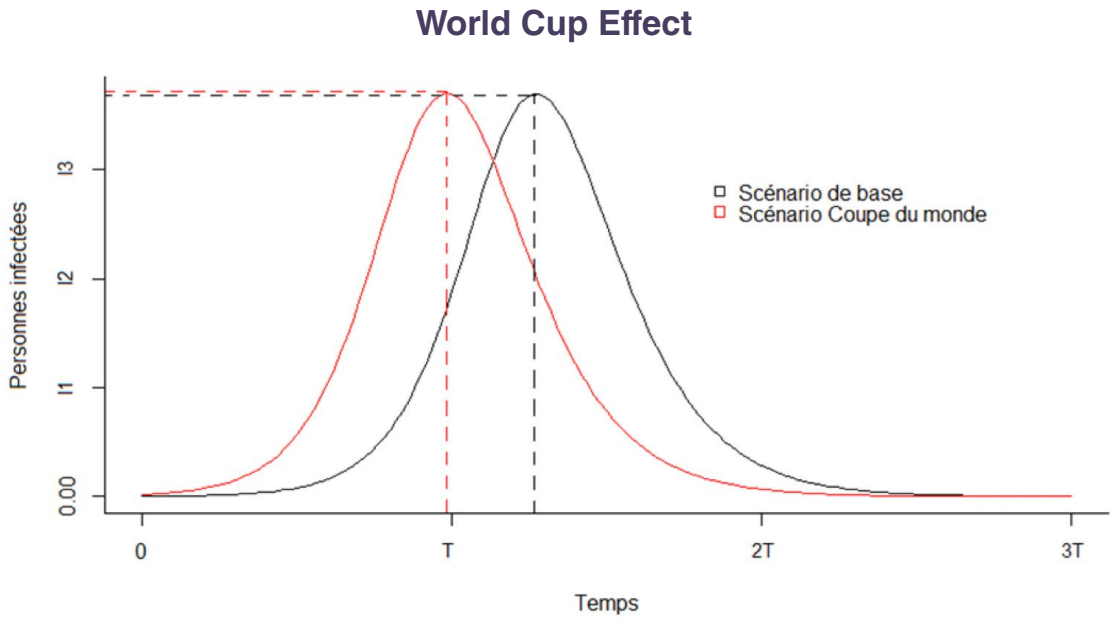


Source : Authors' simulations.

The figure below is used to highlight the effect discussed in the scenario of exit from lockdown without self-protection, including mask wearing, social distancing, and other self-protection provisions. It indicates that the difference in terms of the number of people

2. The parameters chosen for the calibration of the model are the same as those used by the HCP (High Commission for Planning) in its work on « THE COVID-19 PANDEMICIN THE NATIONAL CONTEXT: Situation and Scenarios ».

infected at the peak is positive (Δy> 0) while it is negative in terms of the time travelled before the peak (Δx< 0).

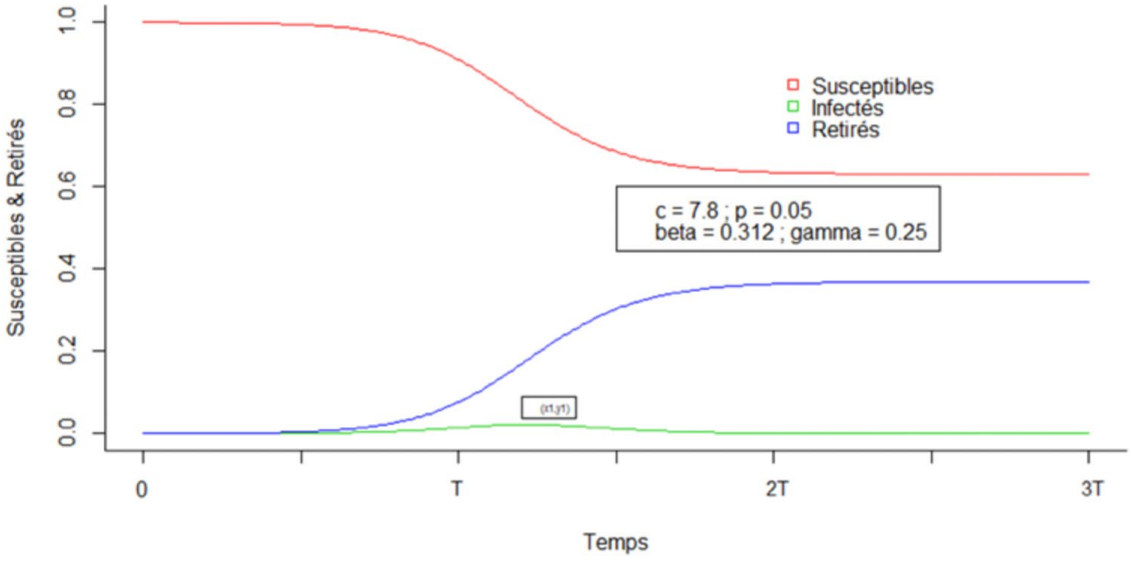


Source: Authors' simulations.

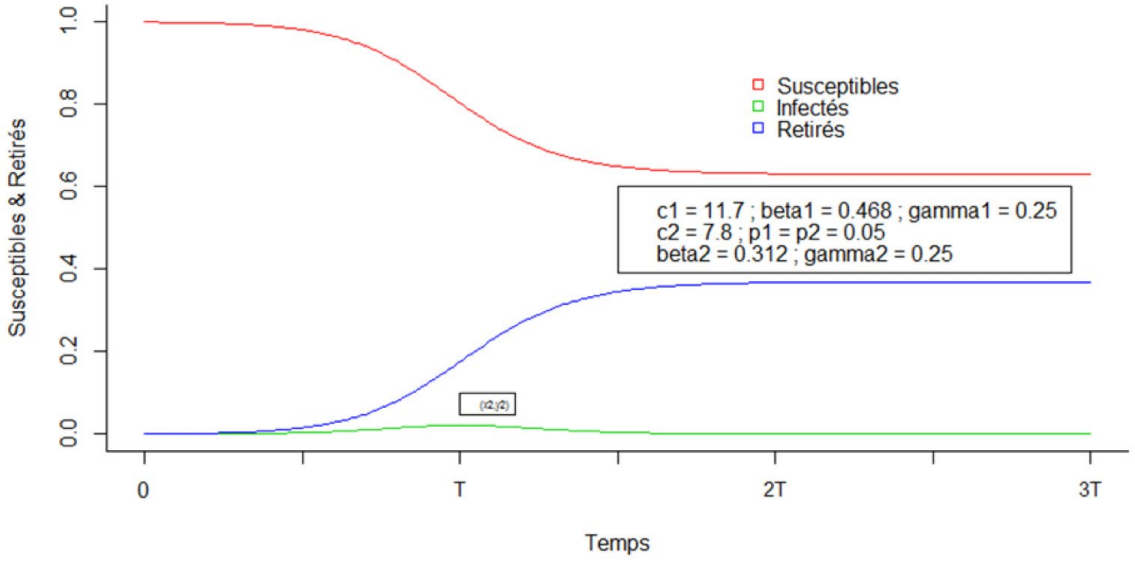
- **Case of de-confinement with self-protection**

In this case, our estimates point to a positive impact of the protective measures on the number of infected persons at peak time, but also in terms of the flattening of the curve of infected persons, as indicated by the time between the day of lifting of the lockdown and the peak day. These estimates show, once again, a higher peak in a shorter period in the context of the World Cup scenario, compared to the baseline scenario. The latter indicates a peak in the number of infected persons of about 0.78/10,000 less than in the World Cup scenario. Also, this peak is reached after 22 more days, again reflecting a less flattened curve in the presence of the World Cup Effect.

De-confinement with self-protection

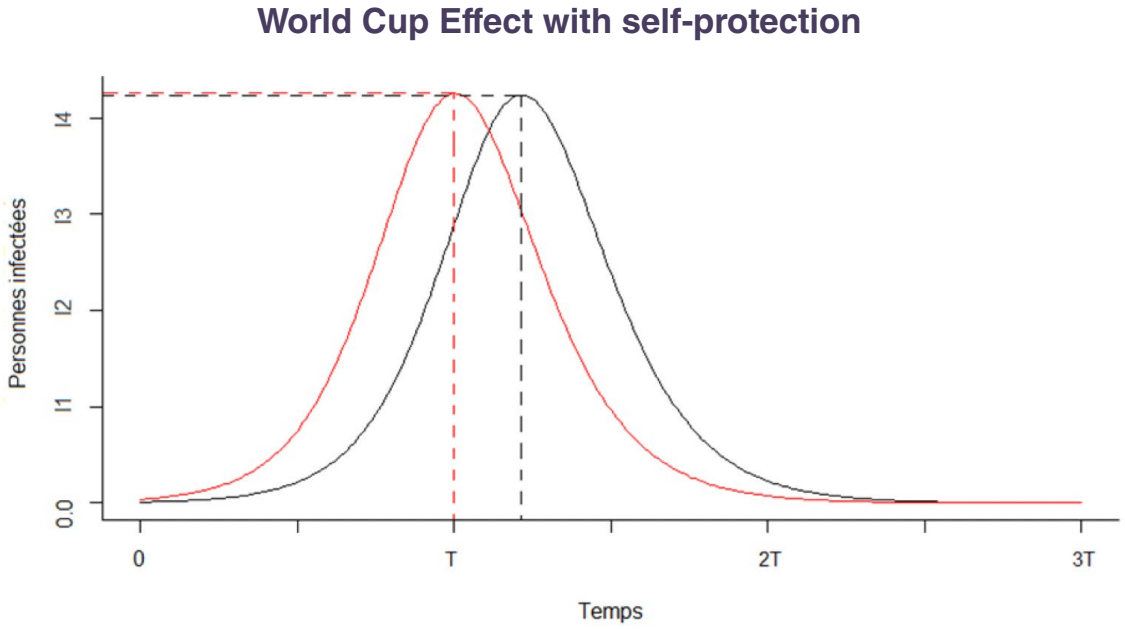


De-confinement with self-protection – World Cup



Source: Authors' simulations.

The figure below confirms the presence of the World Cup Effect in the case of de-confinement, this time with self-protection (mask wearing, social distancing, and other self-protection provisions). It also indicates that the difference in terms of the number of persons infected at the peak is positive ($\Delta y > 0$), while it is negative in terms of the time travelled before the peak ($\Delta x < 0$).



Source: Authors' simulations.

IV. How Can the COVID-19 Reproduction Number be Influenced During Periods of Lockdown Relaxation? Lessons Learned

The literature and facts, in addition to our estimates, indicate that density is a decisive factor. The virus spreads much more efficiently in densely populated areas, including those that may arise as a result of a World Cup Effect. Usually, de-confinement practices, social distancing, and face-mask wearing tend to decrease the reproduction number and thus reduce the number of coronavirus cases.

In the context of a World Cup Effect, the use of technology would be very useful to inform those who manage community attachment to places during events that generate crowds of a certain size and/or mass entertainment.

To this end, partial or complete lifting of the lockdown should be accompanied by the maintenance of social-distancing measures, which happens to be the winning strategy. This includes maintaining the closure of mass-gathering places, including cinemas, stadiums, and schools.

In public spaces, mask wearing is compulsory. Limiting contacts should be the rule until the return to 'life as before'. Recommendations in terms of hygiene and protective behavior (towards each other) remain in place.

The management of population flows should also be part of the measures at this stage of gradual de-confinement. This concerns both public spaces with large flows (e.g. railway stations and stops) and work spaces.

The consequence of gradual de-confinement implies that population flows in all workspaces will have to be rigorously analyzed in the context of the pandemic. New conditions for the management and use of these spaces should be subject to appropriate analysis, followed, for example, by adjustments to the start and end times of activities identified as relevant to effective flow management.

In addition to these practices, which we consider appropriate in a World Cup Effect context, other good practices, dictated by the authorities and identified in the literature, are essential for the lockdown to be successfully lifted.

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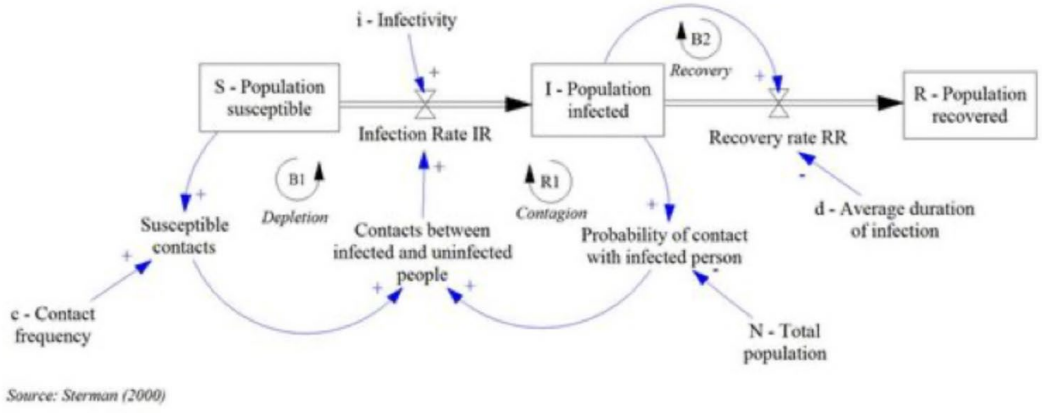
Annexes

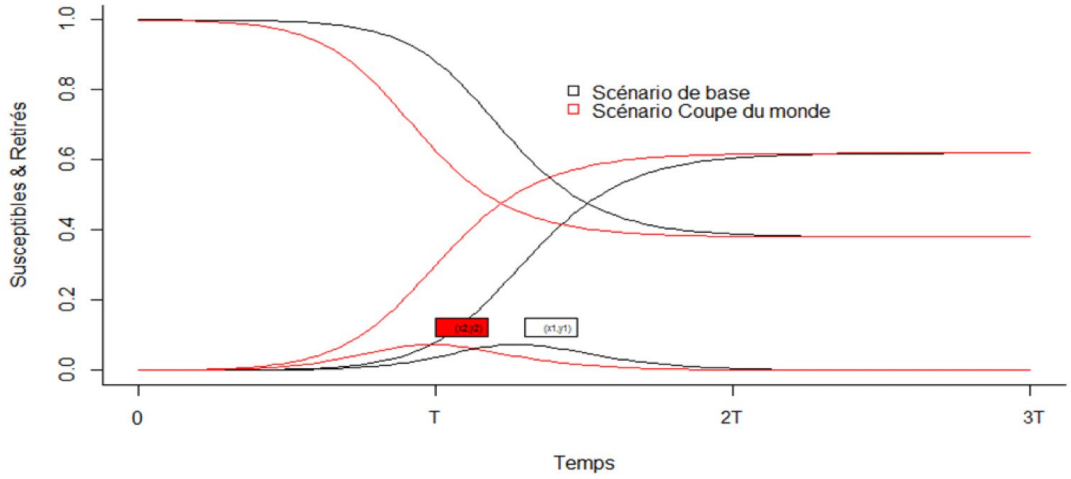
Pandemic explained using System Dynamics



Source: Sterman (2000)

De-confinement without self-protection

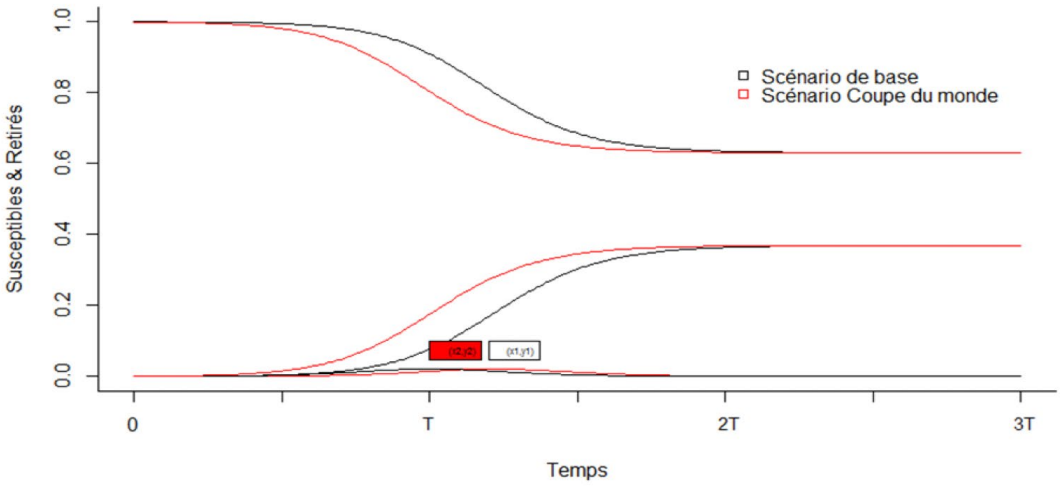
World Cup Effect



Source: Authors' simulations.

De-confinement with self-protection

World Cup Effect with self-protection



Source: Authors' simulations.

About the author, Karim El Aynaoui

President of the Policy Center for the New South, and Executive Vice-President of the Mohammed VI Polytechnic University and Dean of its Faculty of Economics and Social Sciences.From 2005 to 2012, he worked at the Central Bank of Morocco (Bank Al-Maghrib) where he served as Director of Economics, Statistics and International Relations. He was also in charge of the Research Department and was a member of the cabinet of the Governor. Prior to joining Bank Al-Maghrib, Karim El Aynaoui worked for eight years at the World Bank, as an Economist within the Middle East, North Africa, and Africa regions. Read more

About the author, Aomar Ibourk

Aomar Ibourk, is a professor of quantitative methods and social economics at the Cadi Ayyad University in Marrakech, an economist, as well as Senior Fellow at the Policy Center for the New South, who focuses on Applied econometrics, labor market, economics of education and development economics. He is also the director of GRES (Economic and Social Research Group) at the same university. His research focuses on econometric methodologies applied to social sciences (labor economics, economics of education and Development). Mr. Ibourk's doctoral thesis looks into the "Contribution to Econometrics through the Labor Market Matching Process: Macro and Microeconometric Approaches to the Moroccan Labor Market."

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Policy Center for the New South

Suncity Complex, Building C, Av. Addolb, Albortokal Street,
Hay Riad, Rabat, Maroc.
Email : contact@policycenter.ma
Phone : +212 (0) 537 54 04 04 / Fax : +212 (0) 537 71 31 54
Website : www.policycenter.ma