Author: Rex Briggs, Founder and Executive Chairman of Marketing Evolution.
Twitter: @rexbriggs | rex@marketingevolution.com

KEY TAKE AWAYS

1. Briggs Nov20 Forecast predicts an end of Pandemic in Q3 2021, with a drop in annualized deaths from 875,000 in US and Europe to annualized 1,500 or less.

2. Businesses should plan their 2021 budgets with a rough Q1, as infections continue to spread in parallel to vaccine distribution scaling up, but not yet broadly distributed. Q2 will see a slowing rate of infections and deaths as the combination of natural recovery and vaccinations approach 'herd immunity.' The back half of 2021 should see a rebound in social business interactions such as travel, tourism and in-store retail.

3. The pandemic taught people to buy and interact differently. E-commerce, curbside pick-up and other new habits will become expected conveniences.

4. Marketing Research models share many similarities with epidemiology models. Collaboration across disciplines can improve both.

Cross Pollinating Research Practices:

Throughout my career in marketing research, I've made it a point to study the research designs and analytic techniques of other fields, particularly health care. In ESOMAR's book on Best Practices in Marketing Research, I was honored to be a chapter on measuring the effectiveness of advertising using design of experiments borrowed from pharmaceutical clinical trial research. I see an opportunity for epidemiologists to apply some techniques marketers use. Borrowing from marketing research practices for forecasting, I'm applying the way our industry analyzes reach, conversion and impact of marketing exposure to COVID19 forecasting. Reach and conversion are similar to the epidemiological SIR model. SIR stands for Susceptible, Infected, Recovered. In Marketing Research, this is roughly equivalent to modeling Not Reached, Reached, and

Converted. In marketing research, we calculate customer retention and churn. I applied these techniques early in the pandemic to calculate the infection fatality rate (IFR) from COVID19 among a closed population. The figure I arrived at was nearly identical to subsequent published medical data which arrived weeks and months later. This IFR rate informed my Mid-March forecast of COVID19 deaths for 2020 -- which has proven to be highly accurate. Using these marketing research practices was an improvement over the fatality rates estimated by medical experts early in the pandemic. The medical experts' rates over-estimated the fatality rates by three to six times. Using the closed population experience of the Diamond Princess Cruise, and applying standard Marketing Research adjustments produced a much more accurate infection fatality rate estimate.

Marketing Research has learned from the medical community. In the marketing research industry, we measure the effects of advertising using randomized control experiments -- an approach borrowed from Phase 3 clinical trials. In marketing research, we track the duration of impact over time using longitudinal research among those exposed. The same is done in Phase 3 clinical research to track duration of benefit and side-effects.

I have been applying the Marketing Research framework to COVID19 since late January, when I evaluated the model coming out of China that reported COVID19 would peak at 10,000 cases world wide. My calculations suggested COVID19 would run into the millions of cases and was nowhere near peaking. In Mid March, at the ARF Town Hall, I presented my forecast.

Mid March Forecast:

My Mid-March 2020 Forecast Estimated 294 thousand deaths at the end of 2020 in the US. Based on the intense politicization in the US of masks and social distancing, on September 18th, I raised the forecast to between 294 thousand and 396 thousand deaths in the US at the end of the year. Compared to my Mid-March forecasts, vaccines are coming about four months ahead of my

original forecast. Therefore, with the successful Phase 3 trial of two vaccines nearly ready for regulatory approval, I am now forecasting the tail end of the pandemic in the US and Europe in Q3 2021 rather than Q1 2022.

The data and analysis is straight forward, as I think it is far better to have easy to understand models wherever possible. I am using a projected infection rate x infection fatality rate (which I've calculated from empirical data) to forecast total deaths.

The benefit of this approach is that the overall incidence of infection provides a gauge on how close the population is to herd immunity (which many estimate to be around 65 to 70 percent of the population). Deaths are a daily indicator that is both monumentally important and less susceptible to variability due to testing capacity, one can divide deaths by the IFR to estimate total infections and infection incidence within the population. Since IFR may change over time, it is relatively easy to update IRF using serology surveys (which provide an overall measure of infection recoveries) as the denominator and deaths as the numerator.

Here are the fundamentals: I examined research on previous pandemics from 1918 to present along with an analysis of the attack rate of SARS-CoV-2. I built regression models from early spread and considered structural US health jurisdictions, consumer behavior vis-a-vis mobility data at the county level in response to initial confirmed cases. I built a diffusion curve for the infection rate. The initial forecast was for a 15% infection rate in the US at the end of the year - in line with infection rates of H1N1. To calculate deaths, I recognized case fatality rate (CFR) would overstate the severity, built a data set from closed community infections, such as the Diamond Princess Cruise. Separately, I gathered data on deaths by age cohort, and by time lag from infection to diagnosis to death. I built an age adjusted and time lagged model to calculate the infection fatality rate. My initial model for IFR was between 0.4% and 0.6%. I observed that the fatality rate was dependent on hospitals not getting overwhelmed, and considered scenarios where fatality rates would increase based on inadequate care. I also considered that fatality rates would decrease over time (provided hospitals don't get

overwhelmed) as the science delivered recommendations on best practice treatments. For seasonality, I took a global data set of confirmed cases coded by latitude and converted to temperature averages. I applied this data to forecast that the US and Europe would get a reprieve from the virus over the Summer and a second wave in the Fall/Winter.

My first model, from the end of February, was just prior to having enough data to calculate IFR using my own sourced data. I used 15% infection incidence, and weighted down the CFR to 1.6% -- this model suggested COVID19 could take 780k lives in the US by the end of the year. Two weeks later, in early march, I had enough data to calculate IFR. Based on analyzing the Diamond Princess Cruise, and adjusting for age and lag times, I arrived at an IFR of 0.4%. There was a high level of uncertainty as to whether the US Hospital system would become overwhelmed and IFR would increase as a result. I was hesitant to change my initial forecast, and instead shared the lower 0.4% to 0.6% IFR range and its implications at the ARF Town Hall (see slides and video) and subsequent publications. Over time, we saw that hospitals in hot spots like New York did become overwhelmed, with IFR increasing. Fortunately, these were exceptions to the rule. Most hospitals did not become overwhelmed and through the summer, we were on-forecast toward the 294k projection, which I represented as a range of infection rates from 15% to 20% with an IFR range of 0.4% to 0.6% IFR (for simplicity, I used the lower end of the infection rate of 15% and the higher end of the range for IFR for a single point estimate).

When Donald Trump announced a positive COVID19 diagnosis, I paid close attention to consumer sentiment, particularly among Republicans. Initially, mobility data from conservative leaning counties decreased, and polls showed an increased seriousness to precautions to avoid getting COVID19. However, that changed as Trump exited the Hospital and began campaigning. In September, I raised my forecast for the incidence of infections by five percentage points (see highlight in table 2). This increased the projected death toll to a range of 294k to 396k. In other words, I was expecting the second wave to be worse than originally forecasted back in Mid-March due to the politicization of masks and social distancing.

Table 1: US Forecast Infection Rate and Fatalities Due To COVID19 At End of 2020

	Forecast Range		Above Forecast (Reference for lives saved by Vaccine)			
Incidence of infections->	15%	20%	25%	30%	40%	70%
Infected	49 million	66 million	82 million	98 million	131 million	230 million
Deaths (IFR 0.6%)	294 thousand	396 thousand	492 thousand	588 thousand	786 thousand	1.380 million

For simplicity, I am using 20% and 0.6% IFR. If we use my DPC analysis finding of 0.4% IFR and 25% infection rate, we forecast 330,000 deaths around the end of the year.

Table 2: US Forecast of COVID19 Immunity Due To Infections and Vaccinations

Recovered / Immune	US Recovered (includes non-diagnosed)	Cumulative Vaccine Rate	Cumulative Immune
End of December	20%	4%	24%
End of January 2021	23%	8%	31%
End of February	25%	12%	37%
End of March	26%	16%	42%
End of April	27%	22%	49%
End of May	28%	30%	58%
End of June	29%	40%	69%
End of July	29%	52%	79%

As a reminder, I am using TOTAL INFECTIONS and INFECTION FATALITY RATE (IFR), not total diagnosed cases, which undercounts asymptomatic and mild cases. To read about the difference, as well as what I got wrong and right in the original March 2020 forecasts, see the full story here (requires LinkedIn).

The IFR calculation tracks with the death toll reported from COVID19 at Worldometer and John Hopkins dashboards. As the death toll is the most concerning number, it has been the focal point of the forecasts. That said, there are many other consequences of COVID19 in addition to the death toll that

should not be minimized, including longer term health issues of those infected and the impact to the economy.

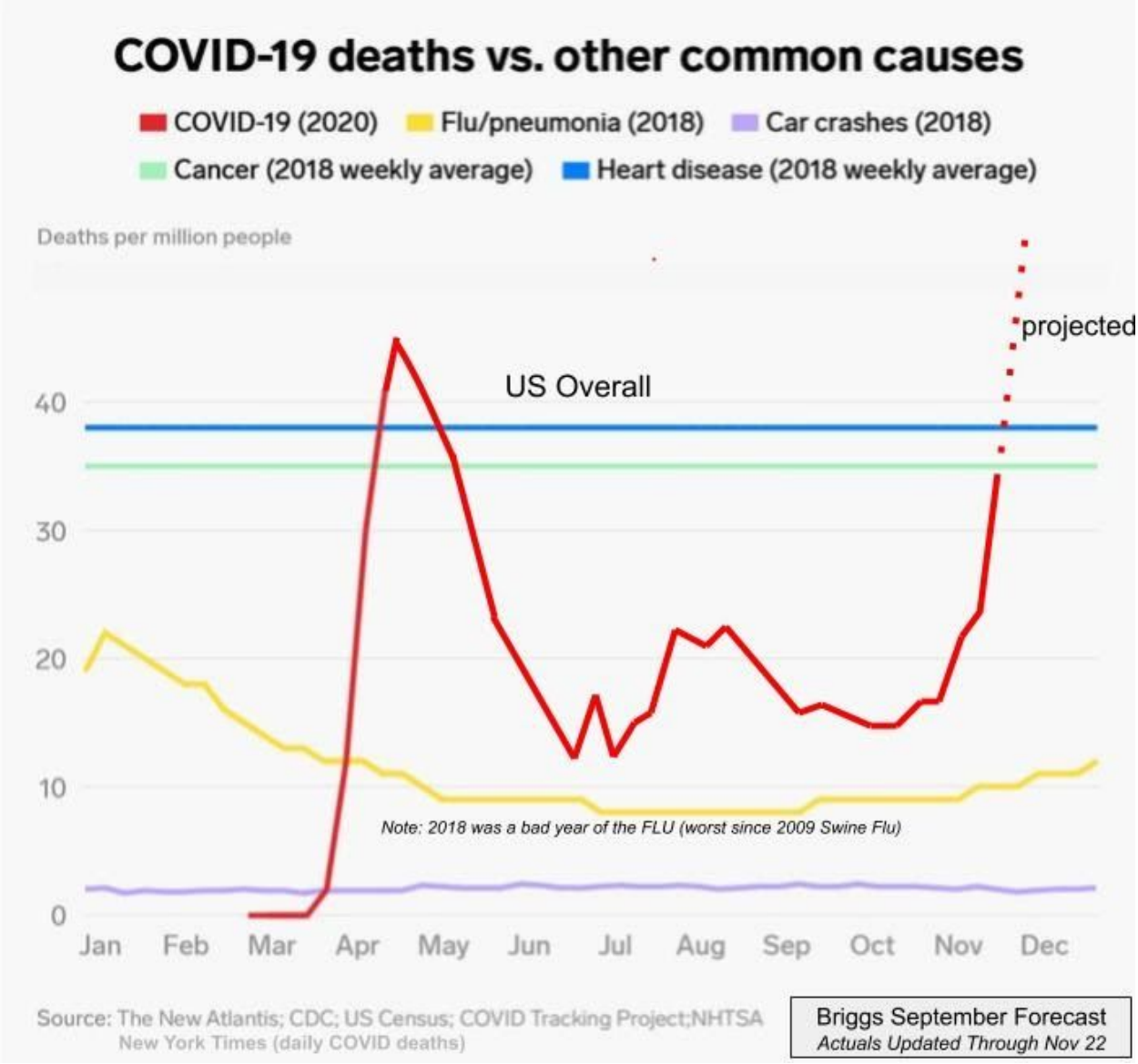
2021 FORECAST:

Initially, in March, I forecast we'd see vaccines at record speed, with an achievement of broad immunization in early 2022. This Forecast (Briggs3-Nov20) moves up this timeline. Considering the effectiveness rates in the 90% range for both Pfizer and Moderna, and my new calculations that combine the natural immunity with vaccine immunity, I am moving up my forecast of when the US and Europe enter the tail end of the pandemic to mid 2021. This forecast is somewhat optimistic in that it depends on a rapid scaling up of distribution, which drug companies and government officials have claimed will occur. Anthony Fauci, reported to the USA Editorial Board, "After prioritizing people at risk of infection or severe disease, the healthy general population can expect first doses of a vaccine starting in April and through July if all continues on track."

This is somewhat optimistic because similar claims of rapid scaling up of testing were also made, but did not materialize. July through August is relatively less advantageous for the virus in terms of temperature, humidity and people congregating indoors. This will also help reduce the spread. The key is to achieve broad distribution of the vaccine before fall 2021 and a third wave of COVID19 deaths.

It will get worse before it gets better. My original forecast expected a second wave of deaths, where COVID19 would once again become the leading cause of death in the US. I'm projecting December to be the most deadly month of COVID in US history, surpassing the previous peak in April.

Since there is a roughly three week lag between infections and deaths, consider the influence of increased holiday travel, college students returning home, and hostility among some to masks and other public health measures. It is hard to conceive of a scenario where the virus doesn't continue to spread and kill at an alarming rate through at least the end of January.



Vaccine To The Rescue:

My model estimates that by the end of this year, 20% of Americans have already recovered and developed natural immunity. Add to this an initial wave of vaccinations reaching about 15 million Americans, or about 4 percent of the US population. Keep in mind vaccination requires two shots, spaced two to three weeks apart. These doses will go to front-line workers first. This will require the distribution of 30 million doses in the US. The estimate of 4% of the US population vaccinated by the end of December is an optimistic but achievable scenario given that Pfizer repored 50 million doses will be produced by end of 2020, and Moderna is simultaneously scaling up producing vaccine doses. In addition, Moderna's announcement included breakthroughs in measuring how long the vaccine remains effective at room temperature, demonstrating that distribution could occur using similar infrastructure as other frozen/refrigerated injectables.

My forecast projects we will scale vaccination distribution to 8% of the US population by the end of January -- this requires about 53 million doses and is also on the optimistic end of the range of possible outcomes. Including Europe's nearly 750 million people in this calculation, and additional 120 million doses will be needed to achieve 8% vaccination penetration by the end of January.

Unfortunately, at the same time vaccinations are scaling up, SarsCoV2 will continue to spread at an accelerated rate due to holiday indoor interactions and more ideal conditions for the virus in terms of temperature and humidity. By the end of February, my model predicts we will hit 25% of the US population infected. In Europe, where many countries have been more effective in flattening the curve over summer, the total infection rate will also increase, but to a lower overall infection rate of around half the US total Infection rate. By comparison, European countries, on average, have about half the number of active cases per 100,000 population compared to the US.

What Table 2 shows is how the vaccine accelerates herd immunity. Whereas herd immunity might have taken several years to achieve, the vaccine could help us achieve it in about six months in the US. In Europe, where the overall rate in infections is lower, it will take a few more months to achieve herd immunity levels

as the vaccine (rather than the virus itself) is doing the vast majority of the immunization. While it will take Europe a couple months longer to achieve herd immunity thanks to the vaccine, European countries will have saved more lives as calculated by the number of deaths per 100,000 population compared to the US.

A key to this successful outcome is an initial focus on vaccinations among the 65+ population, which accounts for more than 80% of COVID19 deaths. In the US, those 65 and older represents 17% of the total population. This older population skews more Republican. If the vaccine becomes politicized the way masks were politicized, the benefits of the vaccine may not be fully realized, and my forecast may be too optimistic.

In addition, as shown in my ZIP Code analysis of COVID infections, there is a greater concentration in communities that skew toward lower income. Research from the COVID Collaborative showed that only 14% of Black Americans and 34% of Latinx Americans trust a vaccine, indicating that an education campaign is particularly important for historically marginalized communities.

The Vaccine Math of Effectiveness:

Let me break down the math of why the vaccine is such a big deal. Here's the headline: An effective vaccine could take us from an annualized death toll in the US and Europe of 875,000 to under 1,500.

That is mind blowingly good.

Here's the math: First, start with the total number of COVID deaths over the last eight months. Annualize it and you'll find the US death toll from COVID19 is running at about 375,000. For Europe it is about 500,000. Now let's look at how I expect the vaccine to change this dynamic. If we combine the Pfizer and Moderna tests, there were roughly 47,423 total people vaccinated. Pfizer reports

94 participants contracted COVID with more than 90% effectiveness. Recently they updated this to 95% effectiveness. If we take the lower end 90% figure, it implies about 9 were in the vaccinated group contracted COVID19. Similarly, Moderna reports 94.5% effectiveness with 95 total infections, which means 5 or 6 were in the vaccinated group. To be conservative, I'll use 15 as the vaccinated and infected out of 47,423 making the infection rate of 0.03%.

If the entire US population of 330 million people was vaccinated (unlikely all would get vaccinated, but for sake of running the numbers), about 105,000 would contract COVID19 given the current levels of community spread. Using the Infection Fatality Rate (IFR) of 0.6% that I analyzed earlier in the pandemic less than 650 people would die. That's a total annual death toll that is lower than the current daily death toll. On an annualized basis, that is less than 2 people a day - if everyone got vaccinated.

In Europe, the math is much better because there is less community spread than in the US. Therefore, the odds of getting COVID19 in the first place are lower. If all the test subjects were in Europe, there likely would have been less than 15 people vaccinated and infected. Accounting for Europe's larger population (748 million) and lower current infection rate, deaths from COVID19 should fall below 500 among those vaccinated. If the vaccine reduces the severity of COVID19, that too would result in even fewer deaths.

It will require a coordinated national, local and grassroots effort to get a majority of the US and Europe vaccinated. Given these numbers, it is well worth the effort.

A caveat is that Pfizer and Moderna used a slightly different standard than Oxford/AstraZeneca. Pfizer and Moderna counted those that showed up in the medical system because they were concerned enough to get a COVID19 PCR test whereas Oxford/AstraZeneca tested everyone with PCR. This means there may be some mild or asymptomatic cases after a vaccine that could spread the virus to others, but one would expect it to be proportionately less, similar to the diagnosed cases. It would be helpful if Pfizer and Moderna should conduct

serology tests among everyone in their study to report the difference in total infection rate between vaccinated and placebo groups.

Business and Personal Planning:

I don't think most businesses have absorbed the implications of the incredible effectiveness rate of the Phase 3 trials, and may be budgeting for 2021 too conservatively. Businesses and individuals should plan on a very rough end to 2020 and a difficult start to 2021 as the virus continues to spread. However, the vaccine is a complete game changer. As consumers get their vaccine shots, their behavior will change. Many will start booking travel for summer and fall 2021 in anticipation of getting a vaccine shot, the strength of the Phase 3 clinical results (and articles like this one translating the effectiveness data into more meaningful numbers). Simply put, COVID19 will drop off the list of leading causes of death.

Let's assume the scenario that the 15 people that were vaccinated and contracted COVID19 are just as severe as if you contracted COVID without a vaccine. Still, this would be a very good outcome. It would mean getting the vaccine carries less than one in half a million chance of death given the high levels of community spread in the US. Even lower risk in Europe. In the US, we get into cars with an annual 1 in 47,852 chance of death.

As fast as the virus shot-up to infect the world, the drop will seem even faster. The pandemic taught people to buy and interact differently. E-commerce, curbside pick-up and other new habits will become expected conveniences. At the same time, there is significant pent up demand for social activities, travel and tourism. If you haven't scenario planned for a mid 2021 end to the pandemic, now is the time to revisit your budgeting.

Unanswered Questions:

The success of two mRNA vaccines is phenomenal news. Yet, there are questions to be answered, including:

1. Were those that got the vaccine and later came down with COVID19 more or less severe compared to those not vaccinated and infected?
2. Are any of those vaccinated contagious for any period of time?
3. What if there are side-effects that present themselves as the scale of vaccines increase?
4. What if the anti vaxxers spread so much misinformation, they sway others not to get vaccinated?
5. How long will the vaccine last? Will it work on the increasing range of mutations?

The first two questions may or may not be definitively known when the drug makers present their full report to the FDA. The other questions require more time.

A concerning question is whether the vaccine makes those receiving it contagious. If so, that carries risk for the overall population. In this scenario, those receiving the vaccine will need to self-quarantine for a month (two weeks after the initial shot, and again for two weeks after the second shot). It is unlikely that everyone would comply with self-quarantine, and this could accelerate infections. With mRNA, it is very unlikely to make someone contagious to others. With attenuated and live vaccines, there is low risk, but not zero risk.

With nearly 50,000 people vaccinated, there is enough data to see short term side-effects, but not enough data to see a side effect that presents 1 in 100,000 cases. In fact, based on the dynamics of creating a representative population for the Phase 3 trials, if a side effect occurs 1 in 10,000 cases among a particular group of people, we may miss it. While it is rare for a side effect to emerge months or years later, it is a possible risk. As the vaccines roll-out in December and January, we will have millions of more data points.

If the trend of greater than 90 percent efficacy continues without significant side effects, it should increase the confidence for later adopters to get the vaccine. Leaders in the healthcare sector tell me that they expect demand for the vaccine to exceed supply for the first half of 2021. It is in the back half of 2021 where they expect to need advertising messages to share the facts and encourage additional people to get the vaccine so we effectively achieve herd immunity.

In terms of the anti vaxxers, and vaccine hesitant people, there is a significant contingency that won't get the vaccine in the US. That might not matter. A new insight from my model is that because the infection rate soared to such high levels in the US (and will continue to do so through fall and winter) we may only need about 55% of the US to get vaccinated to effectively achieve herd immunity. A recent AXIOS/IPSOS poll shows 48% of Americans are willing to take the vaccine.

Given the evidence that re-infection is rare (at least in the first year), getting to the theorized herd immunity of roughly 65 to 70 percent can be achieved by mid 2021 in the US. See Table 2, and note the 40% "vaccinated" + 29% "immune due to recovery" does not account for duplication. In reality, some of those that get a vaccine will have already recovered from undiagnosed mild or asymptomatic COVID19. Accounting for this duplication, a vaccination rate of around 55% nationwide would lead to the end of the pandemic. In Europe, where the overall infection rate is lower, a higher level of vaccination will be required to achieve herd immunity.

A final key question I'd like to know the answer to is how long immunity lasts - but only time will give us that answer. Pfizer, Moderna and AstraZeneca will be staying in touch with all their study participants and are required to publish updates to the regulators. With over 11 million Americans already diagnosed with COVID19, there are plenty of data points to track if immunity is waning in months instead of years. Depending on how long immunity lasts, it may be necessary to repeat the vaccination process annually, similar to flu shots.

Final Forecast Thoughts:

It is possible that the cumulative vaccine rate doesn't scale as fast as my modeled scenario. I initially forecast that we wouldn't achieve broad distribution of a vaccine (70+ percent of US vaccinated) until sometime in early 2022. But, with the higher infection rate I am observing in the US, and the success of three different Phase 3 trials, I've lowered the definition of broad distribution to 55 percent of the US, and moved up the timeline to mid-2021.

Europe has done a better job containing the virus spread, but that will mean more people need to be vaccinated to achieve similar herd immunity. Based on the projected scale-up of vaccines, Europe should hit these levels before the Fall. It is important to stay on pace for broad distribution of the vaccine before the Fall because, as we know, the virus spreads easier in the Fall and Winter months. With twin high school seniors in my home, I am happy to say I expect their freshman year at University in Fall 2021 to approximate normal.

The economy is a problem. Supply chains are straining under the wait of less predictable consumer behaviors and a workforce that is increasingly contracting COVID. Worse than the stock outs is the fact that many families don't have the money to stock up. The unemployment numbers show millions of people out of work compared to pre-pandemic levels - but unemployment doesn't tell the whole story. Look deeper into the labor participation rate, and you see 1.7% of the US workforce has dropped out entirely. They do not show up in the unemployment numbers. These people have given up looking for work.

Back in February, expecting a one to two year dislocation in the economy, I advocated for a work training program to build a stronger economy when we come out of the pandemic. However, with less than 200 deaths in the US at that time, certain political leaders were dismissing the concern. As the death toll climbed into the thousands, both the US and Europe passed stimulus programs. In the US, the CARES Act was passed but it didn't envision an eighteen month or longer dislocation. It assumed a V-shaped recovery that would last a quarter or two. Re-training for affected sectors like travel and tourism wasn't a focus of the plan. The CARES Act expires next month, at the end of the calendar year. In the European Union, a historic agreement to stimulate the economy was reached, but

did it go far enough to offer education and training to those displaced by COVID19? Will the US and European Union pass additional stimulus? For a fuller discussion of the pandemic trigger economic cycle see my February Research World Article.

Even today, we can be assured that it will take at least another six months before a level of immunity is achieved to allow the hardest hit sectors of our economy to bounce back. It is not too late for governments to invest in re-training. Failure to pass additional stimulus will bring a world of hurt to far too many families caught in the crossfire of a deadly virus and politics.

Forecast models aren't perfect. What models can provide is insight on how different factors influence outcomes and a reference point to compare actuals to the modeled expectations. Forecast models are great for scenario planning and then monitoring forecast vs. actual to decide which scenario to activate. Forecast models like this one can help businesses and individuals plan and take action during these unprecedented times.