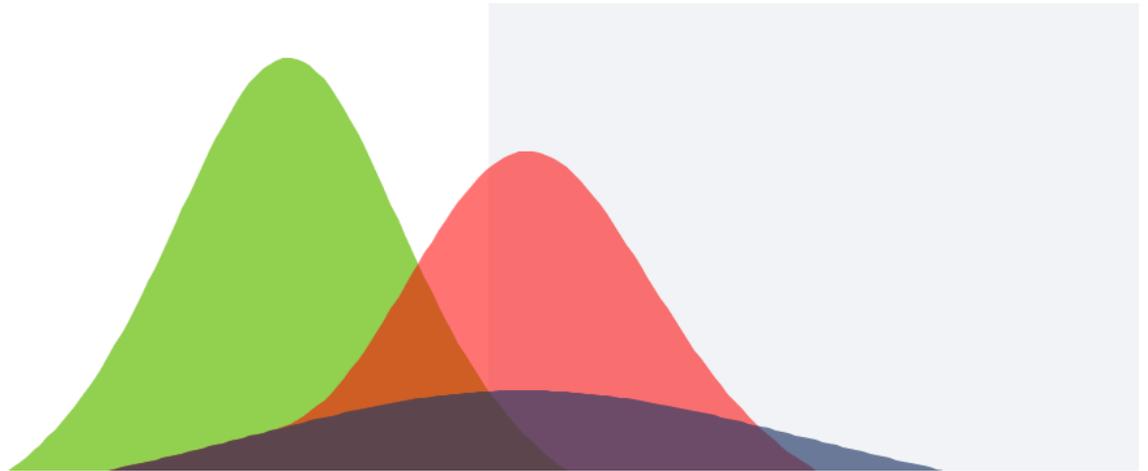


COVID-19: Lives or Livelihoods

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TAKEAWAYS: Using a popular epidemiology model, we make projections for the numbers of COVID-19 infections under different hypothetical scenarios. Model predictions help us better understand the current policy dilemma between public health and reviving the regional economy. Drawing on available labor market data during the ongoing pandemic, we find the cost of shutting down businesses in terms of lost wage earnings for each infection or death avoided to be at least twice as much for the local area as for Texas as a whole.

Policymakers across the nation, especially Texas, are now facing a conundrum of decisions between public safety and reviving an otherwise collapsing economy. After a stay-at-home executive order seemed to be successful in “flattening the curve” of COVID-19 infections, Greg Abbott was one of the first state leaders to begin reopening businesses in May. The number of active cases remained relatively flat through May and subsequently, Governor Abbott further relaxed restrictions on business operations, including reopening high-risk businesses, such as barbershops and bars.

In his announcement of the third phase of reopening the economy on June 3rd, Abbott justified his decision to ease up business lockdowns with the finding that over 45% of new cases between May 26th and June 2nd came from prisons, meat-packing plants and nursing homes.

The [New York Times](#) has also found that about 40% of coronavirus outbreaks across the nation can be traced to these same clusters, where people in tight spaces have little opportunity for physical distancing. In Corpus Christi, an outbreak occurred in a local beef processing plant in mid-May, with more than 60 workers and vendors testing positive for COVID-19.

New Waves

By the first week of June, the state had entered its third phase of reopening its economy as most non-essential businesses other than restaurants were allowed to operate up to 50% capacity. Since then, the numbers of new coronavirus cases in Corpus Christi and the state have surged again. On June 25th, Governor Abbott responded to record numbers of new cases throughout the state by issuing new orders to roll back the state’s reopening plan. During that week, new COVID-19 cases climbed at an average daily rate of more than 60 percent,

meaning the number would double almost every other day.

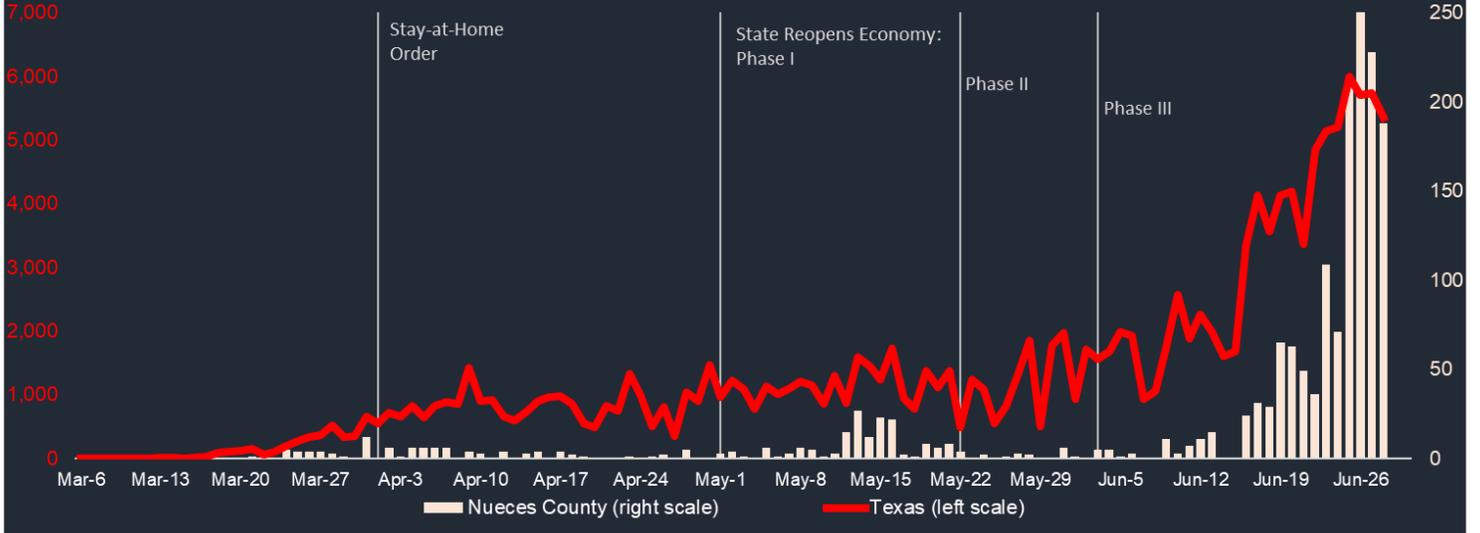
Texas is not alone. Infections have surged nationwide over the past two weeks, especially among states that were first to reopen their economies, like Florida in addition to Texas. Despite being hailed for keeping confirmed cases down, the state of California has also appeared to lose control of the coronavirus pandemic after easing the state’s requirements for reopening businesses in mid-May. Its governor, Gavin Newsom, [described the situation](#) as a result of the fact that “many of us, understandably, developed a little cabin fever ... a little amnesia ... others have just frankly taken down their guard.”

“Selfish” Young People

Unlike those infected before June, new virus cases have been detected increasingly more in younger people. “You’re young, and so you feel a little bit more invincible. But respectfully, often that can be a selfish mindset,” Governor Newsom warned. This assertion highlights an economic concept called externality, which occurs when social interactions transmit infectious diseases like COVID-19. Accordingly, self-interested people decide to interact with others, say in a beach, after weighing their own risk of becoming infected against the related costs, from having symptoms to death.

But they tend to ignore the costs on others who might contract the disease from themselves. Because of this type of negative externalities in a virus outbreak, most economists call for government interventions, such as mandatory lockdowns and quarantines, to limit the spread of the virus before a vaccine is developed. Researchers at University of Virginia, [Zachary Bethune and Anton Korinek](#), estimated that people perceive the cost of becoming infected to be about \$80,000, while the total cost to society, which includes infection externalities that they

New COVID-19 Cases



impose on others, is more than three times as much. As a result, people tend to practice less social distancing than what is considered “optimal” or best for society as a whole.

This is especially true for the case of the coronavirus pandemic. Unlike its genetic cousin, SARS, which was spread in past outbreaks mostly from people with symptoms. In the current pandemic, there is now [early evidence](#) that even asymptomatic people, or those show no symptoms at all, could transmit the coronavirus to others.

Perceived Risk

The perceived risk of infection seems to explain Texans’ social distancing behavior quite well. Drawing on mobility data derived from phone apps, people in Corpus Christi and the rest of Texas spent about 20% more time at home on average in early April, after an initial virus outbreak that triggered business lockdown and stay-at-home orders. As the number of daily confirmed cases stayed relatively flat throughout April across the state, the perceived risk of infection might have dwindled. Since the second week of April, a typical Texan has spent less and less time at home, especially over weekends.

While some people might have returned to work in businesses that were allowed to reopen, many others have spent their time away from home at grocery stores and other retail stores. In the local area, the average amount of time that people spent at retail stores was higher in May than in January, the pre-COVID-19 benchmark for comparison.

The percentage increase was evenly higher for the time that people spent on the area’s beaches. This reflects the behavior of

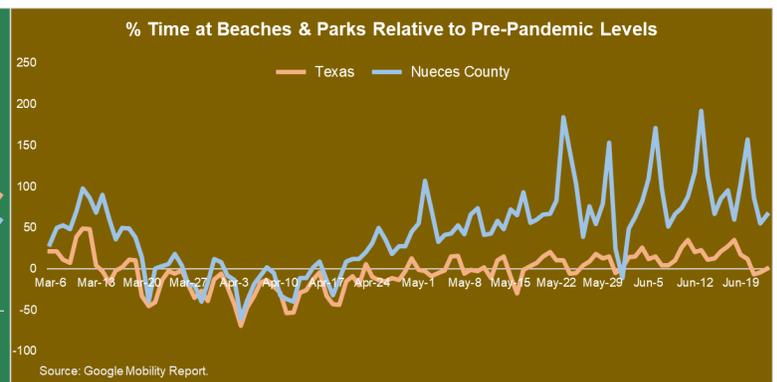
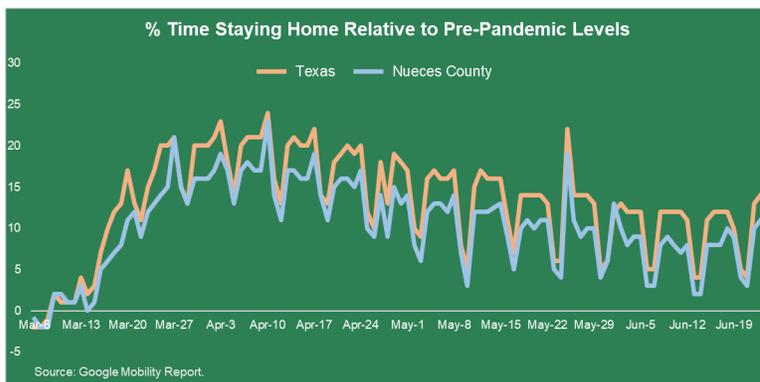
“irrational exuberance,” a term coined by former Federal Reserve chair Alan Greenspan to describe unfounded optimism that eventually led to a stock market bubble in the late 1990s. This uptrend might also explain the development of a new wave of positive cases in recent weeks, particularly among young people.

Policy Dilemma

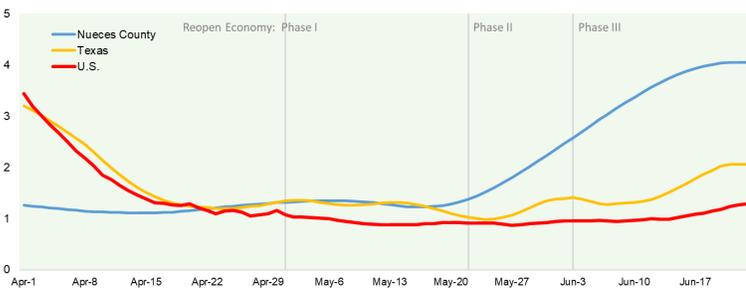
Today, state and local officials are at a crossroads. In the absence of a vaccine, policymakers are once again grappling with the tradeoffs between public health and the health of the economy. Despite exponential growth in the state’s infections and hospitalizations, Governor Abbott has [made it clear](#) that “closing down Texas again” will only be a last resort. Apparently, “flattening the curve” during the month of April was achieved at a cost that perhaps we cannot afford to repeat.

To better understand the current policy dilemma, it’s instructive to review what might have happened if the governor and local officials did not issue stay-at-home orders in April that also shut down businesses statewide. To find out the number of people that could have been infected under this hypothetical or counterfactual scenario, we apply a popular infectious disease model in epidemiology called SEIR, an acronym for Susceptible-Exposed-Infectious-Recovered. The model consists of differential mathematical equations that depict the flows between four groups (susceptible, exposed, infectious, and recovered) of a population. We can use this model to predict the number of infections over time and the duration of the pandemic under some assumptions.

One assumption is called the transmission or reproduction rate, which is the speed at which the COVID-19 disease is capable of spreading among people. In the context of the SEIR model, this is



Transmission Rate



a factor that affects the transition between the susceptible and infectious populations. Because human behavior or policy interventions may affect its size, this factor is the focus of epidemic research. Only when a transmission rate less than one will the virus that causes the COVID-19 disease, SARS-CoV-2, will eventually be contained. Under a full lockdown order that quarantines everyone, the transmission rate would be essentially zero.

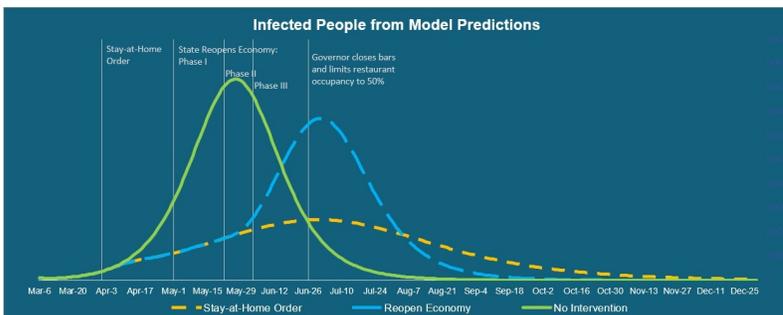
Behind the Curves

The above chart shows estimates of the transmission rates in the SEIR model that best fits the actual numbers of daily COVID-19 cases in Nueces County, Texas, and the United States, respectively, since the onset of the pandemic. Our model is more sophisticated than the conventional SEIR models in that it allows the estimated transmission rates to change over time. The transmission rates of the state and the nation declined throughout April when stay-at-home orders was effective across Texas and many other states. Even after the Texas stay-at-home orders expired by the end of April, the estimates for the state and Nueces County remained closed to one through the third week of May. Since then, the county’s estimate began rising, exceeding three by mid-June. The most recent estimates align with the [finding](#) of a Texas A&M University-Corpus Christi research team.

Soon after Governor Abbott announced the third phase of his statewide reopening plan with fewer restrictions on businesses beginning June 3rd, the numbers of new cases in Nueces County and the state surged at exponential rates. While the estimated transmission rate for the nation remained flat around one, Abbott [warned](#) of a “swift and very dangerous turn” in the spread of coronavirus infections statewide.

“Very Dangerous” Turn

So, how dangerous is this turn? The SEIR model can help us understand the impact of our behavioral changes on the spread of COVID-19. First, let’s look at what would have happened in April had the state and local officials failed to issue stay-at-home orders and to temporarily shutter all nonessential businesses. The following chart plots the number of infected people over time (green line) as predicted by the SEIR model using a fixed transmission



Gains from Lockdown: SEIR Model

	Texas	Nueces County
Gain through June 25:		
Infected people	171,053	1,305
Deaths	2,970	8
Net Gain through End of Year:		
Infected people	73,412	560
Deaths	1,275	3

Costs due to Lockdown

	Texas	Nueces County
Lost Earnings through June 25:		
Each Infection Avoided	\$110,564	\$268,847
Each Death Avoided	\$6,367,017	\$15,719,644
Lost Earnings through End of Year:		
Each Infection Avoided	\$351,203	\$853,985
Each Death Avoided	\$47,123,949	\$329,644,659
Cost per Resident	\$2,072	\$3,075

rate of 3.5, which is about what Texas and Nueces County experienced in late March. According to the model, the number of infections would have risen exponentially through the end of May.

The peak of infections at 70% of the population is commonly called herd immunity. When this majority of the population within a community is immune to the virus, the spread of the COVID-19 disease is kept under control and so this provides indirect protection to those who are not immune to the disease. This is widely considered a “dangerous” path because to achieve herd immunity would first overwhelm the existing health systems of most countries in the world. Also, the death toll would be much higher among the elderly and those with a weak immune system.

To slow the spread of the coronavirus, officials in the state and the rest of the world have issued stay-at-home orders instead. The Texas statewide executive order was effective April 1st. Assuming that this policy measure was able to reduce the transmission rate by half, we now estimate the projected number of infections over time according to the SEIR model predictions. In the same chart above, the path of infections (yellow dashed line) flattens but the pandemic will not be fully contained until the end of the year.

Flattening the Curve

So, what are the benefits of “flattening the curve”? To find out the difference in the number of infections between the two hypothetical scenarios, we first scale the model to match the respective populations of Texas and Nueces County. The two projected paths coincidentally intersect on June 25th, the same day that Governor Abbott announced a pause to the progress of reopening Texas. Through that date, the cumulative total of the number of infections beginning April 1st is about 171,000 less for the entire state of Texas under the lockdown scenario with the stay-at-home order than the number under the baseline scenario with no policy intervention.

We also make projections for the number of deaths using the historical data on the death rate, which is the percentage of people who die after being infected by the COVID-19 diseases. During the period through June 25th, the model predicts that nearly 3,000 fewer Texans would have died in association with the lockdown policy. Nueces County would have seen 1,305 fewer infections and 8 fewer deaths, according to model predictions.

After June 25th, however, the model predicts that the number

of infections and fatalities would in fact be greater under the lockdown scenario than the baseline without interventions. The entire duration of the flattened curve would extend through the end of the year. So, without “getting it over with quickly due to herd immunity,” the total numbers of infections and deaths that the lockdown would reduce by the end of the pandemic are projected to shrink by half compared to those numbers posted on June 25th.

Public Safety at What Cost?

The SEIR model alone does not tell us the economic costs behind the epidemic curves. With hindsight, the monthlong stay-at-home executive order for Texas represents an unprecedented quasi-experiment that has decimated the regional and local economies. As for the rest of the nation, Texas’ unemployment rate spiked from a near-record low of 3.5% at the beginning of the year to a record high of 13.5% in April. During that month, Nueces County’s seasonally adjusted unemployment rate rose by more than 10 percentage points to a historic high above 16%. Employment reduced by 18% in the county and 10% statewide.

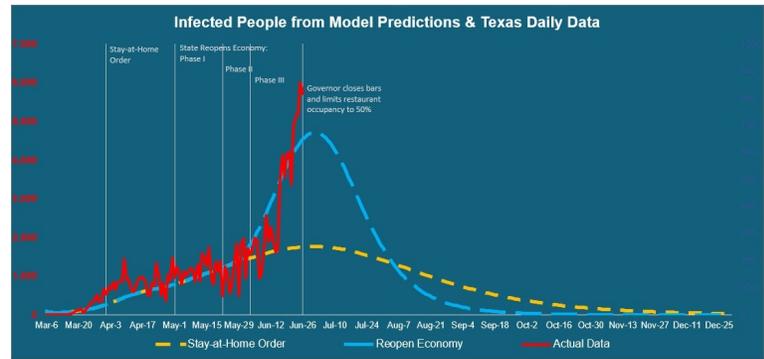
Drawing on those employment numbers and average wages, we can estimate the total amounts of lost earnings over time should the statewide lockdown continue alternatively through June 25 and the end of the year. Dividing the estimates of lost earnings by the previously projected infections and deaths avoided in association with the lockdown gives us estimates for the costs associated with the lives saved by the lockdown policy. As of June 25th, each life saved is associated with a loss of roughly \$6.4 million in wage earnings. This loss in wage earnings is more than twice in Nueces County due in part to a lower risk of infection and fatality. Again, since the projected numbers of infections and deaths are higher with the lockdown policy than those without it after June 25th, the cost estimates in terms of cumulative earning losses would be substantially higher through the end of the pandemic.

The unemployed are not the only ones who bear the burden of lost wage earnings as a result of the lockdown order. The economic costs are a burden for all citizens in the community in the view of unemployment benefits for those who lose their jobs. From this perspective, we divide total wage losses by the population to arrive at the policy cost per person, which equals about \$2,000 for Texas and slightly more than \$3,000 for Nueces County.

Our cost estimates based solely on wage earnings are for the sake of illustration. These back-of-the-envelope estimates ignore many factors that affect the total economic costs of a pandemic as well as any policy measures aimed at slowing down the virus outbreak. First, we have not considered the costs of treatments and hospitalizations for the infected people and the entire community. Most existing health systems in the world cannot handle a pandemic without any measures to slow down the virus spread, or so-called nonpharmaceutical interventions. Also, the economic impacts of a lockdown order or any mandatory social distancing measure would be different in the long run than the short run that we have focused on. A full assessment of the economic impacts of different scenarios would require an integration of the infectious disease model with a macroeconomic framework, which captures key aspects of an economy.

Cost Disparities

Nonetheless, the objective of this exercise is not the exact measure of the economic cost associated with each infection or death avoided. Instead, we highlight the extent of differences in our cost estimates between Texas and Nueces County. A sweeping executive



order to shutter businesses across the state would result in a relatively higher economic burden per infection or death avoided in Nueces County than elsewhere in Texas. Despite a 15% lower average wage level, Nueces County suffered an 18% employment loss compared to 10% statewide in April. The local death rate associated with COVID-19 infections is 0.6%, less than half of the 1.7% for the state. These distinctions contribute to the more than double in the cost estimates locally relative to statewide for each infection or death avoided under the lockdown policy.

Reopening Economy

In reality, the situation is more complicated than the hypothetical scenarios described in the model. For instance, Governor Abbott began reopening the economy on May 1st. According to mobility data, Texans’ social distancing behavior did not change noticeably until three weeks later or Phase II, which allowed bars and other businesses to reopen and restaurants to increase occupancy to 50%. To model the effects of reopening the state economy, we assume the transmission rate returns to its pre-lockdown level of 3.5 beginning May 22nd.

The above chart shows the path of new COVID-19 cases under the scenario of reopening businesses after closing them for about one month. The outcome over time is similar to the baseline, but because of the lockdown policy that slows down the virus spread for more than a month, the peak number of new cases is much lower. The cumulative number of infections over the entire pandemic duration is about 30% lower than the baseline but it is still higher than that under a permanent lockdown.

It is reasonable to ask how well those theoretical projections describe the real world. To support the model’s relevancy, the following chart plots the Texas daily COVID-19 cases along with the predictions that has been scaled to match the state’s population. The model seems to track the Texas data closely until the past week when the number of positive cases spiked well above the peak of our projected path.

Despite Governor Abbott’s assertion that closing the economy again would only be a last resort, recent developments underscore the conundrum that policymakers in Texas and the rest of the nation are facing.

Flattening Tradeoffs

We are no epidemiologists. Yet economists can contribute to the ongoing policy debate by first quantifying the unintended economic consequences of policy measures before a vaccine is developed. In particular, we have found the economic burden of a one-size-fits-all stay-at-home mandate to be substantially higher in the local area than elsewhere in the state. As such, in addition to “flattening the curve,” policymakers can potentially flatten the tradeoff between public health and the health of the economy by taking disparate local