Covid-19 in Germany

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The past, the future, the health-income trade-off and an exit plan

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7 May 2020

1. Introduction

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- How can we understand its spread up to today?
- What do we expect for the future?
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Talk consists of two parts

- Spread up to today and what this tells us about
  - restrictions of social contacts (section 2.1)
  - relaxing restrictions (section 2.2)
- What we expect for the future and what this will tell us about
  - the income-health trade-off (section 3.2)
  - an exit plan (section 3.3)

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  - strongly reduced the spread of CoV-2 infections
- Relaxing restrictions of social contacts as of 20 April
  - had only weak (negative) health effects for Germany as a whole
  - Enormous differences across federal states
- The health-income trade-off
  - is strong (elasticities $>> 1$) and potentially non-monotonic
  - is only half of the story (as income also has health effects)
  - guides us towards an exit plan (do we "want" a second wave?)

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Talk summarizes our work on Covid-19 in Germany

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- Authors of these studies are
  - Jean Roch Donsimoni, Constantin Weiser, Klaus Wälde (Economics and Econometrics, Mainz)
  - Bodo Plachter (Virology, Mainz)
  - René Glawion (Economics, Hamburg)
  - Tobias Hartl, Enzo Weber (Econometrics, Regensburg)
  - Jens Timmer (Physics, Freiburg)
- The Covid-19 Trade-Off Between Income and Health
- Covid-19 in Deutschland – Erklärung, Prognose und Einfluss gesundheitspolitischer Maßnahmen, Perspektiven der Wirtschaftspolitik
- Should contact bans be lifted in Germany? A quantitative prediction of its effects, R&R
- Projecting the Spread of COVID19 for Germany, German Economic Review, German summary in Wirtschaftsdienst
- Measuring the impact of the German public shutdown on the spread of Covid-19, Covid Economics: Vetted and Real-Time Papers

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- Unrestricted spread before 13 March 2020
- Social restrictions and restrictions on firms as of 14 March
- Partial exit as of 20 April
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Do we see effects of public health measures?

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- Public health measures (second regulatory phase)
  - 14 March onwards: no schooling, no major sports events
  - 22 March onwards: no restaurants, theaters, public sports facilities
  - Effects should be visible one week later due to
    - incubation period
    - contacting a doctor and
    - testing

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  - 14 March onwards: no schooling, no major sports events
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  - Effects should be visible one week later due to
    - incubation period
    - contacting a doctor and
    - testing
- Hypotheses
  - Hypothesis 1: Measures of 16 March are visible around one week later
  - Hypothesis 2: Measures of 22 March are visible one week later as well

2. The spread up to today

2.1 The effects of restricting social contacts

- Statistical findings

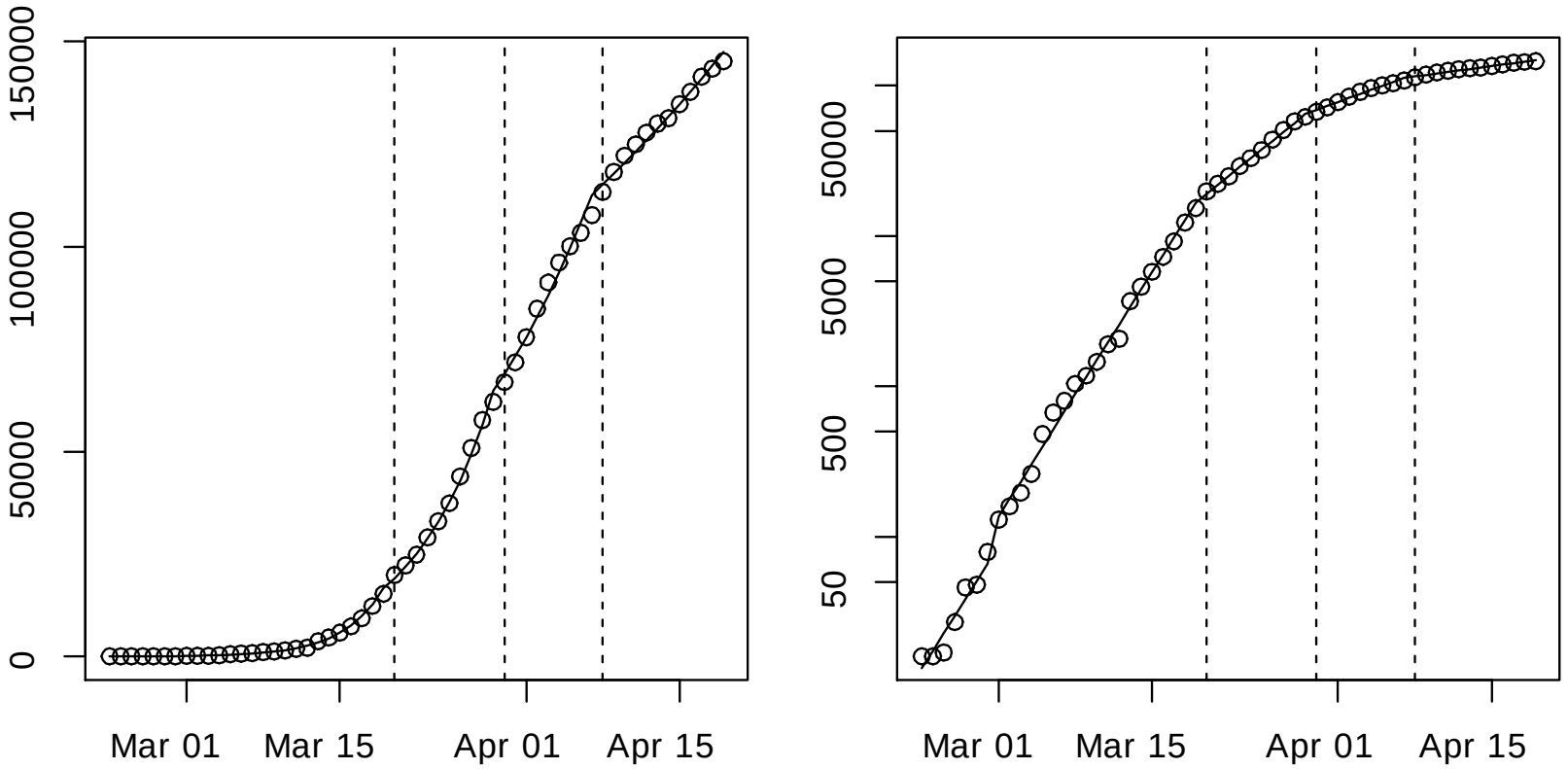

Figure 1: Number of reported infections (logarithmic scale on right) (Donsimoni et al., 2020, PWP, Hartl et al., 2020, Covid-Econ)

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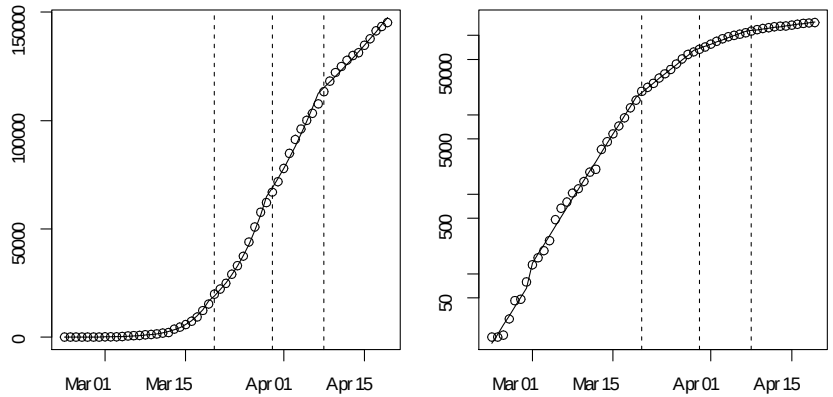

Figure 1: Number of reported infections (logarithmic scale on right) (Donsimoni et al., 2020, PWP, Hartl et al., 2020, Covid-Econ)

- Significant reduction of growth rates on 20. March (by almost 50%), 30. March (and 8. April)
- Effects are visible one week after policy measures
- Public health measures were successful in reducing the number of reported infections

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- We were in a relatively stable regime
  - relatively constant rules between 14 March and 19 April
  - relative acceptance by population
  - confirmed by estimation of Gompertz curves at various points in time
- Restrictions of social contacts (RSC) are being relaxed
  - New rules as of 20 April (third regulatory phase)
  - What are the effects of relaxing RSC on infections?

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- The effects of relaxing RSC as of 20 April
  - Incidence has been and continues to fall since April 2nd (RKI data)
  - Incidence falls less quickly at national level: Relaxing RSC comes at a (small) health cost
  - Incidences rise and fall relative to pre-20 April times in federal states

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- Incidence has been falling since April 2nd

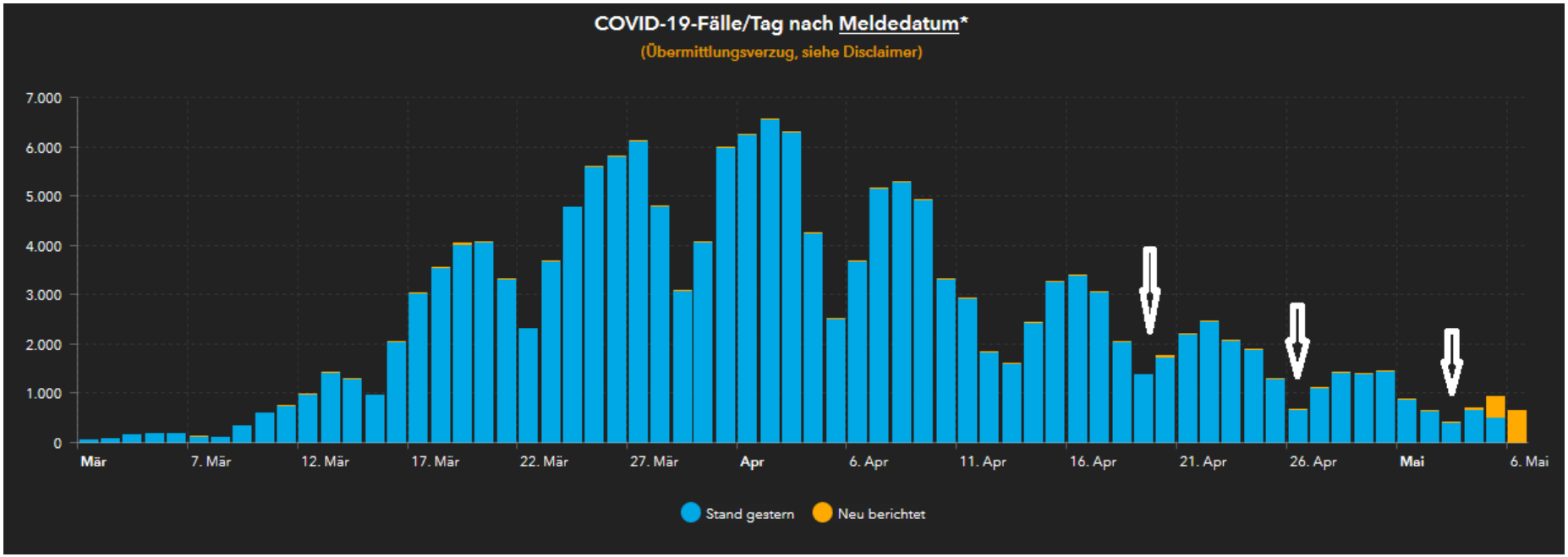

Figure 4: Incidences by date of reporting (RKI - download today)

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- Relaxing RSC comes at a small health cost

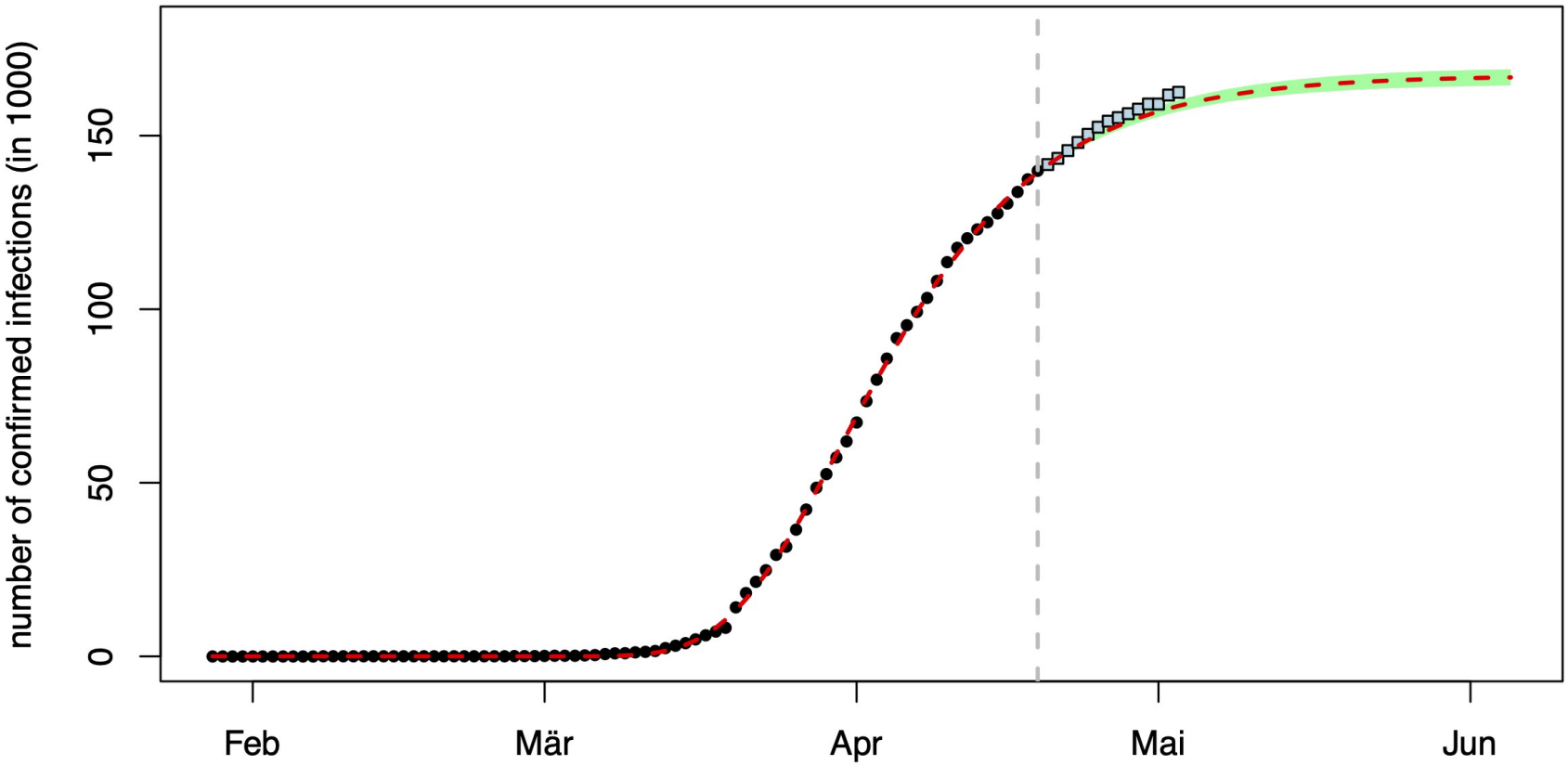

Figure 5: Gompertz curve (number of infected in 1000) – Post-April-20 infections (grey) slightly above projection (red dashes)

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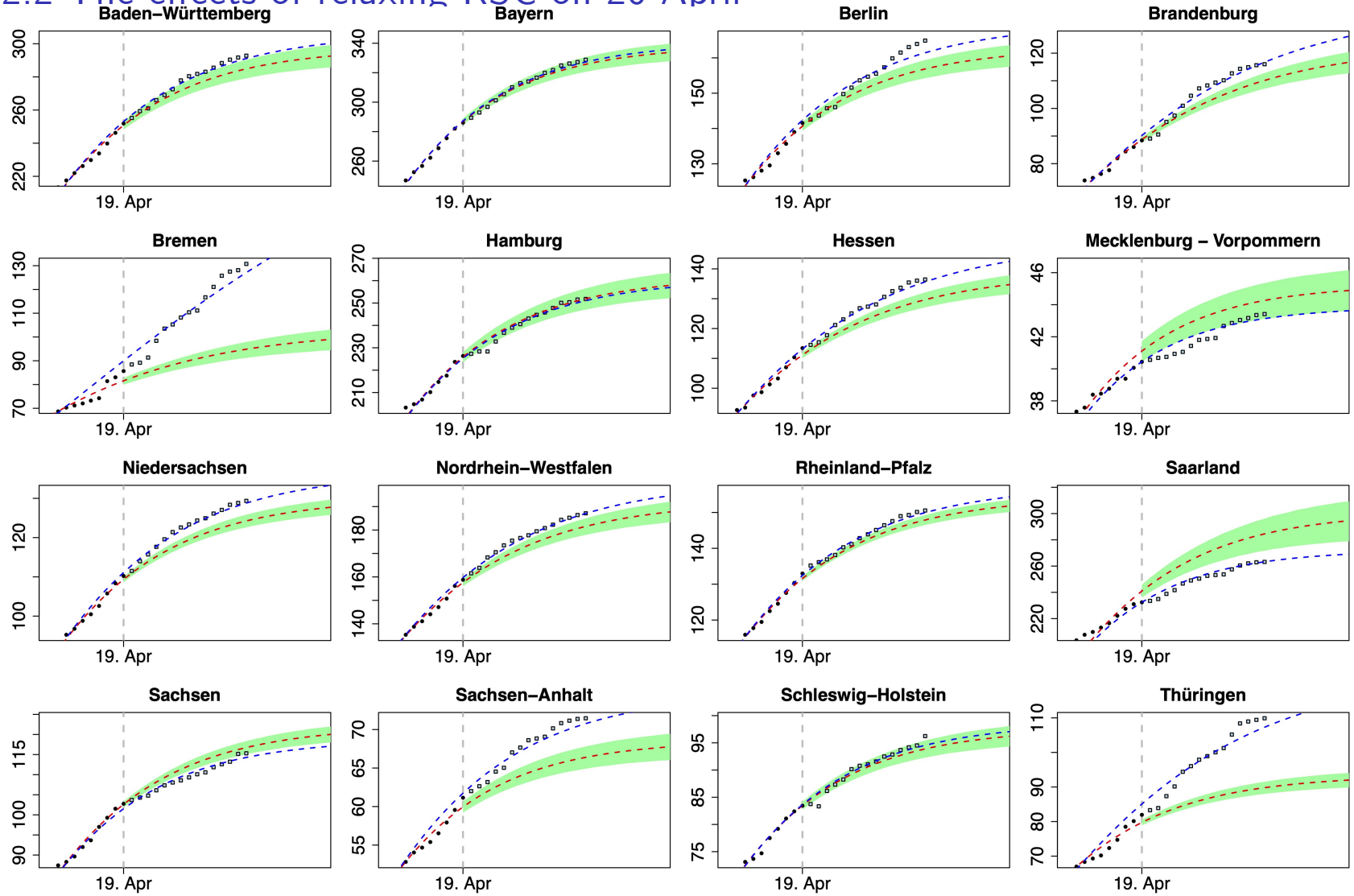

Figure 6: Changes in federal states (number of infected per 100,000 inhabitants)

3. What we expect for the future

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3.1 The model

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- Extend existing SIR models to cover Covid-19 specificities
- Calibrate/ estimate parameters of model
  - using RKI data
  - making two assumptions on share of hidden infections and long-run infection rates

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- The model (graphically speaking)

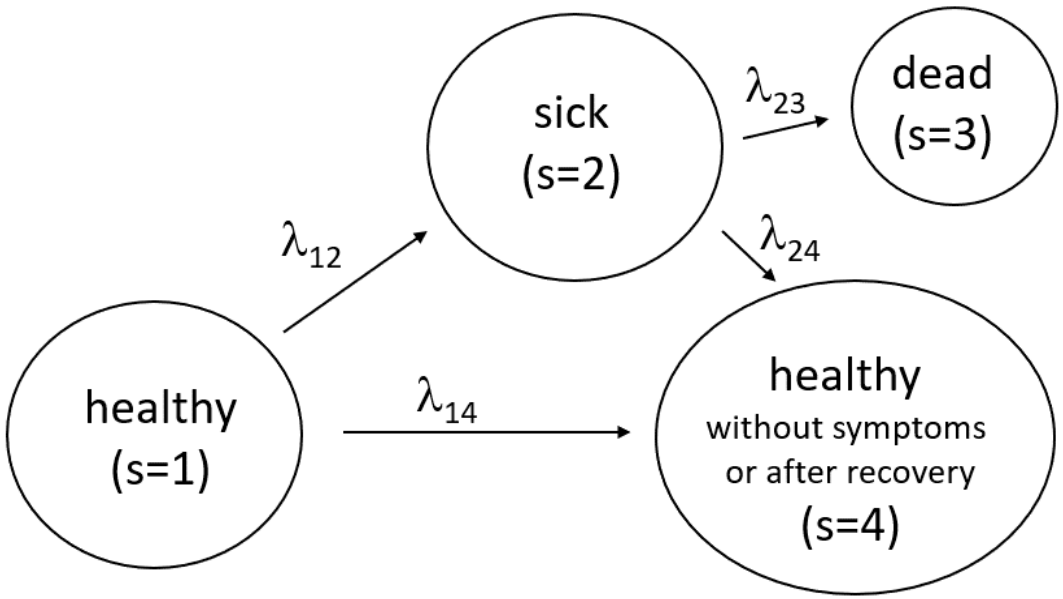

Figure 2: An extended SIR model for Covid-19 (Donsimoni et al., 2020, GER)

3. What we expect for the future

3.1 The model

- Central variable of model (theory, calibration) is sickness rate

$$\lambda_{12}(t) = \lambda(a(t), ...)$$

  Depends inter alia on "the susceptible" $N_1(t)$, "the infectious" $N_2(t)$ and "the recovered" $N_4(t)$ and on a *contact rate* $a(t)$
- Healthy individuals work and are called the employed

$$L(t) = N_1(t) + N_4(t)$$

- Cobb-Douglas production function

$$Y(t) = Aa(t)^{\beta} L(t)^{1-\alpha}$$

  - We assume constant TFP and constant capital stock, all merged in A
  - Output elasticity of capital is denoted by α
  - Social contacts $a(t)$ affect output via capacity utilization and labour supply – captured by $a(t)^{\beta}$ where β is an elasticity parameter
- Incidences over next month denoted by $N^{\text{new}}_{\text{month}}(t, a)$
- GDP over the next month is $GDP(t, a) = \int_t^{t+31} Y(s, a)\, ds$

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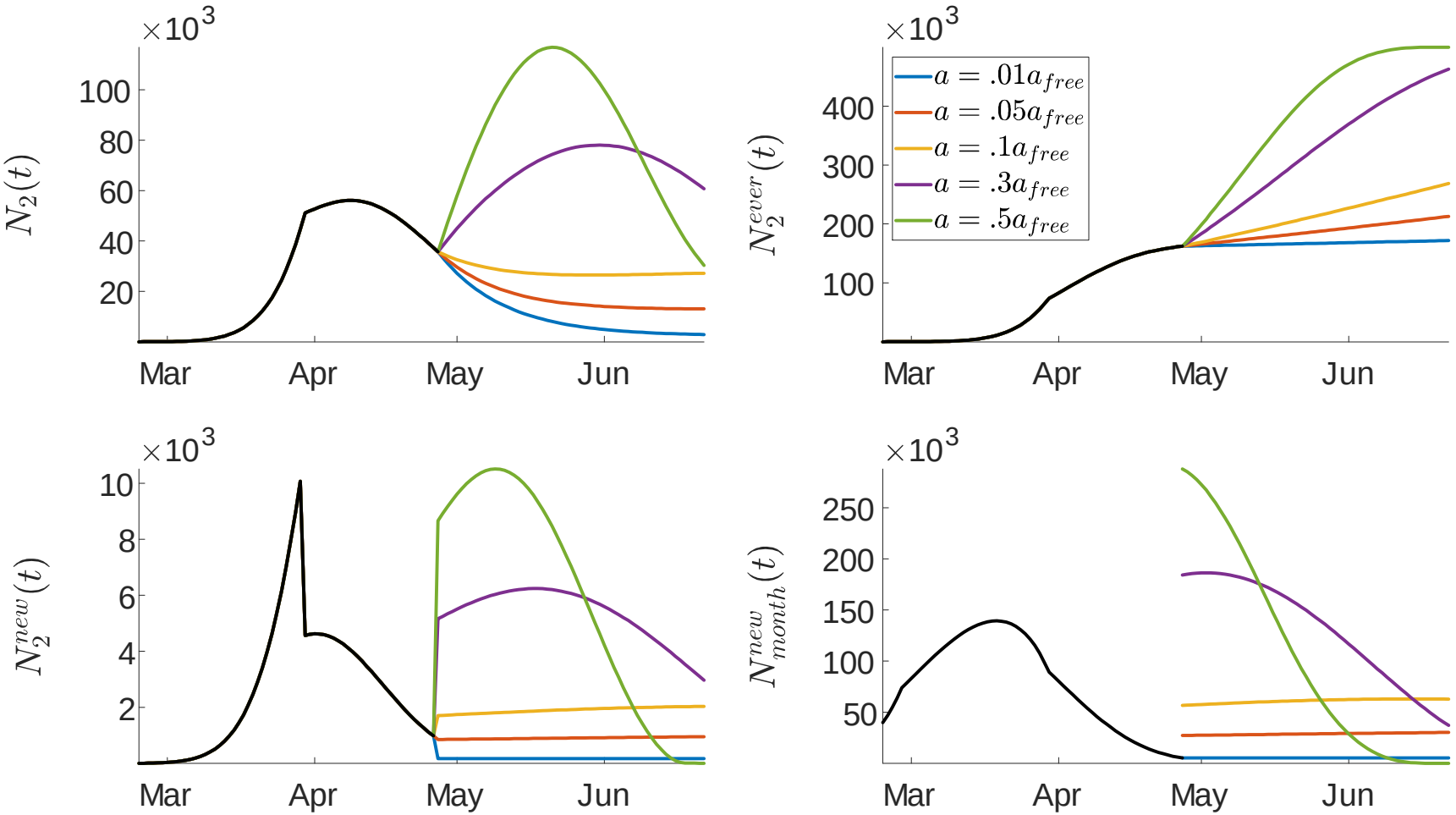

Figure 7: Prevalence (left top) and incidence (left bottom), accumulated incidence (right top) and incidence over next month

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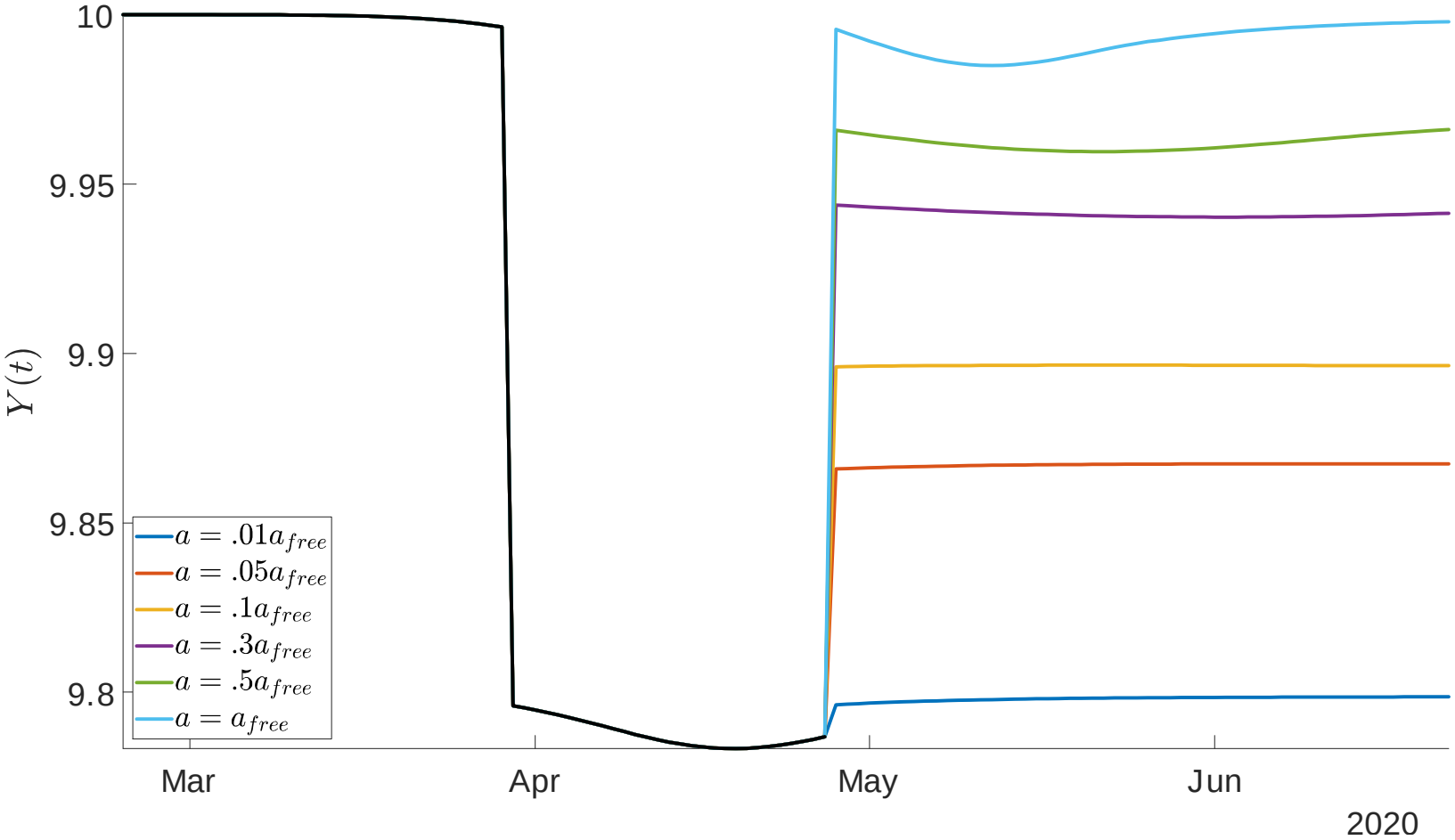

Figure 8: Output (in Billion Euro per day) over time with the effect of the shutdown (2% drop) on 30 March and exit scenarios as of 27 April

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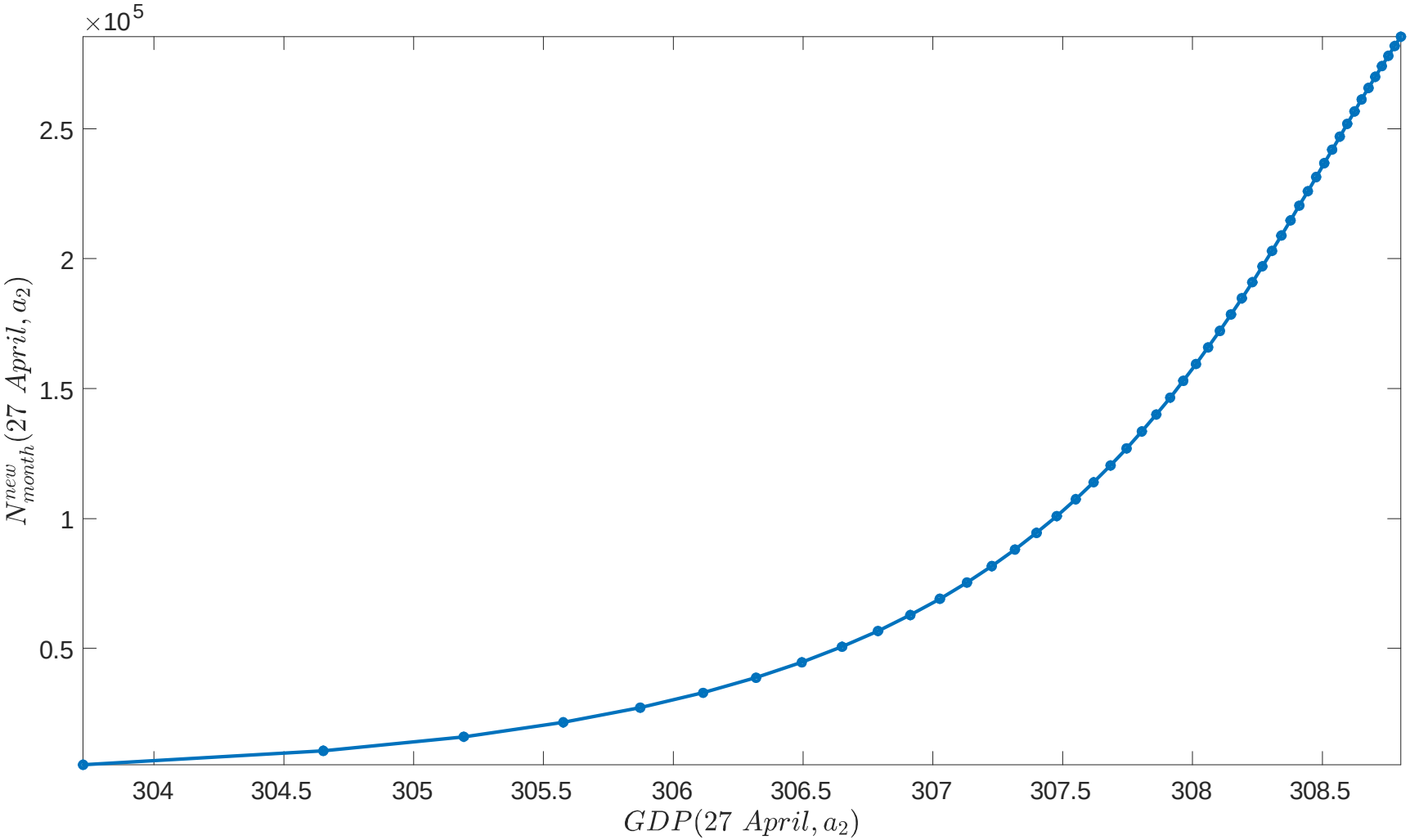

Figure 9: *The* trade-off between GDP over the next month and incidences over the next month (GDP elasiticity of incidences around 250%)

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The trade-off in simple words

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- Some background
  - GDP in Germany is approx. 3450 Billion Euro
  - GDP per day is therefore – roughly – 10 Billion Euro per day

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The trade-off in simple words

- Some background
  - GDP in Germany is approx. 3450 Billion Euro
  - GDP per day is therefore – roughly – 10 Billion Euro per day
- RSC over a period of 5 weeks (14 March to 19 April)
  - reduce output by 6%, i.e. 6% of 35 $\times$ 10 Billion Euro
  - cause a prevalence of 40.000 Covid-19 patients on average
  - and a total of approx. 165.000 Covid-19 patients
- Simple conclusion
  - If we do not want any further Covid-19 patients ...
  - ... we pay 6% of GDP, i.e. 600 Million Euro per day
  - Higher GDP needs acceptance for more Covid-19 patients

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  - If we do not want any further Covid-19 patients ...
  - ... we pay 6% of GDP, i.e. 600 Million Euro per day
  - Higher GDP needs acceptance for more Covid-19 patients
  - Do we need a second wave?
  - This points to the following principles of an exit plan

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3.3 The exit plan for Covid-19

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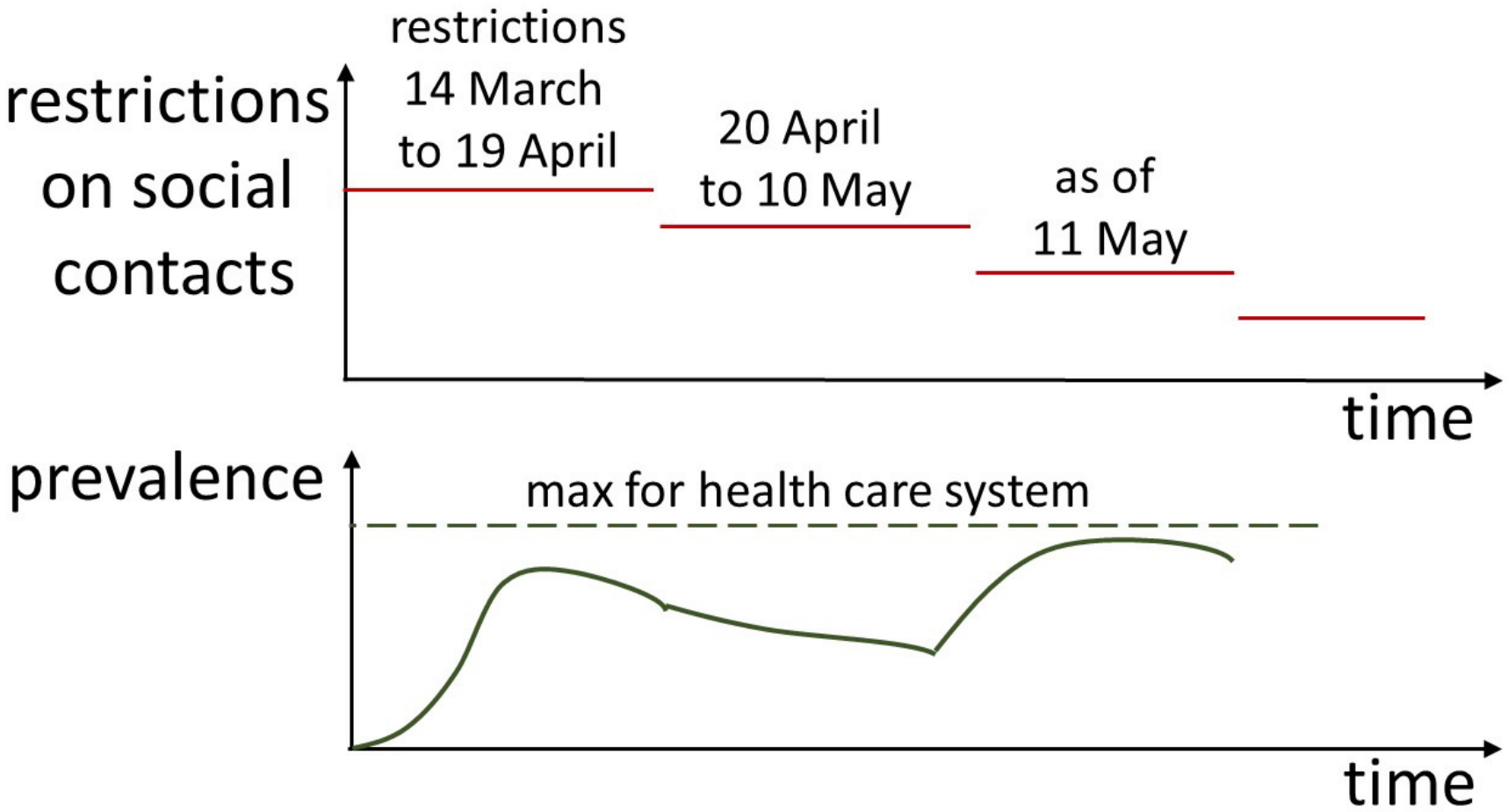
- Relax RSC
- Wait for prevalence to reach the acceptable level
- Relax RSC further and so on



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- guides us towards an exit plan (allowing for a second wave)

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- What needs to be done
  - Extend income-health trade-off
    - Include non-Covid-19 diseases (crucial!)
    - Include health effects of shut-down via increase in other diseases (mental, physical)
  - Quantify exit plan
  - Study effects of public health measures in spatial regression setup
    - Learn from differences across federal states and communities
    - Understand which policy measures (schools, shops, masks ...) are most useful/ most harmful for keeping infection numbers low
    - Joint project with Reinhold Kosfeld, Timo Mitze and Johannes Rode

Thank you!

More information on our Covid-19 research is available at

- https://www.macro.economics.uni-mainz.de/corona-blog/
  (General public / student information in German)
- https://www.macro.economics.uni-mainz.de/klaus-waelde/ongoing-work-and-publications/
  (Covid-19 research papers)