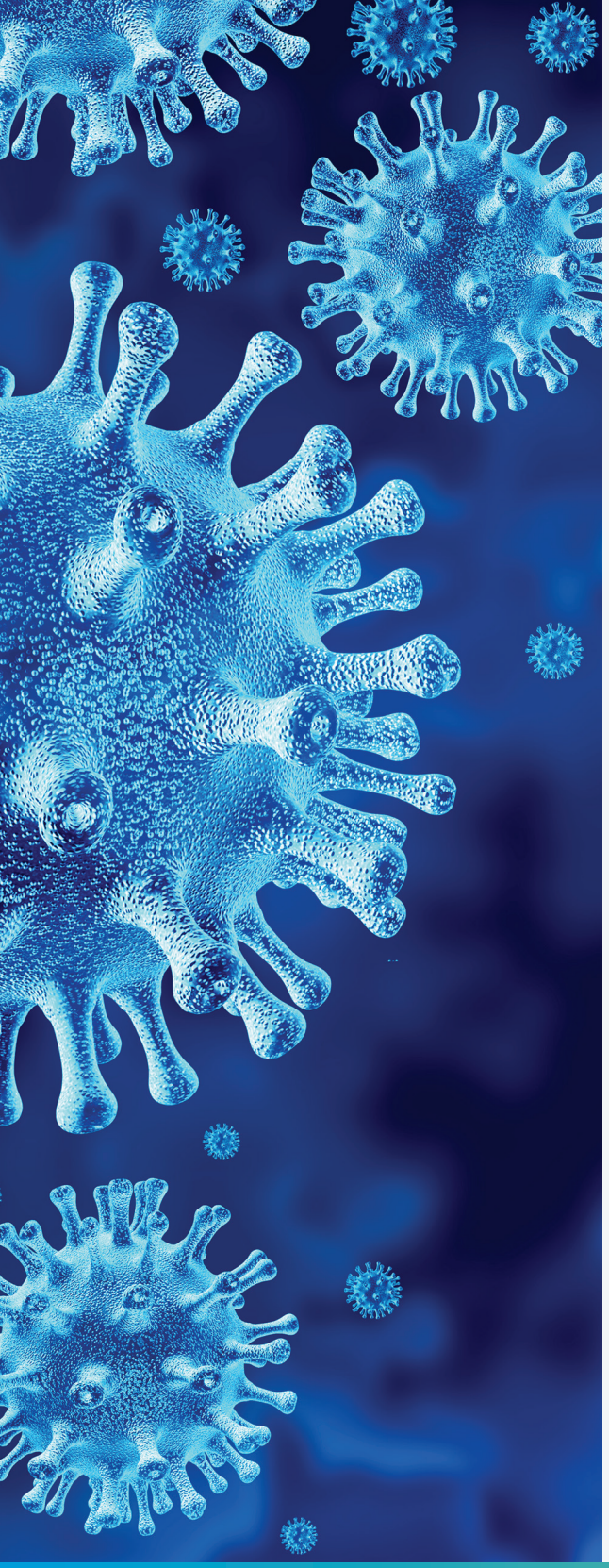

February 25, 2021

MACRO STRATEGY

What's the Worst that Could Happen?

The Past is Prologue

2020 began with most market participants focused on the prospect for a recession in 2021, likely driven by traditional business cycle dynamics or a trade war. No investment house was predicting a global pandemic or noting the risk of a pandemic. While this is forgivable, it is useful to note that a pandemic forecast would not have been unreasonable. Since 1889, there had been five global pandemics not counting COVID-19 – the 1889 Russian Flu, the 1918 Spanish Flu, the 1957 Asian Flu, the 1968 Hong Kong Flu and the 2009 Bird Flu. In recent times, other viruses had also emerged and caused regional concerns including SARS, MERS, Ebola and Zika. There had been a pandemic roughly every 26 years, or a 3.8% chance that 2020 would be a year that saw a pandemic. In the defense of analysts everywhere the time between pandemics has ranged from 11 to 41 years making the emergence of COVID-19 quite quick from a historical perspective.

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Lions and Tigers and Bears...oh my!

Other natural events also occur with some frequency including, but not limited to, volcanic eruptions, solar flares and earthquakes. Available history suggests we will have either a large volcanic eruption, a severely disruptive solar flare, a large earthquake or a pandemic roughly every nine years.[1]

Volcanic Eruptions

Since 1600 there have been ten severe volcanic eruptions, which we define as a minimum of "6" on the "Volcanic Eruption Index" scale, a logarithmic scale ranging from zero to eight.[2] The largest eruption in modern history, Mt. Tambora in 1815, reached a "7" on this scale. The remaining nine eruptions are all estimated to have been a "6" on the scale. This suggests we can expect a volcanic eruption reaching at least a "6" on the VEI scale roughly once every 42 years for a single year risk of just under 2.4%. However, like pandemics, they do not occur with regularity. The minimum seen between events has been as low as 11 years but the world has gone as long as 123 years without witnessing an eruption of this magnitude. It has been 39 years since the last major eruption in 1991.

How meaningful can a volcanic eruption really be to the modern world? The eruption of Mount Pinatubo in 1991 lowered global temperatures by a noticeable amount.[3] Smaller eruptionshave recently led to widespread flight cancellations. Indeed, history has shown that significant volcanic eruptions, particularly those that created an impact on global temperatures, can prove quite disruptive as they impact weather and, relatedly, food production. Relatedly these impacts can also prompt social strife.

Solar Flares

In 1859 the Earth was buffeted by a solar flare in an event now known as the "Carrington Event". The event disrupted telegraphs and created Auroras intense enough for people to read by. In 1921 a similar event also created widespread disruptions to communications, disrupted train signals and caused some fires and destroyed fuses. A smaller flare in 1989 resulted in a widespread blackout in Quebec. A 2012 flare which is believed to have been as significant as that of the Carrignton Event narrowly missed the Earth.[4]

Scientists have estimated that a significant solar flare, defined as -500nT or larger, hits the earth once every 25 years on average giving the probability of a solar flare hitting the earth as 4%. Those same scientists estimate the probability of a Carrington-type event reoccurring in any given year as 0.7%.[5]

Flares are more likely to occur during periods of increased sunspot activity that are seen during solar maximums. The next solar maximum is expected in mid-2025.[6]

Earthquakes

Earthquakes occur with a relatively higher frequency than either volcanic eruptions or solar flares but can have a substantial impact on regions impacted by them. Since 1900 there have been 21 Earthquakes recorded at an 8.5 or higher on the Richter scale, the logarithmic scale used to categorize the severity of the earthquake. Five of these earthuakes have been recorded at 9.0 or higher.[7] This would mean the probability of an earthquake of 8.5 or greater is 17.5% in any given year and the probability of a 9.0 or higher quake is 4.2%.

The shortest gap between these quakes is less than one year while the longest gap has been 39 years. For earthquake of 9.0 or greater the range is between four and 40 years. It has been eight years since an earthquake of 8.5 or greater.

Known Unknowns

We belive none of these events are both highly likely and also likely to create an impact large enough to upset the economy. Most of these events never rise to a level that creates worldwide disruption. They are normally background noise against the focus on man-made disasters and the potential for even more man-made disasters in our view. Still, when taken together, the probability of either a pandemic or a volcanic eruption or a consequential solar flare or an earthquake is roughly 11%, or roughly one year in nine.[8]

The complete story is difficult to tell as the impact of the event is often the result of non-natural events preceding the natural event. For there to be true disruption the volcanic eruption must push enough ash into the atmosphere to not only disrupt nearby air traffic but to disrupt agriculture by altering weather patterns. Throughout history volcanic eruptions may

have been the catalyst for famines and droughts that culminated in political instability and revolution. Other similar eruptions at a different time may have had only modest effects.

A solar flare that disrupts communications or causes a short-term blackout is largely an annoyance. However, a Carrington-type event buffeting a world dependent on communications, GPS and other technologies could lead to long-term disruptions of the economy. One study noted that a similar storm would place 20-40 million people in the United States at risk of an extended outage of electricity for between 16 days and two years. The estimated cost for a storm of that magnitude in 2013, the time the paper was written, was between $600 billion to $2,300 billion.[9]

Earthquakes are not necessarily driven by their size but rather by the ability of the affected area to absorb the shock. Hence, some of the most damaging earthquakes have registered far below the 8.5 threshold used here. Nevertheless, consider the impact of a significantly larger earthquake on the same location where widespread damage has occurred with an earthquake of lower intensity.

Finally, when we finally emerge from the COVID crisis it seems likely that the clock will start ticking on the next pandemic, as they occur with some regularity.

More worrisome may be that the world will focus on the possibility of future pandemics to the exclusion of the other naturally-occurring phenomena resulting in greater loss than otherwise could have been the case.

Endnotes

1 Adding in hurricanes the space between events would decline dramatically. However, there is not a consistent evaluation of hurricanes. The U.S. National Oceanic and Atmospheric Administration (NOAA) has a large list of signiciant hurricanes to have hit the United States and, comparing this list to a list of the "Most Damaging Hurricanes in United States History" there were some not listed on the NOAA list that showed on the other list. As such, we chose not to include hurricanes in this report although the roughly probability of a significant hurricane hitting the United States in any given year would seem to be about 1 in 3.

2 https://en.wikipedia.org/wiki/List_of_large_volcanic_eruptions#Overview; https://volcanoes.usgs.gov/vsc/glossary/vei.html

3 https://pubs.usgs.gov/fs/1997/fs113-97/

4 https://science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm

5 Using the Index Over the Last 14 Solar Cycles to Characterize Extreme Geomagnetic Activity

6 https://www.nasa.gov/feature/goddard/2020/what-will-solar-cycle-25-look-like-sun-prediction-model

7 Note: Various sources disagree on relative strengths. The following represents the core source. https://www.usgs.gov/natural-hazards/earthquake-hazards/science/20-largest-earthquakes-world?qt-science_center_objects=0#qt-science_center_objects

8 MIM

9 https://www.lloyds.com/~/media/lloyds/reports/emerging-risk-reports/solar-storm-risk-to-the-north-american-electric-grid.pdf

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Drew Matus is chief market strategist for MetLife Investment Management (MIM). In this capacity Matus is responsible for formulating MIM's global outlooks, which ultimately help to shape the company's portfolio management and business decisions. His team also conducts research on investment themes to advise and inform MIM's global team of investment professionals.

Prior to joining MetLife, Matus was the deputy chief U.S. economist at UBS Securities LLC. He has also worked as a senior economist at Bank of America-Merrill Lynch and as the senior financial markets economist at Lehman Brothers, Inc. Prior to his work in banking, Matus worked in the market research group at Moore Capital Management, a hedge fund in New York and also worked on the open market desk of the Federal Reserve Bank of New York assisting in the implementation and analysis of monetary policy operations and conducting Treasury market surveillance on behalf of several regulatory agencies.

Matus frequently appears on CNBC and Bloomberg to discuss his views on the economy and markets. He has also been quoted in The Wall Street Journal, The New York Times and other business publications.

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About MetLife Investment Management

MetLife Investment Management (MIM),[1] which had over $659.6 billion in total assets under management as of December 31, 2020,[2] serves institutional investors by combining a client-centric approach with deep and long- established asset class expertise. Focused on managing Public Fixed Income, Private Capital and Real Estate assets, we aim to deliver strong, risk-adjusted returns by building tailored portfolio solutions. We listen first, strategize second, and collaborate constantly as we strive to meet clients' long-term investment objectives. Leveraging the broader resources and 150-year history of the MetLife enterprise helps provide us with deep expertise in navigating ever changing markets. We are institutional, but far from typical.For more information,

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[1] MetLife Investment Management ("MIM") is MetLife, Inc.'s institutional management business and the marketing name for subsidiaries of MetLife that provide investment management services to MetLife's general account, separate accounts and/or unaffiliated/third party investors, including: Metropolitan Life Insurance Company, MetLife Investment Management, LLC, MetLife Investment Management Limited, MetLife Investments Limited, MetLife Investments Asia Limited, MetLife Latin America Asesorias e Inversiones Limitada, MetLife Asset Management Corp. (Japan), and MIM I LLC.

[2] At estimated fair value. Includes MetLife general account and separate account assets and unaffiliated/third party assets.

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