2. Europe's Exit from Lockdowns: Early Lessons from the First Wave

Europe was among the regions most severely affected by corona virus (COVID-19) in the early months of 2020. Countries responded with stringent lockdown measures designed to reduce transmission and flatten the infection curve in the face of overburdened care facilities. As the first wave of disease ebbed and the outbreak appeared controlled, most European countries started to reopen their economies. This chapter documents the different exit strategies followed across Europe and explores how reopening policies affected economic activity and subsequent infections. It finds that reopening measures led to a recovery in mobility but at the cost of some uptick in infections—an uncomfortable trade-off already documented in studies of lockdowns. However, the experience with reopening points to some novel dimensions of this trade-off. First, the increase in COVID-19 infections after reopening appears less severe in fatality rates. Second, a given reopening step is associated with a worse reinfection outcome in countries that started reopening earlier on the infection curve or that opened all sectors at a fast pace in a relatively short time.

Europe experienced a severe COVID-19 outbreak, with cumulative cases and fatalities reaching close to 5.5 million and 231,000, respectively, by the end of September. The escalation of cases during the first wave of the pandemic led governments to introduce stringent lockdown measures in order to slow the spread of the virus and avoid overwhelming the health sector. As the first wave of infection curves flattened and the outbreak appeared controlled, most European countries started to reopen their economies to alleviate the unprecedented economic contraction generated by the lockdown (see Chapter 1). The strategies adopted to reopen the economy while containing the virus outbreak differed significantly across countries in their timing, pace, and sequencing of sectoral reopening. For example, many countries took sectoral reopening measures over several weeks, while others chose to open several sectors simultaneously. The timing of exits from lockdown also varied across countries—some countries waited until the infection curve had flattened, while others chose to exit near the peak of the infection curve.

As reopening plans evolved and economic activity started to normalize, several countries experienced an uptick in their infection curves (Figure 2.1), though with different pace and intensity. Given that authorities will need to continuously adjust their containment policies as the pandemic evolves, understanding the trade-offs of alternative reopening strategies is of the utmost importance.

Against this backdrop, this chapter seeks to answer the following questions:

- How do reopening strategies compare across countries in their timing, pace, and sectoral sequencing?
- How do official reopening measures translate into actual improvements in activity and influence the subsequent evolution of COVID-19 infections?
- What early lessons can be drawn from the reopening experiences? Were some strategies associated with lower reinfection risks than others and, if so, at what cost in reduced activity?

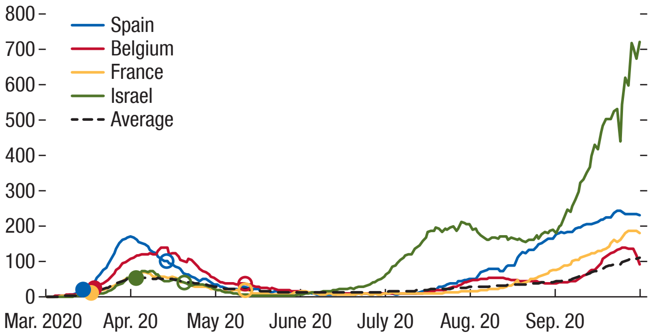
Diverse Reopening Plans

To document the reopening strategies used by European countries, the chapter builds a novel daily database that captures the sector, timing, and intensity of reopening measures taken by country

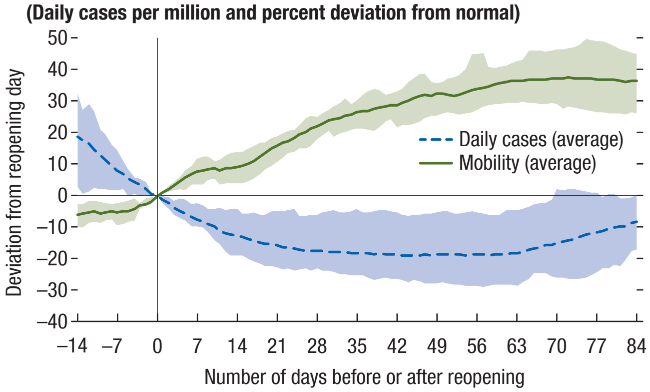
Bertrand Gruss (co-lead), Carlos Mulas-Granados, Manasa Patnam (co-lead), and Sebastian Weber prepared this chapter under the supervision of Enrica Detragiache and the guidance of Jeffrey Franks. Zan Jin provided excellent research support.

Figure 2.1. Infections and Activity

1. Daily COVID-19 Cases
(Daily new confirmed cases per million, 7-day moving average)



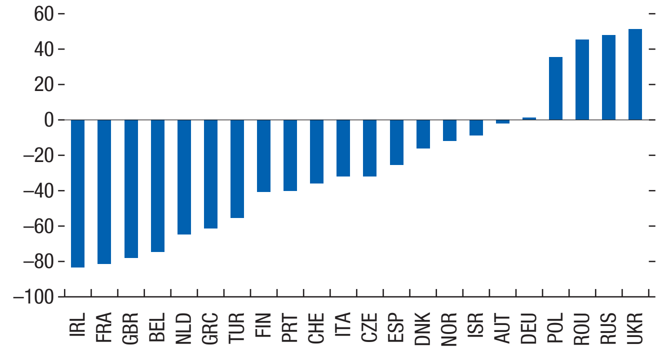
2. Mobility and Daily COVID-19 Cases since Reopening
(Daily cases per million and percent deviation from normal)



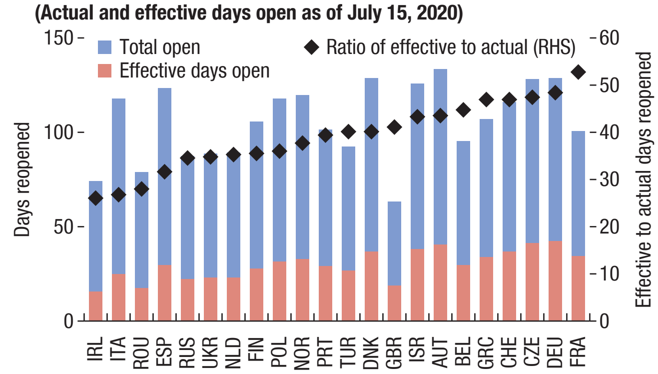
Sources: Google; Our World in Data; European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: Solid (hollow) markers in panel 1 denote lockdown start (end) dates. Mobility in panel 2 denotes the seven-day moving average of Google mobility (expressed as percentage point difference from pre-COVID baseline) around retail stores, workplaces, and transportation hubs. Interpretation of reported values: 70 days after reopening, the mobility index was (daily cases per million were) on average 40 percentage points higher (20 cases less) than on the day the first reopening action was taken. Shaded areas denote interquartile range. Sample of countries shown in footnote 1.

Figure 2.2. Heterogeneous Timing, Speed, and Sectoral Sequencing of Reopening Strategies

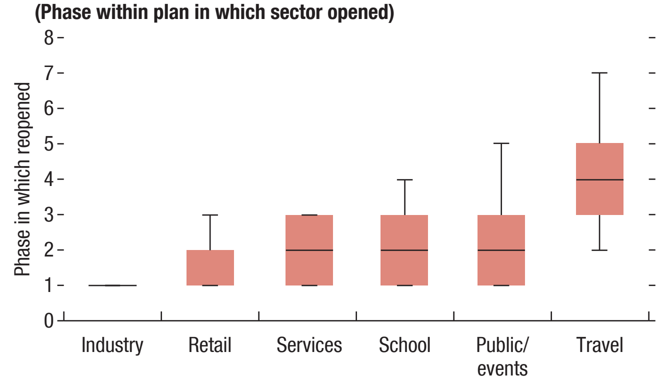
1. Time of Reopening
(Percent change in daily deaths from peak to first reopen)



2. Speed of Reopening
(Actual and effective days open as of July 15, 2020)



3. Sectoral Reopening Sequencing
(Phase within plan in which sector opened)



Sources: Authorities announcements; Our World in Data, European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: In panel 1, the seven-day moving average of daily deaths is used; the sign is reversed for countries that opened before the series peaked. Panel 2 plots the number of days since reopening; the shaded area shows the number of effective days open (see Online Annex 2.1). Panel 3 plots the cross-country distribution of the phase within the overall reopening plan in which each sector covered in the database opened. The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles; and the markers denote the top and bottom deciles. Country abbreviations are International Organization for Standardizatoin country codes.

authorities.[1] The database reveals that reopening plans differed significantly across countries:

- A first clear difference relates to the *timing* of the first reopening measures in relation to the epidemiological situation in the country (Figure 2.2, panel 1). Using the evolution

[1]The countries in the database include Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Switzerland, Turkey, Ukraine, and the United Kingdom. The intensity of a sector's reopening is coded based on the extent of easing its containment status (fully closed; partially open; open with restrictions; and open). See Online Annex 2.1 for further details.

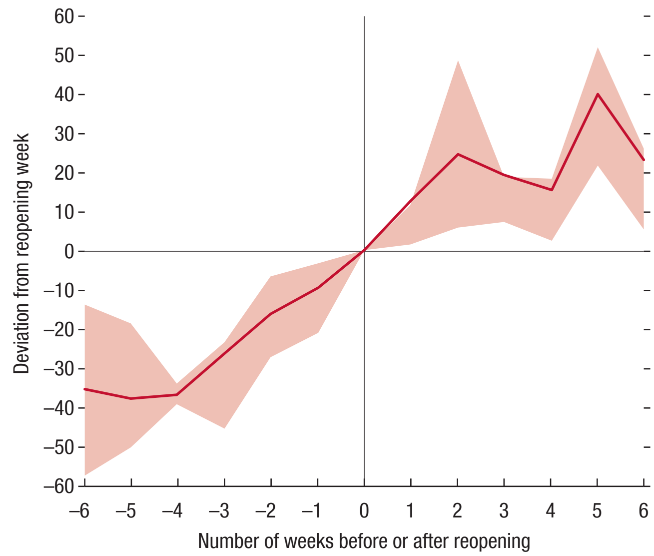
of daily fatalities as an indication of the pandemic's stage, the data reveal that some countries (for example, *Belgium*, *France*) started opening only when the number of daily deaths had declined substantially with respect to the peak. Other countries opened at about the time that fatalities started to decline (for example, *Austria*, *Germany*), or even when they were still on the rise (for example, *Poland*, *Russia*).

- Another key difference across plans relates to the *speed* or pace of sectoral reopening actions once they started opening (Figure 2.2, panel 2). One way of capturing the difference in speed is to compute, for a given sector and at a given date after reopening, the ratio of effective days of reopening to total days of reopening, where effective days are adjusted to take into account the extent of the reopening.[2] As of mid-July, when reopening plans had plateaued, this metric ranged from about 30 percent (for example, in *Italy* and *Spain*, which followed a gradual approach) to above 50 percent (for example, in *France*, which opened later but at a fast pace).
- A final key distinction relates to how sectors were *sequenced* to reopen (Figure 2.2, panel 3), which varied significantly across countries. For example, retail was among the first sectors, with the median country reopening it in phase 2 of its overall plan. There has been more variability in the case of schools. *Austria* and *Denmark,* for example, introduced easing actions among its first opening measures, but in other countries, such as *Italy* and *Spain,* easing actions for schools were in the last phase.

In many countries, reopening steps were accompanied by additional health-related measures, such as the recommendation or mandates to use face masks in some public places (public transportation, for example), the launch of contact tracing applications, and an expansion of testing. Some survey-based evidence shows that the use of face masks continued to increase after countries started to reopen (Figure 2.3). The chapter does not explore the effect of such health-related measures because of data limitations.

The tracked reopening actions are used to construct country-specific and country sector-specific daily reopening indices. The next sections explore how the official aggregate reopening measures translate into actual improvements in activity and how they affect infections; and how different reopening strategies may affect the trade-off between more economic activity and a lower risk of new infections.

Figure 2.3. Face Mask Usage since Reopening
(Mask-wearing intensity, percent deviation from reopening week)



Sources: Imperial College; and IMF staff calculations.
Note: The chart plots the percent deviation of average responses regarding the use of face masks per country from the day of reopening. The solid line shows the mean percent deviation across countries, and the shaded area denotes the interquartile range. Respondents were asked how often they wore face masks outside their homes during the past 7 days, ranging from 0 (never) to 4 (always).

[2]For example, if a country reopened schools for four days by 50 percent and then by 100 percent for one day, the effective days reopened for schools over those five days is three. Taking equal weights across sectors, the analysis aggregated and obtained the total number of effective days for each country. Actual days open are the number of days passed since the first reopening. See Online Annex 2.1 for further details.

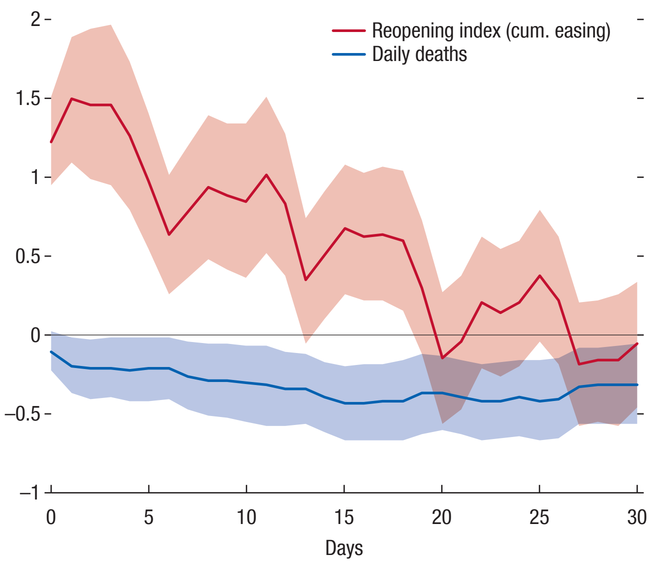
Back in Business: Reopening and Activity

This chapter examines the effect of reopening measures on activity using daily data and a panel regression model, in which a proxy of economic activity is regressed on the reopening index and a set of control variables.[3] The analysis uses the mobility variables compiled by Google to proxy for economic activity due to a lack of readily available official daily data. These variables correlate well with GDP growth for European countries, with an estimated correlation coefficient of about 0.5 in Q2 explaining over 80 percent of GDP variability (see Franks and others 2020).

The main explanatory variable is the aggregate reopening index, which measures the cumulated easing actions in each country at a given point of time.[4] The regression controls for country and time fixed effects (to capture common trends and time-invariant country characteristics such as demographics), lagged mobility, lagged infection incidence, a dummy that indicates the time elapsed since the first reopening action (to control for the endogeneity related to the timing of the exit from lockdown), and country-specific infection time trends.

The results suggest that a marginal change in the reopening index (e.g, moving from fully closed to partially open in one of the sectors) is associated, on average, with an initial increase in mobility of 1 to 1.5 percentage points (Figure 2.4, red line).[5]

Figure 2.4. Effect of Reopening Measures and Voluntary Social Distancing on Mobility
(Percentage point change)



Sources: Google; Our World in Data; European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: The graph shows point estimates (solid line) of reopening measures and lagged daily deaths on mobility with 90 percent confidence intervals (shaded area).

The effect declines gradually over time but remains statistically significant for almost two weeks.[6]

The Role of Voluntary Social Distancing

Changes in mobility can reflect not just the effect of reopening policies but also voluntary social distancing, as people may reduce activity because of fear of infection even when restrictions are relaxed. If voluntary social distancing is a function of the severity of the epidemic, then the coefficient of lagged infections in the regression (measured as the average number of daily deaths over the preceding week) can be used to assess the effect

[3]The regression analyses in this chapter rely on local projection methods (Jordà 2005), which can easily accommodate nonlinearities in the lagged response of the dependent variable.

[4]The analysis considers policy actions taken between April 10 and July 15. The reintroduction of restrictions after that time is not included. For the mobility analysis, the period is restricted up to July 15, excluding the time around summer vacations to avoid confounding the decline in mobility with changes in reopening policies or infections. The analysis on infections incorporates data up to the end of August. See Online Annex 2.1 for definition of variables and data sources.

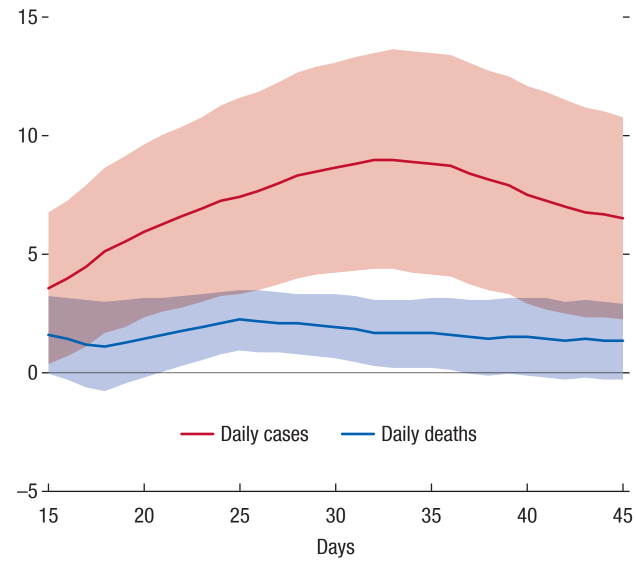
[5]Evidence from surveys conducted by Imperial College, London, also shows an increase in the number of social contacts by respondents in line with an increase in mobility as countries reopened (Franks and others 2020).

[6]Exploring the effect of containment policies is potentially subject to endogeneity concerns, and the estimates could be biased if time-varying unobservables affect both mobility and reopening plans. Including lagged infections in the baseline specification attenuates this concern but may not be sufficient. In a robustness exercise, the sectoral variation inherent in both the mobility and policy measures is exploited to difference out time-varying country unobservable factors; the results are qualitatively similar (Franks and others 2020).

of voluntary social distancing on mobility. The results show that a unit increase in per capita daily deaths is associated with a statistically significant and persistent decline in mobility of up to 0.5 percentage point (Figure 2.4, blue line).

The results also suggest that reopening policies explain a larger fraction of the increase in mobility than voluntary social distancing, although the latter effect is more persistent.[7] For instance, an increase in the reopening index of one standard deviation leads to a rise in mobility of 0.2 standard deviation, while a decline in daily deaths of one standard deviation is associated with an increase in mobility of only 0.05 standard deviation. In the same vein, about 40 percent of the variability in mobility explained by the model (60 percent in total) is attributed to the reopening policies. Lagged infections or voluntary social distancing explains a much smaller fraction (about 14 percent).[8]

Figure 2.5. Effect of Reopening Measures on Infections
(Percent change)



Sources: Google; Our World in Data; European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: The graph shows point estimates (solid line) of reopening measures on daily cases and deaths with 90 percent confidence intervals (shaded area).

Fever on the Rise: Reopening and Reinfections

A key question to assess the success of reopening strategies is whether they lead to a significant resurgence in infections. To explore whether the uptick in cases observed in many European countries can be attributed to the reopening measures adopted, a similar regression analysis is conducted, but with the log of daily COVID-19 cases or, alternatively, fatalities per million inhabitants replacing mobility as the dependent variable. The analysis starts by exploring the response of the epidemic to movements in the overall reopening index, while continuing to control for other factors.[9]

The results suggest that a unit easing in the reopening index is associated, on average, with a significant increase of about 4 percent in daily cases after two weeks and close to 8 percent after one month (Figure 2.5). The effect for fatalities is also statistically significant but quantitatively smaller: daily deaths increase by about 2 percent one month after each unit of easing.

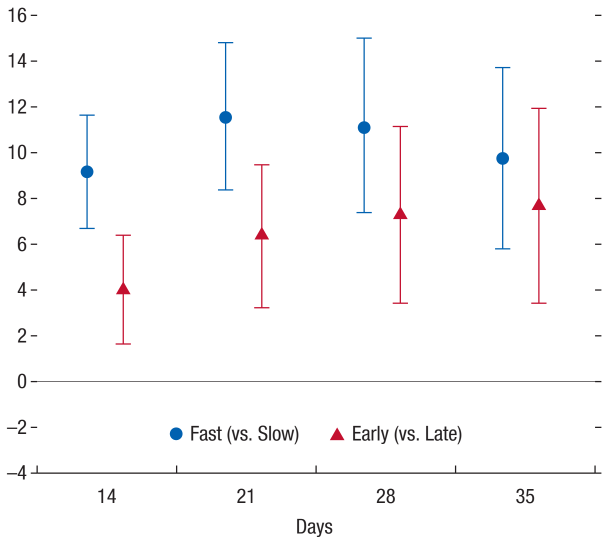
In contrast to studies that focused on lockdown measures (see, for example, Chapter 2 of the October 2020 *World Economic Outlook*; Jinjarak and others 2020), the analysis finds a much lower effect of containment policies on deaths. The smaller response of fatalities during reopening compared with that experienced during lockdowns

[7]One caveat to this result is that lagged deaths is, at best, only a proxy for voluntary social distancing and other factors, such as changing cultural norms due to the extent of the pandemic, could have additional effects.

[8]The result that voluntary social distancing matters less than the easing of restrictions differs with earlier findings for lockdowns (for example, Chapter 2 of the October 2020 *World Economic Outlook* finds that lockdowns and voluntary social distancing played a nearly comparable role). This asymmetry is broadly in line with the evidence for the introduction and lifting of stay-at-home orders in US states and cities in Glaeser and others (2020). They propose a model to show that easing restrictions can signal that going out has become safer. Government actions, therefore, have both a direct effect (preventing people who want to go out from doing so) and an indirect effect (signaling to people when it is safe to go out again).

[9]The control variables include country and time fixed effects, lagged mobility, lagged infection incidence, a dummy indicating the period since the first reopening action (to control for the endogeneity related to the timing of the exit from lockdown), and country-specific infection time trends.

Figure 2.6. Differential Effect of Fast versus Slow and Early versus Late Reopening Strategies on Daily Cases
(Percent difference)



Sources: Google; Our World in Data; European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: The graph shows the percentage difference in the response of infections (daily cases) to one unit of reopening between fast (early) and slow (late) reopeners in blue (red). Vertical lines denote 90 percent confidence intervals.

could reflect, among other factors, a shift in the demographics of the infected population toward lower-risk groups, such as the young (ECDC 2020), a weakening of the virus, seasonal factors, or better medical therapies. An expansion in testing may also have led to increased detection of asymptomatic or mild cases, but additional analysis suggests that this is not the key driving factor of the lower fatality rate.[10] A comprehensive analysis of the drivers of the lower fatality rate is beyond the scope of the chapter.

In sum, while reopening measures have a welcome effect on mobility and economic activity, they also result, on average, in an unwelcome uptick in infections. But can any lessons be extracted from the different strategies adopted by European countries to reduce this negative side effect? The next section examines whether the effects of reopening on daily cases vary depending on how early countries reopened and how fast they reopened.

Timing and Pace of Reopening Plans

Some countries waited until the infection rate was well past its peak before taking the first reopening steps, while others opened when daily fatalities were still rising (Figure 2.2). Another key difference between the country reopening plans was the speed or pace of sectoral reopening actions, with some countries taking gradual actions while others fully opened all sectors in a matter of days. Were these diverse reopening approaches associated with differential outcomes?

To tackle this question, the regression analysis for infections is extended to allow the effect of reopening to differ by whether countries opened early or late (in relation to their daily fatality curve), and whether countries opened fast or slow (based on the speed of reopening, that is, the share of effective to actual reopening days shown in Figure 2.2).[11]

The results suggest that for any given reopening step, opening at an earlier stage is associated with larger reinfection risk (Figure 2.6). Early reopeners suffered significantly higher daily cases per unit of easing of about 4 percent at a 14-day horizon and about 7 percent after one month.[12]

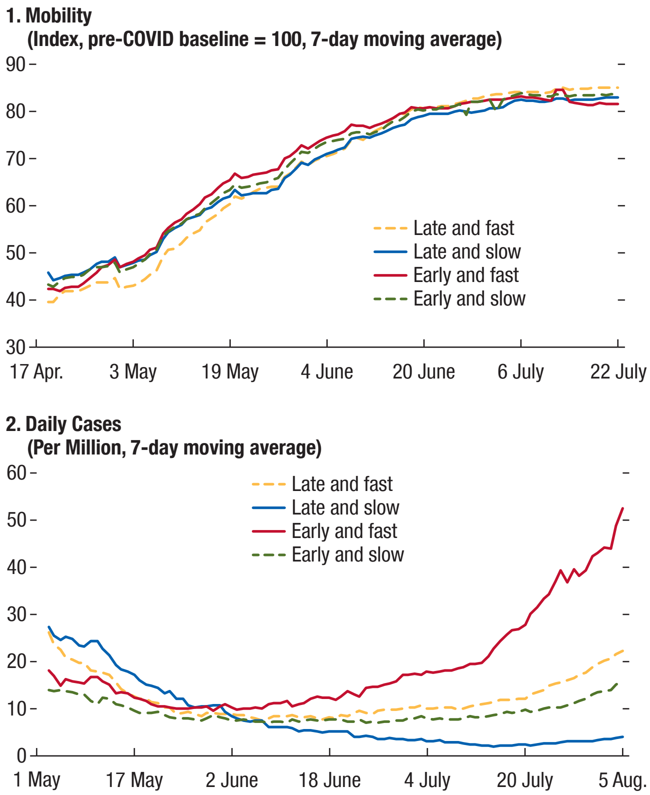
The results also point to a statistically significantly larger response in daily cases per reopening step, on average, for countries that reopened fast versus those that reopened slowly (Figure 2.6). The response of daily cases per unit of easing is about 8 percent higher for countries that reopened fast

[10]Using a smaller sample because of data limitation, an additional regression specification was run, controlling for daily tests per capita as well as self-reported compliance with other non-pharmaceutical interventions such as mask mandates and social distance guidelines. This regression yields similar results as the baseline model (see Franks and others 2020).

[11]The extended regression includes two dummy variables interacted with the reopening index. The first dummy indicates that a country is an early opener when the reduction in daily deaths (relative to the peak attained) it had registered before taking the first reopening action is below the median across countries. For countries that registered more than one wave in daily deaths, the first wave is considered. The second dummy indicates that a country opened fast when its effective-to-actual days open metric is above the sample median.

[12]The difference in responses is statistically significant at a 90 percent confidence at all horizons between two and six weeks.

Figure 2.7. Alternative Reopening Strategies: Predicted Paths by Reopening Strategies



Sources: Google; Our World in Data; European Centre for Disease Prevention and Control; and IMF staff calculations.
Note: The figures show in-sample fitted values using parameter estimates from Equation (2) in Online Annex 2.2 at a one-week horizon for mobility (panel 1) and a three-week horizon for daily cases (panel 2) and mean covariate values (including for reopening) for all four country groups.

at a 14-day horizon and about 12 percent higher after one month.[13]

Taken together, these results indicate that the effect of reopening on infections differs based on the strategy being pursued. This likely reflects the very nonlinear nature of contagion. For instance, a given easing of restrictions is likely to lead to a larger increase in infections when many people are still infected (that is, when reopening happens early). Similarly, reopening twice as fast is likely to lead to a more-than-proportional increase in infections. This suggests that reopening strategies in which partial restrictions remain in place during a transition period and are removed only slowly are more favorable in lowering the risk of infection.

When it comes to the recovery in mobility and hence economic activity, on the other hand, no difference is found between countries that reopened late or early or between countries that reopened fast or slowly.[14] That is, the benfit in terms of increased mobility per unit of easing is not statistically different across strategies.

One way to illustrate the contrast in the results for mobility and infections is to compare the model predictions for these variables under different strategies. The results indicate that alternative reopening strategies produced marked differences in the trajectory of infections but only minor differences with respect to mobility (Figure 2.7). In other words, easing containment restrictions by one unit delivers similar economic effects, as proxied by mobility, regardless of how and when a country exits, but it generates a much smaller increase in new infections if reopening is pursued in a late and slow manner.

These results do not mean that the effect on activity is inconsequential, because postponing or slowing the reopening actions implies that full reopening is delayed. But the results suggest that the economic gain of rapid and early strategies is not disproportionately larger, while the reinfection risk appears to be so.

Conclusions and Policy Implications

The need to calibrate containment policies to keep COVID-19 in check will keep policymakers busy until a vaccine or an effective treatment becomes widely available. This fine-tuning

[13]As before, one concern is whether the larger effect found for countries opening faster or earlier reported in Figure 2.6 may be reflecting increased testing capacity in those countries. An additional specification controlling for daily tests (using a smaller sample given data limitations) yields similar results, suggesting this is not the case. See Franks and others (2020).

[14]To examine this question, additional analysis regresses mobility on the reopening strategies using the same framework as used for the infection regressions. The results are reported in Franks and others (2020).

involves uncomfortable trade-offs: the results in this chapter show that reopening measures have led to a much-needed recovery in economic activity but at the cost of an uptick in infections already under way at the end of August.

Although this result is consistent with studies on the effect of lockdowns, the findings in this chapter point to some novel dimensions of the trade-off between economic activity and the spread of the pandemic during the reopening phase. First (and fortunately), the unwelcome increase in COVID-19 cases soon after the reopening phase appears less severe regarding fatalities than what the earlier findings for lockdowns would have suggested. This likely reflects a shift in the demographics of the infected population toward lower-risk groups but also that better medical care for severe cases may have been developed. Nonetheless, as the resurgence in infections has gained strength in several countries in recent weeks, authorities have had to reintroduce containment measures to avoid overwhelming the health system.

Second, the results suggest that the reinfection risk increases disproportionally under certain reopening strategies. In particular, a given reopening measure appears to have a larger effect on subsequent infections if the country starts opening when the circulation of the virus is still pervasive and infection rates are growing or if the reopening measures are not sufficiently gradual. Although opening later or slower is associated with a delayed recovery in mobility (because a fully reopened stage is postponed further), the incremental cost is not disproportionally larger. Taken together, these findings suggest some merit in reopening gradually and beginning at a late stage in the infection cycle.

Certainly, the overall success in dealing with the pandemic as economies reopen will depend on not only the general principles regarding the timing and pace of measures outlined here but also, crucially, on the population's collective behavior. As activity continues to resume, making it more difficult to maintain social distancing, some evidence of more widespread use of face masks is encouraging, but it may not be sufficient to keep new large outbreaks in check.

Annex 2.1. Description of Reopening Database

Most European economies have followed a phased-in approach, opening sectors differentially and in a gradual manner. The database constructed for this chapter compiles measures taken by European authorities to reopen the economy based on the (i) sector, (ii) timing, (iii) phase and (iv) intensity of reopening.[1] For each country and date, the chapter defines the reopening measures as follows:

(i) *Sector of reopening*: Sectors are classified as schools, industry, retail, services (e.g., hotels, restaurants, hairdressers etc.), events/public-places, and international travel (including intra-European).[2]

(ii) *Timing of reopening:* The date in which a country opened a specific sector.

(iii) *Phase of reopening:* The phase within the overall exit plan in which a sector's first reopening measure was taken.

(iv) *Intensity of reopening*: Change in the opening status of a particular sector. Opening status is coded as 0 (open), 1 (open with restrictions/guidelines), 2 (partially open with only a subset of the sector allowed to function) and 3 (closed).

These indicators are constructed based on authorities' reopening measures from official and other news sources. The chapter also uses supplemental information from the Oxford Covid-19 Government Response Tracker, the European Commission measures dashboard, and the ACAPS government measures dataset.

Two related metrics built from the reopening database are used in the chapter to characterize the overall reopening plan for each country: the *speed* and *timing* of reopening plans.

- The *timing* of a country reopening strategy is calculated as the percentage change in daily deaths between the peak of the infection-death curve and the day the first reopening measure is introduced. The infection curve that was used refers to deaths rather than cases as it is a more robust benchmark (cases could be under-detected, for instance depending on the testing capacity). In addition, policymakers were more likely to monitor deaths, at least in the first wave, as they are more closely linked to hospital capacity issues.
- The *speed* or pace at which countries reopened is computed as the ratio of effective to actual days since the first reopening measure is introduced. The effective days open is defined, at the sector level, by the cumulative extent of each sector's reopening each day. For instance, if a country reopened schools for four days by 50 percent and subsequently by 100 percent for one day, the effective days reopened for schools is three. The aggregate effective days open is the sum of the effective days open across all sectors.

[1]The countries in the database include Austria, Belgium, Czech Republic, Germany, Denmark, Finland, France, Greece, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Switzerland, Turkey, Ukraine, and United Kingdom. Sweden does not feature in our database as it is not possible to comprehensively characterize its reopening given that it did not have a full lockdown.

[2]The analysis does not make a distinction between essential and non-essential lines of work within each sector, and mostly follows authorities' announcements of how the economy was planned to reopen. In principle, many countries left essential businesses to operate even under lockdown. Further it should be noted that despite the sectoral reopening announced by authorities, many workplaces encouraged (and continued to) telework both during lockdown and the reopening phases and the database does not collect information on its application.

Annex 2.2. Empirical Methodology

The chapter estimates the effect of reopening on activity (reported in Figure 2.4) and on infection related variables (reported in Figure 2.5) using local projections methods (Jordà, 2005) and panel data of daily observations for 22 countries:

$$Y_{i,t+h} = \alpha_i^h + \eta_t^h + \beta^h.\ Reopening_{i,t} + \lambda_1^h.\ Deaths_{i,t-1} + \lambda_2^h.\ Cases_{i,t-1} + \mu^h\ .Mobility_{i,t-1} + \theta^{\boldsymbol{h}}.\ \mathbf{X}_{\boldsymbol{i,t}} + u_{i,t} \quad (1)$$

The main outcome variables, $Y_{i,t+h}$, are a mobility index ($Mobility_{i,t}$) and COVID-19 infections ($Deaths_{\ i,t}$, $Cases_{\ i,t}$). The mobility data is taken from Google and realigned in index form, where 100 corresponds to pre-COVID-19 baseline (normal) mobility (average of retail, workplace, and transport) and with values below 100 indicating the percentage mobility below normal. The data for infections (daily cases and deaths per million) are obtained from the ECDC. $Deaths_{\ i,t}$ and $Cases_{\ i,t}$ are then defined as the log of the seven-day moving average of daily deaths and daily cases per million, respectively.[1] $Reopening_{i,t}$ is the aggregate cumulative easing of restrictions constructed from the database described in Annex 2.1. Specifically, it is the cumulative of the i*ntensity of reopening* variable which measures the daily change in the sectoral opening status, aggregated across all sectors. $\mathbf{X}_{\boldsymbol{i,t}}$ is a vector of covariates including a control for the first reopening, country infection trends and day of the week effects. All specifications also include a full set of country and time fixed effects (α_i and η_t). Equation (1) is estimated by OLS for each daily horizon $h = 1, \ldots, H$. For inference, the coefficient standard errors are adjusted for heteroskedasticity and serial correlation (using a bandwidth of 7 days). The variance decompositions reported in the chapter (section on the role of voluntary distancing) are derived by decomposing the share of explained variance of the model in Equation (1) into contributions of regressor variables using the Shapley value method.

To explore the heterogeneity in average effects by reopening strategies (reported in Figure 2.6), the baseline regression (1) is extended to include two indicator variable classifying each country into whether they were fast ($Fast_i$) reopeners (versus late) and whether they were early ($Early_i$) reopeners (versus late). These variables are then interacted with the main variable of interest, the reopening policy ($Reopening_{i,t}$), to retrieve the differential effects (γ_1^h, γ_2^h). Standard errors are robust to heterosked-asticity and serial correlation (using a bandwidth of 7 days).

$$Y_{i,t+h} = \alpha_i^h + \eta_t^h + \beta^h.\ Reopening_{i,t} + y_1^h.\ Reopening_{i,t} * Fast_i + y_2^h.\ Reopening_{i,t} * Early_i + \lambda_1^h.\ Deaths_{i,t-1} + \lambda_2^h.\ Cases_{i,t-1} + \mu^h\ .Mobility_{i,t-1} + \theta^{\boldsymbol{h}}.\ \mathbf{X}_{\boldsymbol{i,t}} + u_{i,,t} \quad (2)$$

The results shown in Figure 2.7 are in-sample fitted values using parameter estimates from Equation (2) at a one-week horizon for mobility and a three-week horizon for daily cases and mean covariate values (including for reopening) for all four country groups: fast and early, fast and late, slow and early, and slow and late.

[1]The data on daily cases and deaths is from the European Centre for Disease Prevention and Control (ECDC), as reported by Our World in Data (https://ourworldindata.org/coronavirus).

References

ECDC (European Centre for Disease Prevention and Control). 2020. "Coronavirus Disease 2019 (COVID-19) in the EU/EEA and the UK—Eleventh Update: Resurgence of Cases." ECDC Rapid Risk Assessment (August 10, 2020), European Centre for Disease Prevention and Control, Stockholm.

Franks, Jeffrey, Bertrand Gruss, Carlos Mulas Granados, Manasa Patnam, and Sebastian Weber. Forthcoming. "Exiting from Lockdowns: Early Evidence from Reopenings in Europe." IMF Working Paper 20/218, International Monetary Fund, Washington, DC.

Glaeser, Edward L., Ginger Zhe Jin, Benjamin T. Leyden, and Michael Luca. 2020. "Learning from Deregulation: The Asymmetric Impact of Lockdown and Reopening on Risky Behavior During COVID-19." NBER Working Paper 27650, National Bureau of Economic Research, Cambridge, MA.

Jinjarak, Yothin, Rashad Ahmed, Sameer Nair-Desai, Weining Xin, and Joshua Aizenman. 2020. "Accounting for Global COVID-19 Diffusion Patterns, January–April 2020." NBER Working Paper 27185, National Bureau of Economic Research, Cambridge, MA.

Jordà, Òscar. 2005. "Estimation and Inference of Impulse Responses by Local Projections." *American Economic Review* 95 (1): 161–82.