

The Four Horsemen of the Investment Apocalypse¹

Pandemic, War, Corruption, and Climate Change

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¹ Forthcoming: *Journal of Performance Measurement*. In more normal times, my friend and co-author Jeffrey Horvitz has used a similar wording for “Fees, Taxes, Inflation, and Consumption” as the four primary threats to private wealth

Two Thoughts

For every bad there is a worse

Thomas Hardy

Our story takes place between the *second war to end all wars*, and the *third*, which by eliminating mankind altogether will actually do the trick.

From The List of Adrian Messenger by Philip MacDonald

Introduction

- While the world continues to struggle with the impact of the coronavirus pandemic, investors need to remain cognizant that other thematic effects can be vastly influential on investment outcomes in both the near term and the long term.
- Of our four themes, pandemic and war are sufficiently violent and episodic (hopefully) as to dominate investor thinking in the moment.
- The other two themes, corruption and climate change affect investment outcomes in a slow acting, but persistent fashion that is often too subtle to be captured by a conventional risk assessment.
- Much like the fable of the “tortoise and the hare”, it is unclear which of these thematic effects will ultimately win the race for greatest influence on global investment outcomes. *While focused on the coronavirus as the matter at hand, global investors must be prepared to address all four.*

Defining Investment Risk

- Different investors and investment agents (i.e. asset managers) do not agree how risk is defined. Many may consider risk in terms of absolute loss of the value of the portfolio assets. Pensions may view risk as the inability to earn sufficient long-run returns to meet their actuarial expectations.
- Most asset managers see risk as the potential to underperform some mandated benchmark index. Implicit in benchmark relative risk assessment may be *an unhelpful indifference* to absolute risk, as described in Roll (1992).
- Whatever risk may be, *it is in the future*. While financial markets may have experienced period to period volatility in the past, economic risk can only exist in the future. Risks associated with either rare, extreme events or slow persistent effects may not be foreseeable from measures of financial market volatility.

The Ostrich Method

- The potential for *rare* extreme events of any kind is routinely ignored by financial institutions, as discussed in diBartolomeo (2018).
 - Under Cornish and Fisher (1938), a 2% annual probability of a 90% loss is the equivalent of more than tripling annual return volatility
- Recent releases by the Swiss regulator, FINMA are an example.
 - The essence of the FINMA position was that since the pandemic was not foreseeable in a traditional bank “Value at Risk” model, any realized losses which exceeded the model expectations for losses **would be ignored** for the purpose of ongoing bank capital requirements.
 - This is like Pompeii residents in 79 AD saying the risks are low because *it is unlikely that the adjacent volcano will erupt today*.
 - Of course, what matters *the cumulative likelihood for as long you are exposed to the danger*. **The cumulative effect is obviously the matter at issue for climate change.**

Investor Response to Information Overload

- Wars and pandemics represent massive flows of information
- A sophisticated view of asset pricing is that in setting discount rates investors actually consider three components.
 - The first is the risk free rate. The second is that they demand an additional return (an increase in the discount rate) which is proportional to the risk of the investment.
 - Brown, Harlow and Tinic (1988) argue for a third component to discount rates. Investors set higher discount rates for investments they understand poorly and set lower discount rates for investments they feel are well understood.
 - Under the extremes of war or pandemic, the uncertainty of global circumstances implies that investors will demand very high returns on risky investments.
 - For investors the old adage *No News Is Good News* has an economic basis.

Great Anomalies Need Not Be Global

- Another consideration is the impact of “great anomalies.”
 - Much of the empirical literature on financial markets does not include rare but extreme events such as the collapses of Russian financial markets at the time of the Russian revolution, the German financial markets in the 1930s, and the expropriation of private enterprises at the Communist takeover in China in 1949.
 - While rare, such collapses have a meaningful impact on how investors should view returns from various financial markets (Dimson, Marsh, Staunton, 2014).
- Even in relative peacetime, there have been numerous example of financial collapse at the national level.
 - Venezuela (current), Zimbabwe (2008), Russia (1998), Southeast Asia (1997), Mexico (1982)

The Covid-19 Pandemic

- We've written extensively on the coronavirus pandemic including an analytical model. This combined material is forthcoming in *Investments and Wealth Monitor*.
 - <https://www.northinfo.com/Documents/937.pdf>
 - <https://www.northinfo.com/Documents/941.pdf>
- To summarize the developments subsequent to mid-March, we can simply say that the best-case scenarios have gotten much worse, but the worst-case scenarios have gotten much better.
- The process of slowing the spread of infections in Western Europe and the United States has taken much longer than in the reported data on countries earliest to be affected, China and South Korea.

Current Status of Covid-19

- As of May 24, *the death toll stood at about 330,000, but we estimate the total number of deaths at about 28 million over the same period.*
 - The *current impact of virus* on global mortality has been small at about 1.3% of all deaths (.0043% of global population) though the figure has exceeded 50% in a few cities at the respective local peaks of the crisis.
- Most countries where the pandemic has infected large numbers are now reporting declining new infections and deaths.
 - Brazil, Russia and Mexico are notable exceptions
- The global growth rate of both known cases and deaths has slowed to about 1.5% per day.
 - The estimated rate of infection spread is now considered similar to Ebola at $R_0 = 2.5$ over a **14 day average time to resolution**. This equates to a 9.4% per day growth rate if unchecked.
 - A daily growth rate of 5.07% would keep the number of infected persons constant as new infections balance recoveries and deaths.

Financial Impact of “Fast Risk Events”

- Both pandemics and wars share the common theme of *widespread death*. If investors are similarly impacted by mortality in both cases, we can use the historical record to be informative of both.
- Our first hypothesis is that long term financial market returns will negatively correlated with periods of unusually high mortality.
- Our second hypothesis is that the effects of war on bond markets will be particularly acute.
 - Wars are expensive driving up bond yields, losers in war can't pay, and there is no “upside” for lenders even if their borrowers win.

Data on the Impact of Mortality

- For financial market returns, we take global value-weighted index values for equities and bonds calculated in US\$ from the Dimson, Marsh, Staunton (2014) dataset, which is free of survivorship bias.
- For the measure of global geopolitical conflict, we created a proprietary data set. Our metric is “deaths by conflict” globally year by year as percentage of world population (32 major events). We included high/low and median estimates for each event. The events included all wars, civil wars, genocides and induced famine (deprivation of food aid) even in countries where there were no financial markets.
- For conflict events lasting longer than one year (e.g. World War II), we allocated linearly across the conflict years, so 20% of deaths would appear in each year for a five year event. We break our sample period into **eleven decade long periods** (all statistics have been adjusted for small sample bias).

Conflict Mortality Analysis Results

- Depending on use of the “high,” “median” or “low” estimate for conflict, the negative correlation of the global equity market to mortality is between 30% and 38%, but not statistically significant.
- For global bond markets the simple negative correlation ranges from negative 63 to 71%, which is statistically significant.
- For a 60/40 typical institutional portfolio, the correlation averaged around negative 45% which is significant ($P > 95\%$)
- We also considered the log of our death metric as the independent variable to reduce the impact of outliers. The negative correlations increase to as high as 86% for the bond market.
- Given these empirical results, we can reject the null of our first hypothesis for both fixed income markets and a 60/40 portfolio. For second hypothesis, we can again reject the null.
 - Fixed income investors should pray (or perhaps pay?) for peace.

Implications for Long Term Investors

- Even if the implausible worst case of 60 million deaths had to come about from Covid-19, this would represent about a 9% increase in global total mortality over a ten-year investment time horizon
- Let's walk through the financial algebra for a typical investor.
 - Future equity returns would be 6% in an average year with a volatility of 15% (this is a geometric mean return of 4.875%) or a cumulative return of 59% over a decade
 - Future fixed interest returns would be 2% with a volatility of 7% (this a geometric mean return of 1.755% annually)
 - The correlation of equities and fixed interest returns is .3
 - The investor is 60% equities and 40% fixed interest by asset value (-.45 correlation with mortality)
 - The total portfolio expected arithmetic return works out to 4.4% with a volatility of 10.67. This equates to a geometric mean return of 3.83% annually or a cumulative return of 45.6% over a decade

A Hypothetical on Covid-19 Mortality

- *If an investor had a 10-year time horizon and the pandemic effects are similar to war, the expectation of the cumulative return of their portfolio would decline by -1.85%.*
 - $(45.6 * .09 * -.45) = -1.85$
 - The expectation of cumulative return over a decade declines from 45.6% to 43.75% is a net geometric mean return of 3.70%.
 - The expectation of the geometric mean annual return on the investor's portfolio *has declined only by a very .13% per annum*, conditional on an extremely grim scenario for mortality.
 - This could be a pessimistic assessment. During World War II the US military budget reached 35% of GDP for a sustained period, more than double the recent US stimulus for Covid-19.
 - War casualties are also skewed toward younger persons who would otherwise be the most productive members of an industrial society. The coronavirus mortality is skewed toward the elderly. As such, the economic impact of each death is smaller.

Short Horizon Investment Effects

- As Niels Bohr said, “It is always hard to forecast, especially about the future”. However, it seems that the crashing of financial markets around the world early in the pandemic period cannot be explained by rational actions of long-term investors conditioned on the available data on large variations of mortality rates.
 - Investors appear short sighted so that nobody was thinking about 10-year horizons during the early days of the pandemic
 - Investors switching from risky assets to riskless assets (e.g. cash, sovereign debt) have a simple decision as they don’t have to wonder what the risk-free asset is. Investors choosing to move from riskless assets to risky assets have to make decisions about which risky assets.
 - Various processes defined by Kahneman and Tversky (1992), Wilcox (2003), Barro (2005), and Gabaix (2009) also suggests that investors are relatively indifferent to small changes in their wealth level but are extremely sensitive to larger changes in wealth.

Pandemic and War Risks in the Short Run

- If investors are thinking “one day at a time” we can use our US Short Term Model to assess risk beliefs.
 - The model uses changes in option implied volatility on individual stock options to adjust individual security and factor volatility expectations.
 - See diBartolomeo and Warrick (2005) for the mathematical details.
- As of November 1st, 2019 the expected annual volatility of the S&P 500 (both capitalization and equal weighted) was around 12%.
 - Both values peaked at over 60% on March 13th, 2020. The concurrent VIX value was over 80%.
 - By March 16th, the values had fallen to the lower 55% and 52% respectively, and fell below 40% by April 15th.
 - The current value is around 26%.

Inference on the Length of Events

- In a recent webinar, <https://www.northinfo.com/Documents/939.pdf> we illustrated how the difference between short term and long term risk expectations could be used to infer investor's expectations about the duration of high volatility events.
 - As of mid-March, 2020 the investor implied expectation on the length of the Covid-19 pandemic was about seven months (ending October).
 - As of mid-April, 2020 the same calculation rendered a result of five months (ending September)
 - As of today, the implied length of the pandemic is *26 days*, or an effective return in late June to whatever you define as the "new normal".
 - The implied "end dates" of the pandemic for investors had been **after** the estimates arising from medical models such as that of the University of Washington IHME. The June implied "end date" is well **before**.
 - *Relative to IHME, US investors have shifted from pessimistic to optimistic.*

Final Thoughts on Covid-19

- Even inclusive of some hard hit industries (e.g. airlines), global equity valuations are now about 3% below their November levels.
 - The value of aggregate corporate debt is less than one third of corresponding value of public equity. This is around the median ratio from 1992 to date. Under the model of Merton (1974) and the related sustainability model of diBartolomeo (2010), corporate bond yield spreads seem more than sufficient to compensate for credit risk.
- Assessing the readiness of a particular country or state to relax measures against the pandemic is difficult.
 - Most jurisdictions still do not have enough testing to actually confirm that a person who tested positive has tested negative in a second test.
 - Switzerland reports 6% mortality, 90% recovery and 4% active cases
 - The US is reporting 6% mortality, 27% recovery, and 67% active infections. The US data is mathematically impossible given a 14 day infection duration. Only 20% of known infections are new within the past two weeks, so at least the prior 80% should be recovered or dead.

The Cross-Section of Corruption

- Unlike pandemics and wars, the impact of societal corruption may be imperceptible on a short term basis. However, we can assess the *cumulative* differential effects across geographic regions.
- Corrupt practices in government and economic affairs contribute to slow economic growth and the instability of sovereign states.
 - The seminal study is Shleifer and Vishny (1993). They found GDP growth is slower in countries perceived to be corrupt. They also found the value of traded equity markets as a fraction of GDP to be smaller in corrupt countries.
 - In countries with low corruption, investors are willing to participate in “arms-length” transactions over a stock exchange, confident that legal and regulatory oversight will protect their interests. In countries with high corruption, investor confidence is lacking, creating bias toward a culture of “face to face” transactions. With today’s widespread accusations of “fake news” investors will demand higher return premiums for information *uncertainty* (aforementioned study of Brown, et. al.)

Testing for Corruption

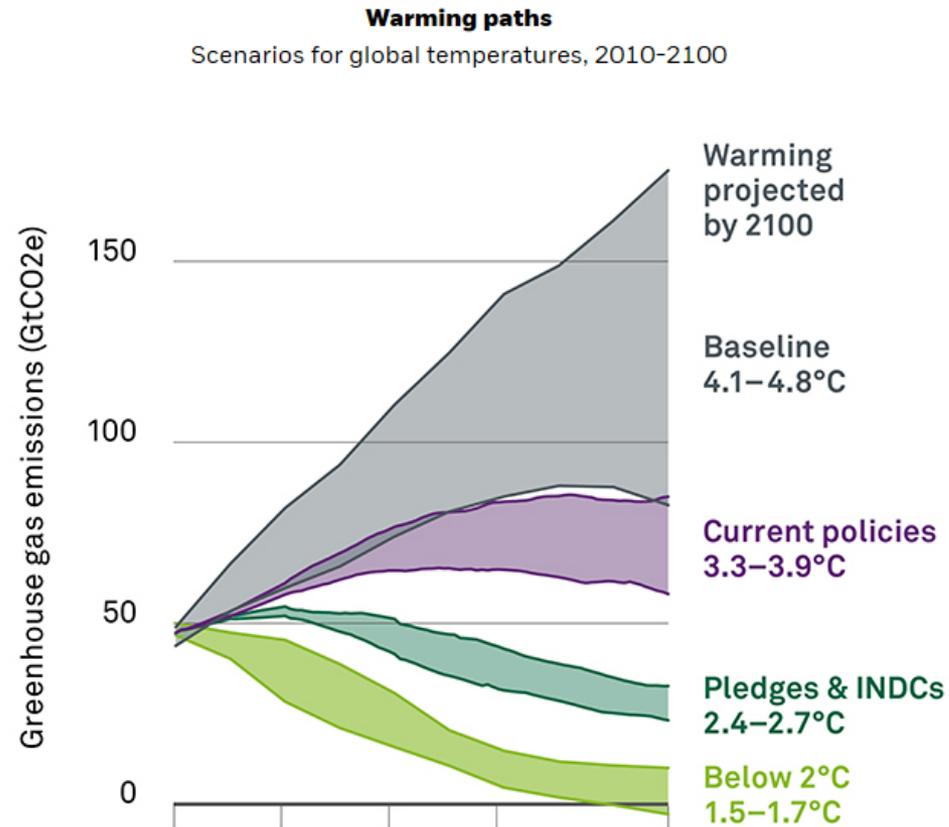
- We updated to the published analysis to 2012. Our hypothesis is that the ratio of equity market valuation divided by GDP will be lower for countries with a high perceived degree of corruption.
 - As data for our analysis of corruption, we obtained country level GDP and total market value of equity markets reported as year-end values in the World Bank online database.
 - Corruption levels were measured by the Transparency International Corruption Perceptions Index. This index is compiled by an annual survey of business and government officials, with data being collected on essentially every country on earth. Annual data begins in 1995.
- Our empirical investigation calculates the ratio of equity market cap to GDP for a sample of countries from 2002 (82) to 2012 (105).
 - The correlation of market cap/GDP to the corruption index ranged from was negative 45% ($r^2 = .21$) in 2012 to negative 48% ($r^2 = .23$) in 2002. *All years were highly statistically significant ($T > 5$).*
 - Obviously, public equity investors should disdain corrupt governments.

The Climate Change Challenge

- Unlike societal corruption which we can study or impact country by country, climate change is a truly global effect.
 - However, some asset classes and geographic areas are more likely to be affected than others, so investors can act to mitigate potential risks of climate effects on their portfolio.
- In some ways, the “climate change risk” is a misnomer.
 - In financial markets, the word risk is often used as a proxy for uncertainty. There is little uncertainty about the direction of climate change. The “risk” is in what the economic effects will be.
 - Against a background of natural variation in temperatures over centuries, the existence of greenhouse gases in the atmosphere has biased the process of global temperature variation upward.
 - *The world is being made hotter by some amount*, and the increased energy levels associated with this greater heat is manifesting in various ways including higher intensity and frequency of extreme weather events.

The Magnitude of Climate Change

- This is a chart from a 2016 Blackrock report on climate change illustrating their range of projections for future increases in temperatures.



Equity Investors and Climate Change

- The most obvious question facing investors is the future of fossil fuel production and consumption which is widely accepted as the single largest cause of global warming. The most basic question is whether to reduce or eliminate investment in oil, coal, natural gas, and other fossil fuel related enterprises.
 - The first research on this point *was published nearly a quarter-century ago*. In diBartolomeo and Kurtz (1996) a detailed analysis is done to attribute performance differences in an equity index (now called MSCI KLD 400) which had been “screened” for environmental effects against a similar but unscreened equity index (the S&P 500).
 - At the time, approximately 80% the variation in relative performance could be attributed to the inclusion or exclusion of fossil fuel related firms. This study was subsequently updated in diBartolomeo and Kurtz (2011) with similar conclusions. Both papers also illustrate how investors could change company level weights in their portfolios so as to minimize the variations in relative performance over time.

Understanding Fossil Fuel Risks

- While many models of equity risk explicitly consider membership in the energy sector, not all directly measure the statistical relationship of all firms to oil prices (which have recently collapsed).
 - Doing so ensures that the impacts of energy are captured for consumption as well as production. For example, it can be shown that the earnings of “big box” retail companies (e.g. Walmart, Home Depot) are particularly sensitive to energy costs both in direct operations and in terms of impact on consumer behavior. Risk assessments that rely solely on industry classifications to capture energy sensitivity are insufficient in this regard.
 - There are also deficiencies in equity benchmark index construction. With particular respect to climate change, one such deficiency is the fact that in many nations, energy resources such as oil have been nationalized and hence are under-represented in equity market indices in terms of the impact of the energy sector on the local economies of many countries.

Climate Change and Credit Risk

- De Jong and Nguyen (2016) illustrates how to mitigate climate risk in fixed income portfolio fixed income portfolio construction conditional on the expectation of rapid climate change.
- Belev and diBartolomeo (2019) address how dependence on the energy sector of the economy may influence the creditworthiness of sovereign debt.
 - An obvious issue in countries economically dependent on oil exports (e.g. Saudi Arabia).
- The aforementioned use of a Merton style analysis for credit risk means that all of the information described above for equities flows directly to the consideration corporate credit risk, and the aggregation of corporate credit risk, equity risk, and tenant credit risk in real estate at the enterprise level of an asset owner.

You Can't Avoid Weather

- Many asset owners are large investors in geographically bound assets such as real estate and public infrastructure.
 - Baldwin, Belev, diBartolomeo and Gold (2005) provides a detailed approach to evaluating the risk of real estate and similar assets. A key fact is *knowing exactly where that asset is located, down to a specific neighborhood or even street address.*
 - A major part of climate change risk is the expectation that sea levels and weather patterns will be changing and these changes will naturally impact some locations more than others (e.g. waterfront cities).
 - Investors should also consider the potential for climate changes directly on their portfolio companies. In a recent study, Kruttli, Tran, and Watugala (2019) show that option implied volatility values for equities increase during periods of extreme weather events (e.g. hurricanes). This effect is unsurprisingly stronger for firms whose operating facilities or headquarters are associated with coastal locations and hence are more likely to be harmed by such events.

Conclusions

- While we do not take a position on the matters of morality, ethics, or public policy associated with pandemic, war, corruption or climate change, it is clear investors should be undertaking policies that mitigate the likelihood of negative outcomes.
- Of greatest concern is that many organizations, companies, and governments have been engaged in an undesirable game of managing the “optics” of the situation. The actions of many entities are being driven by a desire to be perceived as managing risk as opposed to actually managing risk in response to factual information and analysis.

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