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The Dao of Corporate Finance, Q Ratios, and Stock Market Crashes

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Takeaways

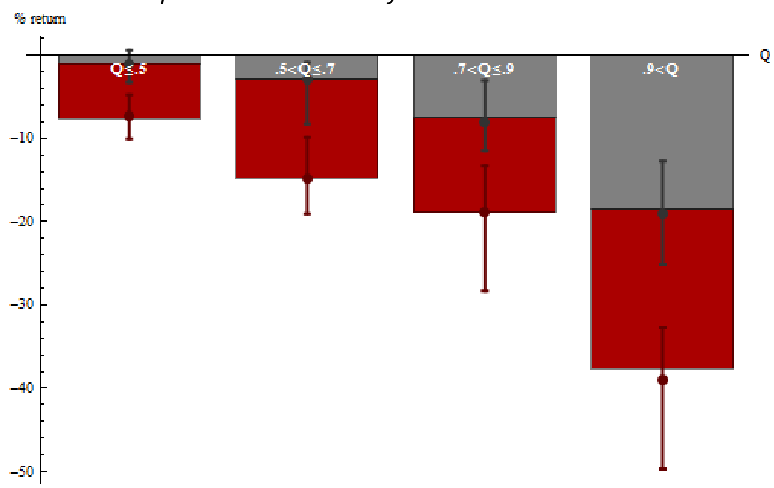
- ✓ **This white paper provides clear and rigorous evidence of a direct relationship between overvaluation and subsequent extreme losses in the aggregate stock market.**

- ✓ **Of equal importance is the use of the Q ratio as the most robust aggregate overvaluation metric, which isolates the key drivers of valuation.**

- ✓ **At current valuations (*Q* ≈ 1.04)—and if this 110-year relationship continues—there is an expected (median) drawdown of 20%, and a 20% chance of a larger than 40% correction in the S&P500 within the next few years; these probabilities continually reset as valuations remain elevated, making an eventual deep drawdown from current levels highly likely.**

Not a Pretty Picture

Median and 20th percentile S&P500 3-year maximum drawdowns since 1901



Historically, the higher the Q ratio, the fatter the subsequent left tail in the S&P500 (with 99% confidence).

Methodology

I begin with the deductive, exploring the corporate finance-based validity and robustness of the Q ratio as the appropriate measure of aggregate equity market valuation, and move to the inductive with an investigation of the empirical relationship between the Q ratio and crashes, utilizing non-parametric measurement of tails through straightforward quantile estimation and significance tests thereof.

I. The Dao of Corporate Finance

I start with first principles, a review of basic valuation (which will require only middle school maths). First, the "firm-foundation" principle from the 1938 book *The Theory of Investment Value* by Williams [1], which identified a stock's valuation as the discounted value of its stream of future dividends. This is the later formalized Gordon-Shapiro dividend discount model (or constant growth model) from 1956 [2]

$$Value = \frac{Dividend(1)}{y - g}$$

where *Dividend(1)* is the next dividend, *y* is the discount rate, and *g* is the constant growth rate of dividends.

Next, it is of course more correct to replace dividends with free cash flow (the net capital generated and available to shareholders, whether returned or not), identified as

$$\text{Free Cash Flow} = NOPLAT(1 - IR)$$

Where *NOPLAT* is "net operating profit less adjusted taxes" and *IR* is the rate of investment of *NOPLAT* back into the operations.

By adding some granularity to the growth rate

$$\text{g} = \text{ROIC} \times IR$$

where *ROIC* is the "return on invested capital", we come to

$$Value = \frac{NOPLAT\left(1 - \frac{g}{ROIC}\right)}{WACC - g}$$

(*WACC* is the "weighted average cost of capital", and *g* is now the growth rate of *NOPLAT*). I refer you to the Bible of valuation textbooks, *Valuation: Measuring and Managing the Value of Companies* by Koller, Goedhart, and Wessels [3], where the above formula is their "*key value driver formula*" (a.k.a. the "*Tao of corporate finance*"). In the authors' erudite words, "*You might go so far as to say that this formula represents all there is to valuation. Everything else is mere detail.*"[1]

With the simple relationship $NOPLAT = IC \times ROIC$, where *IC* is total tangible invested capital, we can arrive, finally, at our destination

$$Value = \frac{IC \times ROIC\left(1 - \frac{g}{ROIC}\right)}{WACC - g}$$

or

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[1] Furthermore, we will stay with the constant growth model for our intuition because, not only do we avoid the fussy and complex smoothing of inputs, but when it comes to the identification of aggregate market overvaluation (where there are no discernable or terribly relevant stages of returns and growth) more detail adds no insight.

$$\frac{Value}{IC} = \frac{ROIC - g}{WACC - g}$$

Rigorously simplifying valuation in this way, to quote Williams, “shows us what is relevant and why,” and we can specifically back out the implied *ROIC - WACC* spread[2] so that the formula becomes “a touchstone for absurdity.”[1] This ratio is indeed a very insightful metric to look at because, in aggregate, one would not expect the ROIC to deviate for long from the WACC. Competition drives excess returns on capital down toward the cost of that capital. We see this on individual companies (with some persistence), and we similarly see this on aggregate in an economy. To expect otherwise is to expect *greedy* entrepreneurs to sit by idly and watch excess profits delivered to (by definition) average businesses; of course in reality they swarm to such opportunities, competitively driving down the excess return on capital and driving up the cost of that capital, so that there is no such thing as excess profits for average businesses.[3] Similarly, aggregate ROIC below the aggregate cost of capital is unsustainable in a competitive economy because demand for capital would naturally diminish until the costs move in line with available average returns.

This is mere economic logic (like the *praxeology* of the Austrians) that would seem to hold by definition. As it turns out, unsurprisingly, it also happens to be how the world actually works, insofar as how *ROIC* has been constrained going back as far as we can look.[4]

So once ROIC must conform to *WACC*, the significance of g falls away in the formula (i.e., there is no gradient at g where *ROIC* = *WACC*). We have gone from three degrees of freedom (*ROIC, WACC, g*) to one (*ROIC* – *WACC)*, the excess profits generated. We are thus separating the wheat from the chaff, whenever $\frac{Value}{IC}$ is high it simply and precisely means that implied *ROIC* exceeds *WACC*, and this is really all we need to know.[5] Significantly, we are left with an unarguably robust valuation metric that requires no forecasts or assessments of the slippery inputs to DCF models. We avoid the need to predict the unpredictable.

Note that PE ratios, in contrast, require high implied growth rates *g* in order to perceive overvaluation, and are insensitive to even very high implied *ROIC* when implied g is low.[6]

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[2] Technically it is the implied $\frac{ROIC}{WACC}$ ratio that matters, of course, but I’ll refer to spreads here for simplicity.

[3] This does not apply to individual businesses, as competitive advantages certainly do exist—but this advantage is at a cost to the less advantaged, and such competitive advantages cannot exist, by definition, across all companies on average.

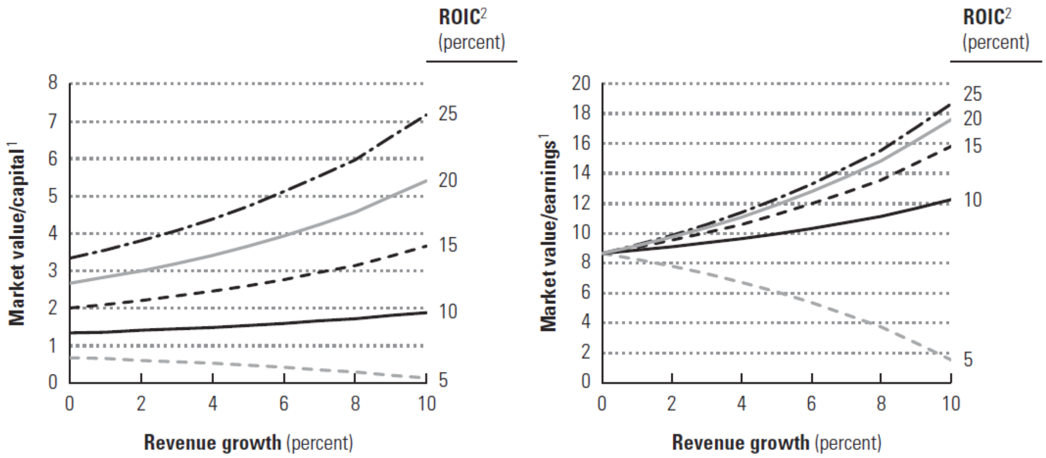
[4] I refer specifically to U.S. (nonfinancial) aggregate ROIC including goodwill, as omitting goodwill is akin to looking at EBITDA, conveniently and arbitrarily ignoring costs associated with a return (in this case the costs of acquisitions and resulting synergies). Since 1963, this *ROIC* has bounced around 8%, and meanwhile the median cost of capital has also been, surprise surprise, 8%—this during enormous gains in productivity, a clear case of competition at work [3].

[5] This would require forecasting if we were trying to estimate the right level of $\frac{Value}{IC}$ for an individual company, as individual companies will have dramatically differing *ROIC*s, some very high and some very low, and, again, these differences do in fact persist.

[6] Notice that $\frac{Value}{NOPLAT} = \frac{ROIC-g}{WACC-g}/\mathrm{ROIC}$, so it shouldn’t be surprising that the added degree of freedom of implied *ROIC* in the PE multiple creates a much noisier valuation metric. The well-known 10-year cyclically adjusted P/E ratio smoothes some of this, helped by the long term nominal stability of *ROIC*, making it a reasonable and consistent though still somewhat noisier measure of long-term value. (Pundits may be surprised at the near randomness of the TTM PE as a valuation metric.).

We can see how the *ROIC* - *WACC* spread drives $\frac{Value}{IC}$ below in *Figure 1* (reprinted from [3]), a basic sensitivity analysis on the present value formula.

Figure 1
Market Value, ROIC, and Growth: Theoretical Relationship *[3]*



[1] Market value is enterprise value, capital is invested capital, and earnings is earnings before interest and taxes (EBITA).
[2] Valuation assumes a competitive advantage period of 15 years, after which ROIC equals WACC at 7.5 percent and growth equals 3 percent in continuing value.

As long as implied *ROIC* = *WACC* in aggregate, valuation is insensitive to purturbations in *g*. But clearly earnings multiples are flawed because large overvaluation could be inpersceptible when driven by high *ROIC* (but with low expected future growth); $\frac{Value}{IC}$ would always show this overvaluation.

II. The Q ratio

I have established $\frac{Value}{IC}$ as the most robust metric with which to recognize aggregate overvaluation in the stock market. This is simply because it removes the need to pinpoint the three value drivers and instead isolates only whether or not implied *ROIC* = *WACC* in aggregate (which should hold under fair value), in which case nominal levels of the drivers are irrelevant; they become relevant only in amplifying an already over- or under-valued state.

This ratio is essentially the well known Tobin's Q ratio of Nobel Laureate James Tobin [4], which is the ratio of aggregate enterprise value (equity plus debt) to the aggregate corporate assets or invested capital[7] (or, with no debt, aggregate equity over assets); more specific to equity investors is the equity Q ratio (or *Q ratio*, which I am using in this paper), which is total equity over the net worth of the firm (where total assets are netted against total debt, so with no debt the net worth is the invested capital).[8] Both are thus insensitive to changing aggregate leverage.

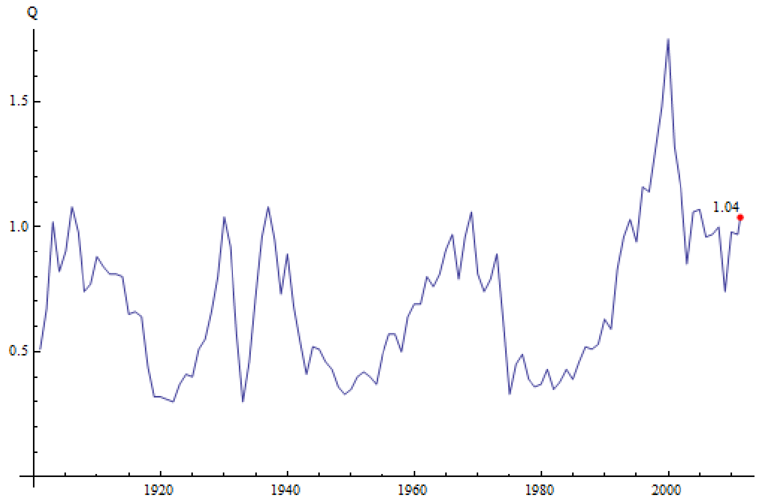
[7] All Q figures exclude financial companies.
[8] Tobin's Q and equity Q ratios take market prices of assets, rather than depreciation of historical invested capital; this is of course the only relevant thing to do when interested in fair equity value relative to the replacement cost of

$$\mathbf{Q} \approx \frac{Value}{IC} = \frac{ROIC - g}{WACC - g}$$

Tobin's original idea was that this ratio would drive aggregate investment and thus be constrained by it, using the competition argument I gave in the previous section. However, while investment and competition has clearly constrained *ROIC*, it has in fact been aggregate stock market valuations that have driven and constrained the Q ratio historically. After all, why would anyone pay more to purchase a business than they can get just by investing the same capital directly into a new competitor themselves? And why would anyone invest capital directly into a business when they can go out and simply purchase an existing competitor and get more for their money?

Here is the annual history of the Q ratio from the most current[9] all the way back to 1900[10], which is as far back as we can go.

Figure 2
U.S. Equity Valuations
The Q ratio, 1901 - present



The reader will notice that, while the Q ratio has clearly been mean reverting, the arithmetic mean to which it has been seemingly attracted is, surprisingly, not 1, but rather about .7. This, then, would be the appropriate "fair value" for use in gauging over- or under-valuation (and the March 2009 low actually came very close to this mean). It would have been expected for this Q ratio level to be where *ROIC* = *WACC*, that is, where the price equals the net worth of the businesses, *Q=1*. Ostensibly, the current value of invested capital (i.e., the replacement cost of company assets) has been systematically overstated (and its depreciation understated). This is evident in the historical aggregate *ROIC* as computed from Flow of Funds data *vis-à-vis* the actual known aggregate *ROIC* (and adjusting thereto is consistent with *Q ≈ 1*). This is further discussed in [5].

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the associated assets—real estate comes to mind, whose collapse has certainly helped boost the Q ratio in recent years.

[9] Current Q-ratios were estimated based on the updated market value of the aggregate US stock market. The most recent Z.1 Flow of Funds data was released June 9 and is current through Q1 2011 (and actually included some minor revisions back to 2004, none of which would change any of my results here if left unrevised).

[10] Q ratio data come from two sources: Data from 1952-2011 was calculated from Federal Reserve Z.1 Flow of Funds quarterly balance sheets, specifically by dividing section B.102 line 35 by line 32 (http://www.federalreserve.gov/releases/z1/Current/data.htm); data from 1900-1952 was extracted from historical Q data developed by James Tobin (which data corresponding to 1952-2011 matches Flow of Funds data well).

The Q ratio today is approximately 1.04. As is clear in *Figure 2*, this number is exceedingly high historically. This would imply that the U.S. equity market is today quite overvalued. The question for the remainder of this paper is: *What does this mean for the equity investor?*

If the Q ratio, like our $\frac{Value}{IC}$ from the *Dao of corporate finance*, is in fact the most robust and rigorous metric of aggregate stock market valuation and represents all there is to know about aggregate stock market valuation, shouldn't it be the case that it has empirical validity as well? That is, shouldn't it tell you something *ex ante* about subsequent aggregate equity returns? (The caveat of course, from Williams, is that, since "*the public is more emotional than logical, it is foolish to expect a relentless convergence of market price toward investment value.*"[1])

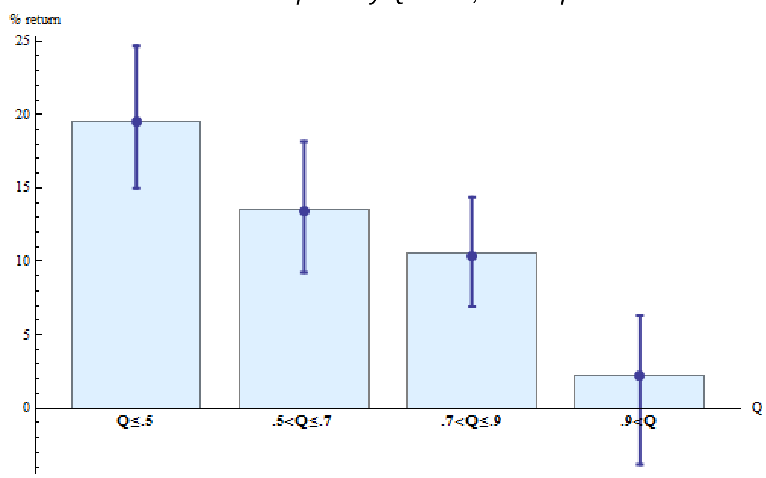
Just a casual perusal of *Figure 2* (and a basic memory of what U.S. stocks did during this period) tells the story quite well, but let's put some numbers on it. Figure 3 depicts a clear relationship between mean 1-year S&P500 total returns[11] and the starting level of the Q ratio,[12] going back to 1901.

Figure 3

Lower Expected Returns With Higher Q Ratios

S&P500 1-year mean total returns (with 99% confidence intervals)

Conditional on quarterly Q ratios, 1901 - present



When stocks are overvalued on aggregate, as identified by the Q ratio, their returns have been lower (with 99% confidence) than when they are less overvalued, not to mention undervalued. (Whenever one hears a reference to historical aggregate stock returns to support forecasts of future returns, it is good to recall that *not all historical returns were created equal*.)

I used non-parametric bootstrap confidence interval estimation to find the 99% confidence intervals of the sample means; my bootstrap methodology means I make no assumptions about the underlying distributional

[11] I use Standard & Poor's 500 price and dividend series data from Robert Schiller (http://www.econ.yale.edu/~shiller/data.htm), which is long (before 1900) and consistent data, both of which is essential for a paper that is studying tail properties.

[12] 1-year returns are calculated every quarter, due to the frequency of new Q data. The data were separated into four bins by their starting Q ratio, using Q = .5, .7, and .9 to get four roughly equal sized bins of sufficient size for testing (approximately 110 data points each, from 110 years times four quarters each year).

process/symmetry/ fat tailedness in any of this—which would be a strange thing to do particularly since I am ultimately investigating tail properties.

These are very historically significant conditional return expectations for investors, but it is the shape of the noise around these expectations (or, more specifically and pertinent to risk, the depth of the left tail), conditional on Q, which is particularly interesting. This brings us to the main point of this study.

III. The Left Tail

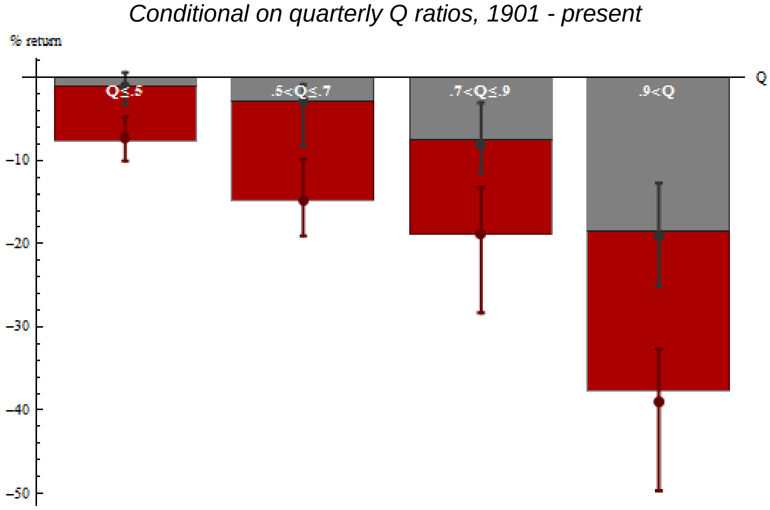
The Q ratio clearly and simply demonstrates a consensus opinion on whether the implied aggregate *ROIC - WACC* spread is positive or negative; furthermore, it has thus historically indicated over- or under-valuation with significant implications for corresponding subsequent performance (with 99% confidence). Insofar as the Q ratio is also able to expose the magnitude of that implied spread as well as perhaps of implied growth rates, where material, *it should not be surprising that it in turn indicates susceptibility to shifts from any extreme consensus. And such shifts of extreme consensus are naturally among the predominant mechanics of stock market crashes.*

I investigate the data to see if it corroborates my suspicion. I choose 3-year total return drawdowns (at monthly closes).[13]

Figure 4

The Q Wags the Tail: Tail Risk Explodes With Higher Q Ratios

Median and 20th percentile (with 99% confidence intervals) of S&P500 3-year total return maximum drawdowns Conditional on quarterly Q ratios, 1901 - present



The displayed median (50th) and 20th percentile 3-year drawdowns (with 99% confidence intervals) are the returns below which 50% and 20% of the observed 3-year drawdowns occurred, respectively (within a given Q ratio bin.) Visibly, with north of 99% confidence, the left tails are indeed fatter when conditioning on higher Q ratios *ex ante*.

[13] quite arbitrarily, as that is a window of time that seems to matter. (Due to the impatience from career risk, etc., if I looked at much longer returns I would undoubtedly loose most people.) My results are not surprisingly insensitive to this chosen window.

While overvaluation is murder on mean returns, as one should expect, it is even worse on risk.[14] (And taken together they imply very poor risk/reward in a stock market trading above its average valuation to aggregate tangible net worth.)

I used the non-parametric bootstrap simulation method used in [6], as well as non-parametric bootstrap confidence interval estimation again (as I did in *Figure 3*), to find the 99% confidence interval of a sample estimate of a quantile.[15]

IV. Concluding Remarks

This white paper provides clear and rigorous evidence of a direct relationship between overvaluation and subsequent extreme losses in the aggregate stock market. Of equal importance is the use of the Q ratio as the most robust aggregate overvaluation metric, which isolates the key drivers of valuation.

At current valuations (Q ≈ 1.04)—and if this 110-year relationship continues—there is an expected (median) drawdown of 20%, and a 20% chance of a larger than 40% correction in the S&P500 within the next few years. Should valuations remain elevated (that is, if no large correction materializes), these probabilities continually reset; this makes an eventual deep drawdown from current levels highly likely.

One must always be on guard for the fallacy of *post hoc ergo propter hoc*. While causation can never be proven, if one accepts the *Dao of corporate finance* formula, it would be surprising if conditioning on aggregate $\frac{Value}{IC}$ *ex ante* didn't impact the left tail of aggregate returns, particularly when implied value drivers are demonstrably at unsustainable extremes, and we merely sneak a peek to confirm our suspicion.

Figure 4 is the best picture I have ever seen depicting the endogenous risk control to be had from Benjamin Graham's *margin of safety* principle (which insists on cheapness to conservative fundamental assumptions in one's equity exposures, and thus provides added protection against errors in those assumptions). Downside risks are constrained by the compression of implied *ROIC* well below the cost of capital, just as, on the other extreme, these risks are greatly accentuated by the stretching of implied *ROIC* well above the cost of capital. The margin of safety principle is logically valid, but the focus afforded by the Q ratio (thanks to a little basic corporate finance) helps clearly illustrate this empirically.

Unfortunately, this type of risk control appears quite evidently, on aggregate, unavailable today. Those with an appreciation for the rigor of the evidence presented here and who are exposed to systematic risks are left to either lessen that exposure—impossible, I know, given the institutional imperative—or seek other more exogenous sources of convexity to add to their portfolio; the most rigorous way to do this is of course to overlay downside equity put options on the portfolio.[16]

Fat tails are a truly universal feature of stock market returns, and this white paper has undoubtedly shown one of the criteria from which properties of tails can be better understood and, most importantly, even anticipated.

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[14] The right tail diminishes significantly and similarly—though inversely to the left—with higher Q; there is apparent increasing negative skewness of returns with higher Q, rather than simply a downward shift in the entire distribution.

[15] Any skeptics of my bootstrap approach in this study should note that, assuming the range of power law tails regularly measured in equity market returns (implying non-finite higher moments), any bias in our bootstrap tail measurement methodology will be on the low end (and perhaps very low).

[16] It is quite convenient that, ironically, with the Q ratio exceedingly high today, the pricing of these options is back to their "Great Moderation" levels. In fact, their pricing is historically at worse independent of Q levels, and at best their pricing gets even cheaper as the Q gets loftier.

Appendix 1: Anticipated Grievances

There are four potential criticisms of my analysis and conclusions that I have identified and anticipate. I address them below.

1. **Higher current aggregate intangible capital.** It is demonstrable that aggregate intangible value (assuming it exists) has remained proportional to replacement value of aggregate tangible value (as in the historical stability of *ROIC* with goodwill). I refer the reader to [5] for an excellent treatment of this. Furthermore, excess returns above the cost of capital require a competitive advantage which, by definition, is a zero sum game. One's competitive advantage is another's disadvantage.
2. **Low current aggregate costs of capital.** A look at how the total debt to total equity ratio of the S&P500 has collapsed (by about half from 2007 to now) while interest rates (including corporate costs of debt capital) have also collapsed should convince anyone that *WACC* has not gone down consistent with rates. (In fact, it is the very lack of corporate demand for capital that has prompted the Federal Reserve to be as aggressive as it has, and changes in liquidity preference with changes in interest rates make any benefit from low rates far from straightforward.)
3. **Higher current aggregate returns on invested capital without goodwill.** See footnote 4.
4. **Black swans are unpredictable.** I don't dispute this, of course. I have merely identified and tested the mechanism by which the aggregate market's overvaluation raises its susceptibility to severe adverse re-valuation; the forces which act on this mechanism remain inherently unpredictable. (For instance, the valuation of the aggregate equity market likely would matter not the instant before the world became engulfed in nuclear war.)

Appendix 2: References

[1] Williams J.B., *The Theory of Investment Value* (Harvard University Press, 1938).

[2] Gordon, M.J. and E. Shapiro, “Capital Investment Analysis: The Required Rate of Profit”, *Management Sci.* 3, 102-110, (1956).

[3] Koller, T., M. Goedhart, D. Wessels, and McKinsey & Company, *Valuation: Measuring and Managing the Value of Companies*, 5th ed. (Wiley, 2010). **Graph re-printed with permission.**

[4] Tobin, J., "A General Equilibrium Approach to Monetary Theory", *Journal of Money Credit and Banking* 1, 15–29, (1969).

[5] Smithers, A., and S. Wright, *Valuing Wall Street: Protecting Wealth In Turbulent Markets*, (McGraw-Hill, 2000).

[6] Pandey, M.D., P.H.A.J.M. Van Gelder, and J.K. Vrijling, “Bootstrap simulations for evaluating the uncertainty associated with peaks-over-threshold estimates of extreme wind velocity”, *Environmetrics*, 27-43 (2003)

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