Evaluating NPIs effects on Covid-19 deaths and cases

Evidence from Denmark and Sweden

Data Science and Economics – A.Y. 2021-22
Joint project for the Labour Economics and Policy Evaluation course

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Research question

Theoretical model

The DiD approach "makes use of naturally occurring phenomena or policy changes that may induce some form of randomization across individuals in the eligibility of the assignment to the treatment" (Blundell et al., 2009).

Definitions

In this setting, the job places closing and gathering restrictions (defining the treatment status) contribute to naturally create a reasonable control group (Sweden) and treatment group (Denmark).

Why Scandinavia

As we will see in the next slides, those two countries are very similar in many aspects, but adopted different policies to tackle the Covid-19 spread. Therefore, they constitute the optimal setting for a DiD study.

Institutional background

	Sweden	Denmark		Sweden	Denmark
Population	10,230,185	5,806,081	Hospital beds, per 1.000 inhabitants	2.1	2.6
Population density (per km^2)	25.42	145.79	ICU beds, per 1.000 inhabitants	1.9	2.5
GDP per capita PPP	$ 54,929.53	$ 60,551.57	Gen. medical practitioners, per 1.000 inhab.	4.3	4.2
Life expectancy at birth (years)	80.7	79.6	Nursing prof., per 1.000 inhabitants	10.8	10.1
Healthcare spending (% GDP)	11.4	10.6	Share of aged 65+	20.1 %	20 %

Policy responses

While Denmark implemented gathering restrictions also for groups of less than 10 people and workplace closures, Sweden only applied gathering restrictions for groups grater than 10, and only recommended working from home.

	Sweden	Denmark
Workplace closures	–	March 18 –
Restrictions on gatherings (10–100)	March 12 –	March 13 –
Restrictions on gatherings (< 10)	–	March 18 –

Policy responses

In both countries, there were no mandatory measures in terms of public transport limitations, stay at home requirements and internal movement restrictions.

Facial covering was not mandatory as well.

	Sweden	Denmark
Close public transport	–	–
Stay at home requirements	–	–
Internal movement restrictions	–	–
Facial covering	–	–

Policy responses

Finallly, policies also differed in terms of school closures and international travel bans. However, the effectiveness of these measures is still debated in the literature, and in our case the difference is actually minimal: that is why we decided to ignore these diversities.

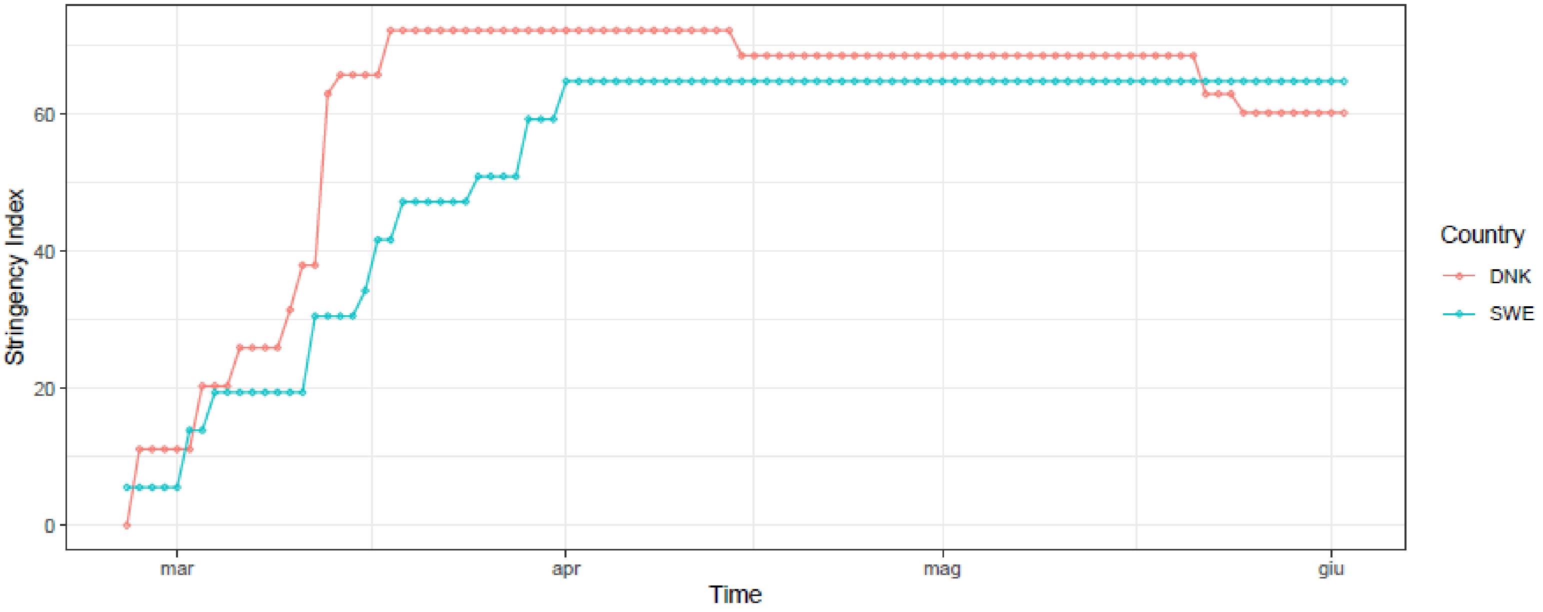
	Sweden	Denmark
School closing (some levels)	March 17 –	March 13 –
School closing (all levels)	–	March 14 – April 14
Travel ban (from high-risk regions)	March 19 –	March 11 –
Travel ban (total border closure)	–	March 14 – May 24

Stringency Index

- The Government Response Stringency Index was created by Oxford University and measures the overall level of strictness of the adopted measures.

- During the reference period of the paper (February 26 – June 3, 2020) Sweden mainly had a lower Stringency Index than Denmark, indicating an overall less strictness in the adopted measures.

Stringency Index



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Model estimation

Data definition and identifying assumptions

Preliminary information

Time frame

Information on Covid-19 deaths and cases in Sweden and Denmark covers the period from February 26 – June 3.

Outcome

The main outcomes are the 7-day moving average of new daily deaths and cases, normalized per million population.

Treatment status

March 18 was the first day that gathering restrictions and workplace closures were applied in Denmark, but not in Sweden.

Identifying assumptions

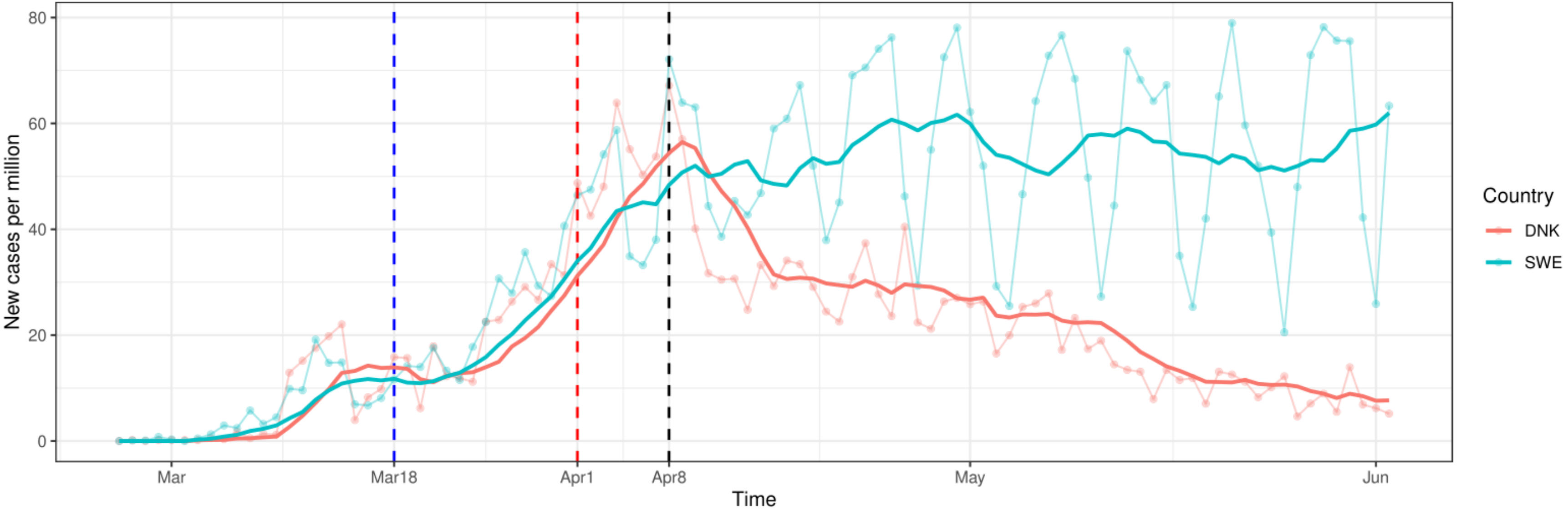
Common trend

In order for the DiD estimator not to be biased, we need to assume that treated and control would have followed parallel trends in the absence of the treatment, and therefore we should observe parallel trends in the pre-treatment period.

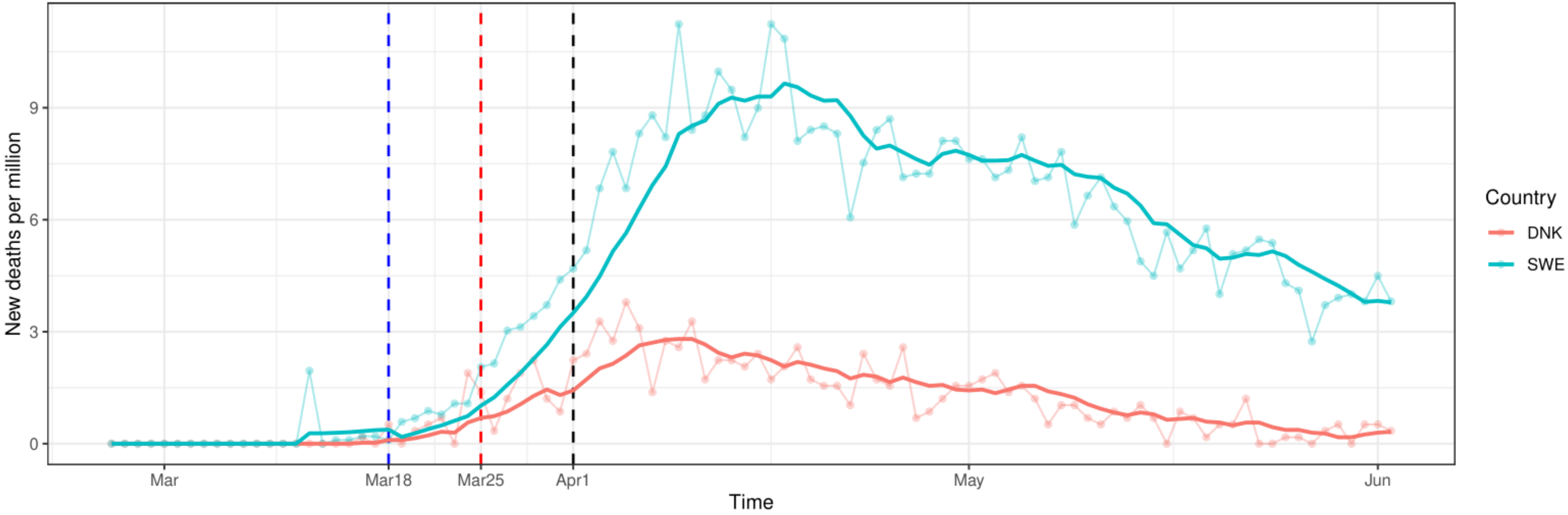
Participation into treatment is independent of idiosyncratic shocks

In order to ensure a meaningful comparability, participation into treatment must be exogenous, i.e., not driven by some time-variant state-specific characteristics or shock.

Covid-19 cases



Covid-19 deaths



Identifying assumptions

Absence of systematic composition changes within each group

If individuals in treatment and control group change significantly over time, the difference we observe in the outcome could be caused not only by the treatment, but also by those changes.

However, it is very unlikely that this assumption is not met in our case, not only because our sample is very big (and so a huge movement of people would be needed to change it substantially), but also because many travel bans were put in place at that time.

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Standard DiD Regression

Estimating the Average Treatment effect on the Treated (ATT)

Theoretical framework

We are estimating an equation of the kind

$$y_{c,t} = \alpha + \gamma \cdot Treat_c + \lambda \cdot Post_t + \boldsymbol{\delta}(Treat_c \cdot Post_t) + \varepsilon_{c,t}$$

Where **δ** will give us an estimate of the ATT, that is the Average Treatment effect on the Treated. In our case, it means the number of deaths and cases avoided by the Danish government thanks to the stricter regulation.

Theoretical framework

We are estimating an equation of the kind

$$y_{c,t} = \alpha + \gamma \cdot Treat_c + \lambda \cdot Post_t + \boldsymbol{\delta}(Treat_c \cdot Post_t) + \varepsilon_{c,t}$$

We will also use three different specifications to define pre- and post-treatment, as lockdown effects are not immediately observable.

Each time we will use a six-week time window (three weeks before and three weeks after), resulting in 84 daily observations for each model's estimation.

Estimation output for cases

	t_0 = March 18	t_0 = April 1	t_0 = April 8
Estimate for y = cases	– 0.60	– 6.40 *	– 16.19 ***
Standard Error	4.37	3.04	4.73
p-value	0.89	0.04	< 0.001

Estimation output for deaths

	t_0 = March 18	t_0 = March 25	t_0 = April 1
Estimate for y = cases	– 1.28 *	– 3.16 ***	– 4.96 ***
Standard Error	0.51	0.66	0.51
p-value	0.01	< 0.001	< 0.001

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Event-study approach

Evaluating how the lockdown effect evolves over time

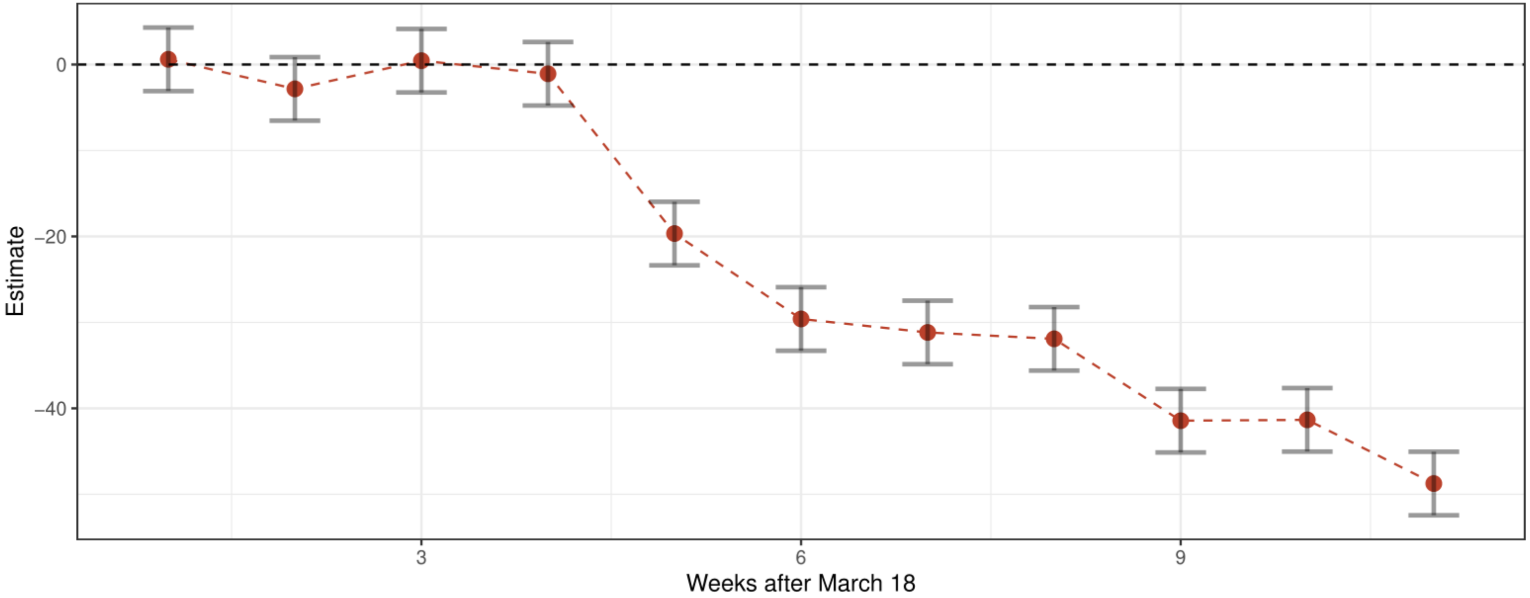
Theoretical framework

We are now splitting the single coefficient of Treat × Post into multiple variables of the kind Treat × Week dummy in order to estimate an equation of the following form:

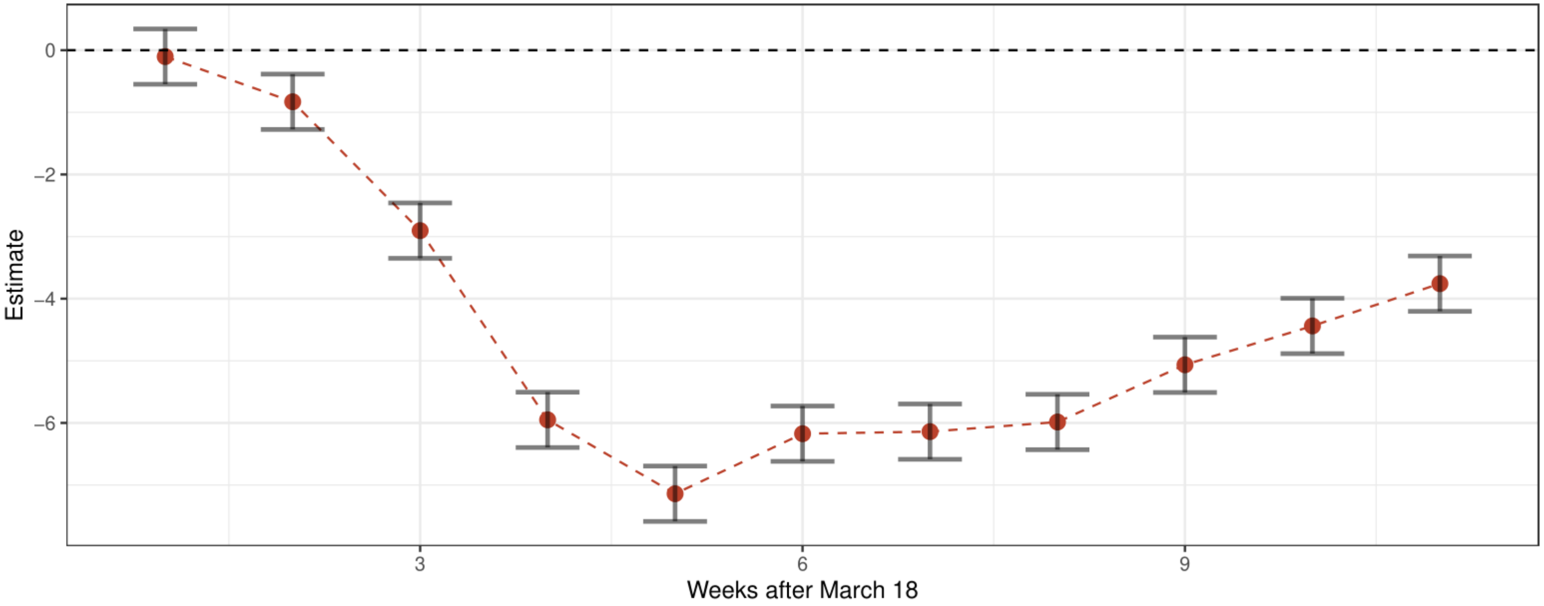
$$y_{c,t} = \alpha + \gamma \cdot Treat_c + \sum_{w=2}^{W} \lambda_w \cdot Weeek_w + \sum_{w=1}^{W} \boldsymbol{\delta_w} \cdot TStatus_{c,t} \cdot Week_w + \varepsilon_{c,t}$$

Our coefficients of interest are the δ's, which capture the weekly difference between the two countries' outcome caused by the treatment.

Event-study for cases



Event-study for deaths



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Conclusions

Limitations and key findings

Limitations

1 Not an optimal outcome

The number of observed new daily Covid cases can be biased by the number of tests executed.

2 Confounding policies

We made several identifying assumptions, ignoring for instance the effects of school closures and international travel restrictions.

3 External validity

A typical disadvantage of a DiD study is its limited external validity, which is further reduced when considering just two countries (as in our case).

Key findings

The similarity in many aspects but the adopted policies, makes Denmark and Sweden optimal candidates for conducting a DiD study on the effects of restrictive policies on Covid-19 deaths and cases. In particular, our analysis found evidence that:

- Restrictive policies did have a significant impact in reducing the number of daily Covid-19 cases and deaths
- Effects on deaths and cases are persistently significant over time.

THANKS FOR WATCHING!

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