NORTHFIELD | modeling financial markets worldwide

The Four Horsemen of the Financial Apocalypse, ESG, and Asset Pricing Theory

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Webinar

Novbember 2021

Introduction

In the Bible, the Four Horsemen of the Apocalypse are harbingers of the "end times". They appear in Revelation Six and the Books of Zechariah and Ezekiel. The four horses are colored White, Red, Black, and Pale

The image at left is one of a series of fifteen woodcuts by Albrecht Durer done around the year 1500.

For the financial activities which dominate much of modern life, we will take the liberty of defining the Four Horses as War, Pandemic, Corruption, and Climate Change

In this presentation we hope to provide relatively concise summaries of our research of how each of these risks is problematic for investors, and what changes in asset pricing if investors already take these issues into account.

A Basic Conception of Risk

The image at right is Rembrandt's ***Storm on the Sea of Galilee*** (1633). Since that date it has been widely used as a representation of danger and risk.

For today's purpose we will loosely define risk only as the potential for undesirable outcomes.

Risk is always in the future. It cannot be measured, only estimated.

As the Greek writer Agathon stated in 450 BC *Even unto the Gods it is forbidden to change the past*.

March 18, 1990

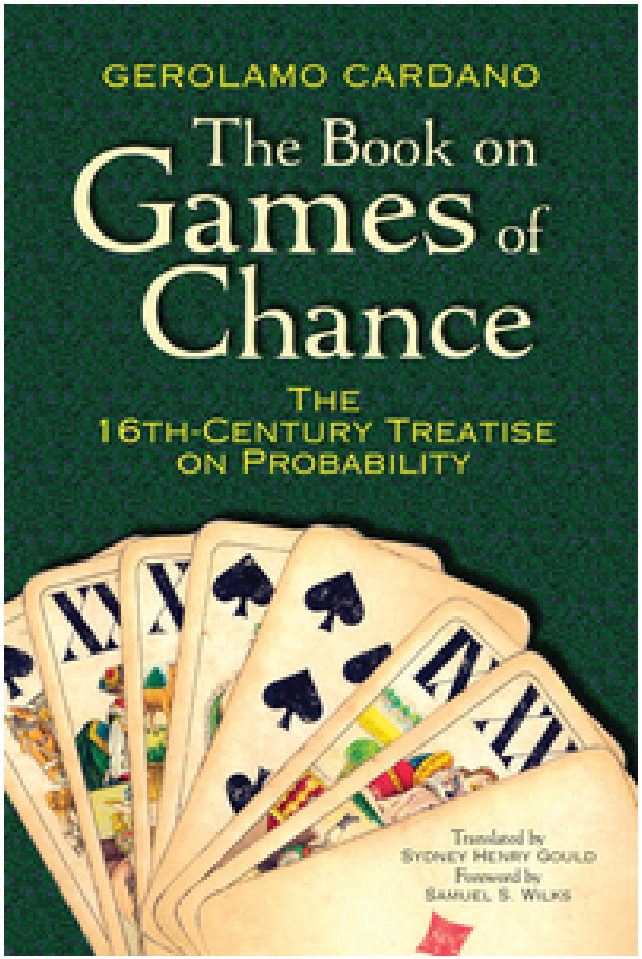
Keys to Understanding: Drinking, Gambling, and STDs

In the modern world we define risks and dangers in terms of conditional probabilities (odds).

The first researcher to get the math right was Gerolamo Cardano, for whom a crypto-currency was recently named.

Unfortunately, Cardo did his research to improve his gambling in card games in Italian taverns. He was a lifelong loser who financed his gambling losses with a good day job. Cardano was a prominent physician by virtue of a ***fraudulent cure for syphilis.***

His book was published posthumously in 1663.

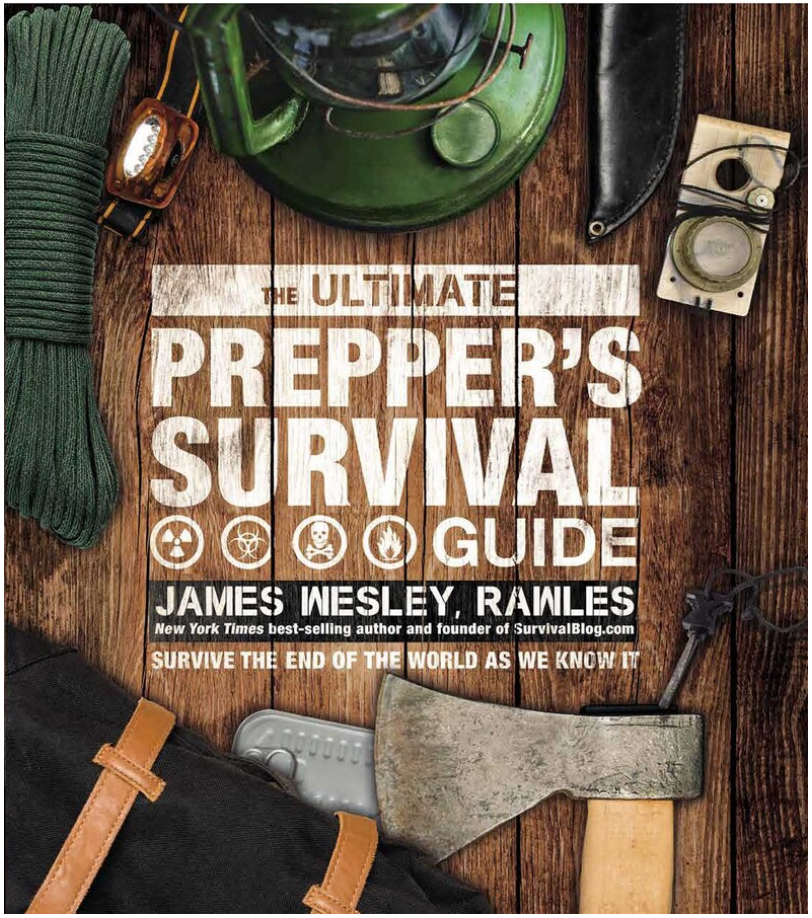


Survival in Unfavorable Conditions

One way to think about being resilient to our Four Horseman of the Financial Apocalypse is to form a hold a portfolio least likely to be in distress during unfavorable conditions.

We published our model of corporate sustainability

- diBartolomeo, Dan, “Equity Risk, Default Risk, Default Correlation and Corporate Sustainability”, *Journal of Investing*, Winter 2010.



Could “Survivalist Views” Hurt You Financially?

While avoiding investment in companies that don’t go bankrupt sounds *prima facia* appealing, we must at least consider the possibility that some firms might survive in the long run by being pathologically conservative and never growing.

- A manifestation of “Nothing ventured, nothing gained”
- There is evidence in the real estate markets that US states that discourage real estate speculation (“flipping”) through taxation have had the lowest rates of property appreciation.

We studied this issue by creating portfolios that were intentionally survivorship biased.

- We formulated portfolios from firms that had survived at least twenty- five years without changing the primary line of business.
- Several studies including ours found an annual equity alpha of around 3% for survivors (if you know who they will be in advance) in the US
- Northfield News December 2018.pub (northinfo.com)

Wars and What Starts Them

As per Shakespeare in Henry V after receipt of a gift of medieval tennis balls from a French cousin

We are glad the Dauphin is so pleasant with us:
His present and your pains we thank you for.
When we have march'd our rackets to these balls.
We will, in France, by God's grace play a set,
Shall strike his father's crown into the hazard.

Later Antony urges "let slip the dogs of war", which Henry identified as **famine, sword, and fire.**

Kenneth Branagh
as Henry V

A War Portfolio?

Our published "Four Horsemen" paper (*Journal of Performance Measurement*, 2021) relied on previous Northfield research on the statistical relationship between global war casualties and returns for global equities and bonds.

- This work was done at the request of the US State Department.
- Historical data was reviewed back to the 1880s.
- https://www.northinfo.com/Documents/646.pdf
- The key findings of this study were that equity markets declined during periods of conflict but recovered quickly at the cessation of hostilities

Fixed income markets declined very sharply during wars and there was no appreciable recovery at the cessation of violence.

- War is expensive to wage, industrial capacity and infrastructure are destroyed
- Young, healthy members of the labor force are killed as combatants
- Countries that lose wars don't pay their debts
- A war resilient portfolio would be tilted to most negative exposure to returns on the global bond market return factor present in many Northfield models.

Financial Considerations of the COVID 19 Pandemic

Our early published work on the pandemic was accurate in forecasting that *financial markets would recover quickly from* the lows in March 2020.

- diBartolomeo, *Investments and Wealth Monitor,* May 2020.

Our sustainability model has presented one very interesting indication in terms of corporate sustainability in the pandemic period.

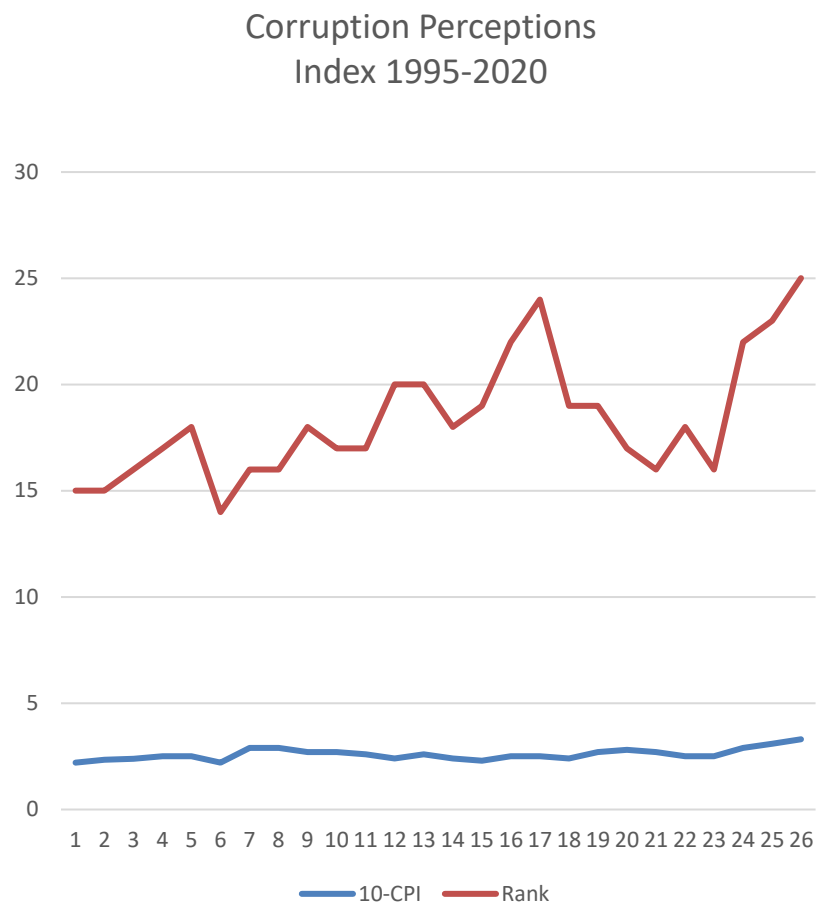
- Perversely, the expected half life of firms *increased* markedly.
- This effect was concentrated in banks that moved to a seventy-year average half-life suggesting a default rate of only 1% per annum.
  - This result arises from the enormous liquidity injected by the US Fed and other central banks. It's hard to go broke if you have borrowing costs below zero.
    - Belev, Emilian and Dan diBartolomeo "Finance Meets Macroeconomics: A Structural Model of Sovereign Credit Risk", M. Crouhy, D. Galai ande Z. Weiner Editors, "Contingent Claims Analysis in Corporate Finance", World Scientific, 2019.
    - Bodie, Zvi, Dale Gray and Robert Merton, "A New Framework for Measuring and Managing Macrofinancial Risk and Financial Stability", NBER, 2007 (Updated 2021).

US Corruption Trends Don't Look Good

We rely on the Corruption Perception Index (CPI) which has been compiled annually from global surveys since 1995.

Since 1995 the US has moved from 15th best among world nations to 25th best. Over the same sample period, the level of perceived corruption (1-CPI) has increased by half from 22% to 33% (0 to 10 scale)

Averages during Republican administrations are slightly worse, but the *differences are not statistically significant.*



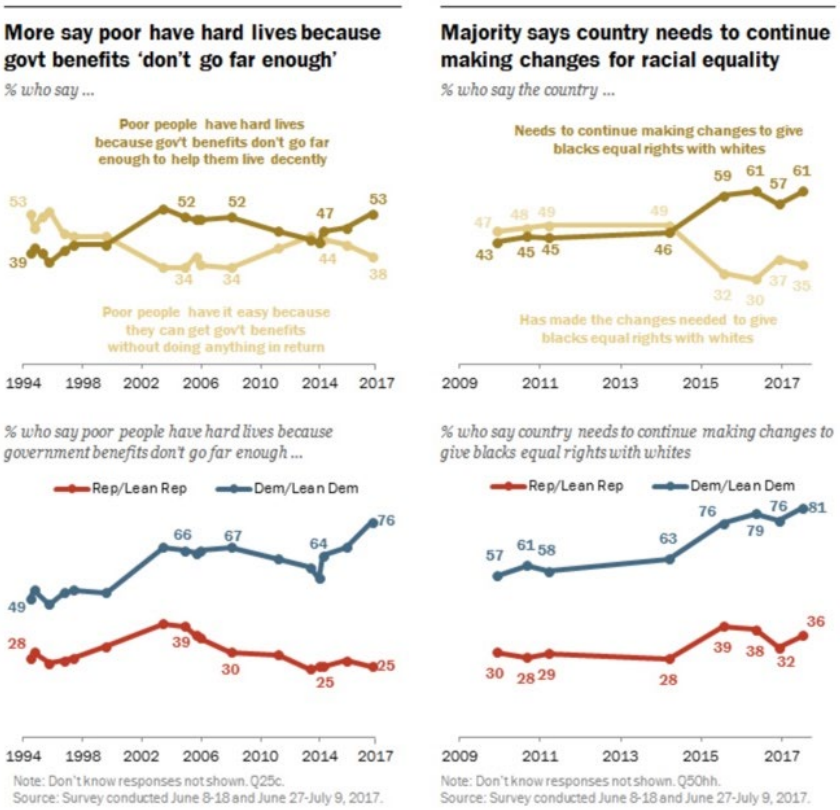
Domestic Perceptions of Corruption

The US is more widely divided along political party lines at the current time than has been evident in the past.

- It is therefore plausible that domestic views on corruption of the political process and business community *may simplify to whether or not the political party favored by a given individual is or is not in a dominant position of political influence.*

We have previously analyzed historical factor data for the US equity market based on whether the presidential administration is from the Democratic or Republican parties.

- [The US Presidential Election, Pandemics, and Long-Term Factor Returns (northinfo.com)]



Another Response to Perceived Corruption

The image at right depicts the "Oath of the Tennis Court" taken in 1789 in Paris just prior to the French Revolution.

In response, the Revolutionaries burned all but three tennis courts in France, as well as ***beheading some of the attendees by guillotine.***

A Climate Change Portfolio

Unless you want to make active bets, the most obvious strategy to deal with climate change is to remove companies related to fossil fuels as either producers or heavy consumers from your portfolio.

- Businesses sensitive to the cost of fossil fuels will be negatively correlated with fossil energy producers
- Some businesses that are negatively correlated with oil prices aren't obvious.
- The strongest negative correlations arise in "big box" retailers like Walmart and Home Depot where both consumer spending and operating expenses are impacted by energy costs.

We published early two papers on the dominance of the fossil fuels on the relative performance of SRI/ESG portfolios. About 80% explanatory power

- Kurtz, Lloyd and Dan diBartolomeo. "Socially Screened Portfolios: An Attribution Analysis Of Relative Performance," *Journal of Investing*, 1996, v5(3,Fall), 35-41.

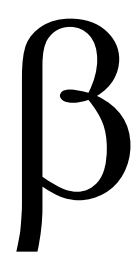
- diBartolomeo and Dan and Lloyd Kurtz. "Long Term Performance of a Social Investment Universe", *Journal of Investing*, Fall 2011.

But What If Investors Already Pay Attention?

The ongoing coronavirus pandemic has strongly reminded equity investors that rare but extreme events occur from time to time. These events represent periods of increased volatility and in some cases very negative returns for extended periods.

By incorporating the probability of such rare events in factor models we conclude that strategies that focus on “alpha” (risk adjusted return) as defined in Jensen (1968) are structurally superior to “smart beta” strategies that attempt to outperform an equity index by active exposure to one or more known factors.

- Northfield US Fundamental Model is close enough in structure to provide persuasive empirical evidence.



Mark Rubinstein Was a Shakespeare Scholar

Antonio (on portfolio diversification)

Believe me, no: I thank my fortune for it.
My ventures are not in one bottom trusted,
Nor to one place, nor is my whole estate
Upon the fortune of this present year:
Therefore my merchandise makes me not sad.

Unfortunately for Antonio diversification may not help in "large events"

Asset Pricing Features We Want to Explain

The equity risk premium (return of equities minus the risk free rate) is widely considered to the unexpectedly high.

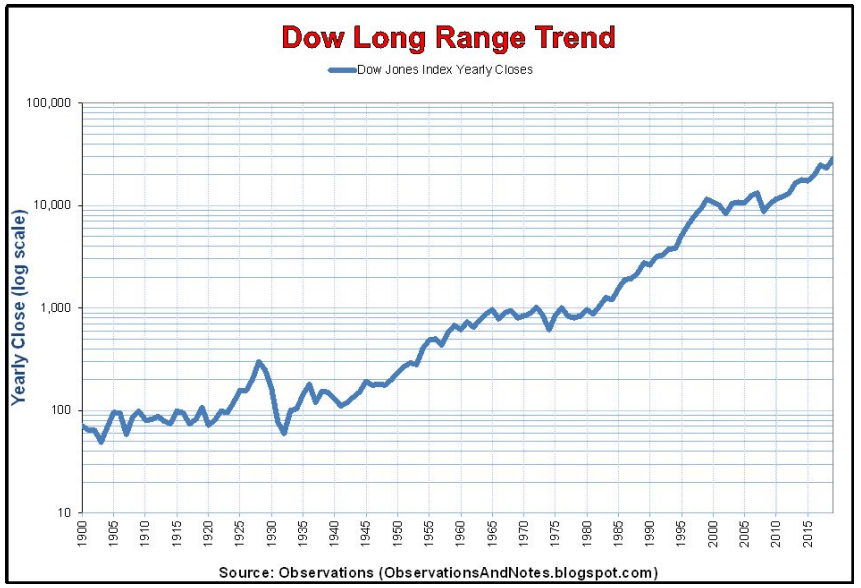
- This has lead some researchers to argue that long term investors should always be fully invested in equities (e.g. Siegel, 2014, Stocks for the Long Run)

There has been widespread criticism of the mostly widely known asset pricing model, the CAPM (Sharpe, 1964) as failing to describe equity asset returns.

- The amount of return associated with low beta stocks versus high beta stocks seems inconsistent with the Sharpe version of CAPM.

There is a massive literature of "factor anomalies" that describe persistent excess returns associated with security attributes in violation of the "Efficient Markets Hypothesis" (Fama, 1970).

- Value, Momentum, Size, Low Volatility



Distinct Semantics of Factor Returns

The first distinction is the difference between "excess return" and "alpha".

- "Excess return" outcomes that outperform some passive benchmark.
- "Alpha" to describe investment outcomes that outperform the some expected return associated with risk

The second distinction is whether we estimate the return outcomes in a simple or orthogonal fashion.

- Factor outcomes can be simple: compare returns on a large cap portfolio and a small cap portfolio, as a "size" factor.
- Those two portfolios will have lots of other differences (e.g. average P/E) so we can't be sure that return actually arise from "size"
- Statistical techniques can be used to control for correlated variables.
- We will always refer to orthogonalized values so we are describing returns associated with factors on a *ceteris paribus* basis.

Capital Asset Pricing Model (Sharpe, 1964)

- The canonical CAPM is expressed as:

$$R_{it} = R_f + \beta_i(R_{mt}-R_f) + \alpha_{it}$$

Where

Rit = return on asset i during period t

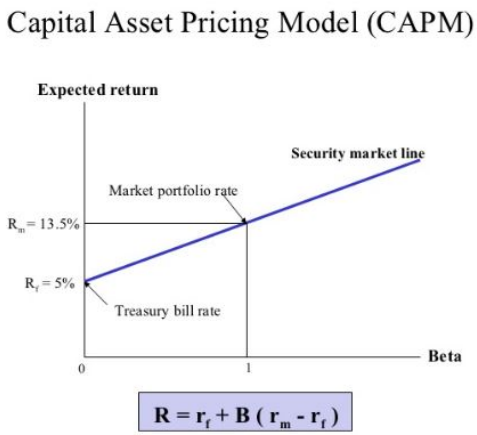
R_f = the risk free return

β_i = the beta of asset i, an index of covariance with the market portfolio

R_{mt} = return on the market portfolio during period t

α_{it} = the unexpected (risk adjusted) return on asset i during period t

Criticism of CAPM



Numerous studies have argued the many unrealistic assumptions that are embedded in the original CAPM

- Single period model. Ignores compounding of returns
- Investors are assumed to borrow and lend at the risk free rate
- No limitations on investor leverage
- The "market portfolio" is well defined
- No transaction costs or taxes
- Beta values are *known not estimated*

The major criticism is that empirical data suggests that the slope of the security market line is much less than (R_{mt}-R_f).

- The many critiques are summarized in Grinold (1992)
- Critiques are about expected returns, *not about beta as a risk measure*
- After 56 years, nobody has come up with a more widely accepted alternative

An Explanation of the Flatter SML

Northfield has previously proposed explanations of the flatter SML

These were covered in https://www.northinfo.com/documents/575.pdf.

Various "fixes" are proposed for:

- The lack of compounding in the single period assumption
- The poor specification of the market portfolio
- The assumption of guaranteed survival (no bankruptcy)
- Use of estimates rather than known values for beta.

The "fixes" individually and in aggregate suggest a flatter SML

Uniquely, we assert that the SML is not a line at all but a curve which curves downward past a critical value we call "beta*"

The SML curve is upward sloping for beta < beta*

The SML curve is downward sloping for beta > beta*

Other Versions of CAPM

Merton (1973) adds additional terms to CAPM to account for multi-period outcomes, hedging of investor consumption risk, and possible future changes in the investment universe.

Black (1972) proposes a key variation on the original CAPM

- He proposes a "zero beta" asset in place of the risk free rate.
- The zero beta asset may have risk (volatile returns) but is uncorrelated with the market portfolio, *so the covariance is zero*.
- Since the zero beta asset can be risky (e.g. gold bars), the zero beta return should be a lot higher than the risk free rate, *resulting in a much flatter security market line.*
- $R_{it} = R_0 + b_i(R_{mt}-R_0) + a_{it}$
- R_0 = return on zero beta assets

CAPM is Derived from Markowitz MPT

With some additional assumptions, the CAPM can be derived MPT (Markowitz, 1952)

- This means that CAPM also embeds some of the assumptions of MPT including that the security returns are effectively random walk where portfolio returns are normally distributed and serially uncorrelated.

Long term studies of equity returns such as Dimson, Marsh and Staunton (2014) illustrate that this assumption confounded by rare but large events.

- At the global level we might consider World War I, the Spanish Flu pandemic (1918), the 1929 Crash and subsequent Great Depression, World War II, the Global Financial Crisis (2007-2010), and the current Coronavirus pandemic. Six "large" events over roughly a century.
- There are numerous example of national financial collapse such as Russia (1917), Germany (1930s) China (1948), Mexico (1982), Russia (1997), Zimbabwe (2008), Venezuela (now)

Catastrophe Bonds and Lottery Tickets

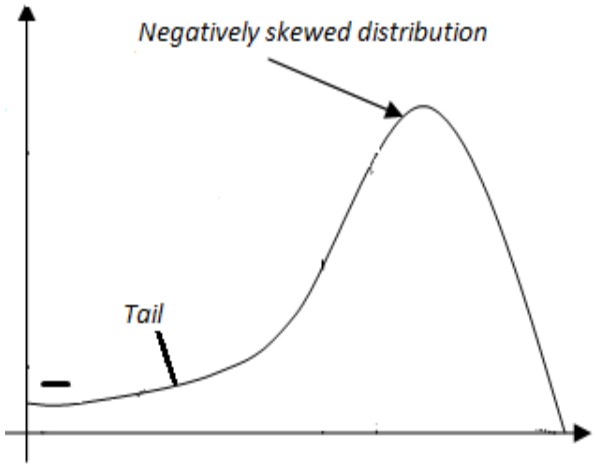
One way to reconcile the CAPM and with the existence of rare, but large events is to think of investors being long the equity market and a short a lottery ticket where **they** randomly sustain large losses.

- Similar to the concept of catastrophe bonds in fixed income

Since the rare events are rare and random, the *expectation of the correlation between lottery payoffs and the market is zero*.

- Our very risky position in lottery tickets therefore has zero beta
- Barro (2005) and Gabaix (2009) argue that investors are aware of the potential for rare, large losses and demand a high equity risk premium.
- If the implicit "catastrophe loss" asset is unavoidably built into an investor's market exposure, this qualifies under Black version of CAPM as the zero beta risky asset.
- The expectation of rare, large losses implies that the expected distribution of equity market returns will have *negative skew and positive excess kurtosis* over finite intervals.

Patching CAPM for Higher Moments



A common approach to reconciling return distributions with higher moments when they are *assumed* to be normal is the method of Cornish and Fisher (1937)

Essentially we adjust the expected volatility of the market portfolio to account for the effects of skew and kurtosis.

- For example, consider an asset 8% expected return with an estimated annual volatility of 10% under the normal distribution assumption.
- If we assume a 6% annual likelihood of a 50% loss, the expected return drops to 5.2% and effective volatility of this asset goes from 10% to 23%.

It should follow that investors will demand additional return compensation for the lost return and increased risk, increasing the magnitude of the portion of equity risk premium (R_{mt}- R_f) that is attributable to R_{0t} and reducing the slope of the SML (R_{mt}- R_{0t})

The Answer is Always Six

There are three components of the expectation of R0

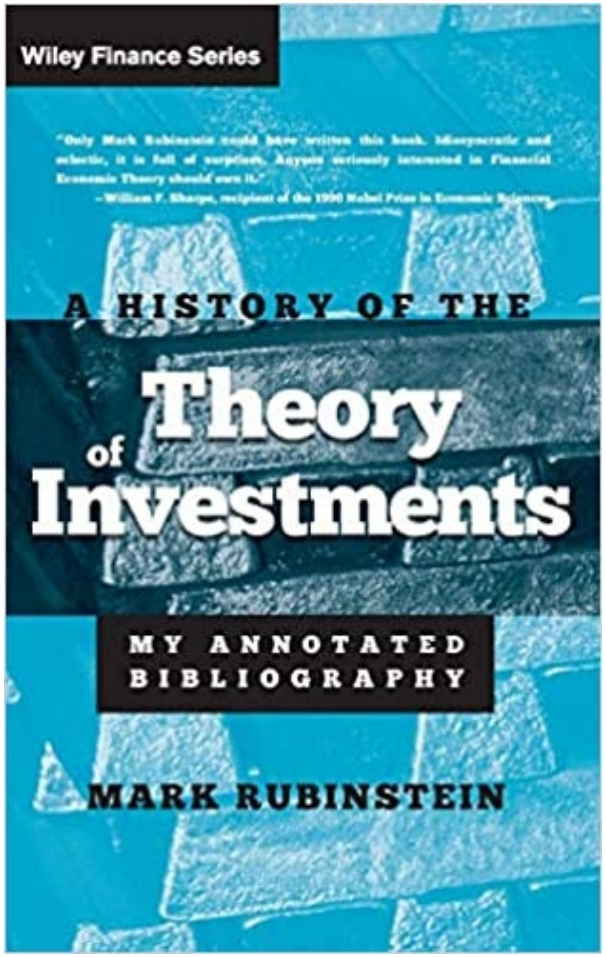
The first is the time value of money, R_f

The second is the change in the expected mean of the distribution

- In our previous example, (8-5.2) = 2.8%

The third is incremental return that investors will demand for the increase in effective volatility

- In the example, the expectation of the incremental return is (23-10)/6 = 2.16%
- For our hypothetical, the effect of including our "short lottery ticket" is 4.96%, a large fraction of usual expectations of the equity risk premium
- The rationale for the denominator of six was explained in a recent webinar, https://www.northinfo.com/Documents/939.pdf as derived from Rubinstein (Journal of Finance, 1976).



An Alternative Approach

Harvey and Siddique (2000) studies the impact of "co-skewness" across securities on asset pricing models.

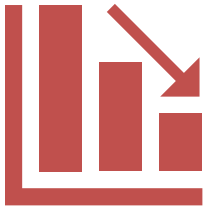
It considers how much a particular security contributes to the skewness of a broad portfolio.

- In a large market decline driven by the onset of war, some equities would might be hurt a lot while other might actually prosper (e.g. defense contractors).
- In the GFC, financial stocks were particularly impacted
- In the coronavirus pandemic, airlines and hotels have been most strongly impacted, while many tech firms and pharma companies have done well.

They conclude that the collective impact of "co-skewness" is on the order of 3.6% return per annum on a typical market index portfolio.

- "In the ballpark" of our estimate of the components of R_0

Bankruptcy Risk



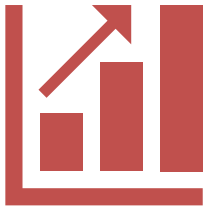
Bankruptcies at the individual firm level are obviously more likely during periods of market stress. The correlation across failures is a major source of "co-skewness"

The CAPM assumes that bankruptcies do not exist.

Merton (1974) shows that bankruptcy risk can described as an option where the volatility of a firm's asset value is the key input.

diBartolomeo (*JOI*, 2010) shows that asset volatility is approximately equal to equity volatility divided by the firm's debt/equity ratio

Several studies have shown that the excess return associated with successfully avoiding bankruptcies is on the order of 3% per annum. https://www.northinfo.com/Documents/848.pdf



If total volatility contributes to bankruptcy losses, but the return associated with beta risk is upward sloping (positive SML) then the return from idiosyncratic risk at the firm level must be negative, while CAPM assumes zero.

Northfield US Fundamental Model

- For empirical analysis of our ideas, we can use the Northfield US Fundamental Model.
  - There is a large sample of data history extending back to January 1989. Analytical changes to the model have been minimal (we got it right the first time) and do not effect this analysis.
  - ADRs are included to give some coverage of global equities
  - The model is based in the class CAPM, with the alpha term subdivided into 66 "factor alphas" (11 unit normal style factors and 55 industries)
  - Estimation of the factor beta and factor alpha is weighted by the square root of capitalization which affords a balance between the influence of large cap stocks and the more numerous small cap stocks. As noted in Grinold and Kahn (1995), there are also desirable statistical properties to this concept.
  - One of the "style factors" is a *rescaled range measure of total volatility* which we will use as our proxy for bankruptcy risk and thus likely contribution to the existence of higher moments in the market portfolio.

Fundamental Model Formulation

- In the original form, our Fundamental Model is expressed as:

$$R_{it} = R_f + \beta_{it}(R_{mt}-R_f) + \Sigma_{(j=1 \text{ to } 66)} E_{ijt}\, \alpha_{jt} + \varepsilon_{it}$$

β_{it} = beta of security i during period t

E_{ijt} = exposure of security i to factor j during period t

α_{jt} = alpha of factor j during period t

ε_{it} = residual return of security i during period t

Reordered US Fundamental Model

- We reorder the terms of the model and replace the classic CAPM construct with a modified version of the "zero beta" CAPM that incorporates higher moments and bankruptcy risk.

$$R_{it} = [R_0 + (E_{i\text{-}vol\text{-}t}\ \alpha_{vol\text{-}t})] + \beta_{it}(R_{mt} - R_0) + \Sigma_{(j=1 \text{ to } 65)}\ E_{ijt}\ \alpha_{jt} + \varepsilon_{it}$$

R_0 = return to zero beta asset ($R_f + R_h$)

R_h = incremental return for market level higher moments

$E_{i\text{-}vol\text{-}t}$ = exposure of security i to total volatility factor in period t

$\alpha_{vol\text{-}t}$ = alpha of total volatility factor in period t

Expected value is 0

Expected value is negative

Expected value is positive

Expected value is 1

Empirical Analysis

- Using 372 months of the US Fundamental Model data ending December 2019, we used the estimation universe (all US traded equities with market cap over $250 million at each moment in time as both portfolio (cap weight) and benchmark (equal weight). The results are summarized in this table from our attribution system.

Beta Stratification Report													
Beta													
Range	Min	Max	Port Wt%	Bench Wt%	Actv W%	Port Ret%	Bench Ret%	Port Contrib	Bench Contrib	Weight Impact	Select Impact	WI T	SI T
1	2.25	< *	2.7	1.2	1.51	0.95	0.9	0.03	0	0	0.02	-0.44	1.93
2	2	2.25	2.1	1.26	0.84	1.08	0.89	0.02	0	0	0	1.42	0.27
3	1.75	2	3.34	2.61	0.74	1.24	1.8	0.04	0.04	0.02	-0.02	2.21	-1.63
4	1.5	1.75	5.95	5.3	0.65	1.2	1.21	0.06	0.04	0.02	0	1.9	-0.02
5	1.25	1.5	13.48	13.97	-0.49	1.06	0.9	0.13	0.13	0	0	0.03	0.34
6	1	1.25	25.13	27.8	-2.67	0.92	0.82	0.22	0.23	0	0	0.15	0.26
7	0.75	1	24.42	26.5	-2.08	0.95	0.86	0.24	0.25	0	0	0.97	0.11
8	0.5	0.75	14	14.68	-0.68	0.94	0.87	0.13	0.1	0	0.02	-0.95	1.38
9	0.25	0.5	7.37	5.77	1.6	0.82	0.75	0.07	0.04	0	0.01	0.1	1.25
10	< *	0.25	1.5	0.92	0.58	0.86	0.84	0.02	0	0	0	0.55	1

Empirical Analysis Discussion

Using the data which underlies the table we are able to estimate the key parameters of the "reordered" Fundamental Model

- There is positive correlation between beta values and portfolio returns on both a cap weighted (.41) and equal weighted (.61) basis. Both produce SML slopes (R_m-R_0)around **+1.6% per annum**, with T-stats of 3 and 3.6 respectively.
- Pooling results in a slope of **1.8% with a T-Stat of 4**
- The average value of R_h (risk premium for rare, large events) is .39% per month or about **4.7% per annum**, close to values from our hypothetical and Harvey and Siddique (3.6 for skew only)
- The times series average factor alpha to total volatility is **-.20%** per month, in line with our expectation of bankruptcy losses in equities with higher idiosyncratic risk.
- If we bifurcate the universe into "high vol" and "low vol" groups the resultant factor active factor exposure is consistent with the **3%** excess return for **bankruptcy avoidance.**

Discussion of Other Factor Alphas

- The foregoing suggests a robust representation of the role of risk in equity asset pricing, but "style factor" anomalies persist
  - An alpha of .71% per month associated with our "relative strength" (momentum) factor.
  - A combined alpha of .55% per month to the aggregate of the four valuation factors (flip signs to get price in denominator).

The Fundamentals Return Impacts

Factor	Port Exposure	Bench Exposure	Actv Exposure	Factor Alpha	Impact	Impact T
Price/Earnings	0.06	0.02	0.04	-0.18	-0.02	-1.67
Price/Books	0.03	0.28	-0.25	-0.07	0.01	0.74
Dividend Yield	-0.04	0.08	-0.11	0.18	-0.01	-1.56
Trading Activity	0.00	-0.24	0.24	-0.06	-0.02	-1.23
Relative Strength	0.00	0.01	0.00	0.71	-0.06	-2.49
Market Cap	0.00	1.88	-1.88	-0.13	0.25	2.21
Earnings Variability	0.04	-0.18	0.22	-0.11	-0.04	-2.98
EPS Growth Rate	-0.08	-0.06	-0.01	-0.03	0.01	0.88
Price/Revenue	0.01	0.16	-0.15	-0.12	0.02	1.78
Debt/Equity	0.02	0.14	-0.12	-0.07	0.00	1.27
Price Volatility	0.00	-0.32	0.32	-0.20	-0.07	-2.38

Now Re-Estimate the Entire Model

We next rebuilt the entire model under the assumptions of a "zero beta" construct where *4.2% per annum of the equity risk premium is ascribed to the potential for rare, large events* (resulting in skew and kurtosis) for the period July 2000 through May 2020 (n= 239 months)

	MEAN	T
Beta	0.11	0.35
Earnings/Price	0.12	2.70
Book/Price	-0.11	-1.72
Dividend Yield	0.03	0.69
Trading Activity	-0.06	-0.99
Relative Strength	0.11	1.06
Log of Market Cap	-0.13	-2.46
Earnings Variability	-0.15	-3.98
EPS Growth Rate	0.02	0.46
Revenue/Price	0.12	2.26
Debt/Equity	-0.07	-1.93
Price Volatility	-0.26	-2.85

Real Alpha Outcomes for 1990/2000-2020

The annual return to "beta" (slope of the SML) is about 1.4% per year not much different from our empirical result with the existing model of 1.6%. However, the result is not statistically significant.

The sum of the four valuation factors produces a more modest alpha of .17% per month (T = 1.37) and falling short of statistical significance.

- Within this group, the alpha for "book/price" was materially negative.

The monthly alpha for "relative strength" (i.e. momentum) remains positive but at much smaller magnitude of .11% per month (T = 1.06) and is *not statistically significant.*

We used the "total volatility" factor as a proxy for bankruptcy risk. The factor alpha was even more negative at -.26% per month (T= -2.85).

The monthly mean alpha for "size", earnings variability and leverage were all negative and statistically significant.

These results seems intuitive given two major events (GFC and the COVID-19 pandemic) in twenty years.

Factor Outcomes by Decade: 1990s

	Traditional CAPM			Extended CAPM		
1990-1999	Mean	StDev	T	Mean	StDev	T
Beta	0.95	4.14	2.51	0.53	4.78	1.22
Earnings/Price	0.06	0.59	1.20	0.09	0.81	1.16
Book/Price	0.17	0.72	2.55	0.04	0.83	0.59
Dividend Yield	0.21	0.89	2.58	0.16	0.99	1.78
Trading Activity	0.08	1.66	0.54	0.09	0.81	1.27
Relative Strength	1.13	2.07	5.97	-0.22	1.86	-1.30
Log of Market Cap	0.00	0.87	0.02	-0.37	4.60	-0.87
Earnings Variability	0.02	0.53	0.35	-0.03	0.56	-0.62
EPS Growth Rate	0.07	0.57	1.29	0.06	1.44	0.43
Revenue/Price	0.09	0.86	1.15	-0.05	0.54	-1.12
Debt/Equity	-0.06	0.78	-0.84	0.64	2.77	2.53
Price Volatility	0.03	1.06	0.32	-0.03	0.89	-0.40

Factor Outcomes By Decade: 2000s

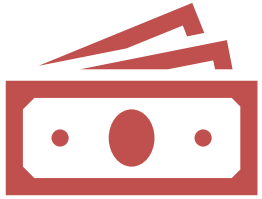
	Traditional CAPM			Extended CAPM		
2000-2009	Mean	Stdev	T	Mean	StDev	T
Beta	0.16	5.50	0.31	-0.08	5.56	-0.16
Earnings/Price	0.31	0.83	4.09	0.33	0.77	4.63
Book/Price	-0.05	1.10	-0.47	0.02	1.01	0.24
Dividend Yield	0.15	0.70	2.31	0.11	0.70	1.75
Trading Activity	-0.19	1.03	-1.99	-0.16	1.02	-1.68
Relative Strength	0.06	1.89	0.33	0.00	1.88	-0.03
Log of Market Cap	-0.28	0.93	-3.24	-0.23	1.06	-2.33
Earnings Variability	-0.24	0.73	-3.58	-0.24	0.74	-3.55
EPS Growth Rate	-0.06	0.78	-0.81	-0.05	0.78	-0.64
Revenue/Price	0.16	1.06	1.67	0.17	1.03	1.80
Debt/Equity	-0.07	0.69	-1.16	-0.05	0.63	-0.90
Price Volatility	-0.32	1.86	-1.90	-0.29	1.55	-2.04

Factor Outcomes By Decades: 2010s

	Traditional CAPM			Extended CAPM		
2010-2019	Mean	StDev	T	Mean	StDev	T
Beta	0.90	4.14	2.38	0.54	4.13	1.44
Earnings/Price	-0.06	0.54	-1.17	-0.04	0.54	-0.76
Book/Price	-0.20	0.80	-2.69	-0.17	0.80	-2.33
Dividend Yield	0.06	0.64	1.02	0.02	0.64	0.37
Trading Activity	-0.01	0.65	-0.14	0.01	0.65	0.21
Relative Strength	0.20	1.28	1.72	0.19	1.27	1.63
Log of Market Cap	-0.07	0.71	-1.04	-0.07	0.71	-1.10
Earnings Variability	-0.08	0.40	-2.24	-0.07	0.39	-2.03
EPS Growth Rate	0.04	0.51	0.86	0.04	0.50	0.80
Revenue/Price	0.08	0.58	1.43	0.08	0.58	1.57
Debt/Equity	-0.08	0.42	-2.19	-0.06	0.42	-1.68
Price Volatility	-0.36	1.21	-3.22	-0.29	1.22	-2.59

Almost Final Conclusions

The risk of large events, however defined has been a matter of great interest to investors for centuries.



Our investigation of asset pricing under the assumption that investors emphasize event risk in their decisions yields:

A large part of the equity risk premium is associated with rare but extreme events.

A smaller part of the equity risk premium is associated with the classic CAPM view of beta as the relevant risk measure for asset pricing.

The CAPM view that idiosyncratic risk should carry no return is refuted. We expect and find a negative return arising from bankruptcy risk at the firm level and contributing to co-skewness at the market level.

A Lesson in Financial Risk From Shakespeare

If we spirits have offended
Think but this and all is mended
That you have but slumbered here
While this visions did appear
And this weak and idle theme
No more yielding than a dream.

Gentles do not reprehend
If you pardon, we will mend
And as I am an honest Puck,
If we have unearned luck
Now to 'scape the serpent's tongue
We will make amends ere long;

Else the Puck a Liar call
And so Good Night unto you all;
Give me your hand if we be friends
And Robin shall restore amends.