The sooner, the better

The early economic impact of non-pharmaceutical interventions during the COVID-19 pandemic

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Fighting COVID-19 - NPIs

- COVID-19 caught (most) of the world by surprise. Few healthcare systems were prepared to deal with the outbreak of an infectious disease like the one caused by the SARS-CoV-2 coronavirus.

- In the absence of a vaccine or a treatment, non-pharmaceutical interventions (NPIs) are an effective way to contain the disease. Extensive testing and contact tracing has become the “gold standard” but only some countries have the capacity to do it.

- The most popular type of NPI was the strictest one: the implementation of a full lockdown. By late March 2020 about 25% of the world population was under some kind of “stay-at-home” order.

Impact of NPIs – Policy Debate

- NPIs are introduced to contain the pandemic – “flatten the curve.”

- Both the pandemic and the NPIs impact the economy
  - Demand (reduced consumption out of concern/stay at home orders, closing of non-essential businesses)
  - Supply (sick workers, reluctance to work/businesses are shut down)

- Heated public debate on the relative importance of these impacts
  - Is the cure worse than the disease?
  - Smart containment policies – how to minimize economic impact while still saving lives

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This paper

- Contribute to the emerging literature by analyzing the early economic impact of the pandemic and different types of NPIs implemented by countries in Europe and Central Asia – until late April 2020.
- We rely on the high-frequency proxies to trace the disruptions - electricity consumption, NO_2 emissions and mobility (from smartphones) - and calibrate them to estimate the impact on economic activity.
- Our main results show that a full lockdown leads to a 10 percent decline in economic activity. The pandemic itself (absent NPIs) has also a significant effect that can be comparable depending on the stage of the pandemic.
- On average, countries that implemented the NPIs at the early stages of the pandemic appear to have better economic outcomes and lower cumulative mortality and peak death rates. In part, this is because speedier NPIs have been less stringent.

Data on high-frequency variables

1. Daily electricity consumption
   - Available for 37 countries in Europe and Central Asia
2. NO_2 emissions:
   - Nitrogen dioxide is a byproduct of the combustion of fossil fuels and, therefore, directly indicative of economic activity.
   - Satellite readings of NO_2 density obtained from the Ozone Monitoring Instrument (OMI) on NASA's Aura satellite.
   - Daily data relatively noisy, so use 30-day moving averages. Available for 48 countries in ECA.
3. Mobility trends
   - Produced by Apple as derived from the requests for directions using Apple Maps.
   - The trends data distinguish mobility by types – driving and walking. Available for 33 countries in ECA.

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Data and definitions on NPIs

- Main source of data on NPIs is the Oxford Government Response Tracker. Complemented with the WB Education GP COVID-19 Dashboard and news sources.
- Four types of NPIs are distinguished:
  1. Cancelation of public events (social distancing)
  2. School closure
  3. Partial lockdown (workplace restrictions for a group of activities or a part of the country)
  4. Full lockdown (workplace and mobility restrictions for all activities, for the whole country)

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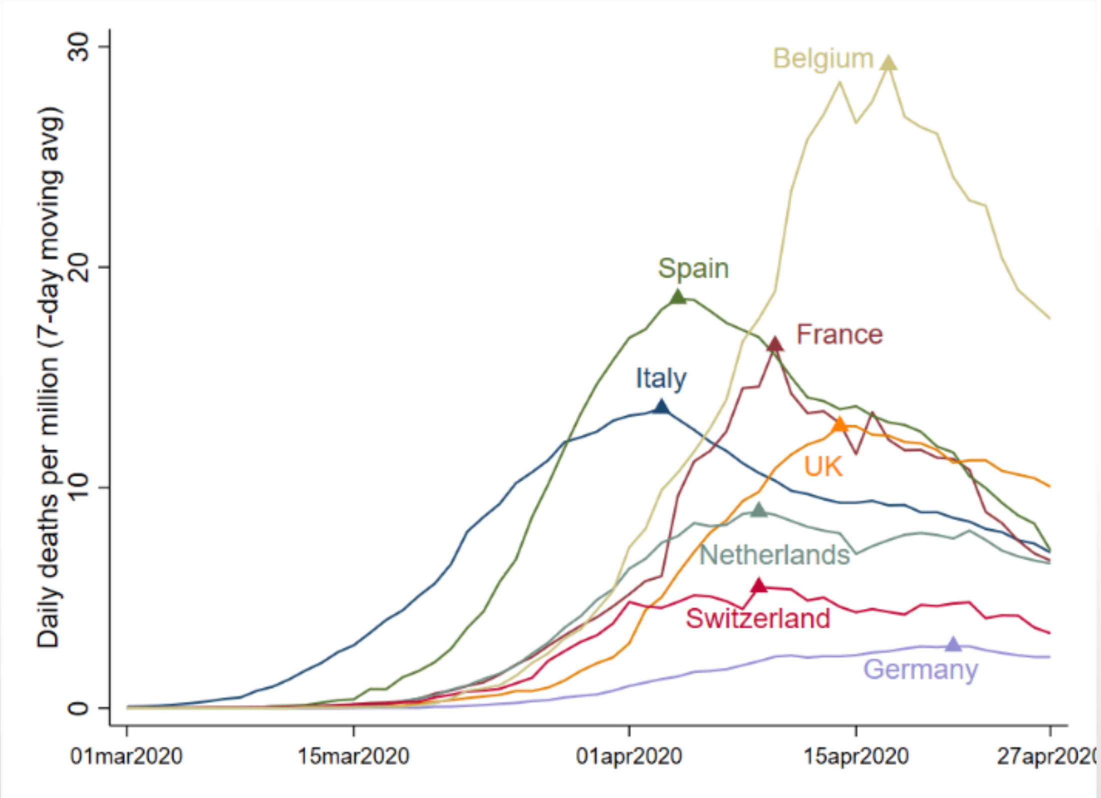
COVID-19 evolution and NPIs



The pandemic first hit Southern and Western Europe, moving later to the North and the East

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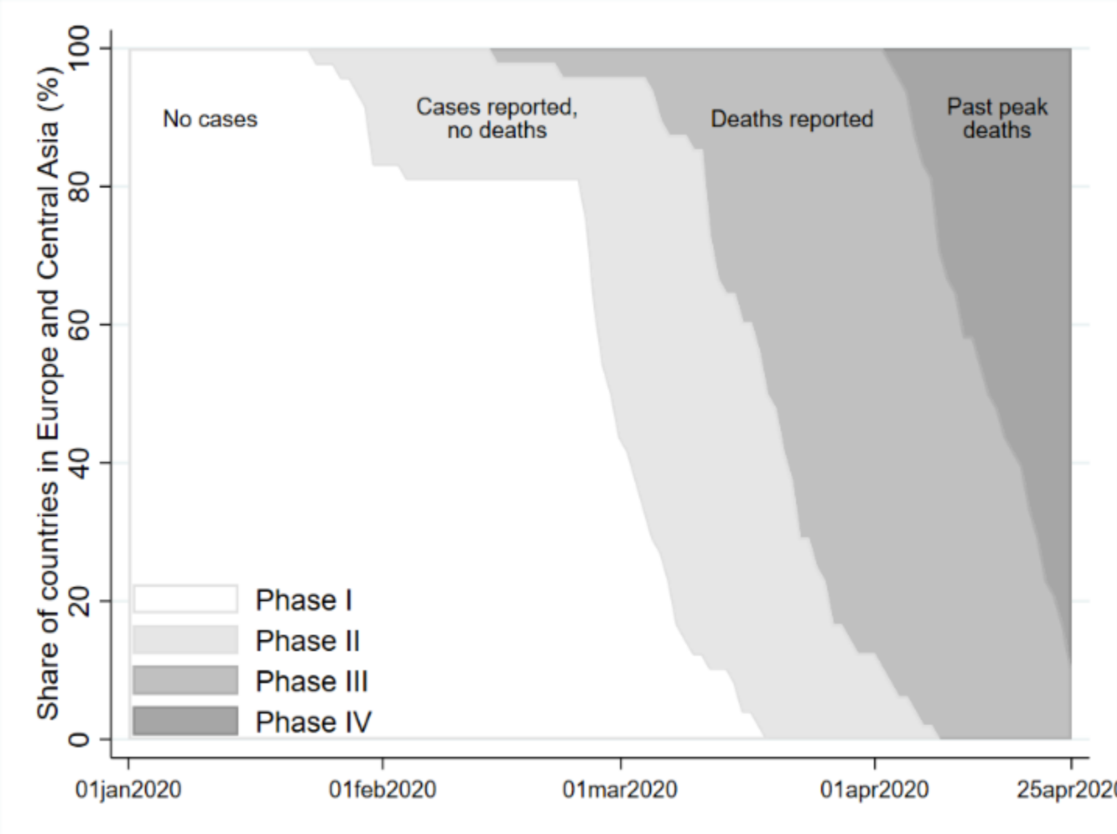
COVID-19 evolution and NPIs



By late April most countries had passed the peak of daily deaths

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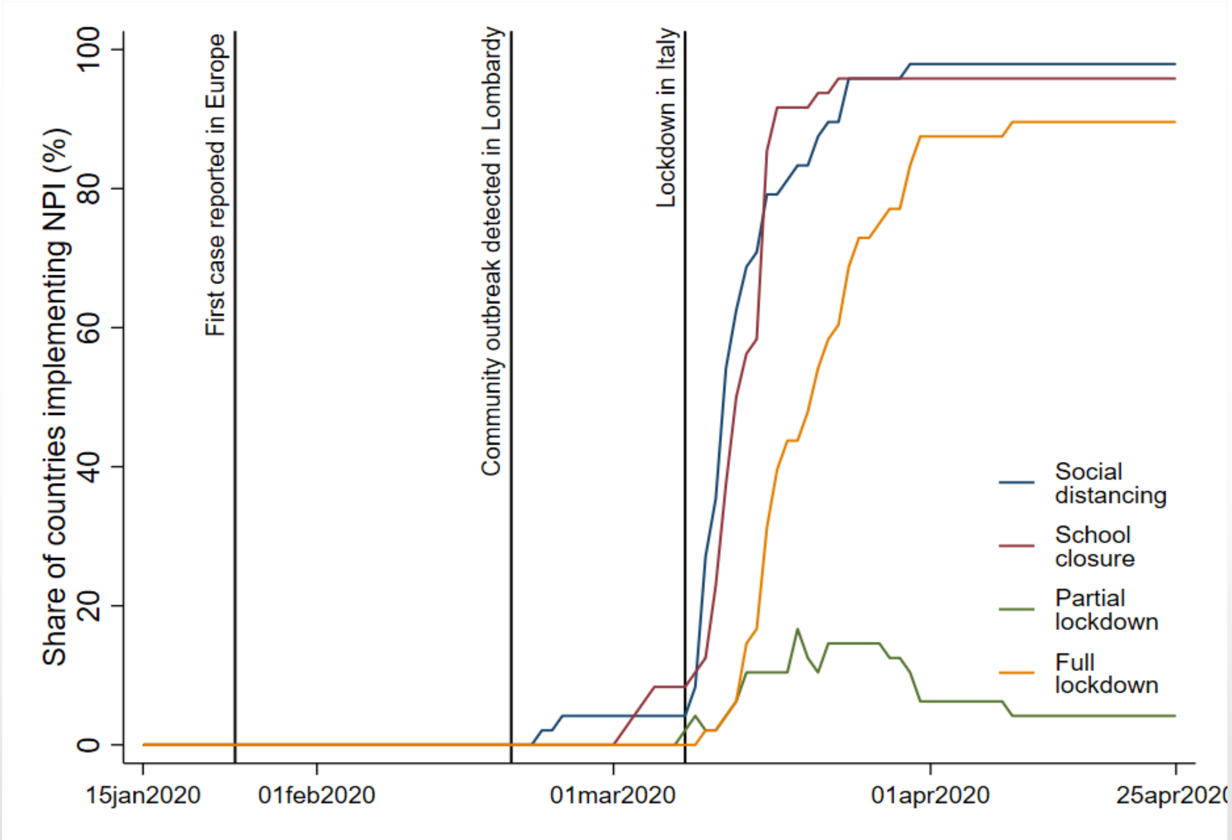
COVID-19 evolution and NPIs



Countries quickly implemented NPIs during March.

By April 9 more than 90% of countries in ECA where in full lockdown.

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COVID-19 evolution and NPIs

Type of NPI	I (No cases)	II (Cases but no deaths)	III (Deaths reported)	IV (Past peak daily deaths)
	Phases of the local outbreak at the time of implementation			
	Mean daily deaths per million at peak			
Ban of public events	1.19	2.75	11.75	-
School closure	0.41	1.16	11.75	-
Partial lockdown	-	1.05	6.22	-
Full lockdown	-	0.79	6.29	-

Countries that implemented NPIs earlier in the pandemic had lower peaks → a “flatter” curve

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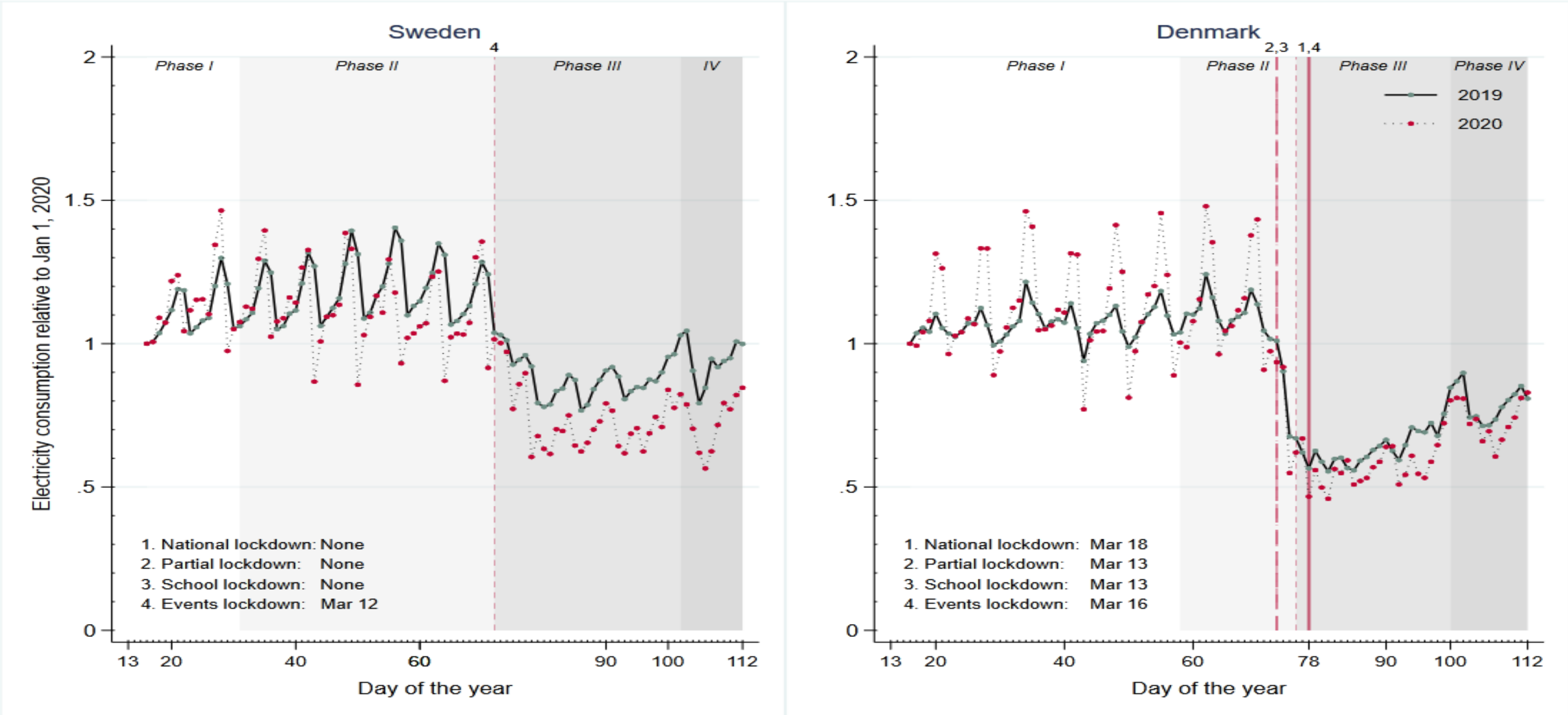
Proxy measures of activity: Electricity



A drop in electricity consumption is clear in Denmark, which implemented a lockdown, and less so in Sweden, which took less stringent measures.

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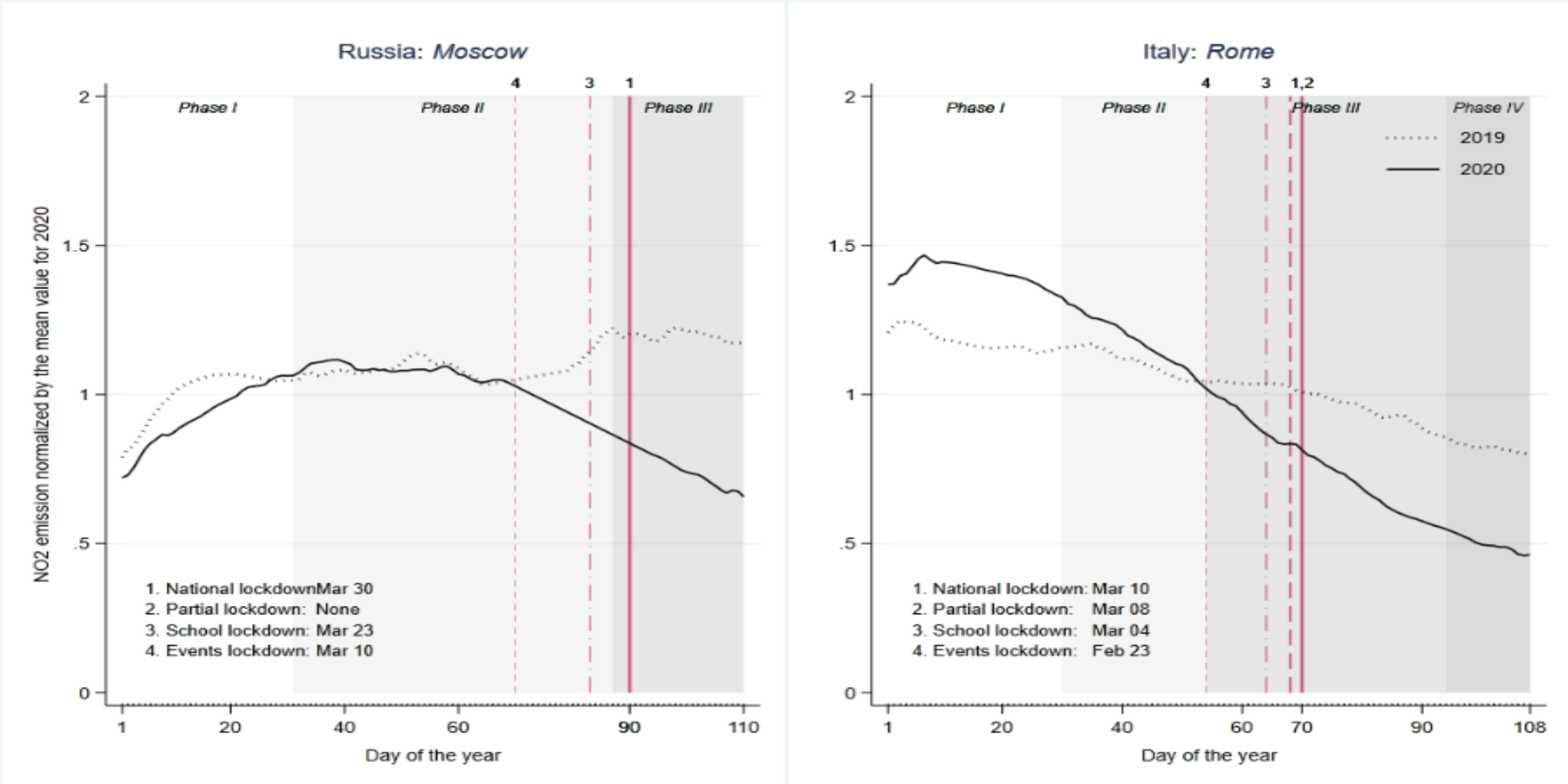
Proxy measures of activity: NO_2 emissions



2020 NO_2 emissions in Moscow and Rome decline with the pandemic but particularly after a lockdown was implemented.

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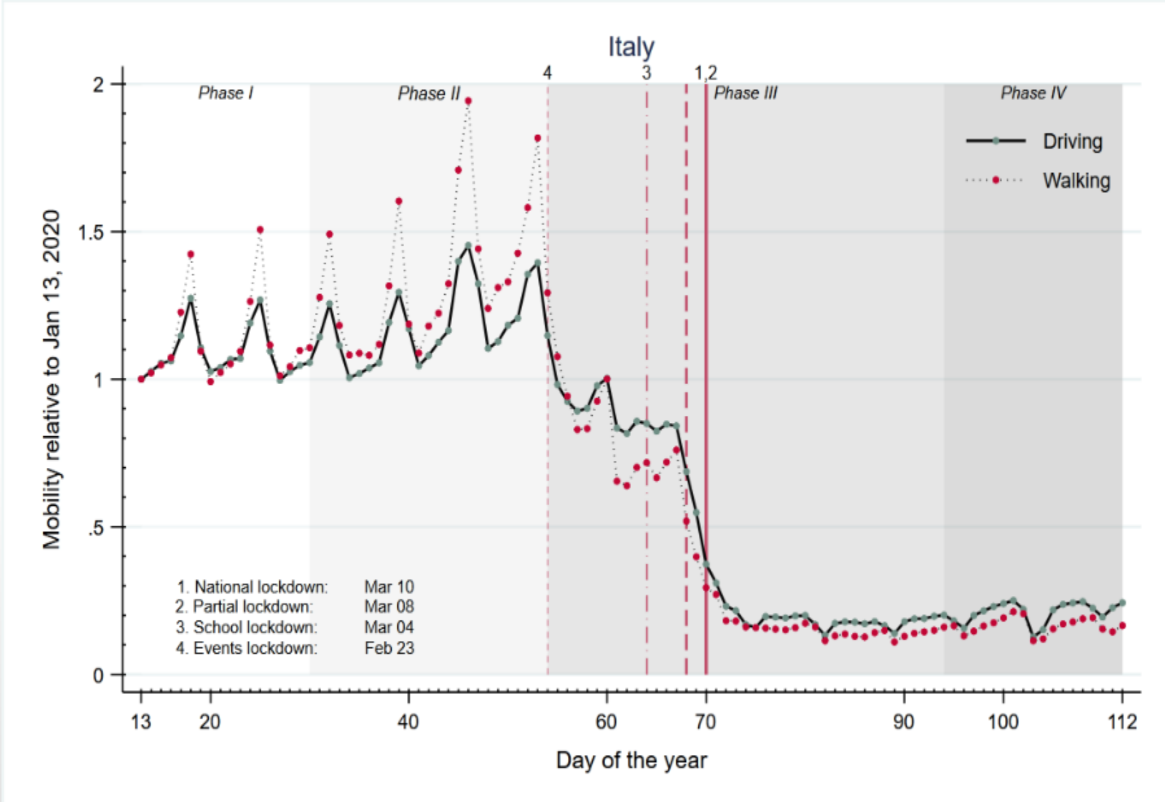
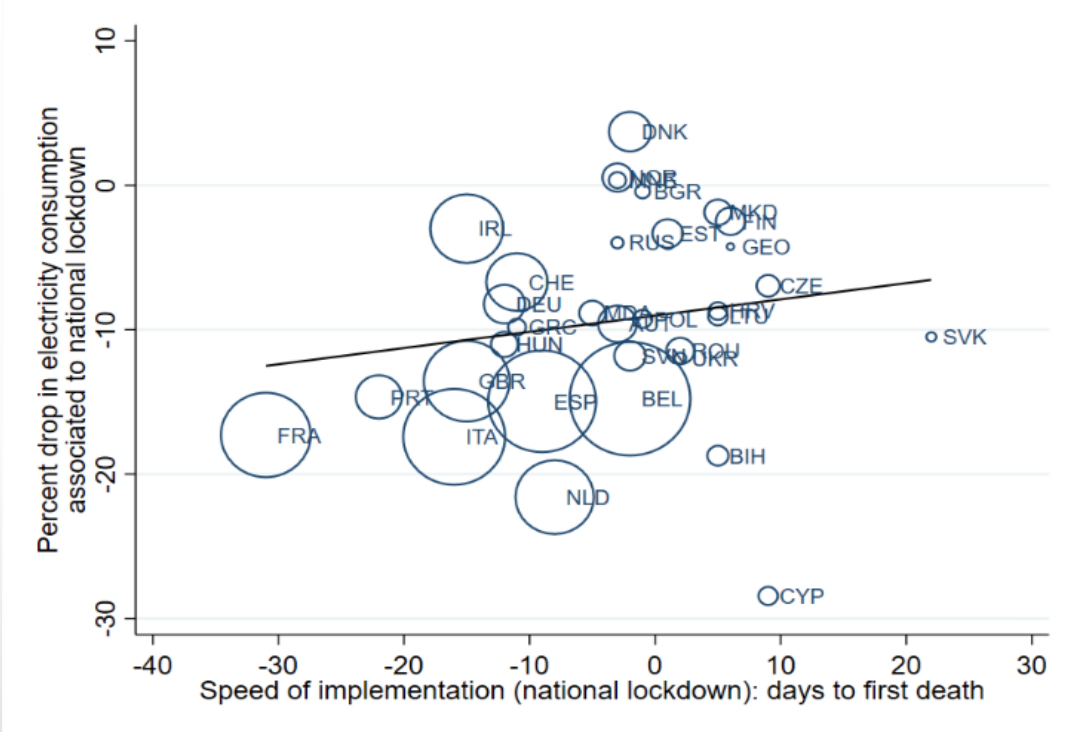
Mobility during the initial stages of the pandemic



A drop in mobility is observed in Italy as the disease started spreading, and then a strong drop when a lockdown is imposed.

Speed of implementation and electricity consumption



Countries that implemented faster a national lockdown seem to have had a smaller drop in electricity consumption and lower mortality.

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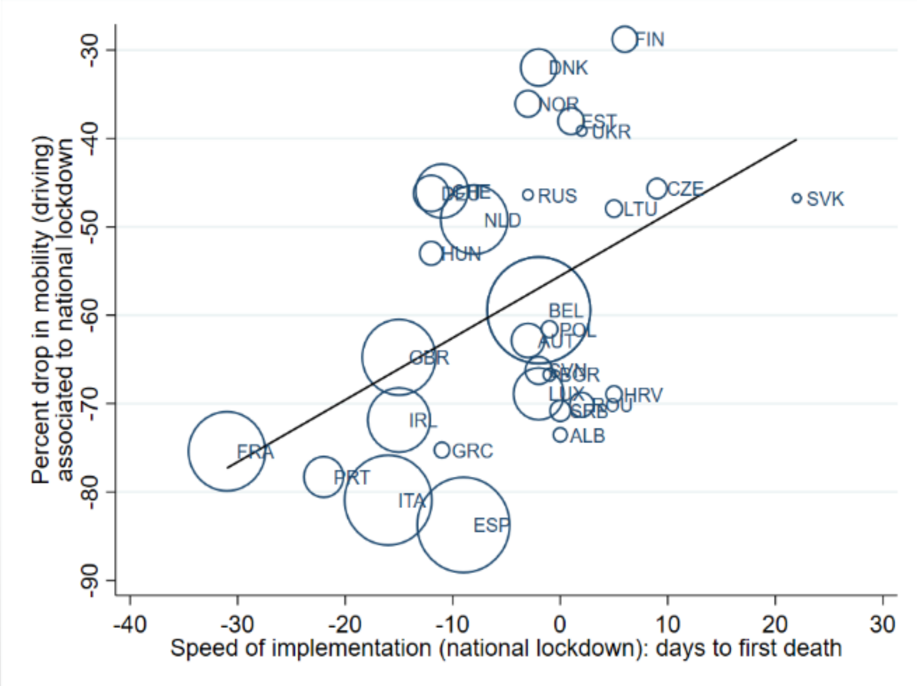
Speed of implementation and change in mobility



The drop in mobility ("de facto" stringency) is larger for countries that implemented a lockdown relatively late. Same holds for "de jure" stringency.

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Empirical analysis

$$Ln(Y_{i,t}) = \beta NPI_{i,t} + \vartheta P_{i,t} + \omega H_{i,t} + \theta CH_{i,t} + \pi D_t + \gamma W_t + v_i + \epsilon_{i,t}$$

$Y_{i,t}$ is the electricity consumption in country *i* in date *t*,
$NPI_{i,t}$ is a vector of four dummies representing four types of NPIs,
$P_{i,t}$ is the daily number of deaths per million due to COVID-19,
$H_{i,t}$ is equal to one if date t is a national holiday,
$CH_{i,t}$ represents two variables for the heating and cooling days,
D_t are six dummies for days of the week,
W_t are week of the year dummy variables,
v_i is the country-specific fixed effects,
$\epsilon_{i,t}$ is an i.i.d. innovation term.

The daily number of deaths is instrumented with the daily predictions from a standard SIR epidemiological model that assumes an unmitigated spread of the disease, where cross-country variation comes from demography, heatlh care system and an initial rate of contagion.

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Empirical analysis: electricity

	Log of Electricity consumption					
	OLS				IV	
	(1)		(2)		(3)	
	Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*
	Non-pharmaceutical interventions (NPIs)					
National lockdown	-0.119***	*0.014*	-0.111***	*0.015*	-0.075***	*0.016*
Partial lockdown	0.042	*0.026*	-0.016	*0.027*	0.013	*0.027*
School closure	-0.023	*0.026*	0.043	*0.026*	0.047	*0.026*
Ban on public events	-0.105**	*0.036*	-0.104**	*0.036*	-0.103**	*0.036*
	Pandemic progression indicators					
Daily deaths per million			-0.005*	*0.003*	-0.024***	*0.004*
	First stage instruments					
Modeled death rate					0.298***	*0.002*
F-test					*19.30****	
# of observations	38,399		38,399		38,399	
# of countries	33		33		33	

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Empirical analysis: NO_2

	Log of NO_2 emission level					
	OLS				IV	
	(1)		(2)		(3)	
	Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*
	Non-pharmaceutical interventions (NPIs)					
National lockdown	-0.187***	*0.034*	-0.174***	*0.036*	-0.179***	*0.037*
Partial lockdown	-0.118**	*0.057*	-0.114**	*0.057*	-0.115**	*0.057*
School closure	-0.114**	*0.054*	-0.112**	*0.054*	-0.113**	*0.054*
Ban on public events	-0.244***	*0.063*	-0.243***	*0.063*	-0.243***	*0.063*
	Pandemic progression indicators					
Daily deaths per million			-0.008	*0.007*	-0.005	*0.009*
	First stage instruments					
Modeled death rate					0.317***	*0.002*
F-test					*14.87****	
# of observations	38,399		38,399		38,399	
# of countries	33		33		33	

Empirical analysis: speed and stringency of lockdown

		Log of Electricity consumption											
		(1)		(2)		(3)		(4)		(5)		(6)	
		Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*	Coef.	*S. Err.*
Interaction with national lockdown dummy	Speed of implementation	0.003**	0.001	0.002**	0.001								
	Stringency (“de jure”)					-0.002***	0.000	-0.002***	0.000				
	Drop in mobility									-0.114***	*0.014*	-0.085***	*0.014*
National lockdown		-0.111***	0.015	-0.107***	0.016	0.031	0.062	0.001	0.026	0.010	*0.011*	-0.007	*0.012*
Partial lockdown		-0.008	0.036	-0.000	0.036	0.024	0.041	-0.019	0.027	-0.062***	*0.011*	-0.054***	*0.010*
School closure		0.046**	0.028	0.046**	0.028	0.063*	0.036	0.043*	0.026	-0.028**	*0.009*	-0.026**	*0.009*
Ban on public events		-0.102**	0.038	-0.102**	0.038	-0.069**	0.036	-0.105**	0.036	-0.007**	*0.008*	-0.008	*0.008*
Daily deaths per million				-0.003	0.002			-0.024	0.003			-0.005***	*0.001*
# of observations		35,983		35,983		29,987		29,987		2,402		2,402	
# of countries		31		31		26		26		25		24	

Summary of empirical results

- Drop in electricity consumption associated with lockdowns is around 10 percent. This translates 1-to-1 to economic activity based on short-term elasticities (Cicala, 2020). NO_2 emissions show similar magnitudes.
- The pandemic itself (as measured by daily deaths) has a significant effect on activity. In its peak, the outbreak has a similar effect as the one triggered by the NPIs.
- Faster implementation of lockdowns is associated with lower peak mortality ("flatter curve") and smaller drops in activity. This is partly because faster lockdowns are less stringent.

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COVID-19 in Belarus

- As of June 22, 2020, Belarus reports 58,505 cases of COVID-19 and 346 related deaths. The case fatality ratio (CFR) is 0.59%, among the lowest in the world.
- While Belarus' low CFR could be explained by extensive testing (about 89 tests per thousand), countries with higher testing (Denmark, 147 per thousand; Portugal, 102 per thousand; Russian Federation 114 per thousand) have considerably higher CFR (Denmark, 4.84%; Portugal, 3.91%, Russian Federation, 1.38%).
- Reported deaths by COVID-19 in Belarus may therefore be an underestimate of the actual death toll of the disease.

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Rescaling COVID-19 death rate in Belarus

- For the purpose of simulating the effect of NPIs and the pandemic on the economic activity in Belarus, the death rates are scaled up by the CFR of the estimating sample in our paper: 4.96%. This is very close to the value of Denmark (4.84%).
- This does not imply that this is the “real” CFR of COVID-19 in Belarus. This is an expansion factor that is needed to make the Belarusian data compatible with the data which was used to estimate our model.
- The rescaling is done such that a death occurs 10 days after a case is reported.
- This rescaled death rate suggests that the peak of the pandemic probably occurred in late May, with a peak value of 5.01 daily deaths per million.

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Belarus simulations

- We use our IV specification of the effect of NPIs and COVID-19 deaths on electricity consumption.
- The baseline scenario (rescaled deaths rates) suggests that the associated decrease in economic activity was about 13.5% at the peak.
- We simulate a scenario in which an early national lockdown is implemented on April 1, two days before the first reported death in Belarus (April 3). This lockdown reduces peak daily deaths to 0.79 per million (median peak value for countries that implemented a lockdowns before any death). The associated decrease in economic activity at the peak is 8.0%.
- We simulate a scenario in which a late national lockdown is implemented on April 10, seven days after the first reported death. This lockdown reduces peak daily deaths to 2.81 per million (median peak value for countries that implemented late lockdowns). The associated decrease in economic activity at the peak is 13.5%.

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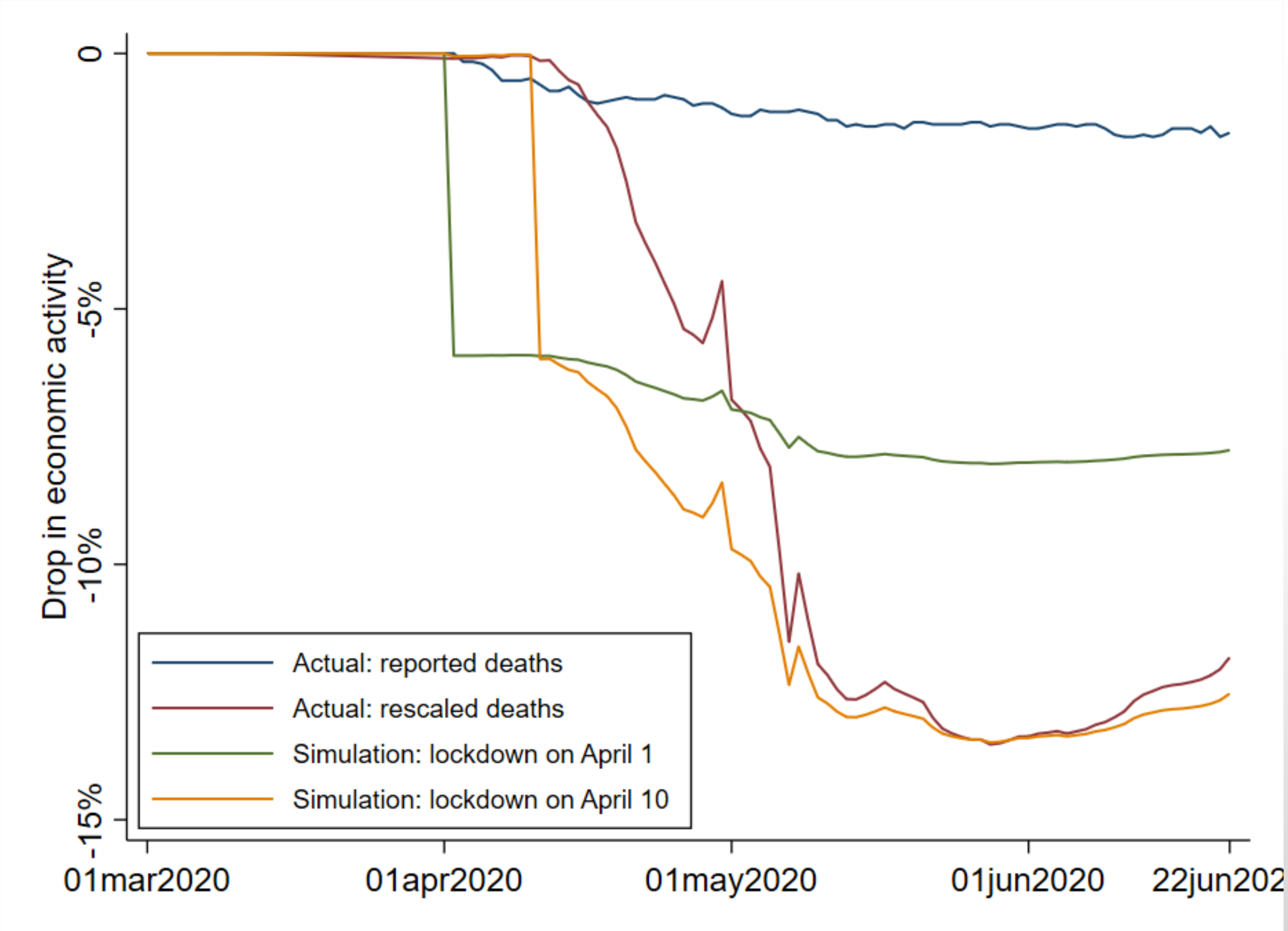
Belarus simulations



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Belarus simulations

- Implementing no lockdown brings little economic benefit as compared to a late lockdown: the decrease in economic activity at the peak is almost the same (-13.5%). However, a late lockdown reduces the peak death rate almost by half (from 5.01 to 2.81 daily deaths per million).
- Implementing an early lockdown reduces both the drop in economic activity (at the peak, from -13.5% to -8.0) and the peak death rate (from 5.01 to 0.79 daily deaths per million).

Conclusions

- Using publicly available high-frequency proxy measures, our results suggest that fast action minimizes the human and economic costs of the pandemic.
- The drop in economic activity is not only driven by NPIs but also by the pandemic itself
- Policymakers should be cautious in reopening their economies too fast:
  - A rebound in the spread of the disease can be damaging not only in human terms but also in economic ones.
  - An increase in the infection rates or the number of deaths after opening up might slow down or even reverse positive economic trends.