

*To contain the coronavirus (COVID-19) pandemic and protect susceptible populations, most countries imposed stringent lockdown measures in the first half of 2020. Meanwhile, economic activity contracted dramatically on a global scale. This chapter aims to dissect the nature of the economic crisis in the first seven months of the pandemic. It finds that the adoption of lockdowns was an important factor in the recession, but voluntary social distancing in response to rising infections also contributed very substantially to the economic contraction. Therefore, although easing lockdowns can lead to a partial recovery, economic activity is likely to remain subdued until health risks abate. Meanwhile, countries should protect the most vulnerable and find ways to support economic activity compatible with social distancing, for example, by reducing contact intensity in the workplace and enhancing work from home where possible. This chapter also provides new evidence of the uneven effects of lockdowns, which are found to have a larger impact on the mobility of women and younger cohorts. This calls for targeted policy action to prevent a widening of inequality. Finally, the analysis shows that lockdowns can substantially reduce COVID-19 infections, especially if they are introduced early in a country's epidemic and are sufficiently tight. Thus, despite involving short-term economic costs, lockdowns may pave the way to a faster recovery by containing the spread of the virus and reducing the need for voluntary social distancing over time, possibly having positive overall effects on the economy. This remains an important area for future research as new data become available.*

## Introduction

The COVID-19 pandemic has raised unprecedented health challenges on a global scale. To contain the spread of the virus, most countries have resorted to stringent lockdown measures, closing schools and business activities and sometimes even preventing

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people from leaving their homes, except for essential reasons. Meanwhile, economic activity has contracted dramatically, as discussed in Chapter 1. No country was spared, with GDP declining sharply in advanced, emerging market, and developing economies.

This chapter's first goal is to shed light on the extent to which the economic contraction was driven by the adoption of government lockdowns instead of by people voluntarily reducing social interactions for fear of contracting or spreading the virus. This issue is important to understand retrospectively the nature of the recession and to provide insights into the strength of the upcoming recovery. If lockdowns were largely responsible for the economic contraction, it would be reasonable to expect a quick economic rebound when they are lifted. But if voluntary social distancing played a predominant role, then economic activity would likely remain subdued until health risks recede.

The analysis starts by examining the cross-country association between lockdowns and economic activity across a broad sample of countries. It finds that countries that endured more stringent lockdowns experienced larger growth declines relative to pre-COVID-19 forecasts, even after controlling for the severity of the local epidemic. The chapter then assesses the impact of lockdowns using high-frequency proxies for economic activity, namely mobility indicators provided by Google and job postings provided by the website Indeed.<sup>1</sup> Regression results show that lockdowns have a considerable negative effect on economic activity. Nonetheless, voluntary social distancing in response to rising COVID-19 infections can also have strong detrimental effects on the economy. In fact, the analysis suggests that lockdowns and voluntary social distancing played a near comparable role in

<sup>1</sup>Google Community Mobility Reports provide information on daily attendance rates at various locations relative to precrisis levels. Data are available at a national level for a large set of advanced, emerging market, and developing economies. For various countries, mobility information is also available at a subnational level. Data can be downloaded at <https://www.google.com/covid19/mobility/>. The job site Indeed provided the IMF with anonymized information about daily job postings in 22 countries, disaggregated by job categories.

driving the economic recession. The contribution of voluntary distancing in reducing mobility was stronger in advanced economies, where people can work from home more easily and sustain periods of temporary unemployment because of personal savings and government benefits.

When looking at the recovery path ahead, the importance of voluntary social distancing as a contributing factor to the downturn suggests that lifting lockdowns is unlikely to rapidly bring economic activity back to potential if health risks remain. This is true especially if lockdowns are lifted when infections are still relatively high because, in those cases, the impact on mobility appears more modest. Further tempering the expectations of a quick economic rebound, the analysis documents that easing lockdowns tends to have a positive effect on mobility, but the impact is weaker than that of tightening lockdowns. These findings suggest that economies will continue to operate below potential while health risks persist, even if lockdowns are lifted. Therefore, policymakers should be wary of removing policy support too quickly and consider ways to protect the most vulnerable and support economic activity consistent with social distancing. These may include measures to reduce contact intensity and make the workplace safer, for example by promoting contactless payments; facilitating a gradual reallocation of resources toward less-contact-intensive sectors; and enhancing work from home, for example, by improving internet connectivity and supporting investment in information technology.

The chapter also contributes to the growing empirical evidence on the uneven effects of the crisis, with particularly acute impacts on more economically vulnerable people. Using novel anonymized and aggregated mobility indicators provided by Vodafone for some European countries, the analysis shows that lockdowns tend to have a larger effect on women's mobility than on men's, especially at the time of school closures.<sup>2</sup> This suggests that women carry a disproportionate burden in caring for children, which

may jeopardize their employment opportunities. Vodafone data also show that lockdowns tend to have a stronger impact on the mobility of younger cohorts, who are economically more vulnerable because they generally rely on labor income and have less stable jobs. Thus, targeted policy intervention is needed to protect the employment prospects of women and younger cohorts and prevent a widening of income inequality.

Finally, the chapter finds that lockdowns can reduce infections substantially. The effects of lockdowns on confirmed COVID-19 cases tend to materialize after a few weeks of delay, given the incubation period of the virus and testing times. This underscores the importance of early intervention, also because lockdowns are more effective in curbing infections if they are introduced early in the stage of a country's epidemic. The analysis also suggests that lockdowns must be sufficiently stringent to reduce infections significantly.

The effectiveness of lockdowns in reducing infections suggests that lockdowns may pave the way to a faster economic recovery if they succeed in containing the epidemic and thus limit the extent of voluntary social distancing. Therefore, the short-term economic costs of lockdowns could be compensated by stronger medium-term growth, possibly leading to positive overall effects on the economy. This is an important area for future research. Meanwhile, policymakers should also pursue alternative ways to contain infections that may involve lower short-term economic costs than lockdowns, such as expanding testing and contact tracing, promoting the use of face masks, and encouraging work from home. As the understanding of the virus transmission improves, countries may also be able to deploy targeted measures rather than blunt lockdowns, for example by focusing on protecting vulnerable people and restricting large indoor gatherings.

The analysis contributes to a rapidly growing literature on the pandemic and the effects of lockdowns, which is reviewed in Box 2.1. The understanding of the crisis is still evolving—some papers detect considerable effects of lockdowns while others emphasize the role of voluntary social distancing. The literature also documents the pandemic's uneven effect on vulnerable segments of the population and provides evidence of the effectiveness of lockdowns and face masks in containing infections.

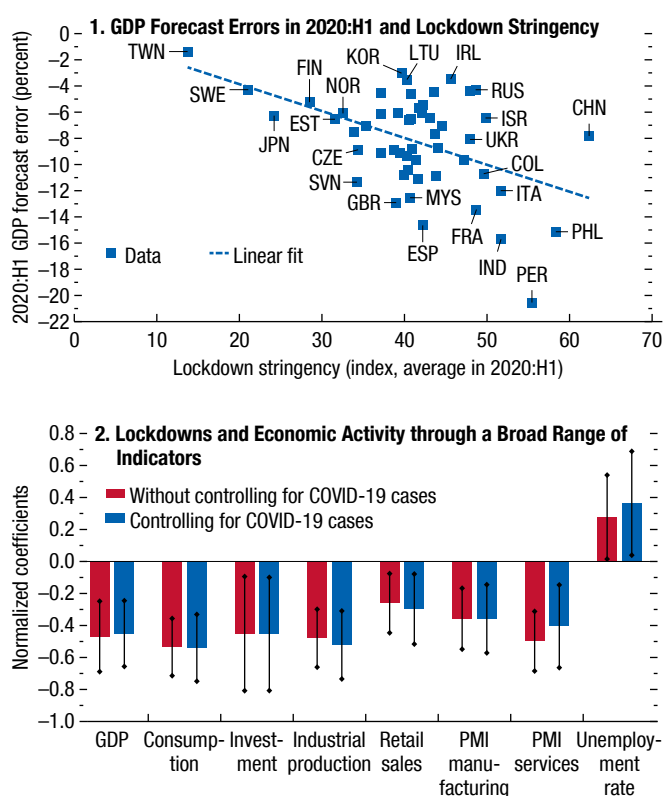
<sup>2</sup>These indicators were prepared by Vodafone's Big Data and Artificial Intelligence team and were provided for the analysis in an anonymized format through a confidential agreement. To protect the privacy of individuals and minority groups, mobility indices were aggregated at the provincial level, including at least 50 customers. The data sharing protocol was subject to technical and organizational controls, including an ethical assessment of the analysis prior to its implementation.

## Cross-Country Evidence on Lockdowns and Economic Activity

The analysis starts by presenting cross-country evidence on the association between lockdowns and economic activity over a sample of up to 52 advanced, emerging market, and developing economies. Panel 1 of Figure 2.1 shows the correlation between the stringency of lockdowns during the first half of 2020 and the decline in GDP relative to

**Figure 2.1. Lockdowns and Economic Activity**

More stringent lockdowns are correlated with sharper economic contractions.



Sources: Haver Analytics; Oxford Coronavirus Government Response Tracker; World Economic Outlook (WEO) database; and IMF staff calculations. Note: Panel 1: The GDP forecast errors are defined as the deviations from January 2020 WEO projections for the first half of 2020 (2020:H1). Online Annex Table 2.1.2 provides the full list of countries. Panel 2: For GDP, consumption, and investment, the analysis uses data for 2020:H1. For the other indicators that are available at monthly frequency, the analysis considers the first three months after COVID-19 cases reach 100 in a country. The regressions control for the logarithm of the COVID-19 cases normalized by population in 2019. Normalized coefficients reported on the vertical axis show the impact of a one-standard-deviation increase in the lockdown index on each economic variable, normalized by its own standard deviation. Standard deviations are based on the cross-country variation in the sample. The vertical lines refer to 90 percent confidence bands. See Online Annex 2.2 for additional details. PMI = purchasing managers' index. Data labels use International Organization for Standardization (ISO) country codes.

pre-pandemic forecasts.<sup>3</sup> The figure illustrates that countries that implemented more stringent lockdowns experienced sharper GDP contractions.

Panel 2 of Figure 2.1 shows that the negative association between lockdowns and economic activity is robust to using other indicators besides GDP. For example, more stringent lockdowns are associated with lower consumption, investment, industrial production, retail sales, purchasing managers' indices for the manufacturing and service sectors, and higher unemployment rates.<sup>4</sup> These correlations persist with and without controlling for the strength of each country's epidemic based on the total number of confirmed COVID-19 cases scaled by population.

Figure 2.1 thus provides suggestive evidence that lockdowns tend to have a negative short-term economic impact. Nonetheless, these findings should be interpreted with caution given omitted variable concerns that affect cross-country analyses and endogeneity concerns about lockdowns. The decision to deploy lockdowns is indeed not random; rather, it may reflect time-invariant country characteristics that also affect economic outcomes. For example, countries with higher social capital may not require stringent lockdowns—as people take greater precautions against infecting others—and could also better withstand the economic impact of the crisis. This may generate a spurious negative correlation between the stringency of lockdowns and economic activity. To strengthen identification by controlling for such time-invariant country characteristics, the next section reexamines the economic impact of lockdowns using time-series variation in high-frequency data.

<sup>3</sup>The analysis uses a lockdown stringency index that averages several subindicators—school closures, workplace closures, cancellations of public events, restrictions on gatherings, public transportation closures, stay-at-home requirements, restrictions on internal movement, and controls on international travel—provided by the University of Oxford's Coronavirus Government Response Tracker.

<sup>4</sup>Data for GDP, consumption, and investment refer to the first half of 2020. For the other indicators that are available at monthly frequency, the analysis considers the first three months after the first 100 confirmed COVID-19 cases in each country to compare economic outcomes during the same phase of a country's epidemic. See Online Annex 2.2 for additional details. All annexes are available at [www.imf.org/en/Publications/WEO](http://www.imf.org/en/Publications/WEO).

## Assessing the Impact of Lockdowns Using High-Frequency Data

Two types of daily data are used to proxy for economic activity at high frequency. First, the analysis uses mobility data provided by Google, which reports the attendance rate at various locations relative to precrisis levels.<sup>5</sup> These data have the key advantages of covering a large set of countries and being available also at the subnational level. The findings based on mobility data are corroborated using job posting data reported by Indeed, an online job search engine. Indeed data are available for fewer countries but capture labor market conditions more directly.

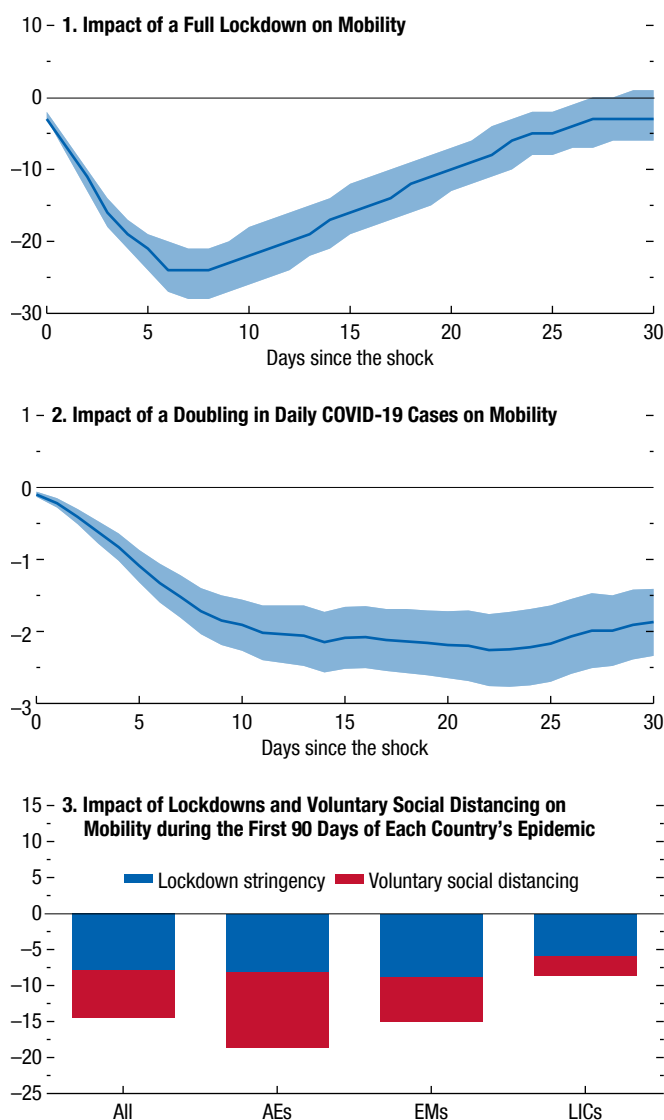
### Lockdowns and Mobility

To assess the impact of lockdowns on mobility, the analysis uses local projections that include country fixed effects and time dummies to control for time-invariant country characteristics and global shocks, respectively. It is important to note that lockdowns are endogenous policy choices that depend on the stage of the epidemic and the degree of mobility. For example, governments are more likely to impose lockdowns when health risks become more acute. At the same time, people tend to reduce mobility because they fear contracting the virus, independent of lockdowns. This may lead to a spurious negative correlation between lockdowns and mobility. To alleviate these endogeneity concerns, the regression framework controls for the number of COVID-19 cases and includes lags of the mobility indicator. In other words, the empirical analysis tries to measure the impact on mobility from a lockdown tightening at a given stage of the country's epidemic. Online Annex 2.3 provides additional details.

The regression is estimated using national-level data for 128 countries. Panel 1 of Figure 2.2 shows that lockdowns tend to have a statistically significant negative effect on mobility. A full lockdown that includes all measures that governments have used during the pandemic—for example, school closures, travel restrictions, business closures, and stay-at-home requirements—tends to generate a reduction in mobility of about

**Figure 2.2. The Impact of Lockdowns and Voluntary Social Distancing on Mobility**  
(Percent)

Lockdowns and voluntary social distancing have a substantial negative impact on mobility.



Source: IMF staff calculations.

Note: The shaded areas in panels 1 and 2 correspond to 90 percent confidence intervals computed with standard errors clustered at the country level. In panel 3, the first 90 days of the epidemic vary across countries as they are counted since the first COVID-19 case in each country. See Online Annex 2.1 for data sources and country coverage. AEs = advanced economies; EMs = emerging markets; LICs = low-income countries.

<sup>5</sup>Data are based on cell phone locations for people who own smartphones and agree to share location data with Google. Because this category of people may have characteristics that differ from those of the broader population—for example, income level, age, or access to the internet—the mobility indices may not be fully representative of the entire country, especially in poorer countries, where fewer people have smartphones.

25 percent within a week. Mobility starts to resume gradually after that as the lockdown tightening shock dissipates, as illustrated in Online Annex 2.3.<sup>6</sup>

To address endogeneity concerns further, the impact of lockdowns is also estimated using subnational data. The analysis considers 15 Group of Twenty countries that imposed national lockdowns in response to severe localized outbreaks and examines the impact on mobility in regions with a relatively low number of COVID-19 cases. This approach strengthens the identification because the adoption of the national lockdown was largely exogenous for regions less affected by the epidemic. As reported in Online Annex 2.3, the results confirm that lockdowns tend to have a strong negative impact on mobility. These findings are robust to controlling for COVID-19 cases at both the regional and national levels.

However, lockdowns are not the only contributing factor to the decline in mobility. During a pandemic, people also voluntarily reduce exposure to one another as infections increase and they fear becoming sick. Several papers document this aspect by showing that mobility has been tightly correlated with the spread of COVID-19, even after controlling for government lockdowns, especially in advanced economies (Aum, Lee, and Shin 2020; Goolsbee and Syverson 2020; Maloney and Taskin 2020). In line with this literature, the regression framework used in the analysis can shed light on the strength of voluntary social distancing by capturing the response of mobility to rising COVID-19 infections for a given lockdown stringency.<sup>7</sup> Panel 2 of Figure 2.2 shows that an increase in COVID-19 cases tends to have a considerable negative effect on mobility. A doubling of daily cases leads to a contraction in mobility by about 2 percent.

<sup>6</sup>Online Annex 2.3 also shows that the results are robust to controlling for COVID-19 deaths instead of cases; using subindicators of mobility provided by Google; controlling for testing, contact tracing, and public information campaigns; and accounting for possible cross-country heterogeneity in the mobility response depending on population density and indicators of governance and social capital.

<sup>7</sup>Besides reacting to the spread of COVID-19, people may voluntarily opt for social distancing also in response to other factors, such as announcements by public health officials, news about celebrities being infected, or even the adoption of government lockdowns. Therefore, the analysis may underestimate the extent of voluntary social distancing. The results are robust to controlling for COVID-19 deaths instead of cases. Normalizing COVID-19 cases or deaths by population is irrelevant, given that the regressions include country fixed effects and population does not vary during the period of analysis.

To gain further insights into the relative importance of lockdowns and voluntary social distancing tied to rising COVID-19 cases, panel 3 of Figure 2.2 shows their contribution in reducing mobility during the first three months of each country's epidemic. Both lockdowns and voluntary social distancing had a large impact on mobility, playing a roughly similar role in emerging markets. The contribution of voluntary social distancing was smaller in low-income countries and larger in advanced economies. These differences likely reflect that people in more economically developed countries can work from home more easily and can even afford to stop working temporarily by relying on personal savings or social security benefits. Conversely, people in low-income countries are often unable to opt for voluntary social distancing as they do not have the financial means to cope with a temporary income loss. This underscores the importance of international support to ensure that low-income countries have budgetary room for expanding safety nets.

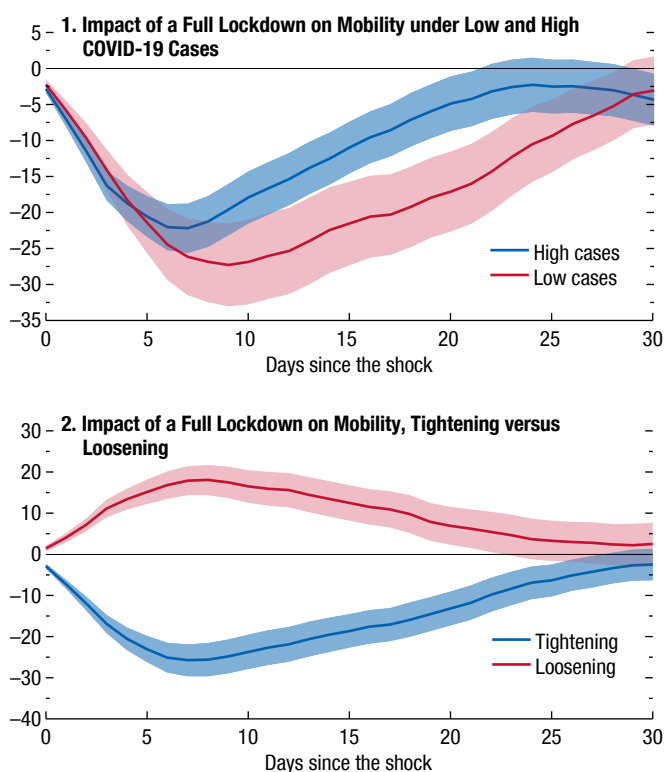
The large contribution of voluntary social distancing in reducing mobility suggests that lifting lockdowns can lead to only a partial rebound in economic activity if health risks persist. In line with this implication, panel 1 in Figure 2.3 shows that the impact of lockdowns on mobility is smaller when infections are relatively high. A likely reason is that people feel uncomfortable with resuming mobility when lockdowns are lifted if they still perceive a considerable risk of contracting or spreading the virus. This insight warns against lifting lockdowns prematurely in hope of jump-starting economic activity. Panel 2 of Figure 2.3 provides additional evidence against expecting a sharp economic recovery just from easing lockdowns. It shows that easing lockdowns tends to have a positive effect on mobility but the magnitude is weaker compared with the impact from a lockdown tightening. As documented in Online Annex 2.3, this difference is statistically significant.

The importance of voluntary social distancing coupled with the modest boost to mobility from easing lockdowns suggest that economies will likely operate below potential as long as health concerns persist.<sup>8</sup> A first implication is that policymakers should be

<sup>8</sup>Given the severity of the downturn, the crisis may have also reduced the level of potential output, thus leading to permanent losses even after the pandemic is over. This is an important issue for future research.

**Figure 2.3. Further Insights into the Impact of Lockdowns on Mobility**  
(Percent)

The impact of lockdowns on mobility is weaker when COVID-19 cases are higher. Furthermore, a lockdown easing tends to have a smaller impact on mobility relative to a lockdown tightening.



Source: IMF staff calculations.

Note: See Online Annex 2.1 for data sources and country coverage. High and low cases in panel 1 correspond to the 75th and 25th percentile of the cross-country distribution of log of daily COVID-19 cases, respectively. The shaded areas in panels 1 and 2 correspond to 90 percent confidence intervals computed with standard errors clustered at the country level.

wary of removing policy support too hastily to avoid precipitating a further downturn and should continue to protect the most vulnerable through social safety net spending. Second, it is important to find ways to support economic activity consistent with persistent social distancing. These may include measures to reduce contact intensity and make the workplace safer—for example by promoting contactless payments—and facilitate the reallocation of resources toward less-contact-intensive sectors. Policymakers should also enhance working from home, for example by improving internet access and supporting firm investment in information technology, which, as shown in Box 2.2, can protect employment during the pandemic.

## Lockdowns and Job Postings

The importance of lockdowns and voluntary social distancing in the ongoing crisis can also be examined using the daily number of job postings provided by Indeed for 22 countries. The analysis uses a local projection framework that mimics the one used for the analysis of mobility. Panels 1 and 2 of Figure 2.4 show that a lockdown tightening and an increase in COVID-19 cases both lead to a statistically significant negative effect on job postings, corroborating the findings based on mobility. Both lockdowns and voluntary social distancing in response to higher infections appear to have played an important role in driving the reduction in job postings during the first three months of each country's epidemic (panel 3). Consistent with the analysis of mobility, the contribution of voluntary social distancing is relatively higher because the country sample includes mostly advanced economies.

Data from Indeed can also be disaggregated by job categories, providing additional insights consistent with the results presented so far. First, panel 1 of Figure 2.5 suggests that both lockdowns and voluntary social distancing contributed to the reduction in job postings. Contact-intensive jobs—such as those in the hospitality, personal care, and food sectors—declined before stay-at-home orders, likely because of voluntary social distancing as customers grew wary of infection risks. Job postings in the manufacturing sector—that do not involve personal contacts with customers—instead started to decline closer to the adoption of stay-at-home orders, reflecting the impact of lockdown measures. The figure also shows that job postings in contact-intensive sectors declined more than in the manufacturing sector, likely reflecting a larger drop in aggregate demand because of voluntary social distancing. Second, panel 2 provides evidence consistent with the notion that easing lockdowns is unlikely to generate a sharp rebound in economic activity. The removal of stay-at-home orders has coincided with only a marginal increase in job postings, even in the less-contact-intensive manufacturing sector.

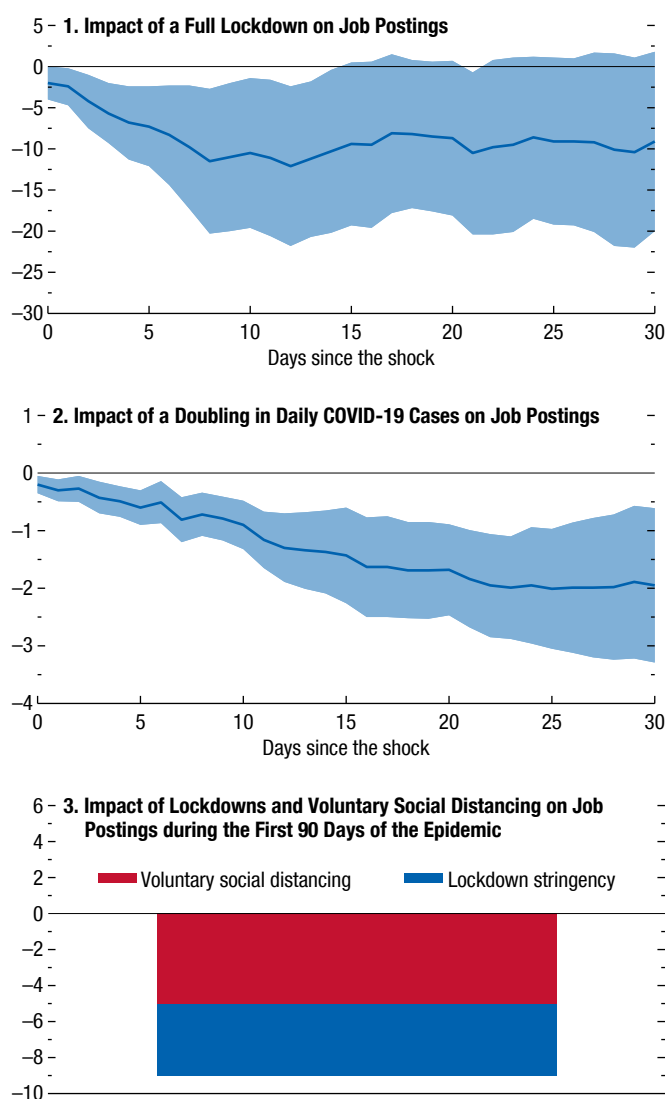
## The Unequal Effects of Lockdowns across Gender and Age Groups

The pandemic is having disproportional effects on the most economically vulnerable segments of the population. As reviewed in Box 2.1, the literature documents strong negative effects on lower-income



**Figure 2.4. The Impact of Lockdowns and Voluntary Social Distancing on Job Postings**  
(Percent)

Lockdowns and voluntary social distancing have a substantial negative impact on job postings.



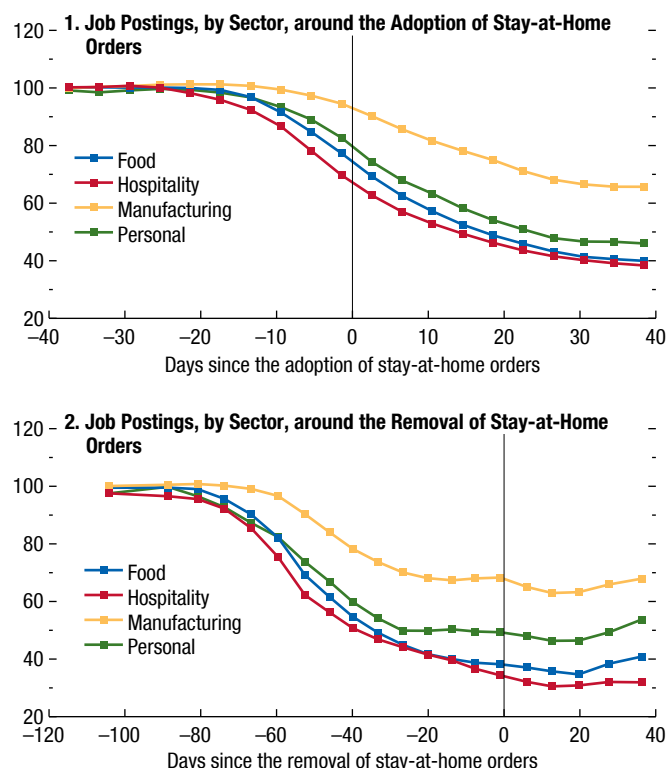
Sources: Indeed; and IMF staff calculations.

Note: See Online Annex 2.1 for data sources and country coverage. The shaded areas in panels 1 and 2 correspond to 90 percent confidence intervals computed with standard errors clustered at the country level.

households, workers with lower educational attainment, minorities, immigrants, and women. For example, unlike during previous recessions, women's employment has generally declined more than men's has. This section provides additional insights on the uneven impact on women using novel mobility data provided by Vodafone

**Figure 2.5. Job Postings, by Sector, around Stay-at-Home Orders**  
(Normalized to 100, 40 days before stay-at-home orders)

Analysis of sectoral job postings confirms the importance of both lockdowns and voluntary social distancing. Jobs in contact-intensive sectors declined before lockdowns, while manufacturing jobs declined around the adoption of stay-at-home orders. Job postings have remained subdued, even after national stay-at-home orders were lifted.



Sources: Indeed; and IMF staff calculations.

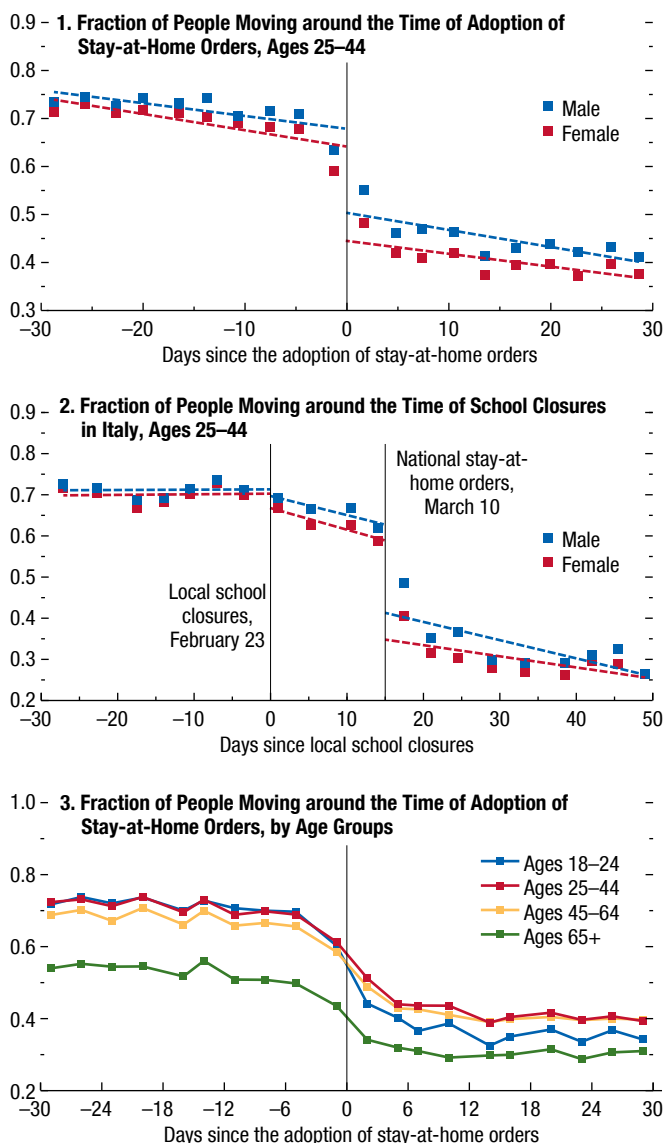
Note: This figure reports binned scatter plots showing the evolution over time of the seven-day moving average of job postings in different categories. The x-axis variable is divided into 20 equally sized bins. The sample includes countries that introduced national stay-at-home orders according to the Oxford Coronavirus Government Response Tracker. The countries included are ARE, AUT, BEL, ESP, FRA, GBR, IND, IRL, ITA, MEX, NLD, NZL, POL, and SGP. Country list uses International Organization for Standardization (ISO) country codes.

for Italy, Portugal, and Spain. By analyzing connections across cell towers, Vodafone can create mobility indices by gender based on the information customers provide when subscribing to a phone plan. Data are aggregated at the provincial level to protect customers' privacy. Vodafone data also differentiate mobility indices by age groups, thus providing novel important perspectives on the mobility patterns during the COVID-19 pandemic.

Panel 1 of Figure 2.6 shows mobility levels for men and women 30 days before and after the adoption of

**Figure 2.6. Differentiating the Mobility Impact of Lockdowns by Gender and Age Group**  
(Percent)

Women and younger workers are disproportionately affected by lockdowns.



Sources: Vodafone; and IMF staff calculations.

Note: All panels present binned scatter plots around the time of stay-at-home orders' introduction. In panels 1 and 2, the series are residualized with respect to province and day-of-the-week fixed effects. In panel 2, the sample is restricted to five northern Italian regions where school closures were introduced before stay-at-home orders. The x-axis is divided into 20 equally sized bins.

stay-at-home orders for people aged 25 to 44. These orders coincided with a large drop in mobility for both men and women, leading to a drop of about 20 percent in the number of people who leave their homes on a given day. However, the effect on women was stronger by about 2 percent, a modest but statistically significant difference. Because stay-at-home orders in Italy, Portugal, and Spain coincided with school closures for almost all regions, the higher reduction in women's mobility may reflect that women are more likely to care for children when schools are closed. Consistent with this hypothesis, data show a smaller difference between men and women for people aged 45 to 64, who are less likely to have young children who require supervision at home.

Panel 2 provides additional evidence on women's role in caring for children. Focusing on a few regions in northern Italy that closed schools two weeks before the national lockdown, mobility data show that the gender gap already widened at the time of school closures. The national stay-at-home order increased the gap further, possibly reflecting higher female employment in contact-intensive sectors (such as retail, tourism, and hospitality) that were closed during the national lockdown. The evidence provided in panels 1 and 2 thus points to a disproportionate effect of lockdown measures on women, calling for targeted policy intervention to support women (by offering parental leave, for example) and to avoid long-lasting effects on their employment opportunities.<sup>9</sup>

Vodafone data also reveal uneven effects of lockdowns across age groups. Panel 3 shows that the adoption of stay-at-home orders led to a considerable reduction in mobility across all age categories. Nonetheless, the effects were considerably stronger for younger cohorts. Starting from a higher level of mobility consistent with the need to go to work, working-age people experienced a sharp contraction in mobility around the adoption of stay-at-home orders. The drop was particularly large for people aged 18 to 24 (some of whom, however, are students) and for people aged 25 to 44. The impact was substantially weaker for people aged 65 and above, who generally no longer work and whose level of mobility was already lower before the stay-at-home orders. These findings

<sup>9</sup>The analysis faces several limitations. For example, the sample is restricted to a few European countries, data do not provide information on the employment status before and after lockdowns, and various other factors can amplify or attenuate gender inequality during the pandemic. These are important areas for future research.



highlight that lockdowns tend to have a disproportionate impact on relatively younger workers and could thus widen intergenerational inequality.<sup>10</sup> While older people can rely on retirement income, especially in advanced economies, younger workers depend on labor income and often have temporary job contracts that are more likely to be terminated during a crisis.

## Lockdowns and COVID-19 Infections

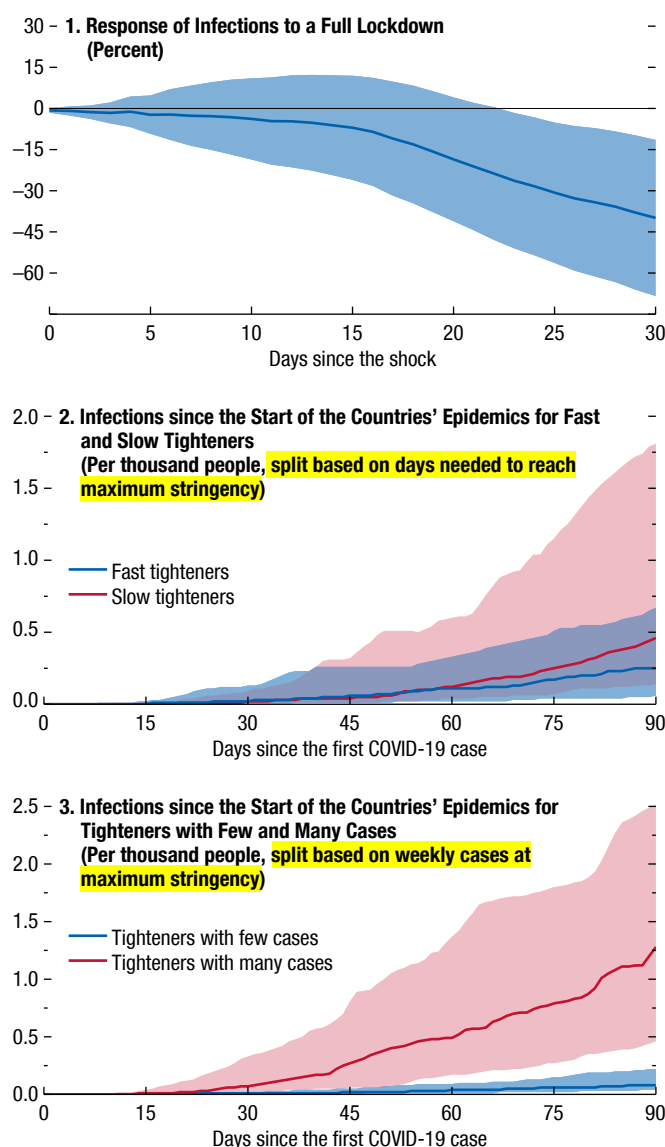
Lockdowns engender sizable short-term economic costs, but they are also an investment in public health to protect susceptible populations from the highly transmissible virus. The analysis now examines the effectiveness of lockdowns in curbing infections. Growth rates of confirmed COVID-19 cases are regressed using local projections over the stringency of lockdowns while controlling for country and time fixed effects as well as other variables that can affect infections, such as outside temperature and humidity, public information campaigns, testing, and contact tracing. Online Annex 2.5 provides additional details.

Panel 1 of Figure 2.7 shows that lockdowns tend to have a negative impact on infections. A stringent lockdown leads to a reduction in cumulated infections of about 40 percent after 30 days. Note that the effects of lockdowns on confirmed COVID-19 cases tend to materialize after at least two weeks, consistent with the COVID-19 incubation period and the time required for testing. Acknowledging this aspect is important to properly guide people's expectations about the effectiveness of lockdowns. Furthermore, the lagged impact on infections points to the need to adopt lockdowns before infection rates increase too rapidly.

Panels 2 and 3 of Figure 2.7 provide additional evidence of the benefits of adopting lockdowns early in a country's epidemic. Panel 2 shows the evolution of infections since the first COVID-19 case, differentiating countries by the number of days between the first case and the day when lockdown measures reached maximum stringency. Countries that imposed lockdowns faster experienced better epidemiological outcomes. The differences are even more striking if countries are divided with respect to the number of COVID-19 cases at the time of lockdowns (panel 3).

**Figure 2.7. The Impact of Lockdowns on COVID-19 Infections**

Lockdowns are an effective tool to reduce infections, especially when they are implemented early in the epidemic.



Source: IMF staff calculations.

Note: See Online Annex 2.1 for data sources and country coverage. Panel 1 shows the response of infections to a full lockdown; panels 2 and 3 show the number of infections since the first COVID-19 case. The shaded area in panel 1 corresponds to 90 percent confidence intervals computed with Driscoll-Kraay standard errors; the shaded areas in panels 2 and 3 correspond to the interquartile range.

<sup>10</sup>Even though lockdowns had a stronger impact on the mobility of younger people, older people have suffered disproportionately from the health consequences of COVID-19 whose case-fatality rate is much higher in people aged 65 and above.

Countries that adopted lockdowns when COVID-19 cases were still low witnessed considerably fewer infections during the first three months of the epidemic compared with countries that introduced lockdowns when cases were already high.

The observation that lockdowns can reduce infections but involve short-term economic costs is often used to argue that lockdowns involve a trade-off between saving lives and protecting livelihoods. This narrative should be reconsidered in light of the earlier findings showing that rising infections can also have severe detrimental effects on economic activity. By bringing infections under control, lockdowns may thus pave the way to a faster economic recovery as people feel more comfortable about resuming normal activities. In other words, the short-term economic costs of lockdowns could be compensated through higher future economic activity, possibly even leading to positive net effects on the economy. This remains a crucial area for future research as more data become available.

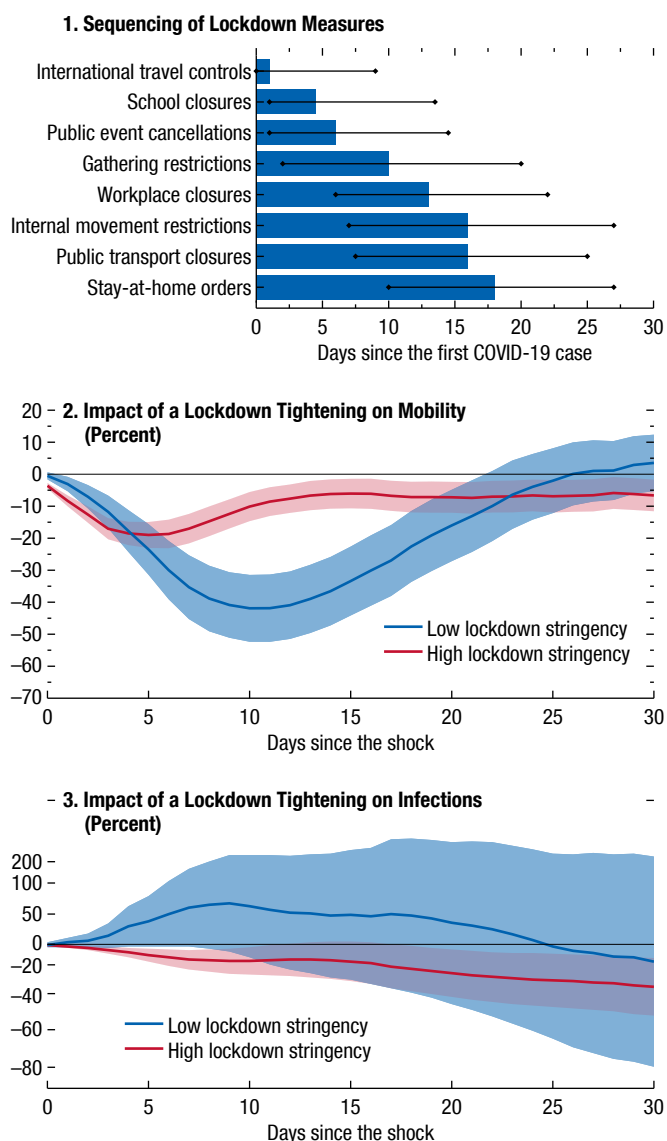
### Individual Lockdown Measures and Nonlinear Effects

So far, the analysis has used a lockdown stringency index that combines a broad range of underlying measures. These include, for example, travel restrictions, school and workplace closures, and stay-at-home orders. Disentangling the effects of these measures is an arduous task because they are highly correlated, as countries often introduced them in rapid succession to contain infections. Furthermore, countries have generally followed a similar sequence, from restrictions on international travel to stay-at-home orders, as illustrated in panel 1 of Figure 2.8. Therefore, the empirical analysis tends to capture the marginal impact of a given measure conditional on those that are already in place. As discussed in Online Annex 2.6, this underestimates the importance of measures that are adopted at a later stage. For example, stay-at-home orders are found to have a modest impact on mobility because various other measures are already in place.

An analytically sounder approach is to examine whether further tightening of lockdown measures continues to have similar economic and epidemiological effects. This can inform policymakers on whether it is best to rely on protracted mild lockdowns or to opt for more stringent measures. To shed light on this issue, the analysis uses quadratic terms of the lockdown index in the regression framework. Panel

**Figure 2.8. Individual Lockdown Measures and Nonlinear Effects**

Countries tend to introduce different lockdown measures following a similar sequence. More stringent lockdowns have a marginally weaker impact on mobility but stronger effects on infections.



Source: IMF staff calculations.

Note: See Online Annex 2.1 for data sources and country coverage. The blue bars in panel 1 represent the median number of days and the horizontal lines the interquartile range. Low and high stringency in panels 2 and 3 refer to the 25th and 75th percentile of lockdown stringency. The shaded areas in panels 2 and 3 correspond to 90 percent confidence intervals computed with standard errors clustered at the country level. A lockdown tightening corresponds to an increase in the index by 100 units.

2 of Figure 2.8 shows that the introduction of additional lockdown measures has a weaker marginal impact on mobility once other measures are already in place—that is, when the lockdown stringency index is already relatively high. This suggests that lockdowns have marginally weaker negative economic effects as they become more and more stringent. For example, stay-at-home orders may have only a modest negative impact on economic activity if governments have already mandated workplace closures.

Conversely, panel 3 shows that lockdowns become progressively more effective in reducing COVID-19 cases when they become sufficiently stringent. Mild lockdowns appear instead ineffective in curbing infections. A possible interpretation is that preventing only a few instances of personal contacts, such as by closing schools alone, is not enough to reduce community spread significantly. Additional measures, such as workplace closures or stay-at-home orders, are needed to effectively bring the virus under control.

These results suggest that to achieve a given reduction in infections, policymakers may want to opt for stringent lockdowns over a shorter period rather than prolonged mild lockdowns. Based on past experience, tighter lockdowns appear indeed to entail only modest additional economic costs while leading to a considerably stronger decline in infections. It will be important to reexamine these results as the pandemic progresses because the relative benefits between mild and tight lockdowns may change. For example, if an expansion of contact tracing and broader use of face masks succeed in limiting infections, mild lockdowns could be sufficient to contain new localized flare-ups of the virus.

## Conclusions

This chapter has documented the crucial role that both lockdowns and voluntary social distancing in response to rising infections have played in reducing economic activity during the pandemic. Consistent evidence on the impact of lockdowns is provided by examining cross-country economic indicators and high-frequency proxies for economic activity, such as mobility and job posting data from Google and Indeed. Furthermore, the negative impact of lockdowns on mobility is robust to using subnational data to strengthen identification.

Despite lockdowns having negative short-term economic effects, letting infections grow uncontrolled can

also have dire economic consequences. This is because voluntary social distancing in response to rising COVID-19 infections has severe detrimental effects on the economy. The contribution of voluntary social distancing in reducing mobility is particularly high in advanced economies, where people can more easily stay at home thanks to teleworking arrangements, higher personal savings, and more generous social security benefits.

The important contribution of voluntary social distancing to the recession should caution against expecting a quick economic rebound once lockdowns are lifted. This is especially relevant for countries that lift lockdowns prematurely, when infections are still relatively high. In this case, lockdowns tend to have a weaker impact on mobility, likely because people's decisions are driven by fear of contracting the virus. Further tempering the expectations of a sharp economic rebound, the analysis shows that lifting lockdowns tends to have a more modest impact on mobility compared with the impact of a lockdown tightening.

These findings suggest that, as long as significant health risks persist, economic activity is likely to remain subdued. Therefore, policymakers should refrain from withdrawing policy support too quickly and preserve spending on social safety nets. Furthermore, it is important to support economic activity consistent with persistent social distancing, for example by encouraging work from home, facilitating a reallocation of resources toward less-contact-intensive sectors, and promoting the adoption of new technologies to limit the contact intensity within given sectors.

The chapter also provides novel evidence about the unequal effects of lockdowns that severely affect economically vulnerable segments of the population. Mobility data provided by Vodafone for some European countries show that lockdown measures—especially school closures—tend to generate a larger drop in women's mobility. This likely reflects women's disproportionate role in childcare, which could jeopardize their employment opportunities during the crisis. Lockdowns tend to also generate a sharper reduction in the mobility of younger cohorts, a worrisome outcome because younger workers rely on labor income and often have temporary job contracts that are at greater risk of being terminated. Targeted policy intervention, such as strengthening unemployment benefits for vulnerable categories and supporting paid leave for parents, is needed to ensure that the crisis

does not contribute to widening gender and intergenerational inequality.

The analysis also finds that lockdowns are powerful instruments to reduce infections, especially when they are introduced early in a country's epidemic and when they are sufficiently stringent. Considering also that lockdowns appear to impose decreasing marginal costs on economic activity as they become more stringent, policymakers may want to lean toward rapidly adopting tight lockdowns when infections increase rather than rely on delayed mild measures. Nonetheless, these recommendations will need to be reassessed as the understanding of the virus and means to counteract it improve. A crucial area of research is to examine the effectiveness of more-targeted instruments compared with blunt lockdowns, for example restrictions on dense indoor gatherings or measures to isolate people who are more vulnerable to the virus.

The effectiveness of lockdowns in reducing infections, coupled with the finding that infections can considerably harm economic activity because of voluntary social distancing, provides an important new perspective on the costs of lockdowns. The prevailing narrative often portrays lockdowns as involving a trade-off between saving lives and supporting the economy. This characterization neglects the point that, despite imposing short-term economic costs, lockdowns may lead to a faster economic recovery by containing the virus and reducing voluntary social distancing.

These medium-term gains may offset the short-term costs of lockdowns, possibly even leading to positive overall effects on the economy. More research is warranted on this important aspect as the crisis evolves and more data become available. Meanwhile, policymakers should also look for alternative ways to contain infections that may have even lower economic costs. In line with the advice of public health experts, these may include expanding testing and contact tracing, promoting the use of face masks, and encouraging working from home.

The analytical results and policy implications presented in this chapter are subject to several caveats. First, the analysis tries to alleviate concerns about the endogeneity of lockdowns by showing that the results hold using cross-sectional and time-series identification and by relying on national and subnational data when available. However, identification concerns cannot be fully dismissed, including regarding the measurement of voluntary social distancing. Second, the analysis relies on short-term indicators, such as mobility and job postings, which provide an imperfect measure of economic activity. The chapter's findings will need to be reexamined as more conventional economic indicators become available. Third, the analysis focuses on the economic consequences of lockdowns, neglecting important side effects, for example, on educational attainment and mental health issues. These are crucial areas for future research.

### Box 2.1. An Overview of the Literature on the Economic Impact of Lockdowns

The literature on the economic crisis triggered by the coronavirus pandemic has been expanding at a very rapid pace. This box offers an inexhaustive overview of some of this literature that focuses on the impact of lockdown measures.<sup>1</sup>

#### *Economic Impact of Lockdowns and Inequality Aspects*

Several authors point to a substantial role of lockdowns in the United States leading to employment losses, substantial decline in spending, and deterioration in local economic conditions (Baek and others 2020; Baker and others 2020; Béland, Brodeur, and Wright 2020; Chernozhukov, Kasahara, and Schrimpf 2020; Coibion, Gorodnichenko, and Weber 2020; Gupta and others 2020). Similar effects have been documented across different countries (Carvalho and others 2020; Chronopoulos, Lukas, and Wilson 2020; Deb and others 2020a; Demirgüç-Kunt, Lokshin, and Torre 2020).

Other papers argue that voluntary social distancing has had a more important role than lockdowns (Allcott and others 2020; Bartik and others 2020; Kahn, Lange, and Wiczer 2020; Maloney and Taskin 2020). This literature notes that people's mobility and economic activity in the United States contracted before lockdowns (Chetty and others 2020), and that lifting lockdowns led to a limited rebound in mobility (Dave and others 2020b) and economic activity (however, Cajner and others 2020 and Glaeser and others 2020 are exceptions). Goolsbee and Syverson (2020) finds small differences in people's visits to nearby retail establishments that faced different regulatory restrictions because they were located in different jurisdictions. Chen and others (2020b) documents similar results; it expands the analysis to Europe and finds no robust evidence of the impact of lockdowns. Sweden's case also highlights the importance of voluntary social distancing—despite avoiding strict lockdown measures, the country has experienced similar declines in mobility and economic activities compared with comparable countries (Andersen and others 2020a; Born, Dietrich, and Müller 2020; Bricco and others 2020; Chen and others 2020b). Aum, Lee, and Shin (2020) draws relatively similar conclusions analyzing the South Korean experience.

The author of this box is Nicola Pierri.

<sup>1</sup>At the time of writing, most of the cited papers had not yet undergone a peer-review process; thus, their conclusions must be interpreted with caution.

The literature also documents that the early phases of the pandemic have had a harsher effect on more economically vulnerable individuals, both in the United States and other countries (Alstadsæter and others 2020; Béland, Brodeur, and Wright 2020). These individuals include those with lower income and educational attainment (Cajner and others 2020; Chetty and others 2020; Shibata 2020), minorities (Fairlie, Couch, and Xu 2020), immigrants (Borjas and Cassidy 2020), and women (Alon and others 2020a; Del Boca and others 2020; Papanikolaou and Schmidt 2020). One reason is that lower-paid workers are often unable to perform their jobs from home (Barrero, Bloom, and Davis 2020; Dingel and Neiman 2020; Gottlieb and others 2020). This warns of a potential widening of inequality (Mongey, Pilossoph, and Weinberg 2020; Palomino, Rodríguez, and Sebastian 2020).

Some papers use rich structural models of production to predict the damage of lockdowns, mostly finding very large effects on economic activities (Barrot, Grassi, and Sauvagnat 2020; Baqaee and Farhi 2020a; Bonadio and others 2020; Cakmakli and others 2020; Fadinger and Schymik 2020; Inoue and Todo 2020) and on firms' liquidity and solvency (Carletti and others 2020; Gourinchas and others 2020; Schivardi and Romano 2020). Chen and others (2020a) looks at stock market reactions instead and presents evidence consistent with market beliefs that mitigation policies are good for businesses in the long term. Furthermore, some papers study how supply shocks may cause demand shortage (Guerrieri and others 2020) and interact with nominal rigidities (Baqaee and Farhi 2020b).

#### *Impact of Lockdowns and Social Distancing on Infections*

Some empirical analyses also document a significant role of social distancing and lockdowns in slowing the spread of the coronavirus (Chernozhukov, Kasahara, and Schrimpf 2020; Ciminelli and Garcia-Mandico 2020; Dave and others 2020a; Deb and others 2020b; Demirgüç-Kunt, Lokshin, and Torre 2020; di Porto, Naticchioni, and Scrutinio 2020; Fang, Wang, and Yang 2020; Friedson and others 2020; Glaeser, Gorbach, and Redding 2020; Imai and others 2020; Jinjara and others 2020; Yilmazkuday 2020). However, several factors have affected effectiveness and compliance, such as social capital (Barrios and others 2020; Ding and others 2020), availability of high-speed

**Box 2.1 (continued)**

internet connections (Chiou and Tucker 2020), electoral concerns (Pulejo and Querubín 2020), labor precariousness (Levy Yeyati and Sartorio 2020), or sick leave policies (Andersen and others 2020b). Some of these papers also argue that less restrictive mitigation policies, such as wearing face masks and mass testing, can play an important role in slowing the spread of infection (Chernozhukov, Kasahara, and Schrimpf 2020; Gapen and others 2020).

*Optimal Mitigation Policy and  
Historical Perspectives*

Some studies use theoretical (mostly quantitative) models to characterize optimal mitigation policies while considering the detrimental impact on the economy. For instance, see Acemoglu and others (2020); Akbarpour and others (2020); Alvarez, Argente, and Lippi (2020); Bodenstein, Corsetti, and Guerrieri (2020); Cakmaklı and others (2020); Checo, Grigoli, and Mota (2020); Eichenbaum, Rebelo, and Trabandt

(2020); Farboodi, Jarosch, and Shimer (2020); Favero, Ichino, and Rustichini (2020); and Jones, Philippon, and Venkateswaran (2020). The higher risk faced by the elderly, the role of voluntary social distancing, and hospital capacity constraints are among several issues these models study. Many of these papers document an important role for targeted lockdown policies and early interventions. Others focus on how optimal policies may differ in developing economies (Alon and others 2020b; von Carnap and others 2020).

A few papers offer a historical perspective on the economic impact of lockdowns. Correia, Luck, and Verner (2020) finds that lockdowns imposed in US cities to contain the Spanish flu had a positive impact on their subsequent growth, although Lilley, Lilley, and Rinaldi (2020) revisits this evidence and argues that it is inconclusive. Bodenhorn (2020) studies the Spanish flu's impact in the US South and finds no evidence that mandated business closures led to more business failures.



### Box 2.2. The Role of Information Technology Adoption during the COVID-19 Pandemic: Evidence from the United States

This box analyzes how firms' adoption of information technology alters the impact of lockdowns and voluntary social distancing on the labor market in the United States. Information technology can dampen the economic effect of the pandemic in several ways: by facilitating teleworking, promoting online sales, or organizing contactless delivery. The analysis finds that employment has been more resilient in US states where firms use information technology more intensively. Panel 1 of Figure 2.2.1 shows the increase in the unemployment rate between February and April for each US state over the stringency of lockdowns during the same period. Similarly, panel 2 illustrates the association between the increase in unemployment and the drop in mobility. In states with low levels of information technology adoption, there is a strong correlation between the intensity of the lockdown, the drop in mobility, and the rise in the unemployment rate. Conversely, lockdowns and mobility are not associated with rising unemployment rates in states with higher levels of information technology adoption. This suggests that information technology may significantly shield local economies during the pandemic.

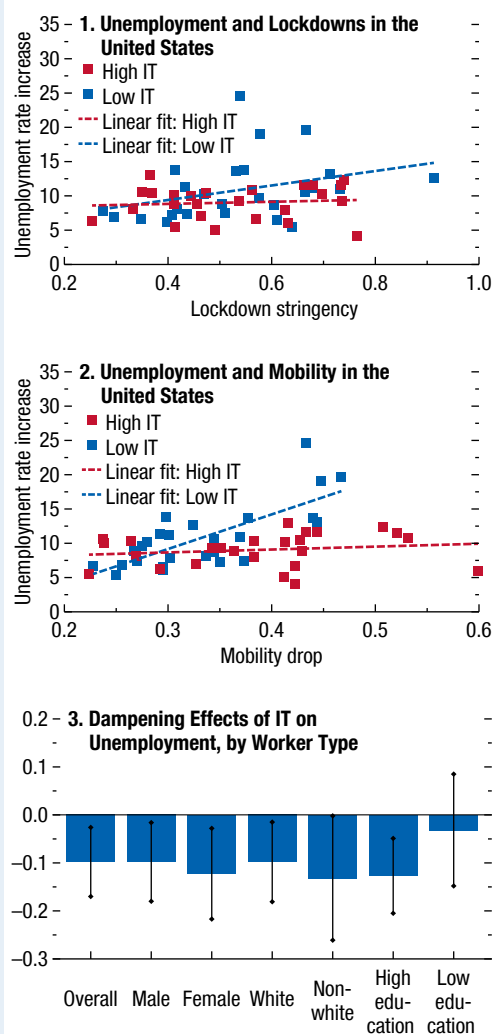
This pattern is confirmed using individual-level data from the Current Population Survey, a joint survey by the US Census Bureau and US Bureau of Labor Statistics. The probability of being unemployed in April is higher for respondents living in metropolitan statistical areas that experienced larger mobility declines, but companies' information technology adoption mitigates this impact.<sup>1</sup> The increase in the probability of being unemployed associated with a large drop in mobility (one standard deviation, equal to 10 percentage points) is 25 percent larger in metropolitan statistical areas with low levels of information technology adoption than in those with high levels (5 percentage points versus 4 percentage points).

The analysis also explores the impact of information technology adoption across different categories of workers (panel 3 of Figure 2.2.1). Information technology cushions the unemployment impact of mobility for both male and female and for both white and nonwhite workers. However, it does not

The authors of this box are Nicola Pierri and Yannick Timmer. The analysis largely draws from Pierri and Timmer (2020), which includes technical details.

<sup>1</sup>A metropolitan statistical area is defined by the United States Census Bureau as a geographical region with a relatively high population density at its core and close economic ties throughout the area.

**Figure 2.2.1. The Dampening Effects of Information Technology Adoption on US Unemployment (Percent)**



Sources: Google Community Mobility Report; Keystone; and IMF staff calculations.

Note: The y-axis in panels 1 and 2 is the increase in the state-level unemployment rate between February and April 2020 in percent. The x-axis in panel 1 is the average lockdown stringency between February and April 2020; the x-axis in panel 2 is the average drop in mobility. Panel 3 illustrates the results of a regression using data from the Current Population Survey in which the dependent variable is a dummy indicating if the respondent is unemployed in April 2020, and the independent variables are the IT adoption and the drop in mobility in the metropolitan statistical area where the respondent lives, together with their interaction. The y-axis of panel 3 reports the magnitude of the coefficient of the interaction term for each subsample. Low education refers to respondents who did not graduate from high school. See Pierri and Timmer (2020) for more details. IT = information technology.

**Box 2.2 (continued)**

mitigate the impact for individuals who have a low level of education. Therefore, even though information technology adoption may, in the aggregate, significantly shield labor markets against the effects

of the coronavirus pandemic, it may also contribute to widening inequality between individuals with high and low levels of educational attainment.

## References

- Acemoglu, Daron, Victor Chernozhukov, Iván Werning, and Michael D. Whinston. 2020. "A Multi-Risk SIR Model with Optimally Targeted Lockdown." NBER Working Paper 27102, National Bureau of Economic Research, Cambridge, MA.
- Akbarpour, Mohammad, Cody Cook, Aude Marzuoli, Simon Mongey, Abhishek Nagaraj, Matteo Saccarola, Pietro Tebaldi, Shoshana Vasserman, and Hanbin Yang. 2020. "Socio-economic Network Heterogeneity and Pandemic Policy Response." Becker Friedman Institute for Economics Working Paper 2020–75, University of Chicago, IL.
- Allcott, Hunt, Levi Boxell, Jacob Conway, Billy Ferguson, Matthew Gentzkow, and Benjamin Goldman. 2020. "Economic and Health Impacts of Social Distancing Policies during the Coronavirus Pandemic." <https://ssrn.com/abstract=3610422>.
- Alon, Titan M., Matthias Doepke, Jane Olmstead-Rumsey, and Michèle Tertilt. 2020a. "The Impact of COVID-19 on Gender Equality." NBER Working Paper 26947, National Bureau of Economic Research, Cambridge, MA.
- Alon, Titan M., Minki Kim, David Lagakos, and Mitchell VanVuren. 2020b. "How Should Policy Responses to the COVID-19 Pandemic Differ in the Developing World?" NBER Working Paper 27273, National Bureau of Economic Research, Cambridge, MA.
- Alstadsæter, Annette, Bernt Bratsberg, Gaute Eilensen, Wojciech Kopczuk, Simen Markussen, Oddbjørn Raaum, and Knut Røed. 2020. "The First Weeks of the Coronavirus Crisis: Who Got Hit, When, and Why? Evidence from Norway." NBER Working Paper 27131, National Bureau of Economic Research, Cambridge, MA.
- Alvarez, Fernando, David Argente, and Francesco Lippi. 2020. "A Simple Planning Problem for COVID-19 Lockdown." NBER Working Paper 26981, National Bureau of Economic Research, Cambridge, MA.
- Andersen, Asger L., Emil T. Hansen, Niels Johannesen, and Adam Sheridan. 2020a. "Pandemic, Shutdown and Consumer Spending: Lessons from Scandinavian Policy Responses to COVID-19." arXiv preprint arXiv:2005.04630.
- Andersen, Martin, Johanna Catherine Maclean, Michael F. Pesko, and Kosali I. Simon. 2020b. "Effect of a Federal Paid Sick Leave Mandate on Working and Staying at Home: Evidence from Cellular Device Data." NBER Working Paper 27138, National Bureau of Economic Research, Cambridge, MA.
- Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review* 104 (9): 2763–96.
- Aum, Sangmin, Sang Yoon (Tim) Lee, and Yongseok Shin. 2020. "COVID-19 Doesn't Need Lockdowns to Destroy Jobs: The Effect of Local Outbreaks in Korea." NBER Working Paper 27264, National Bureau of Economic Research, Cambridge, MA.
- Baek, Chaewon, Peter B. McCrory, Todd Messer, and Preston Mui. 2020. "Unemployment Effects of Stay-at-Home Orders: Evidence from High Frequency Claims Data." Institute for Research on Labor and Employment Working Paper 101–20. <http://irl.berkeley.edu/files/2020/07/Unemployment-Effects-of-Stay-at-Home-Orders.pdf>.
- Baker, Scott R., R. A. Farrokhnia, Steffen Meyer, Michaela Pagel, and Constantine Yannelis. 2020. "How Does Household Spending Respond to an Epidemic? Consumption during the 2020 COVID-19 Pandemic." NBER Working Paper 26949, National Bureau of Economic Research, Cambridge, MA.
- Baqee, David, and Emmanuel Farhi. 2020a. "Supply and Demand in Disaggregated Keynesian Economies with an Application to the COVID-19 Crisis." NBER Working Paper 27152, National Bureau of Economic Research, Cambridge, MA.
- Baqee, David, and Emmanuel Farhi. 2020b. "Nonlinear Production Networks with an Application to the COVID-19 Crisis." NBER Working Paper 27281, National Bureau of Economic Research, Cambridge, MA.
- Barrero, Jose Maria, Nicholas Bloom, and Steven J. Davis. 2020. "The Future of Working from Home." Unpublished.
- Barrios, John M., Efraim Benmelech, Yael V. Hochberg, Paola Sapienza, and Luigi Zingales. 2020. "Civic Capital and Social Distancing during the COVID-19 Pandemic." NBER Working Paper 27320, National Bureau of Economic Research, Cambridge, MA.
- Barrot, Jean-Noël, Basile Grassi, and Julien Sauvagnat. 2020. "Sectoral Effects of Social Distancing." CEPR COVID Economics Vetted and Real-Time Papers 3, Centre for Economic Policy Research, London.
- Bartik, Alexander W., Marianne Bertrand, Feng Lin, Jesse Rothstein, and Matthew Unrath. 2020. "Measuring the Labor Market at the Onset of the COVID-19 Crisis." NBER Working Paper 27613, National Bureau of Economic Research, Cambridge, MA.
- Béland, Louis-Philippe, Abel Brodeur, and Taylor Wright. 2020. "COVID-19, Stay-At-Home Orders, and Employment: Evidence from CPS Data." IZA Discussion Paper 13282, Institute of Labor Economics, Bonn.
- Bodenhorn, Howard. 2020. "Business at the Time of the Spanish Influenza." NBER Working Paper 27495, National Bureau of Economic Research, Cambridge, MA.
- Bodenstein, Martin, Giancarlo Corsetti, and Luca Guerrieri. 2020. "Social Distancing and Supply Disruptions in a Pandemic." CEPR Discussion Paper 14629, Centre for Economic Policy Research, London.
- Bonadio, Barthélémy, Zhen Huo, Andrei A. Levchenko, and Nitya Pandalai-Nayar. 2020. "Global Supply Chains in the Pandemic." NBER Working Paper 27224, National Bureau of Economic Research, Cambridge, MA.
- Borjas, George J., and Hugh Cassidy. 2020. "The Adverse Effect of the COVID-19 Labor Market Shock on Immigrant Employment." NBER Working Paper 27243, National Bureau of Economic Research, Cambridge, MA.

- Born, Benjamin, Alexander M. Dietrich, and Gernot J. Müller. 2020. "Do Lockdowns Work? A Counterfactual for Sweden." CEPR COVID Economics Vetted and Real-Time Papers 16, Centre for Economic Policy Research, London.
- Bricco, Jana, Florian Misch, Khaled Sakr, and Alexandra Solovyeva. 2020. "What are the Economic Effects of Pandemic Containment Policies? Evidence from Sweden." IMF Working Paper 20/191, International Monetary Fund, Washington, DC.
- Cajner, Tomaz, Leland D. Crane, Ryan A. Decker, John Grigsby, Adrian Hamins-Puertolas, Erik Hurst, Christopher Kurz, and Ahu Yildirmaz. 2020. "The US Labor Market during the Beginning of the Pandemic Recession." NBER Working Paper 27159, National Bureau of Economic Research, Cambridge, MA.
- Cakmakli, Cam, Selva Demiralp, Sebnem Kalemli-Ozcan, Sevcen Yesiltas, and Muhammed A. Yildirim. 2020. "COVID-19 and Emerging Markets: An Epidemiological Model with International Production Networks and Capital Flows." NBER Working Paper 27191, National Bureau of Economic Research, Cambridge, MA.
- Carletti, Elena, Tommaso Oliviero, Marco Pagano, Lioriana Pelizzon, and Marti G. Subrahmanyam. 2020. "The COVID-19 Shock and Equity Shortfall: Firm-Level Evidence from Italy." CEPR Discussion Paper 14831, Centre for Economic Policy Research, London.
- Carvalho, Vasco M., Stephen Hansen, Álvaro Ortiz, Juan Ramón García, Tomasa Rodrigo, Sevi Rodríguez Mora, and José Ruiz. 2020. "Tracking the COVID-19 Crisis with High-Resolution Transaction Data." CEPR Discussion Paper 14642, Centre for Economic Policy Research, London.
- Checo, Ariadne, Francesco Grigoli, Jose M. Mota. 2020. "Assessing Heterogeneous Containment Policies to Fight COVID-19." Unpublished.
- Chen, Chen, Sudipto Dasgupta, Thanh D. Huynh, and Ying Xia. 2020a. "Were Stay-at-Home Orders during COVID-19 Harmful for Business?—The Market's View." CEPR COVID Economics Vetted and Real-Time Papers 32, Centre for Economic Policy Research, London.
- Chen, Sophia, Deniz Igan, Nicola Pierri, and Andrea Presbitero. 2020b. "Tracking the Economic Impact of COVID-19 and Mitigation Policies in Europe and the United States." IMF Working Paper 20/125, International Monetary Fund, Washington, DC.
- Chernozhukov, Victor, Hiroyuki Kasahara, and Paul Schrimpf. 2020. "Causal Impact of Masks, Policies, Behavior on Early COVID-19 Pandemic in the US." CEPR COVID Economics Vetted and Real-Time Papers 35, Centre for Economic Policy Research, London.
- Chetty, Raj, John N. Friedman, Nathaniel Hendren, Michael Stepner, and the Opportunity Insights Team. 2020. "How Did COVID-19 and Stabilization Policies Affect Spending and Employment? A New Real-Time Economic Tracker Based on Private Sector Data." NBER Working Paper 27431, National Bureau of Economic Research, Cambridge, MA.
- Chiou, Lesley, and Catherine Tucker. 2020. "Social Distancing, Internet Access and Inequality." NBER Working Paper 26982, National Bureau of Economic Research, Cambridge, MA.
- Chronopoulos, Dimitris K., Marcel Lukas, and John O. S. Wilson. 2020. "Consumer Spending Responses to the COVID-19 Pandemic: An Assessment of Great Britain." <https://ssrn.com/abstract=3586723>.
- Ciminelli, Gabriele, and Silvia Garcia-Mandico. 2020. "Business Shutdowns and COVID-19 Mortality." Unpublished.
- Coibion, Olivier, Yuriy Gorodnichenko, and Michael Weber. 2020. "The Cost of the COVID-19 Crisis: Lockdowns, Macroeconomic Expectations, and Consumer Spending." NBER Working Paper 27141, National Bureau of Economic Research, Cambridge, MA.
- Correia, Sergio, Stephan Luck, and Emil Verner. 2020. "Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu." <https://ssrn.com/abstract=3561560>.
- Dave, Dhaval M., Andrew I. Friedson, Kyutaro Matsuzawa, Drew McNichols, and Joseph J. Sabia. 2020a. "Did the Wisconsin Supreme Court Restart a COVID-19 Epidemic? Evidence from a Natural Experiment." NBER Working Paper 27322, National Bureau of Economic Research, Cambridge, MA.
- Dave, Dhaval M., Andrew I. Friedson, Kyutaro Matsuzawa, and Joseph J. Sabia. 2020b. "When Do Shelter-in-Place Orders Fight COVID-19 Best? Policy Heterogeneity across States and Adoption Time." NBER Working Paper 27091, National Bureau of Economic Research, Cambridge, MA.
- Davis, Lucas W. 2008. "The Effect of Driving Restrictions on Air Quality in Mexico City." *Journal of Political Economy* 116 (1): 38–81.
- Deb, Pragyan, Davide Furceri, Jonathan D. Ostry, and Nour Tawk. 2020a. "The Effect of Containment Measures on the COVID-19 Pandemic." CEPR Discussion Paper 15086, Centre for Economic Policy Research, London.
- Deb, Pragyan, Davide Furceri, Jonathan D. Ostry, and Nour Tawk. 2020b. "The Economic Effects of COVID-19 Containment Measures." CEPR COVID Economics Vetted and Real-Time Papers 24, Centre for Economic Policy Research, London.
- Del Boca, Daniela, Noemi Oggero, Paola Profeta, and Maria Cristina Rossi. 2020. "Women's Work, Housework and Childcare, before and during COVID-19." IZA Discussion Paper 13409, Institute of Labor Economics, Bonn.
- Demirgüç-Kunt, Asli, Michael Lokshin, and Iván Torre. 2020. "The Sooner, the Better: The Early Economic Impact of Non-Pharmaceutical Interventions during the COVID-19 Pandemic" World Bank Policy Research Working Paper 9257.
- di Porto, Edoardo, Paolo Naticchioni, Vincenzo Scrutinio. 2020. "Partial lockdown and the spread of COVID-19: Lessons from the Italian case" Unpublished.

- Ding, Wenzhi, Ross Levine, Chen Lin, and Wensi Xie. 2020. "Social Distancing and Social Capital: Why US Counties Respond Differently to COVID-19." <https://ssrn.com/abstract=3624495>.
- Dingel, Jonathan, and Brent Neiman. 2020. "How Many Jobs Can Be Done at Home?" NBER Working Paper 26948, National Bureau of Economic Research, Cambridge, MA.
- Eichenbaum, Martin S., Sergio Rebelo, and Mathias Trabandt. 2020. "The Macroeconomics of Epidemics." NBER Working Paper 26882, National Bureau of Economic Research, Cambridge, MA.
- Fadinger, Harald, and Jan Schymik. 2020. "The Costs and Benefits of Home Office during the COVID-19 Pandemic: Evidence from Infections and an Input-Output Model for Germany." CEPR COVID Economics Vetted and Real-Time Papers 9, Centre for Economic Policy Research, London.
- Fairlie, Robert W., Kenneth Couch, and Huanan Xu. 2020. "The Impacts of COVID-19 on Minority Unemployment: First Evidence from April 2020 CPS Microdata." NBER Working Paper 27246, National Bureau of Economic Research, Cambridge, MA.
- Fang, Hanming, Long Wang, and Yang. 2020. "Human Mobility Restrictions and the Spread of the Novel Coronavirus (2019-nCoV) in China." NBER Working Paper 26906, National Bureau of Economic Research, Cambridge, MA.
- Farboodi, Maryam, Gregor Jarosch, and Robert Shimer. 2020. "Internal and External Effects of Social Distancing in a Pandemic." NBER Working Paper 27059, National Bureau of Economic Research, Cambridge, MA.
- Favero, Carlo A., Andrea Ichino, and Aldo Rustichini. 2020. "Restarting the Economy while Saving Lives under COVID-19." CEPR Discussion Paper 14664, Centre for Economic Policy Research, London.
- Friedson, Andrew I., Drew McNichols, Joseph J. Sabia, and Dhaval Dave. 2020. "Did California's Shelter-in-Place Order Work? Early Coronavirus-Related Public Health Effects." NBER Working Paper 26992, National Bureau of Economic Research, Cambridge, MA.
- Gapen, Michael, Jonathan Millar, Blerina Uruçi, and Pooja Sriram. 2020. "Assessing the Effectiveness of Alternative Measures to Slow the Spread of COVID-19 in the United States." CEPR COVID Economics Vetted and Real-Time Papers 40, Centre for Economic Policy Research, London.
- Glaeser, Edward L., Caitlin S. Gorbach, and Stephen J. Redding. 2020. "How Much Does COVID-19 Increase with Mobility? Evidence From New York and Four Other US Cities." NBER Working Paper 27519, National Bureau of Economic Research, Cambridge, MA.
- 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.
- Goolsbee, Austan, and Chad Syverson. 2020. "Fear, Lockdown, and Diversion: Comparing Drivers of Pandemic Economic Decline 2020." NBER Working Paper 27432, National Bureau of Economic Research, Cambridge, MA.
- Gottlieb, Charles, Jan Grobovšek, Markus Poschke, and Fernando Saltiel. 2020. "Lockdown Accounting." IZA Discussion Paper 13397, Institute of Labor Economics, Bonn.
- Gourinchas, Pierre-Olivier, Sebnem Kalemli-Ozcan, Veronika Penciakova, and Nick Sander. 2020. "COVID-19 and SME Failures." IMF Working Paper 20/207, International Monetary Fund, Washington, DC.
- Guerrieri, Veronica, Guido Lorenzoni, Ludwig Straub, and Iván Werning. 2020. "Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages?" NBER Working Paper 26918, National Bureau of Economic Research, Cambridge, MA.
- Gupta, Sumedha, Laura Montenegro, Thuy D. Nguyen, Felipe Lozano Rojas, Ian M. Schmutte, Kosali I. Simon, Bruce A. Weinberg, and Coady Wing. 2020. "Effects of Social Distancing Policy on Labor Market Outcomes." NBER Working Paper 27280, National Bureau of Economic Research, Cambridge, MA.
- Hausman, Catherine, and David S. Rapson. 2018. "Regression Discontinuity in Time: Considerations for Empirical Applications." *Annual Review of Resource Economics* 10 (1): 533–52.
- Imai, Natsuko, Katy A. M. Gaythorpe, Sam Abbott, Sangeeta Bhatia, Sabine van Elsland, Kiesha Prem, Yang Liu, and Neil M. Ferguson. 2020. "Adoption and Impact of Non-Pharmaceutical Interventions for COVID-19." *Wellcome Open Research* 5:59. <https://doi.org/10.12688/wellcomeopenres.15808.1>.
- Inoue, Hiroyasu, and Yasuyuki Todo. 2020. "The Propagation of the Economic Impact through Supply Chains: The Case of a Mega-City Lockdown to Contain the Spread of COVID-19." CEPR COVID Economics Vetted and Real-Time Papers 2, Centre for Economic Policy Research, London.
- 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.
- Jones, Callum J., Thomas Philippon, and Venky Venkateswaran. 2020. "Optimal Mitigation Policies in a Pandemic: Social Distancing and Working from Home." NBER Working Paper 26984, National Bureau of Economic Research, Cambridge, MA.
- Kahn, Lisa, Fabian Lange, and David Wiczer. 2020. "Labor Demand in the Time of COVID-19: Evidence from Vacancy Postings and UI Claims." NBER Working Paper 27061, National Bureau of Economic Research, Cambridge, MA.

- Levy Yeyati, Eduardo, and Luca Sartorio. 2020. "Take Me Out: De Facto Limits on Strict Lockdowns in Developing Countries." CEPR COVID Economics Vetted and Real-Time Papers 39, Centre for Economic Policy Research, London.
- Lilley, Andrew, Matthew Lilley, and Gianluca Rinaldi. 2020. "Public Health Interventions and Economic Growth: Revisiting the Spanish Flu Evidence." <https://ssrn.com/abstract=3590008> Documentos de Trabajo Gobierno Nro 8.
- Maloney, William, and Temel Taskin. 2020. "Determinants of Social Distancing and Economic Activity during COVID-19: A Global View." World Bank Policy Research Working Paper 9242, Washington, DC.
- Mongey, Simon, Laura Pilossoph, and Alex Weinberg. 2020. "Which Workers Bear the Burden of Social Distancing Policies?" NBER Working Paper 27085, National Bureau of Economic Research, Cambridge, MA.
- Palomino, Juan C., Juan G. Rodríguez, and Raquel Sebastian. 2020. "Wage Inequality and Poverty Effects of Lockdown and Social Distancing in Europe." SSRN. <https://ssrn.com/abstract=3615615>.
- Papanikolaou, Dimitris, and Lawrence D. W. Schmidt. 2020. "Working Remotely and the Supply-Side Impact of COVID-19." NBER Working Paper 27330, National Bureau of Economic Research, Cambridge, MA.
- Pierri, Nicola, and Yannick Timmer. 2020. "IT Shields: Technology Adoption and Economic Resilience during the COVID-19 Pandemic." IMF Working Paper 20/208, International Monetary Fund, Washington, DC.
- Pulejo, Massimo, and Pablo Querubín. 2020. "Electoral Concerns Reduce Restrictive Measures during the COVID-19 Pandemic." NBER Working Paper 27498, National Bureau of Economic Research, Cambridge, MA.
- Schivardi, Fabiano, and Guido Romano. 2020. "A Simple Method to Estimate Firms Liquidity Needs during the COVID-19 Crisis with an Application to Italy." CEPR COVID Economics: Vetted and Real-Time Papers 35, Centre for Economic Policy Research, London.
- Shibata, Ippei. 2020. "The Distributional Impact of Recessions: The Global Financial Crisis and the Pandemic Recession." IMF Working Paper 20/96, International Monetary Fund, Washington, DC.
- von Carnap, Tillmann, Ingvild Almås, Tessa Bold, Selene Ghisolfi, and Justin Sandefur. 2020. "The Macroeconomics of Pandemics in Developing Countries: An Application to Uganda." CEPR COVID Economics Vetted and Real-Time Papers 27, Centre for Economic Policy Research, London.
- Yilmazkuday, Hakan. 2020. "Stay-at-Home Works to Fight against COVID-19: International Evidence from Google Mobility Data." <https://ssrn.com/abstract=3571708>.