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Effectiveness of Corona Lockdowns: Homburg's Flawed Analysis

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Abstract
This is a comment on Homburg (2020) who claimed that lockdowns were superfluous and ineffective. We demonstrate major flaws: Homburg's data base is not suitable to support his claim and his econometric approach does not allow for an analysis of a lockdown's incremental effect.

JEL Classification: I18.

Keywords: Corona, SARS-CoV-2, Covid-19, Lockdown.

1. Introduction

Homburg (2020) attempts to study the effectiveness of a comprehensive lockdown. It becomes clear in his discussion, he does not refer to traditional containment measures such as social distancing, testing, contact tracing or quarantine. Rather, he "questions [.] that the lockdowns of entire economies yielded additional benefits". With regard to Germany, he refers to the restrictions of March 23, 2020, the so called contact ban and the Germany-wide closure of restaurants and services in body care.

With his short, but far-reaching conclusion "lockdowns were superfluous and ineffective", Stefan Homburg achieved broad public attention. An evaluation of contact restrictions in Germany and elsewhere is of interest in retrospect, but also for the scope of future containments of the SARS-CoV-2 epidemic and the prevention of a second wave. For this reason, it is important to examine the data and the derivation of Homburg's conclusion. In section 2, first, we check for the soundness of his data base and his methodological approach. In section 3, we corroborate his conjecture that infections in Germany started receding before March 23. In section 4, we conclude that although stated otherwise, Homburg does not provide an incremental analysis of the effectiveness of the lockdowns.

2. Data Base and Method

The basic idea of Homburg's analysis is clear. For the evaluation of the SARS-CoV-2 containment measures, the evolution of the daily number of new infections is crucial. However,

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daily reported cases do not provide a clear picture of the dynamics of the epidemic since they depend on the intensity of the quest for cases (test criteria, intensity of testing, diligence of contact identification) and, for that reason, are intertwined with the control intensity. Daily reported Covid-19 deaths, by contrast, as conjectured by Homburg, "are much more reliable" than diagnoses. Thus, the time series of daily Covid-19 deaths is the basis of his evaluation of epidemic control, using Johns Hopkins University's (JHU) database covering the period between March 1 and April 13, 2020.

From the path of the daily Covid-19 deaths, the unobserved („true") path of daily new infections can be deduced if the average time interval between infection and death is known and constant. Homburg applies an estimate of 23 days from two respectable publications of case series from China. With this interval, he transfers the path of deaths back in time to reconstruct the path of infections. Homburg´s stylized figure 1 shows both curves: in black the curve of deaths, and to the left, strikingly red colored, the curve of new infections. Naturally, the red curve does not include any independent information. The corresponding text reads „the red bars correspond to the actual infections, which are not directly observable", bringing home to the reader the unobservable.

As the progression and the peak of infections and deaths are identical except for the shift, the robustness of data interpretation solely depends on how trustworthy daily mortality data are. Homburg finds their maximum for April 7 in calendar week 15, minus roughly three weeks lead time point to March 15. March 12 marks the day of the crisis conference between chancellor Merkel and the prime ministers of the federal states (Merkel: "Where possible, abstain from social contacts"). Therefore, effective, although not yet specified determinants shortly after March 12 should have resulted in a reversal of the unobserved trend of new infections, as inferred from the observable Covid-19 mortality.

2.1. Quality of certified causes of death

The quality of mortality statistics is subject to a long and broad critical literature. In Germany as elsewhere, the classification of Covid-19 deaths has been discussed in terms of death due to or with coronavirus infection. Arguably, classification errors are approximately constant over time, so that the peak of the mortality trajectory can still be interpreted. However, the number of deceased *with* Covid-19, who were positively tested and counted as epidemic deaths, is confounded with case ascertainment and test intensity, factors from which Homburg wants to abstract. In contrast, there must have been patients who died at home or in a skilled nursing facility due to Covid-19, but did not count as epidemic deaths when related symptoms were not recognized, not scrutinized by tests or individuals were not conspicuous within contact chains. Total (or all cause) mortality is resistant to misclassification, so we inspect it in section 3.

2.2. Time interval between infection and death

Homburg's quoted sources report a 95% confidence interval of the incubation period from 4.5 to 5.8 days (Lauer et al. 2020) and the time between onset of symptoms and death from 16.9 to 19.2 days (Verity et al. 2020). A confidence interval of one or two days around the 23 day-interval would not fundamentally question the important finding that the dynamics of the infections must have changed around mid March. However, the mechanism of epidemic control remains a black box. Loose couplings limit a causal inference regarding the effect of the regulatory intervention. People might have changed their contact behavior even earlier, on their own initiative or in anticipation of containment measures. This is very likely, given the results of the COSMO survey: already in the first wave (March 3 and 4, 2020) 96 % of the respondents knew the mode of SARS-CoV-2 transmission (droplets), 95 % stated hand hygiene and 90 % sneezing hygiene (Betsch et al. 2020). In any case, deaths are not a perfect correlate of epidemic dynamics. In this respect, the author's premises need to be qualified, although they are not necessarily false.

2.3. Replication of Homburg's logistic curve – and beyond

Homburg assumes that the epidemic follows a logistic function $f(t) = \frac{S}{1+ae^{-bt}}$, where t is time and a, b and S are parameters of the function. Below, the saturation limit S is of particular interest. The symmetry of the distribution of new infections allows him to derive the turning point t^* where new infections reach their maximum ($t^* = -ln(1/a)/b$, the parameters a and b are estimated separately for each country). He does not present any details of his computations. Using the publicly available JHU data, we reverse engineer his approach using the software package R for model fitting and visualizations. Applying non-linear least squares via the *nls* function from base R, we minimize $RSS = \sum_{i=1}^{T}\left(t_i - f\left(t_i, \Theta\right)\right)^2$, with $\Theta = \left(S, t^*, c\right)$ and $f\left(t_i, \Theta\right) = \frac{S}{1+e^{(t^*-t_i)/c}}$. In this parametrization, slightly different from Homburg's, the turning point t^*, conveniently, is a parameter of the curve.

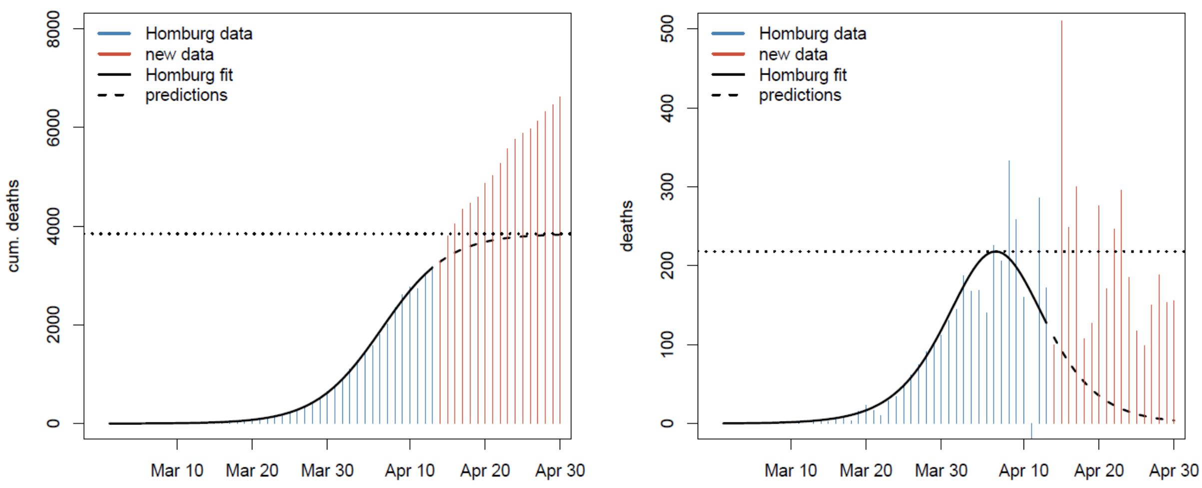

Figure 1: Germany's covid-19 cumulated and daily deaths in March and April 2020

Figure 1 and figure 2 show the fitted curves for the evolution of cumulated and of daily deaths for Germany and Italy, respectively, based on data for the period from t_1 = March 1 to t_{44} =

April 13, 2020 (figure 2 corresponds to Homburg's figure 2 for Italy, except that it also contains the observations until April 30 in order to assess the robustness of his fitted model). The respective estimated mortality rate at the end of the epidemic is 0.005% for Germany and 0.036% for Italy. These mortality rates are obtained as ratios of the implied saturation levels (parameter S of the logistic curve) and population totals; they agree (in the case of Italy up to minor rounding) with Homburg's figures.

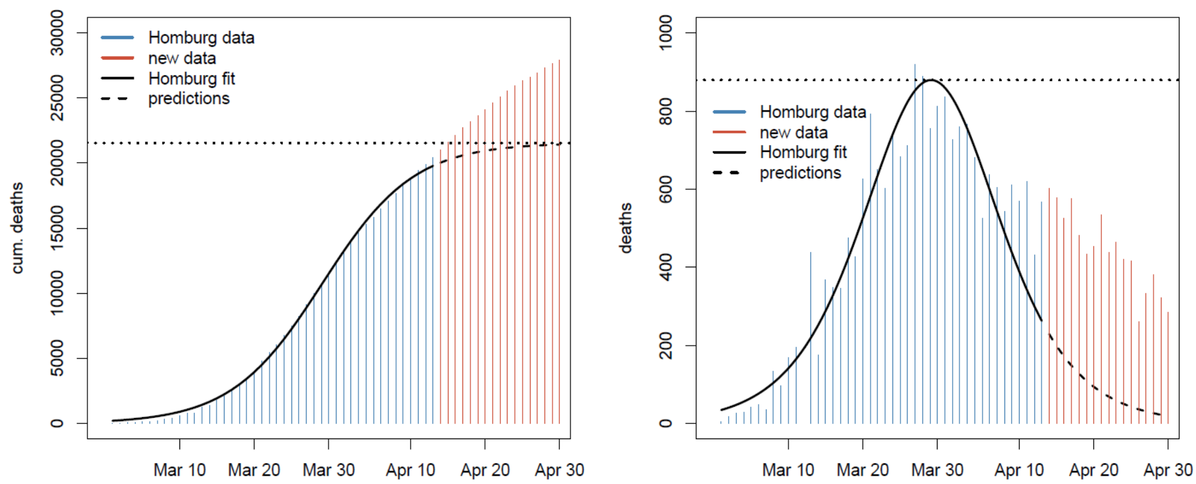

Figure 2: Italy's covid-19 cumulated and daily deaths in March and April 2020

Clearly, the curves fitted to the data up to April 13 do not predict the evolution of the epidemic until April 30. Since the epidemic started earlier in Italy, the corresponding model captures the peak of deaths quite accurately. Still, as with Germany, the saturation limit is substantially underestimated. Symmetry of the implied derivatives is also violated in view of the new data, as the latter are substantially skewed to the right.

Moreover, the logistic curve fitted to the observed series of deaths until April 13 (lagged and down-scaled by the lethality) cannot represent the (logistic) curve of the infection trajectory up to the end of the epidemic. For Germany, the curve is truncated 7 days after its maximum and its trajectory is affected by the curbing effect of the events after mid-March. The future trajectory to which Homburg had no access will be right skewed, and, thus, not symmetric.

2.4. International comparisons do not bail out

International comparisons cannot compensate for the shortcomings of the data base mentioned above as all countries have been affected. Country-specific differences in the methodology of cause of death certification are not addressed, as well as statements on country-specific differences in the implementation of similarly denominated interventions.

3. What Can Be Said Anyway?

To begin with, the maximum of deaths in the JHU dataset, used by Homburg, occurs almost exactly at the same date as the maximum of deaths (8. April) that were reported to and by the Robert Koch Institute (RKI).

More robust than the thin ice of Covid-19 associated deaths appears to be the time trend in excess total mortality. It has long been known that overall mortality is affected by influenza epidemics. This should all the more be the case with SARS-CoV-2 featuring a more unfavorable infection kinetics and higher lethality than influenza (Ruan 2020). The ongoing time series of deaths compiled by Destatis, the Federal Statistical Office of Germany, however, shows a complex picture (figure 3 plots the numbers of death of individuals age 65+).

First, a substantial seasonal variability in the number of deaths stands out. In 2017, numbers peaked in calendar week 5. In 2018 a mortality excess with a peak in calendar week 10 occurred. In 2020, the number of deaths in the first 4 weeks was very similar to that in 2016, 2018 and 2019, but a relative excess can be suspected for calendar weeks 14 to 15.

The influenza season 2017/18 was associated with the highest excess mortality since 1995/96 (RKI 2019, p. 46). Following this excess mortality, we would expect a compensating reduction in mortality to ensue because many vulnerable people have died already. In 2020 containment measures against SARS-CoV-2 also curbed the transmission of respiratory infections including influenza (Buchholz et al. 2020; Buda et al. 2020). With fewer inpatient cases in times of the epidemic, avoidable mortality could increase, but the number of deaths connected with adverse events during hospital stays (roughly 1 in 1000 inpatient cases, Geraedts 2014) would decrease. Still, the evolution of excess mortality in 2020, as far as tentatively observable so far, is not inconsistent with Homburg's finding of a Covid-19 mortality peak in calendar week 15.

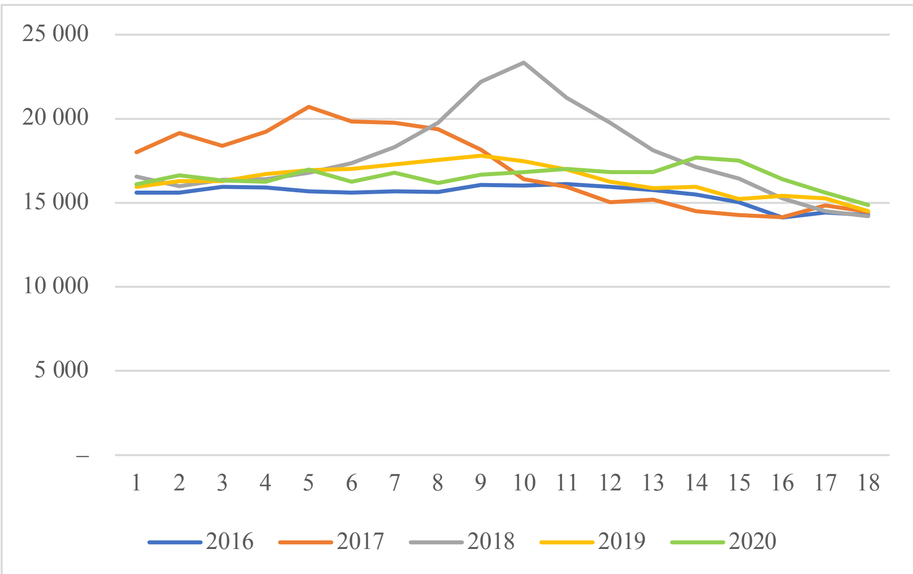

Figure 3: Weekly number of decedents age 65+, Germany, calendar weeks 1 to 18 from 2016 to 2020, respectively

Source: Destatis special analysis, May 29, 2020

If we additionally consider the evolution of reported cases, what Homburg wanted to avoid, a maximum in the reproduction number appears shortly before March 12 (the 4 day moving average on March 11, the 7 day moving average on March 10; see figure 4) in the runup of the events on March 12. The reproduction number published by the RKI lags behind the actual events several days. A peak on March 11 would imply that measures started to be effective before that date (borders closed weekend March 14-15, schools March 16). It is in the nature of an epidemic that the earliest measures can be particularly effective. In airborne or droplet transmission, this would be physical distancing, sneezing etiquette, self-isolation and contact tracing. In the period between March 13 and March 21, the day the reproduction number fell below 1 (the 7 day value on March 22), the dynamics of the epidemic decelerated. The daily number of reported cases continued to increase, however, reaching its maximum on March 19. Whatever happened around March 12 did not necessarily stop the epidemic, at least not immediately. On April 13, when Homburg submitted his paper, there were 2447 Covid-19 cases reported in German intensive care units, 1841 of them were on respirators (DIVI 2020).

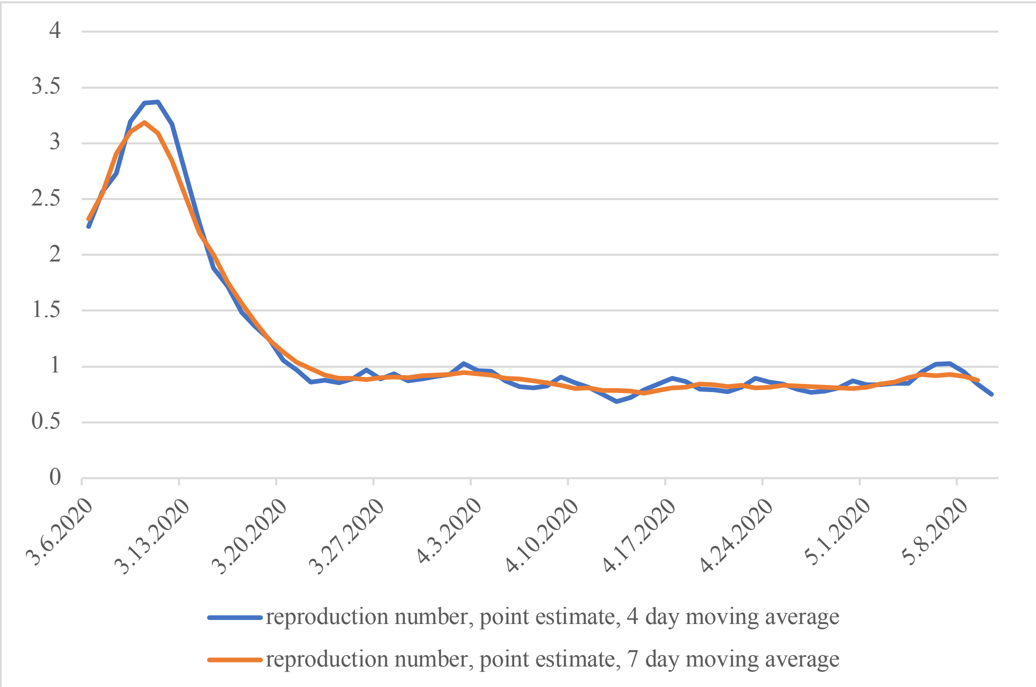

Figure 4: RKI's reproduction number R(t)
Source: RKI Nowcasting, May 14, 2020

4. The Lockdown's Incremental Effect: a Conclusion without Data and Parameters

Homburg posited receding infection rates shortly after March 12, based on two parameters: the peak in the daily evolution of deaths and the time interval of 23 days between infection and death. He does not discuss the robustness of the two parameters. If we include further data such as the (German) excess mortality and the reported SARS-CoV-2 cases, a rather plausible conclusion arises: the measures agreed on March 12, 2020, or already previous preparations, significantly reduced or deferred SARS-CoV-2 infections. If Homburg had presented only that, no objections would arise.

Homburg's quest, however, is for the additional effect of the measures taken at or after March 23, 2020. For such an *incremental* analysis, he should have included all deaths from that day in his 23 day interval, i.e., until April 15, 2020, and, in addition, a sufficiently long period to evaluate the trend. For the assessment of the incremental effect, he lacked the data. Furthermore, for his regression model he would have needed additional parameters, to begin with, a variable for marking the date of the presumed lockdown. Such an approach also would have needed to address state-specific heterogeneity, as Bavaria and the City of Freiburg decreed a curfew even before March 23, 2020.

Although explicitly stated otherwise, Homburg failed to conduct an incremental effectiveness analysis of the lockdown – this was not even feasible with his approach. His model is under parameterized and his conclusion, hence, has no empirical basis. It even is misleading as the lockdown is not modelled. More ambitious analyses of the topic have been made available in the meantime (Banholzer et al. 2020, Dehning et al. 2020, Donsimoni et al. 2020, Hartl et al. 2020, Huber and Langen 2020).

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