PIMCO

Three Dogs That Did Not Bark: Risk Premia and Stock Market Shocks

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Executive Summary

- There's a bone of contention among investors: Are U.S. equity values about right or far too high?
- Based on the equity risk premium, stocks are either marginally expensive or fairly valued (depending on the data window).
- Yet standard valuation ratios – such as market capitalization-to-GDP, Tobin's Q, CAPE and market cap-to-corporate profits – suggest stock prices are severely inflated.
- Equity values are vulnerable to three types of risk premia: the conventional equity risk premium, the risk of monetary tightening and the prospect of decreasing inequality.

What to make of this discrepancy among equity valuation metrics? And what variables matter most in assessing the risk of major shocks in broad equity markets? By simply looking at the Gordon growth model, we can see that equity prices are sensitive to the equity risk premium as well as some definitions of bond risk premia and the equality risk premium, which we define later in this paper. This decomposition can help illuminate how macro events affect equity prices.

We conclude:

- Standard valuation ratios indicate a very expensive U.S. stock market, while the equity risk premium suggests that stocks are fair to slightly expensive relative to bonds. However, the equity risk premium is a deceptive measure of equity value.
- For a fuller picture, we believe investors need to look at three risk premia: the equity risk premium, the bond risk premium and the equality risk premium. (Note: Our definitions of the latter two differ from those in the literature – and both are more definitions than risk premia per se.) These premia have shrunk owing to quantitative easing (QE), increased leverage, lower taxes and other factors. Yet there is a variety of plausible mean-reversion scenarios: monetary tightening, deleveraging, populism that impedes trade flows and raises some taxes, and a clampdown on tech giants, to name a few.
- Bubbles, though, can last longer than intuition suggests: Over short periods, bears are likely to be right on the fundamentals but wrong on the market.

VALUATION RATIOS: RED ALERT

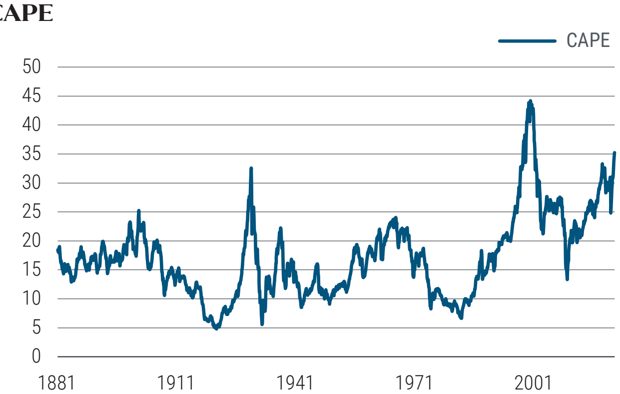
Standard valuation ratios all scream extreme equity values (see Exhibit 1). Equity values, conditional on earnings and replacement cost, range from the 88th to the 100th percentiles on a historical basis. Clearly, not all of these ratios are stationary; for example, market cap-to-GDP tends to increase as economies become more financialized.

Yet, as will be discussed below, this is a far cry from the benign view suggested by the equity risk premium. Note that, unlike the equity risk premium, none of the valuation metrics in Exhibit 1 uses interest rates as a benchmark.

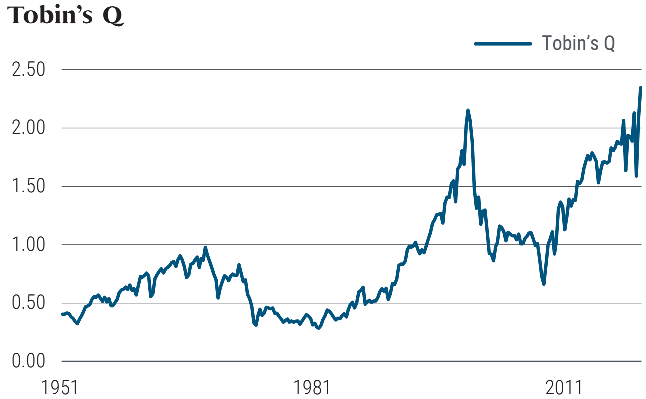
Exhibit 1: Valuation metrics (full history)

	Current	Percentile	Average	Current / average	Minimum	Maximum
CAPE	35.2	98%	17.1	2.1	4.8	44.2
Tobin's Q	2.3	100%	0.9	2.6	0.3	2.3
Market cap / GDP	2.11	100%	0.45	4.6	0.06	2.11
Market cap / corporate profits	17.0	88%	12.0	1.4	3.5	35.0

CAPE

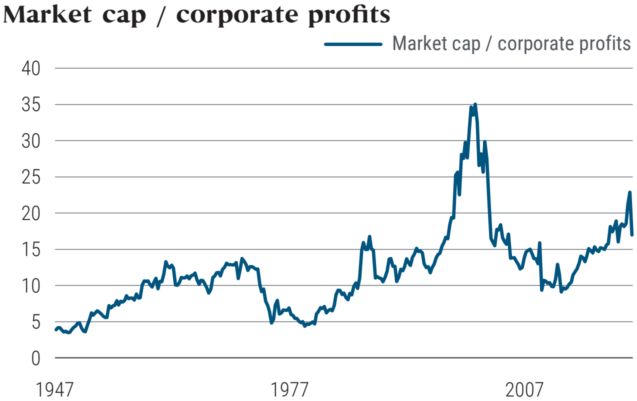


Tobin's Q



Market cap / GDP

Market cap / corporate profits



Source: Robert J. Shiller Database, Global Financial Data, FRED and PIMCO. The CAPE time-series data is available from January 1881 to February 2021. Tobin's Q is computed from December 1951 to September 2020. Market capitalization-to-GDP history is from December 1791 to December 2020. Market capitalization-to-corporate profits is available from March 1947 to September 2020.

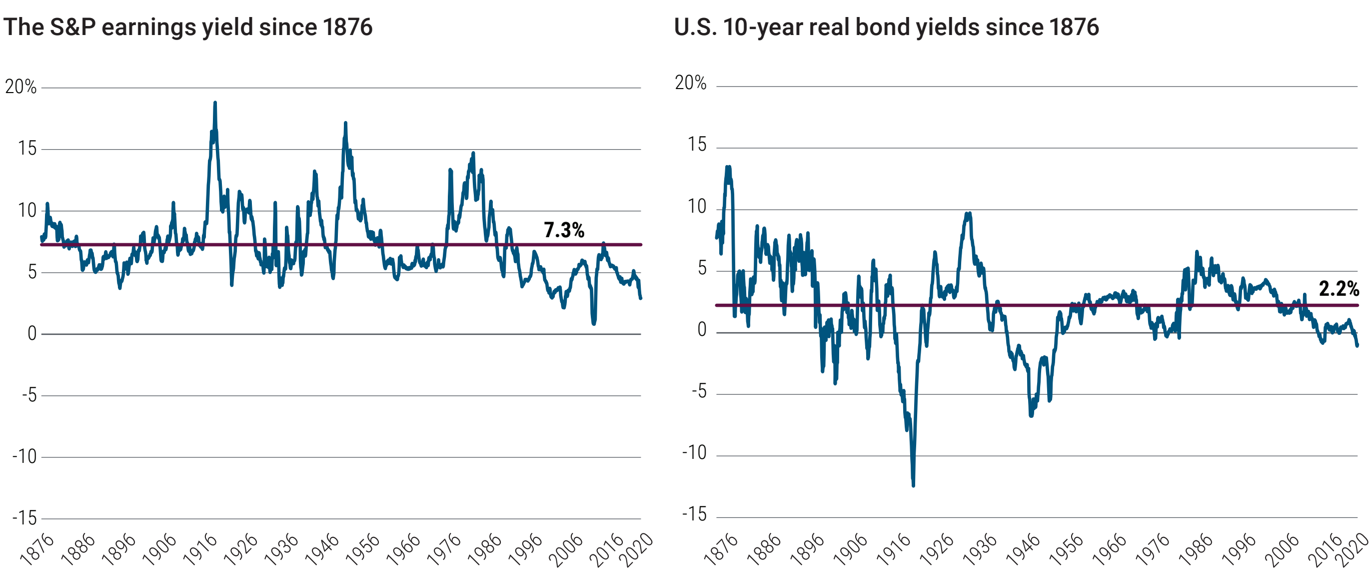
THE EQUITY RISK PREMIUM: BENIGN BUT DECEPTIVE

Often used as a valuation gauge for broad equity indices, the equity risk premium is the difference between equity and bond yields. The real bond yield in the U.S. is set by the market for Treasury Inflation-Protected Securities (TIPS). As of December 2020, the 10-year TIPS yield was about -106 basis points. The real equity yield can be calculated in one of two ways: It is the sum of the dividend yield and real dividend growth; alternatively, as shown in Appendix 1, the real equity yield is the earnings yield, or the inverse of the price-to-earnings ratio.

Using the latter measure, the equity risk premium on the S&P 500 is the earnings yield (2.46%) minus the 10-year TIPS yield (-1.06%), or 3.52%. As noted, this is modestly below the long-term average (see Exhibit 3), and according to this naive view, equity appears to be only marginally expensive against bonds. This may explain the conventional wisdom that "equities are not expensive when taking into account low interest rates."

However, the equity risk premium measures the relative value of equity versus bonds, whereas the real equity yield, or the earnings yield, is a measure of the absolute value of equity. And there an extended time-series tells a different story: As shown in Exhibit 2, real yields for both equities and bonds trade below historical averages. To the extent real yields revert

Exhibit 2: Real yields for both equities and bonds are below historical averages



Source: PIMCO, Shiller Database and Bloomberg as of 31 December 2020 to a long-term mean, there is a presumption that both equities and bonds may be expensive. However, the fact that equities are trading at close to fair value against bonds may still mean that equities are expensive in absolute terms.

THREE RISK PREMIA

To investigate the matter further, it may be informative to express the price of a stock index as a function of three risk premia (see Appendices 2 and 3). Importantly, our definitions of the bond and equality risk premia do not strictly follow the academic definition. In particular, the bond risk premium is generally meant to refer to the difference between forward and expected interest rates – whereas our definition relies on standard macroeconomic models in which the real interest rate is close or equal to the long-term real growth rate.

$$P = \frac{d}{\alpha+\beta+\gamma}, \tag{1}$$

where risk premia are defined as follows:

α = equity risk premium = real equity yield – real bond yield

β = bond risk premium = real bond yield – real GDP growth

γ = equality risk premium = real GDP growth – real dividend growth

$\boldsymbol{\alpha}$, the equity risk premium, measures the extra yield required by investors to hold risky equities instead of bonds. $\boldsymbol{\beta}$, the bond risk premium, measures the disparity between bond yields and GDP growth. In general equilibrium models, there is a close relationship between growth and interest rates. $\boldsymbol{\gamma}$, the equality risk premium, sizes the distribution of the value added within an economy. A high $\boldsymbol{\gamma}$ indicates that labor is favored against capital – the higher $\boldsymbol{\gamma}$, the lower the capital-to-income ratio and the lower the profit-to-GDP ratio.

The stock market likes a lower $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$. That is, stocks tend to rally when the equity yield is low compared with the bond yield, as the bond yield falls relative to GDP growth and as GDP growth undershoots dividend growth. Put differently, the stock market rises when the equity risk premium is low; it also rallies on the back of central bank tampering with intertemporal equilibria by pushing real yields aggressively below real growth; and markets abhor equality to the extent that it stands in the way of rapid earnings and dividend growth.

To state the obvious, risk premia respond to a variety of parameters: For example, the equity risk premium may fall in reaction to lessened risk aversion or lower equity transaction costs; the bond risk premium may decline in response to lower inflation or more expansionary monetary policy; and the equality risk premium could decrease with lower corporate tax rates or reduced bargaining power of the workforce.

What is the sensitivity of the equity price to each premium? As shown in Appendix 3, the duration of the stock market with respect to each premium is equal to the price-dividend ratio – typically a large number, on the order of 20 to 60 years. A secular downward trend in risk premia can do wonders for equity investors.

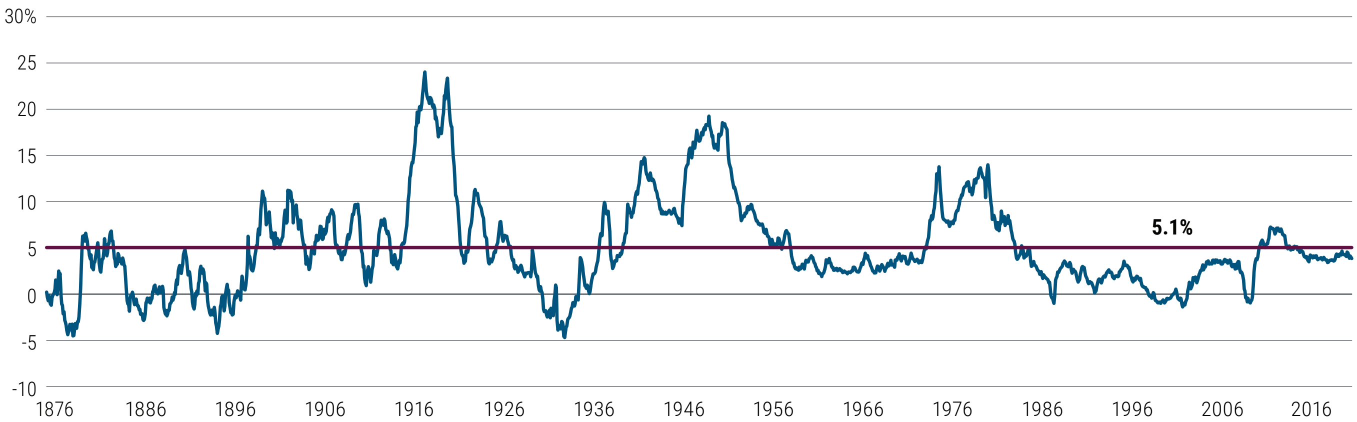
THREE DOGS THAT DID NOT BARK: ARE α, β AND γ TOO LOW?

We believe the answer is yes, but to varying degrees: As Exhibit 3 shows, the equity risk premium $\boldsymbol{\alpha}$ is lower than its long-term average, but only slightly. The bond risk premium $\boldsymbol{\beta}$ is also lower than its long-term average value.[1] The equality risk premium is not observable. However, a simple look at the time-series of the GDP-to-profit ratio shows that this ratio may well increase over a long horizon. This is another way of saying that profits may not be sustainable as a ratio to GDP and that $\boldsymbol{\gamma}$ should increase to get to its long-term average. In summary, all three parameters seem to be on the low side – and certainly, they are too low in combination. One can think of $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ as three dogs that have not barked for a while.

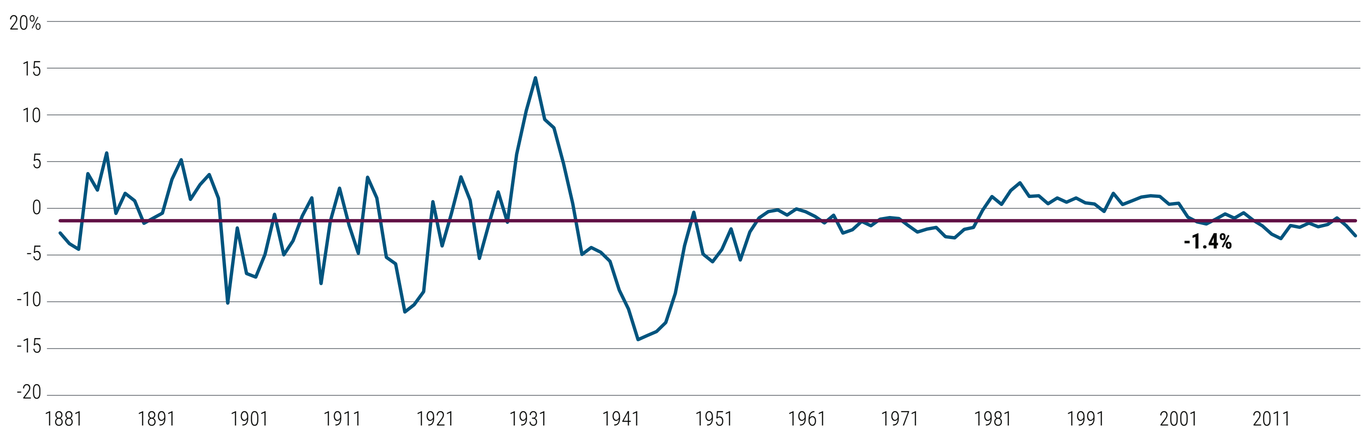
1 Because inflation-linked bonds did not exist before 1997, we estimate real yields by subtracting moving averages of five-year inflation from nominal yields to back-populate the time-series.

Exhibit 3: Evolution of the three risk premia

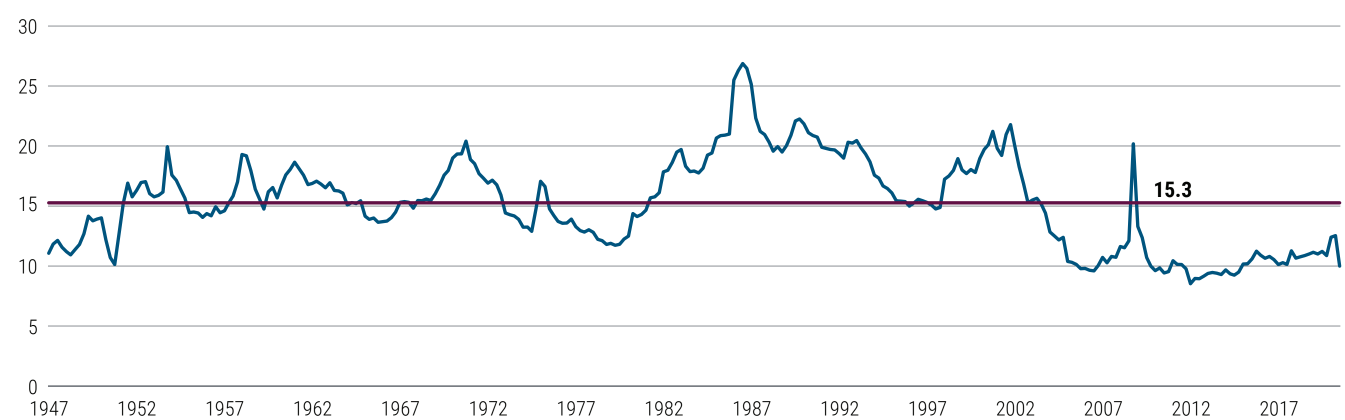
α — earnings yield minus 10-year real bond yield



β — 10-year real bond yield minus 10-year real GDP growth



γ — proxied by the GDP-to-profit ratio (not to scale)



Source: PIMCO, Bloomberg, FRED and the Shiller Database as of December 2020 for α, December 2020 for β and September 2020 for γ. The inflation expectation for TIPS prior to their creation in 1997 and before the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters is estimated based on the assumption that the forecast follows an autoregressive process of the five previous historical yearly levels of inflation with no intercept. We are using the Philadelphia survey data to extract the coefficients. The same approach is applied to the GDP year-over-year forecast.

WHAT WERE THE MAIN CATALYSTS OF LOWER RISK PREMIA?

Quantitative easing is certainly a prime candidate. By forcing riskless rates toward zero, the QE programs the Federal Reserve enacted from 2008–2013 encouraged an excess bid on risk assets, thereby forcing $\boldsymbol{\alpha}$, the equity risk premium, lower. It can also be said that one of the main purposes of QE was to distort the intertemporal equilibrium – that is, to drive $\boldsymbol{\beta}$ lower than otherwise required by normal economic forces. Lastly, by encouraging leverage and lowering the cost of capital, QE drove profit growth (think of financials) well above GDP growth – that is, a lower $\boldsymbol{\gamma}$.

Leverage is a central factor in reducing risk premia. Of course, higher leverage causes excess demand for both stocks and, to a lesser extent, bonds – lowering both $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$. More crucial, perhaps, is the impact of leverage on profits. Recall that GDP can be calculated by accounting for expenditure, or for the income accruing to production factors. This means:

$$\text{Consumption} + \text{investment} + \text{government spending} = \text{wages} + \text{profits} + \text{taxes}$$

In other words:

$$\begin{aligned}\text{Profits} &= \text{investment} + (\text{consumption} - \text{wages}) + (\text{government spending} - \text{taxes}) \\ &= \text{investment} + \text{private deficit} + \text{public deficit.}\end{aligned}$$

But because public deficit and private deficit are, to a first order, the change in public and private debt, profits are the sum of investment and the change in debt:

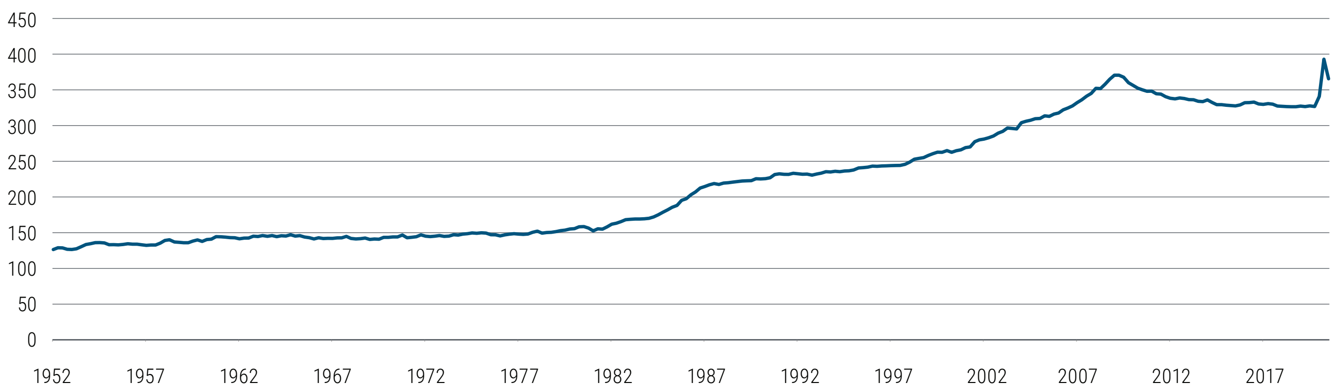
$$\text{Profits} = \text{investment} + \text{change in leverage}$$

Thus, profits (and γ) and leverage are joined at the hip. So if leverage, as shown in Exhibit 4, is at historically high levels that are likely to decline, one has to draw similar conclusions about profits.

Among the garden variety of factors causing lower risk premia, one can add, in no particular order, lower corporate taxes, increased market power of large firms (e.g., network effects, high barriers to entry, increasing returns to scale in the tech sector), open capital accounts, outsourcing, and lower market power of the workforce.

All these factors have played out concurrently. One can see how these factors going in reverse would cause the dogs to bark. Leverage in the Group of Seven countries is at very high levels; fiscal deficits will put upward pressure on tax rates; although monetary policy could remain loose, there is a nontrivial risk that an L-shaped Phillips curve forces central banks to tighten, thus widening the bond risk premium; and political populism may well strengthen labor market power, while restricting trade and capital market flows.

Exhibit 4: U.S. total debt-to-GDP (%)



Source: PIMCO, Haver Analytics and FRED as of 30 September 2020

Exhibit 5: Risk premia prime ingredients

	More restrictive monetary policy	Deleveraging	Higher tax regime	Higher risk aversion	Clampdown on tech giants	Trade war	Labor market power
α	↑	↑	↑	↑	≈	≈	≈
β	↑	↑	≈	≈	↓	≈	≈
γ	↑	↑	↑	≈	↑	↑	↑

Source: PIMCO

Exhibit 5 shows how the prime ingredients of risk are likely to affect the equity, bond and equality risk premia.

It appears that prime market movers stand to affect the equality risk premium more than the equity premium or the bond risk premium. While many may agree that inequality is a societal problem, aggressive redistribution from capital to labor may cause serious damage to the equity market.

To put these risk premia in the perspective of past market shocks, the 1920s were a case of both equity and equality risk premia tanking, leading to the most famous crash in financial history. In the same vein, the beginning of the 2000s saw a rare occurrence – a period of negative equity risk premia. It was followed immediately by a substantial sell-off. The 2008–2009 crash seems to have been partially caused by a combination of low bond and equality risk premia in the prior years.

SHOCK PROBABILITIES

This leaves us with the question of shocks and crashes. How likely is a stock market crash? (See Appendix 4.)

As can be seen, probabilities of large stock market shocks depend critically on whether valuation metrics endure or revert to historical means. Over a 10-year horizon and under a "fairly valued" regime, where valuations stand firm – assuming an earnings yield of 3% – the probability of a 50% sell-off is 59% and that of a 70% sell-off is 57%. Under a full mean-reverting regime, it is a wholly different story: An earnings yield of -1% results in very large drawdown probabilities over 10 years. A 50% sell-off has a 72% probability, and a 70% sell-off has a 69% probability (see Exhibit 6).

What these simple calculations illustrate is the potential for large surprises at current valuation metrics – should these revert to historical norms.

Exhibit 6: One-touch probabilities of shocks and crashes within 5- and 10-year horizons

(Drawdowns from current levels)

	Time horizon: 5Y			Time horizon: 10Y		
Earnings yield	-30%	-50%	-70%	-30%	-50%	-70%
3%	63%	49%	46%	72%	59%	57%
-1%	72%	59%	55%	83%	72%	69%

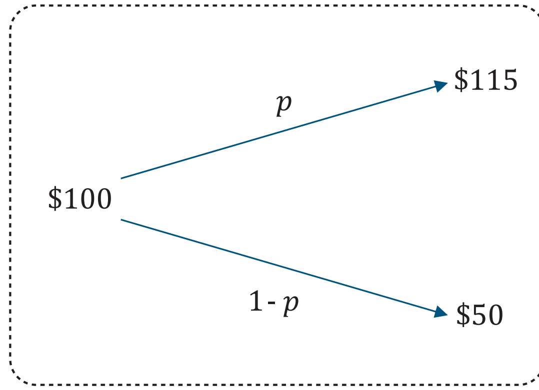
Source: PIMCO and Bloomberg as of 4 March 2021

CAVEATS

There are two caveats to keep in mind: First, broad valuations outside the U.S. appear way more benign. Second, the mean-reversion scenario that we refer to could take a long time, if ever, to materialize.

Lower risk premia may last for an extended period of time. As an illustration, consider the stylistic example in Exhibit 7. An asset is trading at $100 but has a fundamental value of $50. Assume that the asset is priced at $115 in the upside scenario and $50 in the downside (i.e., the mean-reversion) scenario. Also assume that, because this asset is overpriced, the expected return is -3%. A question that may be of interest to investors is: What is the probability of the upside, meaning the probability of the bubble getting bubblier? A simple calculation shows that this probability, contrary to most people's intuition, is high at 72%. The expected life of the bubble is 1(1 - 72%), which is about 3.6 years. This leads to a rather surprising conclusion: If you are an informed bear, you will be fundamentally right but probably factually wrong.

Exhibit 7: Bubble logic illustrated with a binomial tree



$$100 = (115p + 50(1-p))e^{-(-0.03)}$$

$$\boxed{p = 72\%}$$

Source: PIMCO

APPENDIX 1

Why the real equity yield is equal to the earnings yield

A stock index price $\boldsymbol{P}$ is the present value of its dividends, with the initial dividend $\boldsymbol{D}$ growing at a real rate $\boldsymbol{g}$ and discounted at a real equity yield $\boldsymbol{r}$:

$$P = \int_0^{\infty} De^{gt}e^{-rt}dt = \frac{D}{r-g}.$$

Hence:

$$r = \frac{D}{P} + g.$$

With $\boldsymbol{R}$ designating the real bond yield, the equity risk premium is:

$$ERP = r - R = \frac{D}{P} + g - R.$$

With $\boldsymbol{i}$ the real internal rate of return and $\boldsymbol{b}$ the earnings retention rate ($b = \frac{E_R}{E}$ where E_R are the retained earnings and $\boldsymbol{E}$ are the earnings), $\boldsymbol{g}$ can be written as:

$$g = bi.$$

This is true as dividend growth is equal to earnings growth, $g = \frac{dE}{E}$, and earnings grow at the real internal rate of return achieved on retained earnings, so i $= \frac{dE}{E_R}$.

Firms will keep investing until the real internal rate of return matches the real equity yield; hence, $\boldsymbol{i} = \boldsymbol{r}$. We thus have:

$$P = \frac{D}{r - br} = \frac{D}{r(1-b)} = \frac{E}{r},$$

therefore:

$$\frac{E}{P} = r.$$

APPENDIX 2

Equity pricing formula

The simplest formulation of an equity price is given by the so-called dividend discount model:

$$P = \int_0^{+\infty} de^{gt}e^{-rt}\,dt = \frac{d}{r-g},$$

where $\boldsymbol{d}$ is the dividend, $\boldsymbol{r}$ is the real equity yield, $\boldsymbol{g}$ is real dividend growth and $\boldsymbol{t}$ is time. Adding and subtracting the real bond yield and adding and subtracting the real GDP growth rate in the denominator, we obtain:

$$P = \frac{d}{\alpha+\beta+\gamma}.$$

APPENDIX 3

Equity sensitivity to risk premia

From the above:

$$\frac{\partial P}{\partial \alpha} = \frac{\partial P}{\partial \beta} = \frac{\partial P}{\partial \gamma} = \frac{-d}{(\alpha+\beta+\gamma)^2},$$

and the duration D with respect to $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ is:

$$D = -\frac{\frac{\partial P}{\partial \alpha}}{P} = -\frac{\frac{\partial P}{\partial \beta}}{P} = -\frac{\frac{\partial P}{\partial \gamma}}{P} = \frac{\frac{d}{(\alpha+\beta+\gamma)^2}}{\frac{d}{\alpha+\beta+\gamma}} = \frac{P}{d},$$

so that:

$$\frac{dP}{P} = -D(d\alpha + d\beta + d\gamma) = -\frac{P}{d}(d\alpha + d\beta + d\gamma).$$

APPENDIX 4

First passage probability of a minimum

The probability at time zero of the minimum of an arithmetic Brownian hitting a low point $\boldsymbol{x}$ before time $\boldsymbol{t}$ is:

$$Prob(m \le x) = \varphi\left(\frac{x-at}{b\sqrt{t}}\right) + e^{1-\frac{2a}{b^2}}\varphi\left(\frac{x+at}{b\sqrt{t}}\right),$$

where $\boldsymbol{a}$ and $\boldsymbol{b}$ are the drift and volatility of the variable, $\boldsymbol{t}$ is time and $\boldsymbol{\varphi}$ is the cumulative normal distribution operator.

Let us apply this to a price level $\boldsymbol{S}$. If $\frac{dS}{S} = \mu dt + \sigma dW$, then, by Itô's lemma, the price logarithm follows the following equation: $dlnS = \left(\mu - \frac{\sigma^2}{2}\right)dt + \sigma dW$.

To calculate the probability that the minimum level of $\boldsymbol{S}$ goes below some number $\boldsymbol{K}$, set in the first equation $\equiv \mu - \frac{\sigma^2}{2}$, $b \equiv \sigma$ and $x \equiv ln\frac{K}{S}$ to get:

$$Prob(S_{min} \le K) = \varphi\left(\frac{-ln\frac{S}{K} - \left(\mu - \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}\right) + \left(\frac{S}{K}\right)^{1-\frac{2\mu}{\sigma^2}}\varphi\left(\frac{-ln\frac{S}{K} + \left(\mu - \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}\right).$$

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