FIRST QUARTER 2020

COVID19: Thoughts from the Driehaus Life Sciences Team

MARCH 31, 2020

First and foremost, we hope that you are taking appropriate precautions to keep you, your loved ones, and your communities safe. For those of you with family or friends who are suffering from the effects of COVID19, we wish them a safe and speedy recovery.

March was a remarkable month with little precedent in the history of modern finance. COVID-19 has unleashed global financial value destruction on a scale comparable to, and at times even exceeding that of 2008, 1987, and 1929. Expectations for global economic growth this year have cratered, re-casting the question of recession from "whether?" to "how bad?" Some measure of relief returned after the adoption of aggressive fiscal and policy measures, and evidence that countries hit early may be through the worst of the effects of the pandemic, but it's unclear how long this will persist.

If there is a silver lining in this, it's that the investment case for life sciences has only strengthened. Demand for life science innovation is less discretionary than many other markets, and therefore more likely to persist whatever the market backdrop. Increased cost of capital and diminished access to capital, should they persist, increase investors' negotiating power and create dislocations, thus increasing opportunities for value capture for a strategy such as ours. Finally, COVID19 evinces the imperative for strong life sciences industries pursuing innovation to treat novel diseases that is a much-needed narrative often missing from the political debate over pharmaceutical pricing.

This letter is comprised of three sections:

I. COVID19 Context. This section will describe what makes COVID19 different from other respiratory viruses, explain why widespread isolation was the only response immediately available to "flatten the curve," and describe strategies to inform how we move forward.

II. March 2020 Market Reaction. This section will illustrate the depth and breadth of the value destruction caused by COVID19.

III. The Driehaus Approach to Life Sciences Investing in this Market. This section will describe how we approach this market and where we expect to find opportunities.

THE DRIEHAUS APPROACH TO LIFE SCIENCES

Investing in the life sciences industries is a core competency at Driehaus, built over decades of investing, and is a meaningful component of multiple strategies including the Driehaus Micro, Small, Small/Mid, Life Sciences and Event Driven Strategies.

GET IT BACK!

Interview from The New Market Wizards: Conversations with America's Top Traders (1994).

"After the smoke cleared on October 19 [1987], you must have realized that you had just lost one-third of your wealth in one day's time. Is there a feeling that goes with that?

Yes. Get it back! [...My experience then and in 1973-1974] showed me that you could survive that type of break. I had the confidence that I could make it back and the commitment to do it."

– Richard H. Driehaus

Section I: COVID19 Context

From when the first cases were identified in Wuhan, China, in December 2019 until writing today, nearly a million people worldwide have been afflicted with COVID19, the respiratory disease associated with the SARS-CoV2 coronavirus. In the US, over a few short weeks, we've slammed the brakes on the economy, adopting "social distancing" and its inherent lower economic activity and implicitly higher unemployment at once – all in the pursuit of "flattening the curve." Conceptually, it seems widely understood why this is necessary (e.g. "too many patients attempting to utilize too few hospital resources at the same time"). However, the depth of understanding behind that phrase is often incomplete. What makes this virus different? What strategies are immediately available to "flatten the curve?" What strategies will be available in the near future? When will they be viable? And finally: what don't we yet know? We (of course) don't have all the answers, but as life science investors, we do have perspective that we're happy to share.

Importantly, this is not intended to be a comprehensive resource on COVID19, for which there are better, more frequently updated sources[1]. Additionally, our knowledge of COVID19, clinical data, and public policy responses are evolving rapidly and, and therefore this analysis and our conclusions are subject to change.

I.i How is COVID19 different from other respiratory viruses?

At a high level, there are many families of respiratory viruses, including influenzas, respiratory syncytial viruses, adenoviruses, rhinoviruses, and coronaviruses. Functionally, they act in similar ways. They access a host (generally by close contact), enter a hosts' cells, hijack the cellular machinery to produce copies of the virus, release copies of the virus out of the hosts' cells, and escape the host to infect new hosts. Respiratory viruses can be categorized descriptively by (sub)family, but also quantitatively by characteristics such as their incubation period[2], efficiency of transmission (R0)[3], severity of associated disease symptoms, existing herd immunity, and genetic mutation rates, among others (see Table A below).

SARS-CoV2, the virus that causes the disease COVID19, is a novel strand of coronavirus. Coronaviruses are a family of viruses first characterized in the 1960s that have been found worldwide. They tend to cause mild, self-limiting infections (accounting for an estimated 15-30% of respiratory tract infections annually) characterized by nasal decongestion and runny nose, though can represent higher risk in the elderly and immunocompromised. They tend to be seasonal. By contrast, SARS-CoV2 was only discovered recently, having believed to have jumped from bats to humans only in the last year. Most patients infected by SARS-CoV2 develop more severe symptoms, such as fever and cough, and a minority of patients develop pain while breathing that can progress to acute respiratory distress syndrome (ARDS), sepsis, and potentially death.

To help us understand what makes SARS-CoV2 and COVID19 different from other respiratory virus-associated diseases, we did what we often do: create a robust table that allows us to see differences that we may not see absent the organization of the table. In Exhibit A, we've collected data on seasonal, epidemic, and modern pandemic respiratory viruses[4].

[1]For more information on, we encourage you to visit the following organization's websites:
- Basic information – Centers for Disease Control, World Health Organization
- Scientific literature – LitCovid (central access point to Coronavirus on PubMed), New England Journal of Medicine
- Prevalence and mortality tracker – Johns Hopkins Coronavirus Resource Center
- Public policy response – Kaiser Family Foundation Coronavirus Special Topic Page

[2]The time from exposure to an infection to appearance of symptoms. Note that the symptomatic period is generally regarded as the time of peak transmission, although transmission is possible in respiratory viral diseases when patients are asymptomatic.

[3]The efficiency of transmission between hosts is quantified as the basic reproduction number (called R0). R0 of 0 means the disease cannot be transmitted. R0 of 1 means the disease can be transmitted to one other host, and thus sustained. R0 >1 indicates an exponential potential that could signal an epidemic or an endemic infection. See Woolhouse, "Assessing the Epidemic Potential of RNA and DNA Viruses," Emerging Infectious Diseases, 2016

[4]Note that we did not include Spanish Flu of 1918-1919 in this analysis, as we feel that advancements in modern medicine and quality of living improvements make the comparison difficult to interpret. With that understanding, we note that estimates place the R0 of Spanish Flu at ~2.0 and the case fatality rate at ~10%. The CDC estimates that ~1/3 of the world's population became infected with virus.

Exhibit A: SARS-CoV2 Virus Compared to Prior Seasonal, Epidemic, and Modern Pandemic Respiratory Viruses[5]

	Seasonal/Regular		*Epidemic*		*Modern Pandemic*	
	Seasonal Influenza	**Common Cold Coronaviruses**	**SARS**	**MERS**	**Swine Flu**	**COVID19**
Characteristics						
First Identified	1930s	1960s	2002-2003	2012	2009-2010	2019-?
Type	Influenza	Coronavirus	Coronavirus	Coronavirus	Influenza	Coronavirus
Strands	H1N1, H3N2, B/Yamagata, B/Victoria	HCOV-229E, -NL63, -OC43, -HKU1	SARS-CoV1	MERS-CoV	(H1N1)pdm09	SARS-CoV2
Method of Spread	Respiratory droplet	Respiratory droplet	Respiratory droplet	Respiratory droplet	Respiratory droplet	Respiratory droplet
General Symptoms	Fever, myalgia, cough	Nasal congestion, runny nose	Fever, cough, chills	Fever, cough, dyspnea	Fever, myalgia, headache, malaise	Fever, cough, dyspnea
Location	Worldwide	Worldwide	Southern China	Saudi Arabia	Worldwide	Worldwide
Estimated Worldwide Cases	1Bn+ annually	1Bn+ annually	8k	2.5k	1.4Bn	5-10Mn (1Mn diagnosed / 10-20%)
Transmissibility						
R0	2.5	n/a	1.9	1.0	1.5	2.7
Incubation Period	1-4 days	2-5 days	2-11 days	2-13 days	1-4 days	2-14 days
Severity						
Estimated Hospitalization Rate	~1%	n/a	n/a	n/a	0.5%	1-2%
Estimated Case Fatality Rate	0.1%	n/a	9%	34%	0.02%	0.1-0.3%
US Estimated Prevalence	38-54Mn	100-150Mn	8k Worldwide	2.5k Worldwide	43-89Mn	1.1-2.2Mn (213k diagnosed / 10-20%)
US Estimated Hospitalizations	390-710k	n/a	n/a	n/a	195-402k	25k (213k diagnosed x 12%)
US Estimated Deaths	12-61k	n/a	775	858	9-18k	4.5k
Existing Immunity						
Vaccination Rate	49%	None available	None available	None available	None available	None available

Key Assumptions and Source Dates
1. Analysis uses US diagnosis of 213k COVID19, as reported 4/2/2020 by the CDC.
2. Analysis uses 12% hospitalization rate of diagnosed COVID19 patients, as reported 3/26/2020 by the CDC.
3. Analysis assumes 80-90% of cases in the US are not currently diagnosed. This is based on a review of 70k+ patients in China in which 81% of patients were found to have no/mild symptoms of pneumonia (Wu, JAMA, 2020)
4. Influenza vaccination rate based on 2018-2019 estimates, per the CDC.

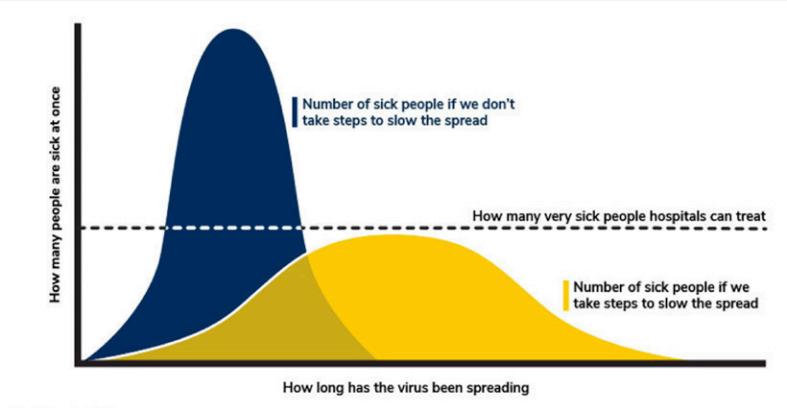
To us, the following stands out (highlighted in yellow above):

- COVID19 does not seem to represent an existential threat to humanity in a way that MERS (and other virulent viruses, such as Ebola, not included above) may have, but it is still lethal and has expanded beyond a limited geography to be worldwide
- Compared to seasonal flu and Swine Flu, COVID19 seems to be easier to transmit, with a longer incubation period and comparable or worse severity
- COVID19 has only infected a fraction of the people infected by seasonal flu and Swine Flu so far…
- …and the population susceptible to COVID19 is much broader than seasonal flu, as there is built-up immunity to seasonal flu via vaccination or previous exposure

[5]Sources: CDC, WHO, Eisenberg, "R0: How scientists quantify the impact of an outbreak like coronavirus and its pandemic potential," University of Michigan School of Public Health, and Su, "Epidemiology, Genetic Recombination, and Pathogenesis of Coronavirus," Trends in Microbiology, 2016.

Put together, this table suggests COVID19 is a serious disease that has the potential to spread broadly and quickly. Due to the limited capacity of healthcare resources (such as hospital beds, staff, containment facilities, and treatment technology such as respirators) and the sheer number of patients we're talking about absent intervention, COVID19 could potentially overwhelm the healthcare system (see Exhibit B below).

Exhibit B: COVID19 Spread Scenarios – Why We Need to "Flatten the Curve" [6]



I.ii What strategies are available immediately to "flatten the curve?"

Unfortunately, no options other than large scale isolation are immediately available to flatten the curve (see Exhibit C below). Risk reduction and targeted isolation without widespread testing and tracking have proven ineffective. No vaccine exists against SARS-CoV2 or is likely to exist in the near-term given lengthy clinical trial requirements to determine safety and efficacy (that can only be abbreviated so much) and manufacturing scale-up requirements. Retrofitted anti-viral therapies can be evaluated more quickly and, in some cases, are already manufactured at scale, but clinical proof for these compounds against SARS-Cov2 is limited and the preclinical translational models upon which much enthusiasm is based have not been historically predictive. Novel anti-viral therapies combine the same poor translatability of preclinical data as retrofitted anti-virals with the long timelines of novel vaccines. Finally, expanding the capacity of our healthcare system by building more hospitals or generating more ventilators requires lead time, and cannot be ramped up overnight.

Exhibit C: Potential Strategies to "Flatten the Curve" from COVID19 [7]

	Strategy	Time to Widespread Availability	Impact on Economy	Probability of Flattening Curve in Near Term
Preventative Strategies	**Risk Reduction** (Travel bans)	Immediate	Modest	n/a
	Targeted Isolation – Before Community Spread (Exposed patients only, intense contact mapping, mandatory quarantine)	Immediate	Low	n/a
	Large Scale Isolation (Social distancing)	Immediate	High	High
	Targeted Isolation – After Community Spread (All patients, widespread testing, intense contact mapping, mandatory quarantine)	Months	Low	Modest
	Novel Vaccine (Moderna, Inovio, BioNTech, others)	Years	None	Low
Treatment Strategies	**Anti-Virals – Retrofitted Therapeutic** (remdemsivir, hydroxychloroquine, convalescent plasma)	Immediate	None	Low
	Expanded Healthcare Facility Capacity (ventilators, PPE, beds, hospitals)	Months / Years	None	Modest
	Anti-Virals – Novel Therapeutic	Years	None	Low

[6]Source: University of Michigan Health, "Flattening the Curve for COVID-19: What Does It Mean and How Can You Help?," adapted from the CDC. Posted Mar 11, 2020. [7]Source: Driehaus Capital Management Analysis

Alternatively, we think large scale isolation has a reasonable chance at flattening the curve immediately. There's empirical evidence at a large scale that shows this is possible (e.g. China and South Korea; more below), but there's also empirical evidence on a relatively small scale. On the cruise ship the Diamond Princess, a single index case of COVID-19 led to an estimated 619 infections over a four-week time period. For the first two-weeks of the cruise, there were no restrictions on movement onboard. However, at two weeks, the crew put in place large scale isolation procedures for the remainder of the trip. After disembarkation, researchers with access to transmission data estimated the pre- and post-social distancing transmission of COVID19 (the R0 of the virus on the cruise ship) to be 15 and 2, respectively – a seven fold decrease[8]. Thus, we think large scale isolation, if followed widely, can lower the R0, and thus flatten the curve in the short-term. That being said, we view large scale isolation as a suboptimal longer-term solution due to its dramatic negative impact on commerce (more on this in Section II below). We believe alternative strategies will increasingly become feasible in the near future to flatten the curve.

I.iii What strategies will be available in the near future to "flatten the curve?"

Long-term, we believe the best solution will be herd immunity achieved either through widespread vaccination or previous exposure. However, neither of these is likely to be achieved in the near-term.

In the coming weeks and months, we think three additional strategies to flatten the curve could increasingly prove viable – the first two with high probability, the third more as a wild card. (For more specific thoughts on how these could be implemented, we encourage you to read former FDA commissioner Scott Gottlieb's report for the American Enterprise Institute entitled "National coronavirus response: A road map to reopening".)

1. We expect treatment capacity to expand as we build new temporary healthcare facilities (e.g. field hospitals) and expand capacity at existing facilities (through additional respirators, patient beds, dedicated COVID spaces, and personal protective equipment (PPE).

2. We expect targeted isolation to increasingly become a viable strategy in Western countries as we ramp production of COVID19 point-of-care diagnostic tests, serology tests, and PPEs, develop systems to track exposure, and adopt protocols for self-quarantine following a positive diagnosis or being exposed to someone who has tested positive.

3. We believe it's possible (though not high probability) that retrofitted therapeutics could prove unequivocally safe and meaningfully effective. Two are farthest along: Gilead's remdesivir (a molecule unsuccessfully developed for HIV and Ebola) and generic hydroxychloroquine (an anti-malarial), though others will surely follow close behind. Gilead expects randomized, controlled data to be available in April from a prospective trial in COVID19 patients in China that, if effective, has the potential to influence the shape of the curve on its own.

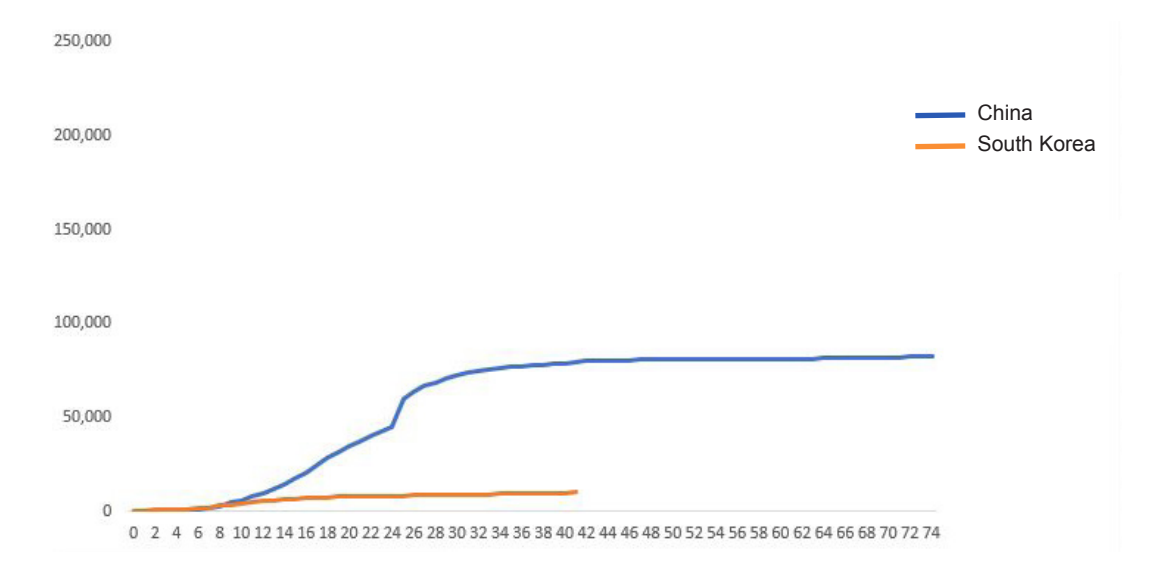
As these strategies become increasingly viable, we expect to transition away from large scale isolation. How quickly will this transition occur? We don't know, but we think the Chinese and South Korean experiences offer clues, though with limitations.

I.iv How soon will these strategies be viable?

China and then South Korea were the earliest epicenters of COVID19 and, consequently, offer the most advanced roadmaps. Though their approaches were distinct and nuanced, at a high level, both countries implemented aggressive public policy measures including social distancing, individual PPE use, increased health care facility capacity, expanded diagnostic testing capabilities, mandatory quarantine for exposed patients, and extensive individual exposure tracking. Encouragingly, the growth rate of new cases in both countries began declining between 10-20 days after cumulative cases had increased beyond 100 (an inexact proxy for when the disease became community spread; see Exhibit D below) and have subsequently flattened.

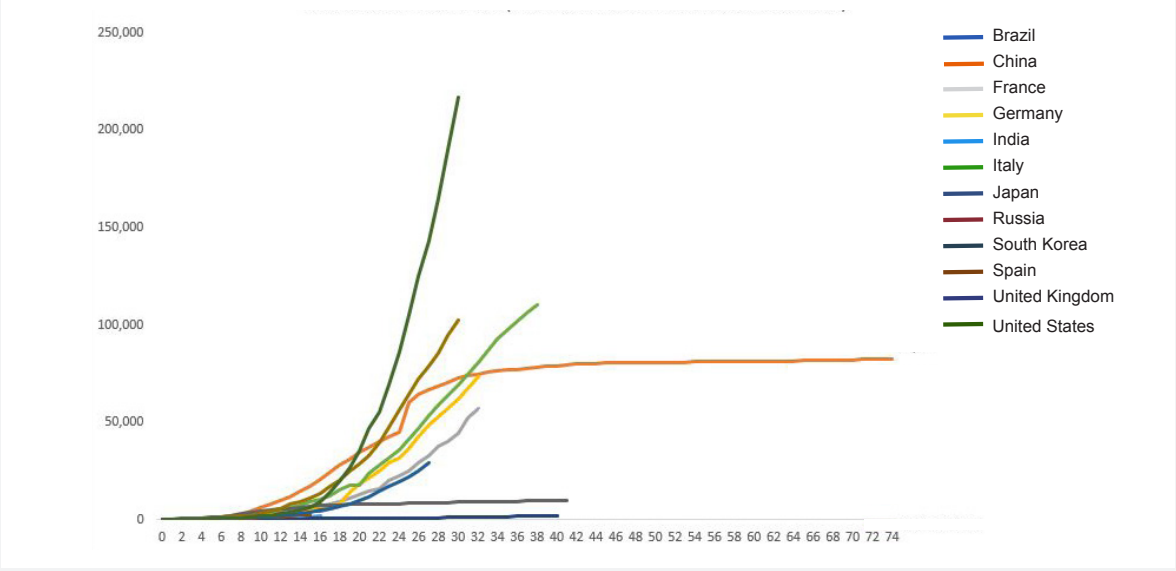
[8]Source: Rocklov, "COVID-19 outbreak on the Diamond Princess cruise ship: estimating the epidemic potential and effectiveness of public health countermeasures," Journal of Travel Medicine, 2020.

Exhibit D: Cumulative COVID19 Cases in China and South Korea, Measured from Index Point[10]
When Cumulative Identified Cases Crossed 100



We believe similar strategies, if adopted in other countries, could work as quickly. However, there are important variables, such as how early, and how widely aggressive strategies are adopted. As of writing, it appears that the US and European nations have not initially been as effective as China and South Korea at flattening the curve (see Exhibit E below):

Exhibit E: Cumulative COVID19 Cases in US, EU5, JP, BRIC Countries, Measured from Index Point[10]
When Cumulative Identified Cases Crossed 100



[10] Source: European CDC, via ourworldindata.org/coronavirus. Accessed Mar 29, 2020.

i.v What don't we know yet?

There's a lot of information about COVID19 that we don't know yet that will influence the pace and nature of our response. A few key questions we're thinking about are listed below, but these are by no means comprehensive:

- What impact will the weather have on SARS-CoV2 transmissibility? We know that other coronaviruses tend to have seasonal patterns. Does that mean that this one will? Based on the concentration of cases in northern hemisphere currently, we believe it's likely that it will, but we're not certain.

- Relatedly, how does SARS-CoV2 tend to mutate, and how will that impact our therapeutic strategies? We know that some respiratory viruses, such as seasonal influenza, tend to mutate regularly and in a way that remains pathogenic, thus creating the need for annual vaccines as opposed to a permanent, one-time inoculation. Some investigators have calculated the mutation rate for SARS-COV2, but it's not clear exactly what that rate will mean.

- What do we make of asymptomatic carriers of SARS-CoV2, and how does this compare to other respiratory viruses? The academic literature seems to use incubation period as a proxy for contagiousness, and generally speaking we think that makes sense. Still, there are anecdotal reports of asymptomatic carriers of SARS-CoV2 who are able to spread the disease, and we're not sure how common it is compared to others.

- Finally, are there key data missing? We're learning from the experiences of others, such as China and South Korea, but our extrapolations about the strategies they put in place are only as good as the data we have available. If, as some reports are suggesting, the data coming out of China are not telling the whole story, it may cause some of our projections to be meaningfully off.

Conclusion

To synthesize all of this: COVID19 represents a threat to life worldwide on an uncommonly broad scale. The only immediately available intervention to slow its expansion is large scale isolation. Over time, additional strategies are likely to become available that will enable us to move away from large scale isolation, but the timing on that is uncertain. We still have open questions that will influence our conclusions that we will learn about over time.

Section II: March 2020 Market Reaction

As discussed in the last section, the only viable immediate option for flattening the curve of COVID19 is to institute large scale isolation. Unfortunately, this has required the widespread and dramatic halting of commerce. It's difficult to represent the depth and breadth of the impact these decisions have had on the economy. One way to conceptualize it is to look at consumer spending trends.

In normal times, US consumer spending typically grows between 0-5% year-over-year. Below is credit card data from March 7th through March 24th from Bank of America (Exhibit F). According to these data, total credit card spending is down more than 30% year-over-year, and the hardest hit industries have seen spending decline by 90% or more (note: >100% reflects refunds). Recall that President Trump declared a national emergency on March 13th, San Francisco became the first major metro area to implement "Shelter in Place" on March 17th, followed quickly by similar state-wide orders in California, New York, and Illinois March 19-20th.

Exhibit F: Change in Consumer Spending by Industry, March 2020[11]
Bank of America Credit Card Data (% year-over-year growth)

	3/24	3/23	3/22	3/21	3/20	3/19	3/18	3/17	3/16	3/15	3/14	3/13	3/12	3/11	3/10	3/9	3/8	3/7
Airlines	-102%	-104%	-87%	-96%	-93%	-95%	-91%	-94%	-88%	-59%	-62%	-61%	-51%	-54%	-46%	-50%	-40%	-28%
Lodging	-121%	-109%	-84%	-107%	-106%	-119%	-128%	-123%	-112%	-48%	-70%	-61%	-48%	-37%	-24%	-30%	-8%	-14%
Cruises	-113%	-100%	-91%	-115%	-112%	-109%	-93%	-102%	-82%	-60%	-69%	-85%	-130%	-126%	-98%	-84%	-40%	-68%
Entertainment	-94%	-93%	-92%	-94%	-94%	-97%	-96%	-67%	-95%	-70%	-79%	-72%	-57%	-32%	-32%	-24%	-26%	-22%
Restaurants	-56%	-61%	-70%	-66%	-58%	-55%	-51%	-42%	-32%	-33%	-26%	-18%	-9%	-2%	-2%	2%	3%	0%
Transit	-49%	-68%	-69%	-53%	-54%	-53%	-48%	-38%	-56%	-42%	-43%	-16%	-31%	-4%	2%	-19%	-12%	-7%
Gas	-46%	-44%	-47%	-38%	-28%	-30%	-28%	-21%	-8%	-19%	-14%	-2%	-3%	-5%	-5%	-3%	0%	-5%
Clothing	-65%	-67%	-79%	-82%	-73%	-68%	-62%	-53%	-46%	-42%	-40%	-37%	-28%	-13%	-9%	-9%	-4%	-11%
Furniture	-41%	-38%	-64%	-59%	-31%	-21%	-22%	-15%	-13%	-14%	-14%	-13%	-4%	1%	1%	-2%	4%	1%
Department store	-59%	-46%	-75%	-82%	-67%	-64%	-65%	-61%	-51%	-52%	-51%	-41%	-36%	-22%	-13%	-7%	-13%	-15%
Online electronics	37%	45%	33%	51%	39%	37%	31%	29%	22%	28%	17%	6%	11%	15%	13%	14%	28%	1%
Grocery	19%	12%	-10%	20%	64%	56%	49%	66%	93%	30%	59%	123%	105%	37%	20%	12%	9%	8%
General Merchandise	-11%	-10%	-32%	-26%	7%	9%	6%	15%	37%	-4%	9%	60%	66%	30%	19%	15%	5%	5%
Health, pers &beauty store	-17%	-16%	-23%	-16%	3%	4%	9%	14%	30%	21%	20%	34%	29%	10%	7%	5%	8%	2%
Home improvement	-9%	-4%	-6%	1%	11%	6%	5%	0%	-1%	12%	8%	3%	4%	6%	6%	4%	7%	10%
Retail ex auto	-17%	-18%	-34%	-25%	-2%	-2%	-2%	7%	23%	-2%	7%	31%	31%	12%	6%	6%	6%	3%
Total card spending	-31%	-31%	-37%	-31%	-15%	-18%	-19%	-11%	0%	-5%	-4%	5%	9%	2%	1%	-2%	1%	0%

Within modern financial systems, periods in which economies experience shocks on this scale result in historic volatility in financial markets. A commonly used measure of market volatility is VIX, the CBOE volatility index that was launched in 1993. To extend the analysis going back to 1962, analysts at SentimenTrader conducted a volatility simulation employing comparable input methodology used by CBOE. As you can see from Exhibit G below, March 2020 saw the third highest level of simulated VIX in the past 58 years.

[11]Source: BAC internal data

That seems like a lot, yet it's still insufficient to capture the scope of what markets have just experienced. The extreme, sudden and broad-based value destruction of March 2020 is only matched historically by periods from the most infamous epochs of financial history, such as the Great Depression (1929-1939), the Great Recession (2007-2009), the Recession of 1973-1975, and Black Friday (1987). See Exhibit H and Exhibit I below.

Exhibit G: S&P500 Volatility from 1962-2020[12]

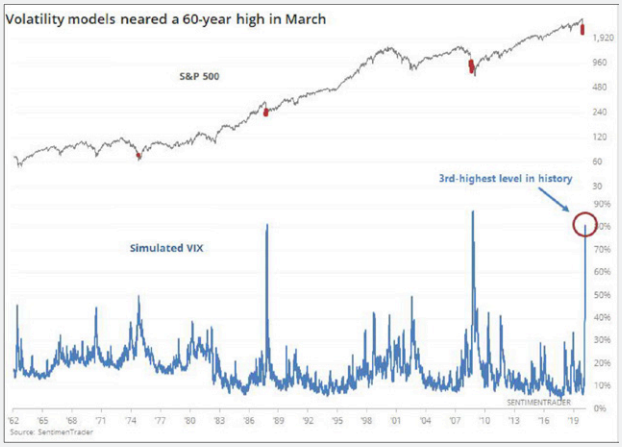


Exhibit H: March 2020 S&P500 Sell-Off Compared to 1927 and 1987[13]

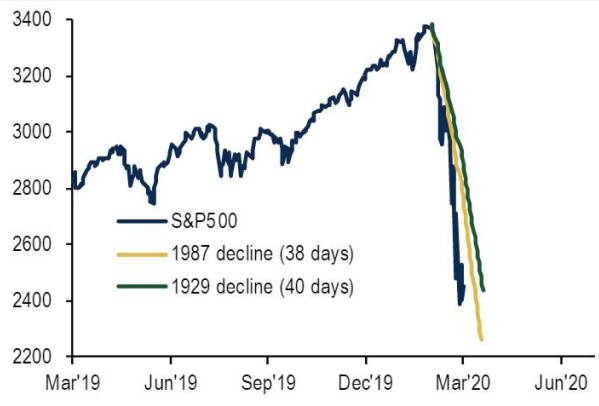


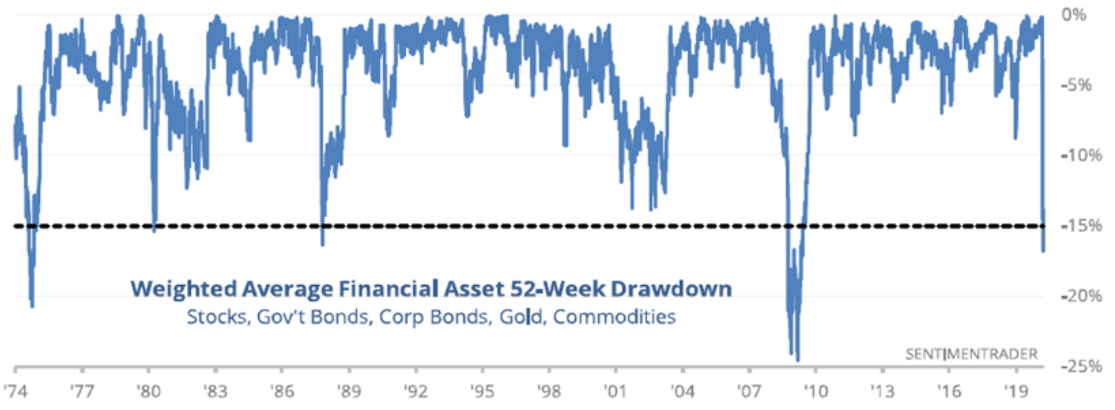
Exhibit I: Top 20 Bear Market Moves from 1928-2020[14]

Rank	Start	End	# of Trading Days	# of Months	Start Price	End Price	% Change
1	November 9, 1931	June 1, 1932	140	7	$12	$4	-62%
2	March 10, 1937	March 31, 1938	267	13	$19	$9	-54%
3	October 9, 2007	November 20, 2008	283	14	$1,565	$752	-52%
4	January 11, 1973	October 3, 1974	436	21	$120	$62	-48%
5	September 16, 1929	November 13, 1929	40	2	$32	$18	-45%
6	April 10, 1930	December 16, 1930	171	8	$26	$14	-44%
7	June 26, 1931	October 5, 1931	70	3	$15	$9	-43%
8	September 7, 1932	February 27, 1933	116	6	$9	$6	-41%
9	March 24, 2000	September 21, 2001	373	18	$1,527	$966	-37%
10	November 29, 1968	May 26, 1970	369	18	$108	$69	-36%
11	November 7, 1940	April 28, 1942	385	18	$11	$7	-34%
12	January 4, 2002	October 9, 2002	192	9	$1,173	$777	-34%
13	August 25, 1987	December 4, 1987	71	3	$337	$224	-34%
14	February 24, 1931	June 2, 1931	69	3	$18	$12	-33%
15	February 19, 2020	March 20, 2020	22	1	$3,386	$2,305	-32%
16	February 6, 1934	March 14, 1935	273	13	$12	$8	-32%
17	July 18, 1933	October 19, 1933	65	3	$12	$9	-29%
18	October 25, 1939	June 10, 1940	155	8	$13	$9	-29%
19	May 29, 1946	May 19, 1947	243	12	$19	$14	-28%
20	December 12, 1961	June 26, 1962	135	7	$73	$52	-28%

[12]Source: SentimenTrader 4/1/2020;
[13]Source: BAML, "The Flow Show: The Reckoning," 3/19/2020
[14]Source: SentimenTrader 3/19/2020

It isn't just equities that have been hit. SentimenTrader tracks a weighted average composite of financial assets that includes stocks, government bonds, corporate bonds, and commodities (see Exhibit J). 2020 represents the third largest drawdown in this composite since 1973.

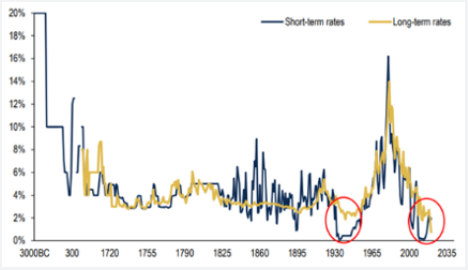
Exhibit J: Weighted Average Financial Asset 52-Week Drawdown from 1974-2020[15]



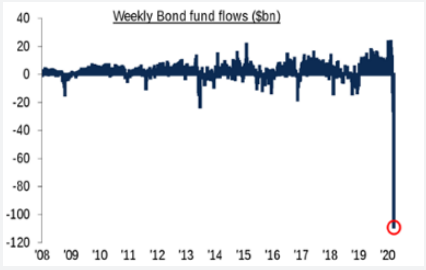
Corporate bond spreads (the rate at which corporations can borrow money, measured as a spread vs. interest rates) are an area we pay close attention to, as spreads are a proxy for cost of capital. Bond fund outflows have been extraordinary during this time of volatility, to a level that dwarfs 2008 (see Exhibit K below). This activity, combined with historically low interest rates (the chart below purports to be a 5000 year chart; that's a little tongue in cheek, but you get our meaning) has driven corporate spreads to treble in a short period of time to or above levels seen in past financial crises:

Exhibit K: Corporate Spreads Widen as Interest Rates Fall and Bond Outflows Increase

Interest Rates from 3000 BC-2020[16]



Bond Fund Outflows from 2008-2020[17]



Investment Grade Corporate Bond Spreads from 1989-2020[18]

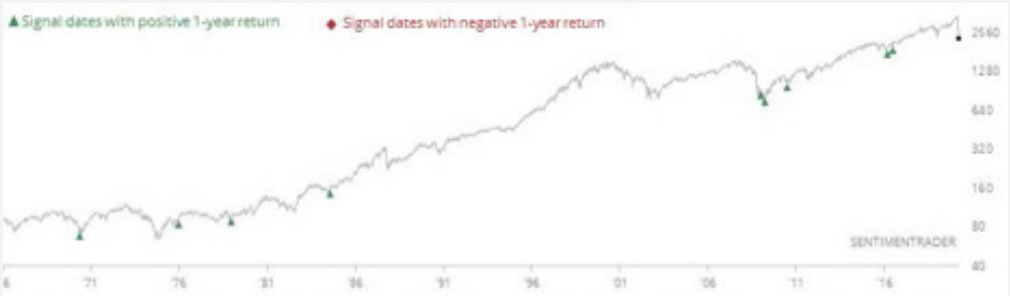
Declining interest Rates + Dramatic Bond Outflows = Widening Corporate Spreads

[15]Source: S&P, Federal Reserve, Bloomberg
[16]Source: Bank of England, Global Financial Data, Homer and Sylla 'A History of Interest Rates' (2005)
[17]Source: BofA Global Investment Strategy, EPFR Global
[18]Source: FTSE Fixed Income, Morgan Stanley Research

Fortunately, there's been some reprieve from policymakers. Policymakers have unleashed aggressive monetary and legislative policies intended to backstop the economy and provide liquidity to financial systems. Will it be enough to avert or shorten a recession? We don't know. We'll leave that to our macroeconomist colleagues to opine on. Here's where it leaves life sciences and the management of our portfolio.

From a top-down level, we don't know which way the market will go from here. We think there is a credible case to be made that markets will retest lows or even put in fresh lows if conditions worsen with COVID19, or if the impacts of COVID19 flow through economics to a greater extent than currently anticipated. Again, we don't know which way the market will go from here, but we also think there is a credible case for markets to be higher in a matter of months because of how swift and severe the carnage has been. From data below going back to 1940 (see Exhibit L), the odds are on our side that markets will be higher in 12 months.

Exhibit L: S&P 500 After Up Issues and Up Volume > 75% For 3 Straight Days (1940-2020)[19]



Signals	1 Week	2 Weeks	1 Month	2 Months	3 Months	6 Months	1 Year
1970-05-29	-0.5	-3.1	-4.8	1.9	5.9	11.2	29.8
1976-01-05	4.1	6.2	9.3	6.8	10.4	12.5	15.6
1979-01-05	0.8	0.6	-1.0	-0.7	4.2	4.5	7.5
1984-08-03	1.9	1.1	1.6	0.1	3.2	10.0	17.9
2009-01-02	-4.4	-8.8	-10.0	-26.7	-9.6	-3.6	21.6
2009-04-02	2.7	4.2	8.7	11.7	7.4	23.4	42.3
2010-07-09	-1.2	2.3	4.6	1.9	7.4	18.2	24.7
2016-02-17	0.2	3.1	5.9	8.7	6.2	13.0	21.9
2016-06-30	1.5	3.0	3.4	3.7	2.5	7.2	15.5
2020-03-26							
Median	**0.8**	**2.3**	**3.4**	**1.9**	**5.9**	**11.2**	**21.6**
% Positive	**67%**	**78%**	**67%**	**78%**	**89%**	**89%**	**100%**
Risk	-0.5	-0.5	-1.0	-2.3	-2.3	-2.3	-2.3
Reward	1.7	2.6	3.6	4.3	6.1	12.6	21.6
Z-Score	0.8	1.3	1.3	0.2	2.0	2.7	3.9

On a bottom-up basis, we're very aware of any changes in cost of capital and how that may affect companies. Spread widening represents an increase in cost of capital for corporates. Changes in cost of capital bleed from low-risk investment-grade issuers through to high-yield issuers, increasing in magnitude further out the risk spectrum. Development-stage healthcare companies tend to be at the opposite end of the risk-spectrum from investment-grade issues, and can see potentially terminal changes in cost of capital. Therefore, given current spreads, we think it's not unreasonable to expect that cost of capital to increase for companies in the life sciences universe. We look at that as contributing to greater opportunities for investment in life sciences, both because we expect it will contribute to greater dislocation in securities and because, as a capital provider, we'll be in a strengthened position when putting capital to work. How long will these dynamics persist? We're not sure, but we're eager to take advantage of them.

[19]Source: SentimenTrader, Mar 27, 2020

Section III: The Driehaus Approach to Life Sciences Investing in this Market

Philosophically, we remain steadfast in looking for companies developing products with a high probability of getting to market, gaining dominant market share, and being able to defend that market share over time. As discussed above, the market is constantly evolving, re-setting things like cost of capital, the bar for where and when value is recognized, and what strategies may be in or out of vogue. Within these changes, no matter how violent, we find that patterns emerge or are repeated that we can exploit.

We don't know how long the current market environment will persist. Based on our fundamental view of COVID and what strategies we believe will be required to move out of large-scale isolation (see Section I), we believe it will continue to be an important macro factor impacting the economy for many months to come.

Within this theme, we're looking for second and third derivatives of COVID, where the implications of the virus are causing ripples that will better position our companies to get to market, gain significant market share, and defend it over time.

What does this mean, practically speaking? It means we're not currently invested in COVID19 diagnostic test companies, though, as we explained in Section I, we believe expanding testing capabilities is central to shifting the policy response from large scale isolation to targeted isolation. Rather, it's because that, outside of large cap diversified medical device and diagnostic companies (e.g. ABT, TMO), few companies with COVID19 tests have meaningfully differentiated diagnostic products or channels, and therefore have limited opportunity to gain significant market share that is defensible. It also means we're not currently invested in COVID19 treatments or vaccines, though, again, as we explained in Section I, we believe treatments and, to a lesser extent, vaccines, could be a wild-card that have the capacity to the flatten the curve on their own in the short term. Our objection to these approaches is not based on the market potential, but rather the probability of success, as they don't meet the criteria of what we tend to look for (high probability). See Exhibit M below for an outline of therapeutics for which data are expected to be released in 2020.

Exhibit M: COVID19 Therapeutics in Development with Data Expected in 2020[20]

Company	Drug	Therapy Originally Developed to Treat...	n	Randomized, Controlled Trial?	Data due
Ascletis / Roche / Genova	Ritonavir + others	HIV	11	No	Apr-20
Gilead	Remdesivir	HIV, Ebola	1000+	Yes	Apr-20
Investigator Sponsored - China	Hydroxychloroquine	Malaria	300	Yes	Apr-20
Investigator Sponsored - China	Favipiravir + others	Influenza	90	Yes	May-20
Investigator Sponsored - China	Methylprednisolone	n/a	80	Yes	May-20
Investigator Sponsored - China	Favipiravir + others	Influenza	30	No	Jun-20
ASCLF / Roche / Genova	Rivonavir + others	HIV	125	Yes	Jul-20
Investigator Sponsored - China	Fingolimod	MS	30	No	Jul-20
Investigator Sponsored - China	Methylprednisolone	n/a	100	No	Jul-20
Investigator Sponsored - Brazil	Chloroquine	Malaria	440	No	Aug-20
J&J	Darunavir	HIV	30	Yes	Dec-20
Investigator Sponsored - Canada	Chrloroquine + Azithromycin	Malaria	1500	Yes	Dec-20

[20]Adapted from ISI Analyst Umer Raffat's COVID19 treatment tracking spreadsheet. Filtered according to "supporting early data," and trial ongoing. Cells without data were excluded. Data accessed 4/1/2020.

It does mean that we're looking for companies with differentiated product offerings whose adoption is likely to be accelerated by COVID19 and, ideally, maintained. For a theoretical example of the type of profile we're talking about (not necessarily something in one of our strategies), we'd highlight life science tools companies that commercialize products used for antibody manufacturing. Antibodies are immune system proteins that bind other proteins with very high affinity. They have many applications including therapeutics and diagnostics. As discussed above, one critical requirement for moving from large scale isolation to targeted isolation is widespread and potentially regular diagnostic testing that uses antibodies. As a result, we could see dramatic increase in demand for antibodies – and thus antibody manufacturing components – in the coming months. As a result, we would consider investing in a company in this area.

Alternatively, we're looking for opportunities where our capital can be a catalyst for fundamental value creation. For example, we've spoken with multiple companies (private and public) who are considering potentially transformative M&A where the bid/ask previously would have been too high, but the volatility and freezing of equity capital markets has caused them to reconsider. We like these opportunities (as appropriate) and believe that they can provide scenarios where all parties mutually benefit.

Investing in the life sciences industries is a core competency at Driehaus, built over decades of investing, and is a meaningful component of multiple strategies. Our fundamental, bottom-up approach prioritizes probability-of-success, and is philosophically and functionally different than the approach taken by many of our peers. To learn more about our approach to investing in the life sciences please contact us.

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- Mike has been investing in healthcare equities for more than a decade. He has analyzed, followed, and interacted with management of the majority of small cap healthcare companies in the Russell 3000.
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- Alex is a member of the University of Chicago George Schultz Innovation Fund Advisory Committee.

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Market Turbulence Resulting from COVID-19. The outbreak of COVID-19 has negatively affected the worldwide economy, individual countries, individual companies and the market in general. The future impact of COVID-19 is currently unknown, and it may exacerbate other risks that apply to the strategies.

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