OLIVER WYMAN

THE GREAT BALANCING ACT

The COVID-19 Pandemic Navigator

May 2020

PREFACE

In the first installment of our Insight Series, we introduced the Oliver Wyman COVID-19 Pandemic Navigator, the most comprehensive toolkit in existence for connecting sophisticated epidemiological modelling with detailed impact on the earnings and capital of businesses. This toolkit is being used by governments, healthcare organizations, businesses, and financial services firms across the world to help make decisions and plan around the coronavirus crisis.

In this, the second installment, we discuss the application of our toolkit in the sphere of the policymakers, who will have to quickly articulate and manage a national risk appetite in terms of health, economy, privacy, and lifestyle.

A BRIEF RECAP ON WHERE WE ARE

As can be seen in the US example in Exhibit 1, the decisive actions taken by policymakers in recent months, combined with changes in citizens' behavior, have had the desired effect of suppressing the transmission rate. As a result, the case curves have been flattened and a major health crisis in the short term has been averted.

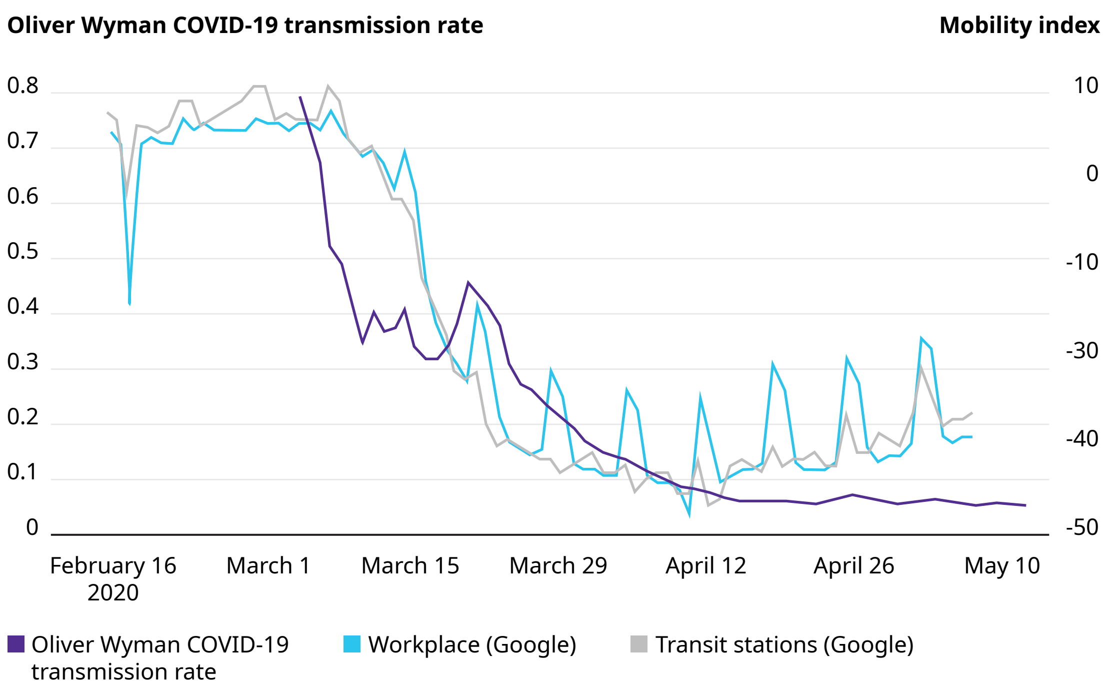
But on the other side of the societal scales, the damage inflicted on the economy by containment measures has been severe:

- Revenue loss for more than 50 percent of business sectors has ranged from 25 percent to 50 percent, and 30 percent of businesses are even more severely impacted.
- For more than 50 percent of businesses, the likelihood of defaulting on their debt has increased threefold.
- In some large jurisdictions, in more than half of business sectors, government stimulus and support have mitigated less than 30 percent of the income loss.

But the infection rate and number of active cases will still need to be controlled to ensure the total caseload is kept under hospital capacity levels. So the key question facing policymakers can now be expressed as follows: What is the revised set of policy measures that can keep the growth in COVID-19 cases under control while inflicting as little further damage as possible on the economy and broader society?

The remainder of this article attempts to lay the foundations for answering this question.

Exhibit 1. Impact on COVID-19 transmission rate of containment actions over time
Comparison of Oliver Wyman COVID-19 transmission rate with changes in mobility (US)



Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

Exhibit 2. Impact on the economy of containment actions

Revenue decrease in full lockdown (sorted by sectors from lowest to highest revenue decrease)

Impact	Revenue change	Sector
Positive shock	Up to +10%	• Retail food items • Postal and courier activities
Modest negative shock	Up to -20%	• Wholesale food items; manufacture of food products • Manufacture of pharma products • Information service activities • Telecommunications • Agriculture, forestry and fishing • Education • Human health and social work activities • Manufacture of beverages
Moderate negative shock	Up to -50%	• Electricity, gas, steam and air conditioning supply • Water supply; sewerage, waste management and remediation activities • Computer programming, consultancy and related activities • Scientific research and development • Public administration and defense; compulsory social security • Office administrative, office support and other business support • Manufacture of computer products and electronic equipment • Retail non food items • Extraction of natural gas • Wholesale non food items • Publishing activities; real estate activities; legal and accounting activities • Activities of head offices; management consultancy activities • Veterinary activities • Warehousing and support activities for transportation • Manufacturing of plastic and metallic products • Water transport • Construction
High negative shock	Up to -75%	• Manufacture of coke, refined petroleum products and chemicals • Manufacture of machinery and equipment • Wholesale and retail trade and repair of motor vehicles • Manufacture of ships and boats • Manufacturing (tobacco, textiles and wearing apparel, furniture etc.) • Manufacture of air and spacecraft and related machinery • Programming and broadcasting activities • Employment activities • Extraction of crude petroleum • Manufacture of motor vehicles, trailers and semi-trailers
Severe negative shock	Up to -100%	• Air transport • Motion picture, video and television program production • Travel agency, tour operator, reservation service and relate • Arts, entertainment and recreation • Other service activities • Accommodation activities • Food service activities

Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

FOUR CRUCIAL FACTORS

Our Pandemic Navigator models allow us to drill deeper into four factors that will have a major bearing on the dynamics of COVID-19 in the coming months: testing and tracing capacity, immunity levels, seasonality effects, and partitioning strategies.

As of May 10, 69 percent of COVID-19 deaths globally have been concentrated in just five countries: the United States, United Kingdom, Italy, Spain, and France (based on official records). Below is a high-level assessment of these factors in these regions in early March, when the crisis took hold, compared with what the prevailing situation might be in July.

Exhibit 3. Infection rate drivers (US, UK, Italy, Spain, France)

Driver	March 2020	July 2020?
Testing and tracing capacity	Largely limited to testing of symptomatic patients in hospitals	Increased testing capacity and potential for a much more sophisticated regime that captures the majority of infections through contact tracing
Immunity levels	Approximately 0% in the beginning, since almost no patients had yet been infected or recovered	Some estimates claim that the infected or recovered rate could be as high as 20-30% in some of the worst-affected cities like London, New York, and Madrid However, we don't yet know whether being infected actually confers immunity and for how long
Seasonality effects	Some evidence that March temperatures in these regions (0 to 15 Celsius) gave ideal conditions for COVID spreading rapidly	Hope that seasonality could contribute to a drop in R in the summer months in these 5 regions
Partitioning strategies	One-size-fits-all approaches, with "shielding" policies for the most vulnerable	Differentiated approaches by sub-region and age-group

Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

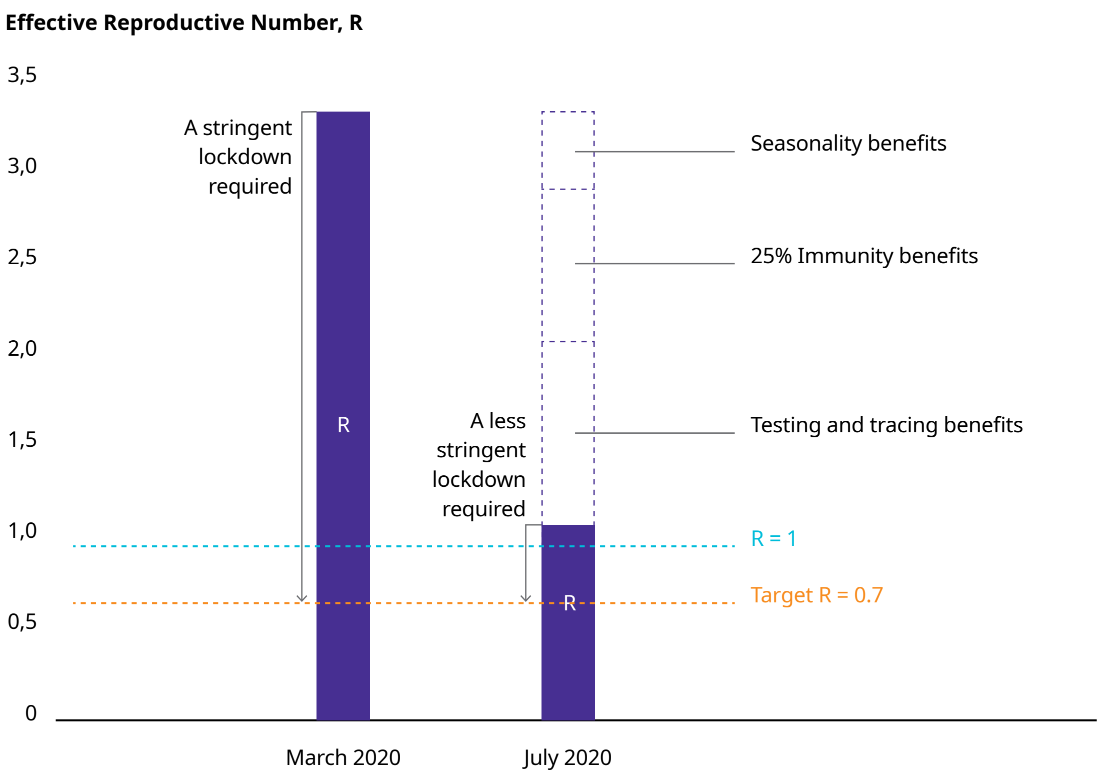
Our models can take these different factors into account to estimate the change in the effective reproductive number, R, one of the key metrics being monitored by policymakers when determining their response.

Our models estimate that R was somewhere between 3.5 and 4.0 in these five regions in early March, before the lockdown measures were put in place. This reflected a situation of limited understanding of the transmission and protective measures by the public, limited availability of testing, no immunity in the system and potentially a negative period in terms of seasonality. In response, policymakers were forced to introduce a stringent set of lockdown measures (social distancing, travel restrictions, stay at home, and so on) that brought R down to just below 1.0. With serious concerns in the health arena, containment and suppression were needed and had to be rushed. As such, the tools used were blunt instruments and inevitably suboptimal in terms of economic and social costs.

In Exhibit 4 we look at how differently things might look in July in a large city such as London. If the build-up of immunity in a badly affected city like London were as high as 25 percent, this alone would knock 25 percent off the effective R number.[1] An instantaneous testing and tracing regime that captured 50 percent of infected patients and forced them into quarantine or self-isolation would similarly subtract a further 1.06 from the value of R. And let's assume for a moment that seasonality behaves in the same direction as influenza and reduces R in summer months: The cumulative effects of these developments would see R reduced to 1.1.

The implications of such a set of developments would be significant. If we assume that the United Kingdom aims to maintain a target level for R of, say, 0.7, then we might need a much less stringent package of containment measures to close the gap to the target R in London in July than we did in March. Crucially this reduced package of measures could be made up of approaches such as mask-wearing, hygiene and plastic screens which are useful at controlling the virus but which place a lower burden on the economy compared with full lockdowns and stay at home orders. Social and physical distancing in the workplace and the prevention of large public gatherings should likely be maintained during the early stages of exit until more data has been gathered.

Exhibit 4. Potential improvement in R in London (without lockdown measures)



Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

1 R = R0 * (1–immunity %) so the effective R drops as immunity levels rise with R, eventually dropping below 1 when we hit the herd immunity threshold. As shown in Exhibit 4, immunity is not the only factor that affects R.

This is just one possible scenario for where we might be in July in London, with a lot of assumptions made, and this is not intended to be a prediction. The aim is to highlight for policymakers that many other factors will impact R beyond the containment measures used to date; that none of these factors will be enough to eradicate the disease on their own, but their combination can make a meaningful difference to the rate of transmission; and that it is vital that policymakers are informed what the value of these parameters might be, both today and in the future when setting out plans.

The remainder of this article looks at these key drivers in turn and shows that it is already possible to start making estimates or to put bounds on the assumptions in different regions. This will help policymakers not only to observe what was happening to R but also to understand why it is happening and which factors are contributing to any changes, allowing plans to be set out with more confidence.

TESTING AND CONTACT TRACING

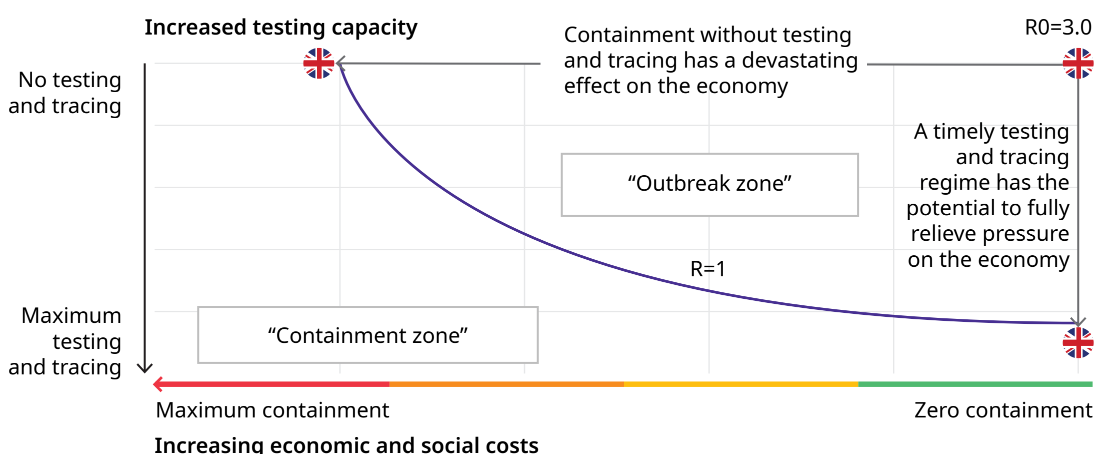
The reliability and availability of testing when the virus first spread was limited, with many countries initially testing only people with severe symptoms in hospitals. This left a great number of cases undetected, with the potential to contract and pass on the virus to many others without knowledge of it.

The blunt-instrument lockdown response slowed down COVID-19 transmission in both the detected and undetected populations — but came at a high economic cost. A smarter approach to achieve a similar level of reduction in R is to increase testing and contact tracing and to coerce this group into self-isolation or quarantine.

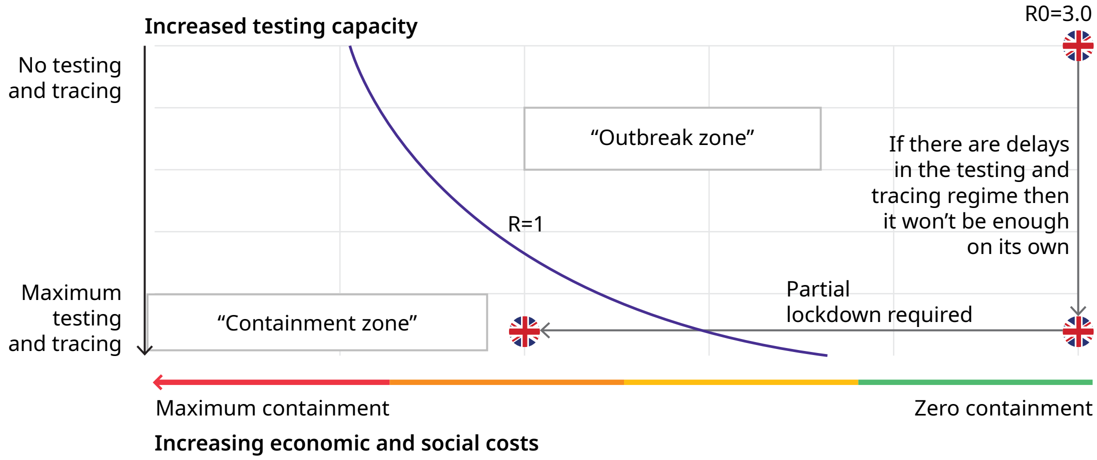
Our models confirm that an increase in the percentage of infections that are detected through increased testing can have a major effect on reducing R. The charts below show how testing reduces the pressure on the economy.

Exhibit 5. Testing capture rate with instantaneous and delayed contact tracing

Instantaneous contact tracing and testing



Delayed contact tracing and testing (with 6-day latency)



Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

As the second chart shows, however, increasing the number of tests is not enough. Testing needs to be accompanied by an instantaneous contact-tracing regime. And the timelines of the test results and the speed with which contacts are informed is vital. Otherwise, the spread of the virus will continue to outpace the speed with which information is being delivered, and the virus will maintain the upper hand.

Most developed countries are already piloting a blend of manual contact tracing schemes and mobile app-based schemes. The manual schemes are likely to have a high level of latency similar to the second chart. The challenges with app-based schemes relate to adoption, compliance, and privacy issues. Countries that already have well-established digital ID schemes with a high level of adoption are going to be better placed to quickly implement something. Countries starting with a blank page are having to set aside large budgets for developing the technology and for promoting the apps to ensure adoption and compliance. But the cost of developing such a program is likely immaterial compared with the potential benefits to the economy.

IMMUNITY LEVELS

It is well understood that the cases disclosed in the widely used Johns Hopkins University dataset represent only the detected COVID-19 cases, and that many cases remain undetected in the system. Getting a handle on this undetected universe is crucial in understanding the dynamics of an outbreak, assuming immunity exists, we extended the traditional susceptible, infected, removed (SIR) model to include two more states: infected (undetected) and removed (undetected).

In our white paper, available at our website, we show the results of our analysis and the academic research on the undetected universe. A summary of the results for a selection of regions is shown below.

Exhibit 6. Ratio of undetected to detected cases by country.
Comparison of Wuhan and Italy study on undetected cases

Number of undetected cases to detected cases, as of May 4th, 2020

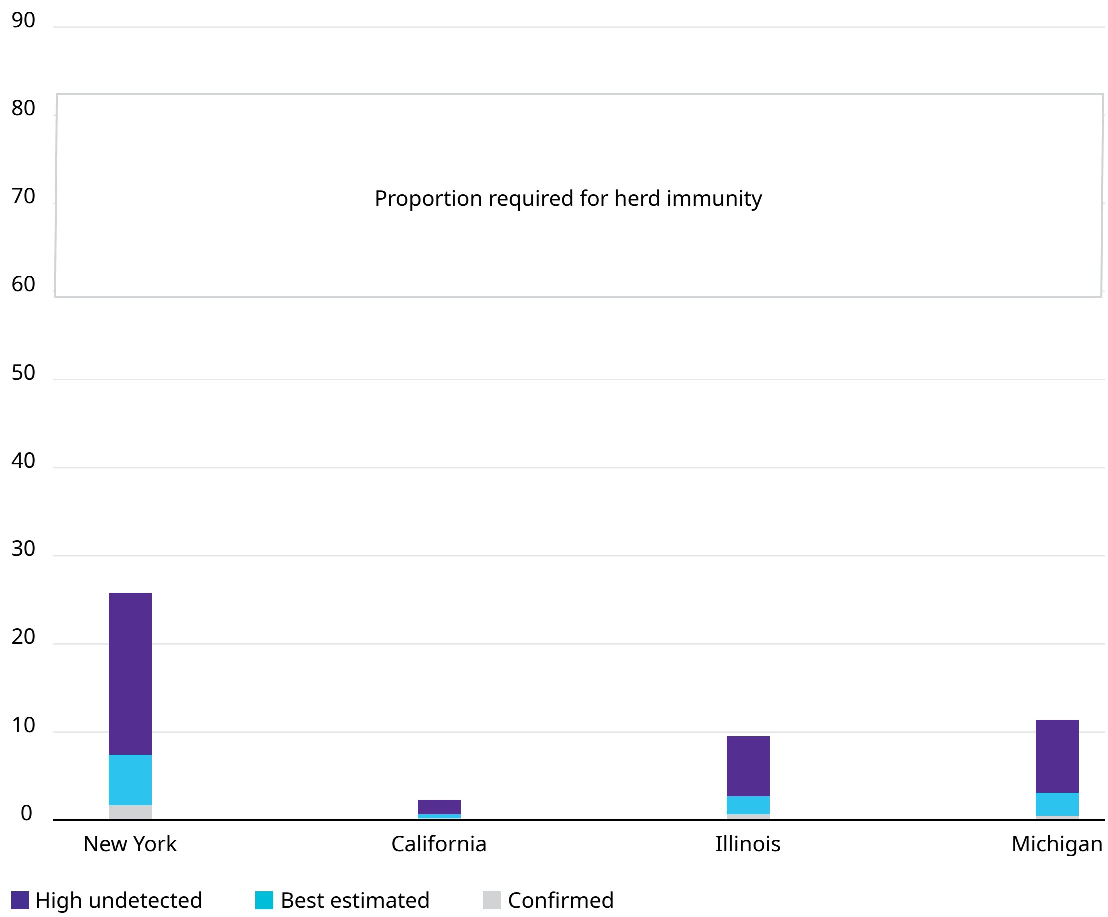
Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

As testing capacity and sophistication have improved in the various regions, the ratio of undetected to detected cases has fallen but remains high in many regions. For example, while the United Kingdom currently reports roughly 227,000 detected cases as of May 12, our upper estimate for total infections is 6.7 million, or approximately 10 percent of the population.

The chart below shows that for most regions we are a long way away from the herd immunity threshold, on average. Even before we reach this threshold, however, growing levels of immunity in the population will help to gradually reduce the effective R over time, and so can still make some contribution to slowing the transmission rate.

Exhibit 7. Estimated infected or recovered proportion of population

Infected proportion of US population (%), by state

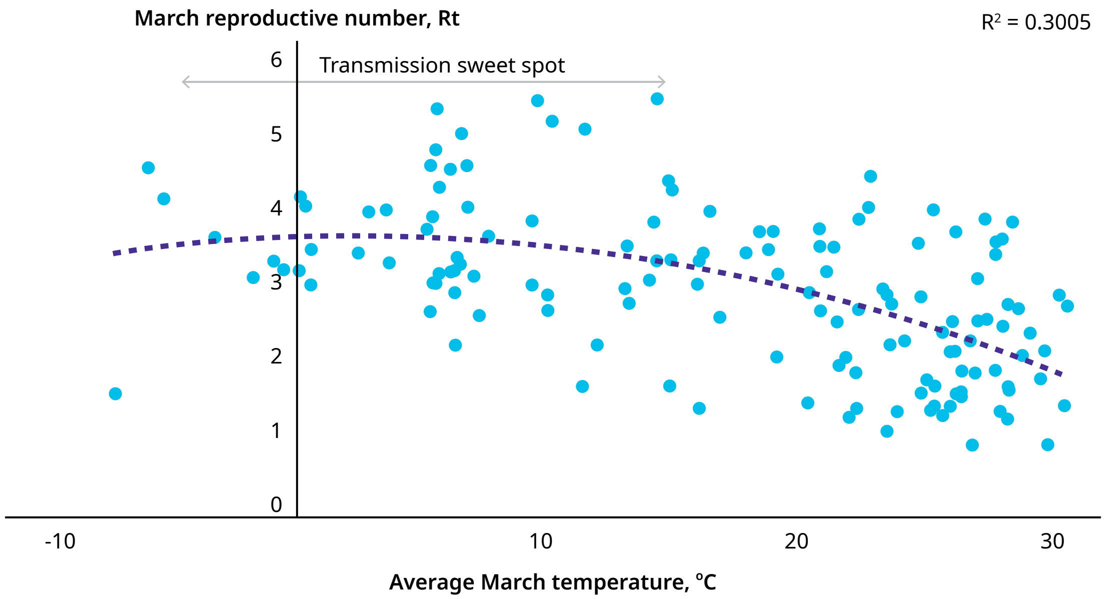


Source: Oliver Wyman, Oliver Wyman Pandemic Navigator

SEASONALITY EFFECTS

We already have some data to help understand the seasonality of COVID-19. The chart below shows the calculation of the average value of R during March for 142 countries against the average temperature during the same period in those countries.

Exhibit 8. Country infection rates and average March temperature



Source: John Hopkins COVID case data, Oliver Wyman Analysis

A pattern exists showing R at lower levels in warm-weather nations during March. We are aware, however, that there are many alternative explanations for this pattern — for instance, that GDP per capita also falls on average for warm-weather regions, which could signal a decrease in testing capacity. Nonetheless, the data does offer some hope that there might be a sweet spot for an outbreak in the -5 to +15 degrees Celsius range and that the summer weather in the Northern hemisphere might lead to slowing growth. What is clear is that seasonality will not be enough on its own to kill the virus, and in our scenarios we treat seasonality as one of the unknown factors that can be switched on and off.

The big Northern hemisphere cities covered in our analysis (such as New York, London, Paris, and Berlin) would clearly stand to gain in the coming months if the assumption of COVID-19 seasonality turns out to be correct.

Exhibit 9. Average monthly temperature for a sample of large cities

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
New York City	0.6	2.1	6.1	11.9	17.1	22.1	24.9	24.3	20.2	14.1	8.9	3.3
London	4.3	4.5	6.9	8.7	14.1	17.3	21.2	19.3	14.3	10.9	7.2	4.7
Milan	2.5	4.7	9.0	12.2	17.0	20.8	23.6	23.0	19.2	13.4	7.2	3.3
Madrid	6.3	7.9	11.2	12.9	16.7	22.2	25.6	25.1	20.9	15.1	9.9	6.9
Los Angeles	14.4	14.9	15.9	17.3	18.9	20.7	22.9	23.5	22.8	20.3	16.9	14.2
Cape Town	20.4	20.4	19.2	16.9	14.4	12.5	11.9	12.4	13.7	15.6	17.9	19.5
Sydney	22.3	22.3	21.2	18.5	15.5	13.1	12.2	13.4	15.5	17.8	19.6	21.3
Singapore	27.0	27.0	28.0	28.0	28.0	28.0	28.0	28.0	27.0	27.0	27.0	26.0
Hong Kong	16.3	16.8	19.1	25.9	27.9	27.9	28.8	28.6	27.7	25.5	21.8	17.9

Oliver Wyman COVID-19 transmission rate: High Medium Low

Source: List of Cities by Average Temperature, Oliver Wyman analysis

PARTITIONING STRATEGIES

Our models show that there could be major benefits in applying partitioned approaches for different demographics or for sub-regions, but that a great deal of care needs to be taken to understand the potential impact of the drivers we have discussed and to study the data at the highest level of granularity possible to avoid generalizations.

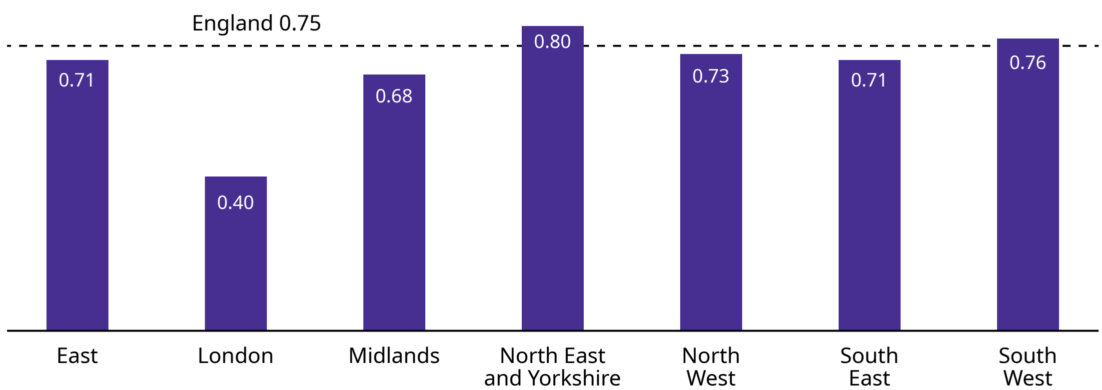
Partitions by region

The latest estimates of R from Cambridge University for the sub-regions of England indicate that London has a substantially lower R level. This has opened up a debate as to whether a different exit strategy or timing might be appropriate. Our model of the same sub-regions also shows London exhibiting the lowest R level, but the difference is less pronounced. Exhibit 10 shows, however, that R for London has been below 1 for longer than the other regions, with London having hit peak infections a week or more before most others.

It also becomes clear when looking at the timeline that it is dangerous to take a single snapshot of R and to define a strategy based on that. Moreover, London is itself a big region with many of its boroughs having had a different experience of the crisis. Large segments of the commuter population and overseas workers have not been in the capital during the lockdown and could change the dynamic when they return. In short, we are dealing with a complex and dynamic problem that needs to be examined from a number of different angles before settling on a course of action.

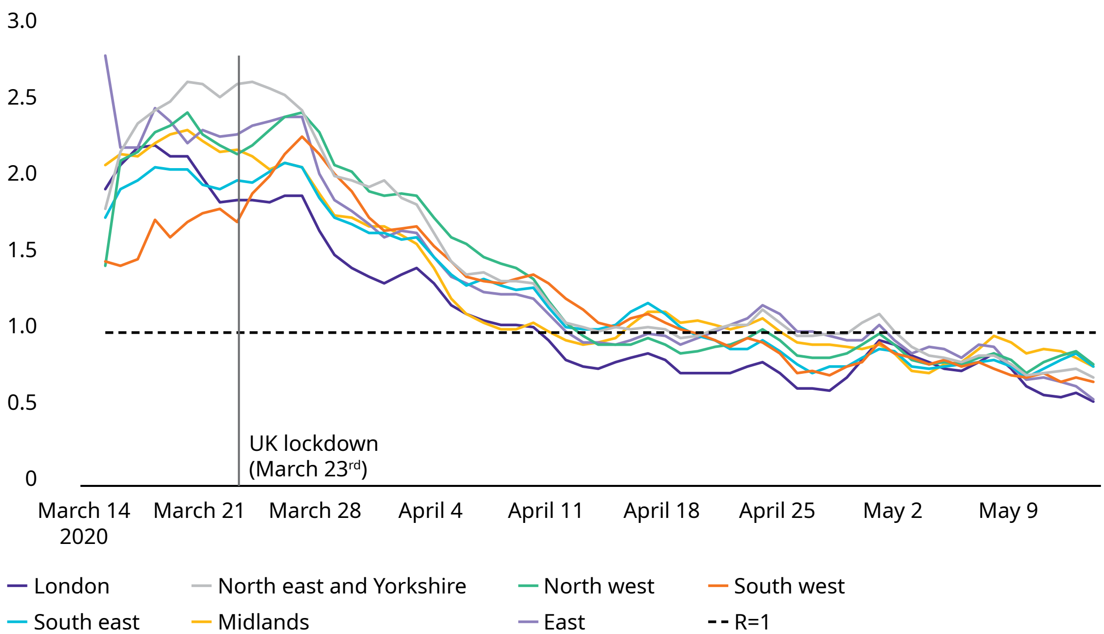
Exhibit 10. Infection rate by sub-region in England

R, English regions



Source: Cambridge University MRC Biostatistics/Public Health England

R, English regions (5-day moving average)

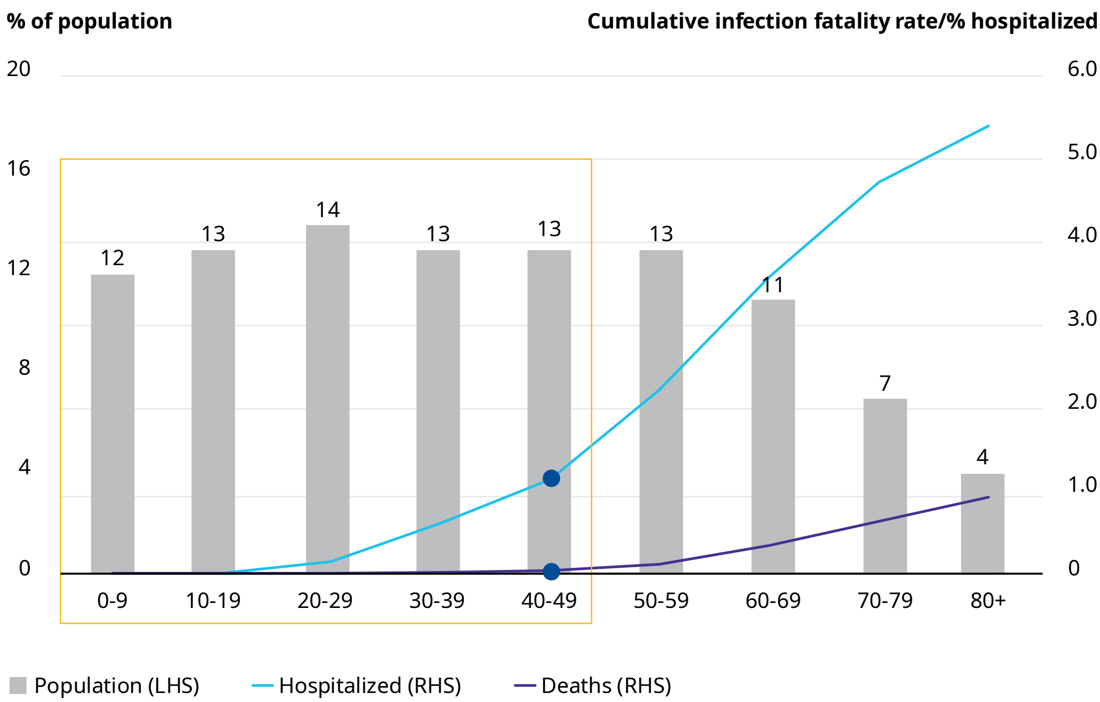


Source: Oliver Wyman Pandemic Navigator/Public Health England

Partitions by demographic

It was established early in the crisis that hospitalization and fatality rates vary significantly between age groups and that the elderly and those with prior conditions are most vulnerable. One of the earliest applications of partitioning has been the attempt to shield the vulnerable from the non-vulnerable, with the latter demographic being given more freedom to keep the economy moving. To date these shielding strategies have not been fully successful, with many well-documented cases of large outbreaks in care homes.

Exhibit 11. Infection fatality ratio by age group (United States)



65% of the US population is below age 50. Assuming 100% of that group was infected by the virus, 1.1% of the population would have been hospitalized and 0.04% would have died – (120,000 deaths)

Source: US Census Bureau, Current Population Survey, Annual Social and Economic Supplement, 2018; Verity et al, Estimates of the severity of coronavirus disease 2019: a model-based analysis, Lancet Infect Dis 2020

Nonetheless, in the scenarios we studied, we have observed meaningful differences in performance between uniform strategies and more stratified approaches mainly driven by the variation in hospitalization ratio and fatality ratio by age groups. We have also found that applying population-wide parameters for immunity levels leads to an over-estimation of the herd immunity threshold, since in reality the number of those susceptible is depleted faster in some sub-populations, slowing growth.

A move toward an instantaneous testing-and-tracing regime that captures the necessary data on demographic groups will also be crucial to allow these partitioned strategies to become a more effective policy tool. For example, it is inevitable that the vulnerable population at some point will come into contact with the non-vulnerable population (for example, the workers in care homes) and we need to have a much higher level of confidence these interactions are not putting the vulnerable at risk.

Partitioning goes hand in hand with the population taking steps to protect themselves and vulnerable groups, through the use of masks, social distancing, screens, better hygiene, temperature checks and other protective measures. The elderly must necessarily have contact with younger age groups, for instance in caregiving, but with these measures and adequate PPE, vulnerable groups can be protected.

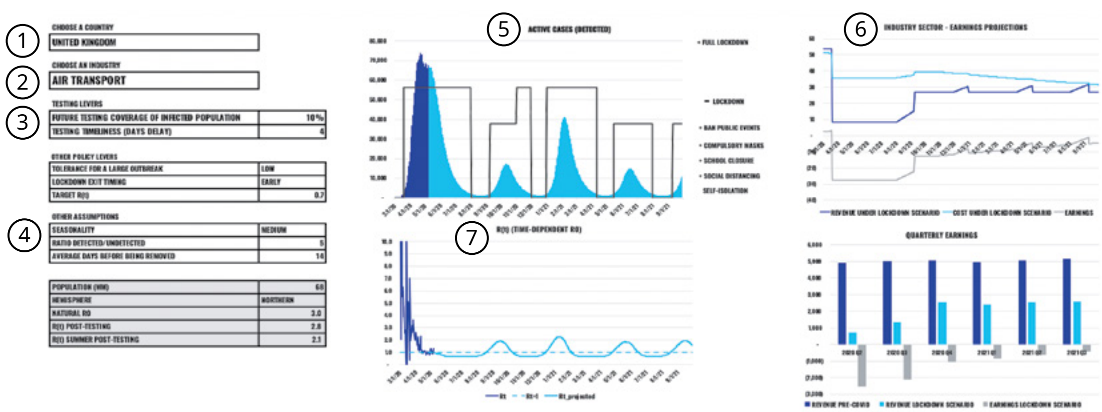
BACK TO THE BALANCING ACT

The purpose of this article was not to lay out a single scenario for COVID-19 or to make the case that the situation will definitely improve in the summer in the Northern hemisphere. There are still too many unknowns to place too much weight on single scenarios.

However, for policymakers, we believe there is now enough data supporting the testing of more sophisticated containment strategies, in which we increasingly understand the implications on R and case levels and can simultaneously assess economic costs.

Exhibit 12 is an example of the dashboard we have been using with clients to a create a more comprehensive and coherent model of the crisis. A joined-up modelling framework such as this one offers policymakers the chance to define and communicate an overarching risk appetite for health and the economy, which can be extended to include privacy and lifestyle metrics.

Exhibit 12. Pandemic Navigator industry-level dashboard (cashflow forecast)



1. Calibrated by region

2. Earnings impact for 40 different sectors

3. Includes testing levers

4. Adjusts for undetected cases and accounts for potential seasonality affects

5. Lockdown patterns of varying intensity

6. Impact on the economy/earnings/cashflows

7. Transparent metrics such as the evolution of R

Source: Oliver Wyman Analysis, Oliver Wyman Pandemic Navigator

While policymakers will set the direction for health policy and economic activity, we are expecting differentiated approaches by companies, communities, and demographics in the future, essentially reflecting their own risk appetite. Any lack of a robust framework, clarity, and transparency at the national level will lead to ambiguity and a more punitive and conservative approach eventually being needed.

CONCLUDING REMARKS

When the COVID-19 virus started to spread globally, it initially gained the upper hand, but was met with the full force of a hammer-like policy response. This hammer had an equally devastating effect in suppressing the economy, however. We hope the next phase of this story will be characterized by human ingenuity, with data, technology, and medical research playing a much more prominent role in our collective response. While the creation of this new apparatus will take a massive coordinated effort and investment, our modelling shows it will pay rapid dividends in the near to medium term. And this invaluable apparatus will remain in place for when future and potentially deadlier viruses threaten humankind.

Oliver Wyman is a global leader in management consulting that combines deep industry knowledge with specialized expertise in strategy, operations, risk management, and organization transformation.

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