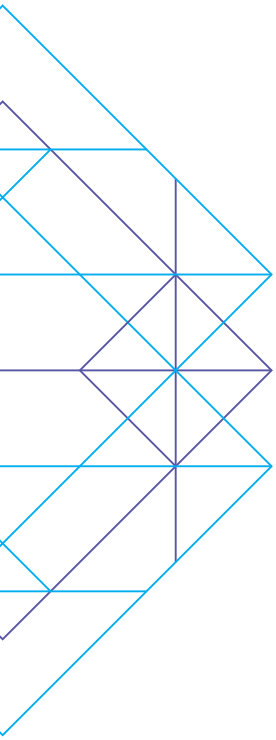
AQR White Paper | November 2019

Chasing Your Own Tail (Risk), Revisited



Introduction

One of the most important topics on investors' minds following the Global Financial Crisis was how to protect their portfolios from the next crisis. Our paper "Chasing Your Own Tail (Risk)" was our response.[1] In it, we argued that for most investors, the conventional way to protect a portfolio — through the purchase of options — was too costly; instead, we presented five ideas that we thought would serve long-term investors better.

Since then, traditional 60/40 portfolios have had above-average returns and much lower-than-average risk.[2] Thus, *any* strategy designed to mitigate risk has recently faced at least two headwinds: few risks to protect against, and a high performance hurdle to warrant its inclusion in a portfolio. But today, perhaps in part due to high stock and bond market valuations,[3] the length of the post-GFC bull run, or fears of where we are in the business cycle,[4] investors have once again turned to addressing the risk of a severely declining market.

With that backdrop, and with eight years behind us, we evaluate how our original recommendations held up and summarize some of the research we've put out since then about building a more resilient portfolio.

Ashwin Thapar
Managing Director

Lars Nielsen
Principal

Daniel Villalon
Managing Director

We thank Gregor Andrade, Emily Cherkassky, Noah Feilbogen, April Frieda, Jeremy Getson, John Huss, Ronen Israel, Roni Israelov, Bradley Jones, and Harsha Tummala for their suggestions and comments.

1 Berger, Nielsen and Villalon (2011).
2 From July 2011-June 2019, a traditional US 60/40 portfolio has had returns in the 83rd percentile versus history and volatility in the 4th percentile versus history when compared to all monthly overlapping eight-year returns from August 1946 to June 2019. The traditional US 60/40 Portfolio is 60% S&P 500 and 40% US 10-Year Treasuries. Prior to the S&P 500, Ibbotson's rendition of the S&P 500 is used. Global data (using MSCI World and G6 country 10-year bonds) has been directionally similar (though less extreme) over the same period, with returns that were 7th percentile versus history, and volatility that was 34th percentile versus history.
3 For example, see AQR Alternative Thinking 1Q2019.
4 Fader and Mees (2019).

Contents

Problem: The High Cost of Insurance

Eight years ago, we showed how expensive option-based financial insurance tends to be for long-term investors.[5] This point has only been bolstered since then. And while it's not surprising that in a bull market, an investor who purchases protection would underperform one who doesn't — over the past eight years, a 5% out-of-the-money put-protected US 60/40 investor would have earned only 7.0% compared to 9.0% for the "unprotected" investor — what might be surprising is this performance drag is almost exactly the same as it's been long term.

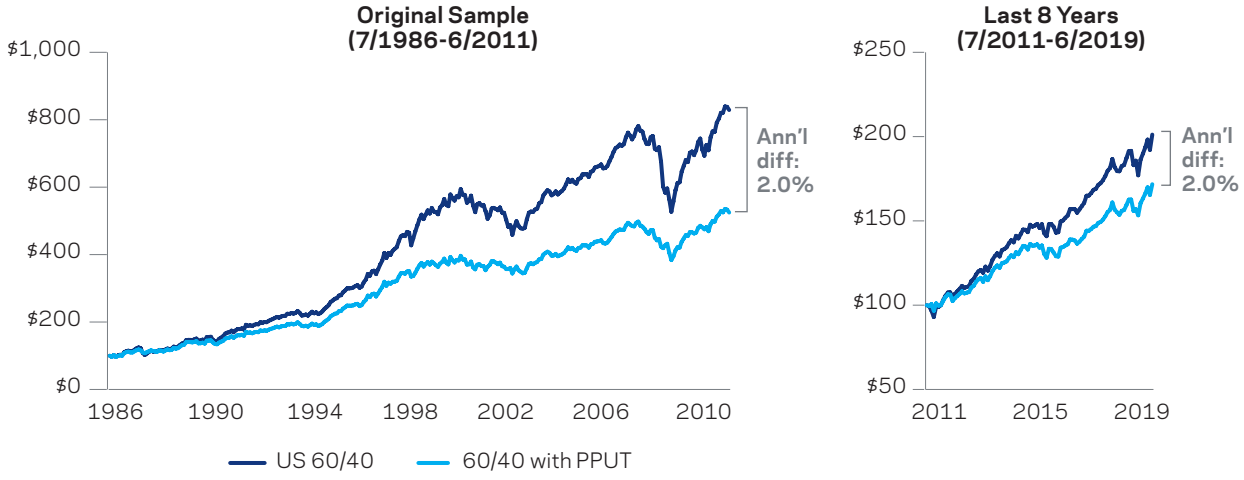
Granted, a drag on *average* returns could be worth it if a protected portfolio were largely able to avoid big drawdowns — for example, it could help an investor stay invested or even be a source of "dry powder" in a crisis. Unfortunately, even this hope isn't well-supported by the data.

Consider the worst drawdowns for equities: a put-protected equity portfolio has been less effective at mitigating losses and the length of drawdowns than most investors might expect (see Exhibit 2). Puts might stand a better chance amid short, sharp sell-offs in otherwise calm markets, but those conditions do a poor job characterizing the worst drawdowns investors have actually faced.

AQR research over the past eight years has added to our critique of options as a hedge for most investors, extending the evidence beyond US equities to include international markets and multiple asset classes:

- **Pathetic Protection**[6]: The hoped-for insurance benefit of options relies crucially on getting two things right: 1) buying an option shortly before a market drawdown, and 2) having the option's expiration align

Exhibit 1 – Options-Based Insurance: What a Drag



Source: AQR and CBOE. 60/40 portfolios represent 40% U.S. Bonds and 60% S&P 500 or 60% PPUT. PPUT is the CBOE's put-protected index, which holds a long position indexed to the S&P 500 and buys monthly 5% out-of-the-money S&P 500 put options as a hedge. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

5 In this paper, we evaluate put options on stocks only (as opposed to on stocks *and* bonds), as stocks tend to be the dominant source of risk in most portfolios, and many investors already view bonds as a diversifier (and sometimes as an indirect hedge) to stock market risk. (But please note, this choice is not to be construed as investment advice or a specific recommendation to buy, hold or sell a security.)

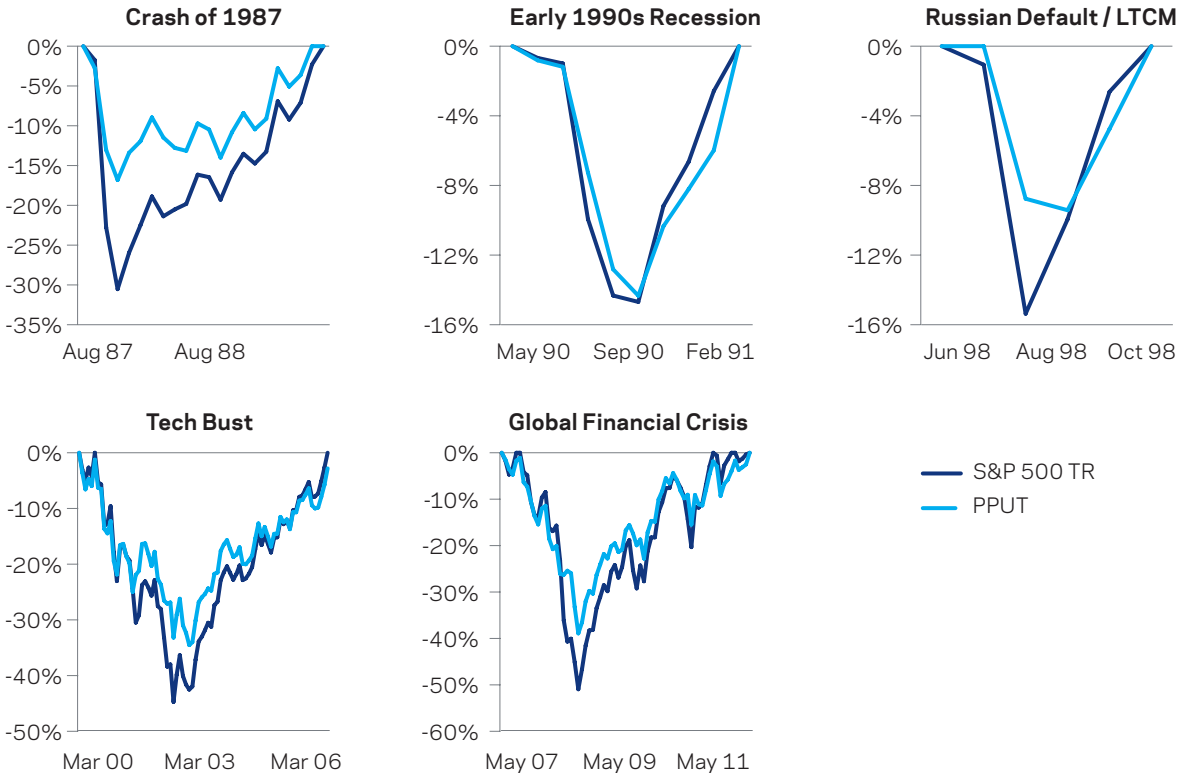
6 Israelov (2017).

with the drawdown. Getting either of these wrong severely weakens an option's ability to act as a hedge. For most investors and for most market drawdowns, options may offer little in the way of downside protection.

- **Embracing Downside Risk**[7]: Across every asset class we evaluate — from stocks to bonds to commodities to credit — we find the majority of returns come from bearing downside risk. Thus, hedging out downside risk takes away a disproportionate amount of an asset's returns. Investors who want to reduce their risk may be better off reducing their allocation to a risky asset than hedging it with options.[8]
- **Still Not Cheap**[9]: The price of portfolio insurance tends to be low when market volatility is low, which raises a natural question: is it better to buy options in calm times? This paper finds that even though an option's price may be low, so is its fundamental value — even calm markets don't make a compelling case for buying insurance against drawdowns.

Exhibit 2 – You Call This Protection?

Five Worst Peak-to-Trough Drawdowns for US Equities and Put-Protected US Equities, July 1986 – June 2019



Source: AQR and CBOE. PPUT is the CBOE's put-protected index, which holds a long position indexed to the S&P 500 and buys monthly 5% out-of-the-money S&P 500 put options as a hedge.

7 Israelov, Nielsen, and Villalon (2017).
8 For evidence across multiple equity markets, see Israelov, Klein, and Tummala (2017).
9 Israelov and Nielsen (2015). Also, see Israelov and Tummala (2018), which investigates how much higher future volatility has to be for options to pay off, finding buying S&P 500 options is only consistently profitable in the highest decile of changes in one-month volatility.

Risk Parity: Two Out of Three Can Be Pretty Good

Even though a 60/40 portfolio is often labeled "balanced," from a risk standpoint, it's anything but. The biggest source of risk in traditional portfolios is equities,[10] so one way to build a more "crisis-proof" portfolio is to better diversify it — both by increasing the number of return sources and by better balancing the amount allocated to each.[11] Eight years ago, we argued that risk parity strategies were an efficient way to get this diversification.

However, since then, most investors haven't really "needed" more diversification. Not only have stocks, bonds, and thus the traditional 60/40 portfolio all had historically strong performance, they've also had historically low risk.[12] Stacking the deck even more against diversification is that many of the non-traditional asset classes found in risk parity strategies — such as commodities — have had *negative* returns (see Exhibit 3). Put mildly, the past eight years might seem like a particularly tough environment for diversification to keep up with 60/40.

As in the original paper, we use a simple risk parity strategy, made of three asset classes: global stocks, global bonds, and commodities.[13] We find that this risk parity strategy, *in spite of holding the one asset class with negative returns over this period*, kept up with the global 60/40 portfolio, albeit with slightly higher volatility.[14] In other words, for a truly diversified portfolio, two out of three can be a good thing — even in an environment that was unusually favorable for traditional portfolios (and of course, in an environment of lower growth and/or higher inflation, we would expect diversified portfolios to have the upper hand).

Because risk parity is seldom an all-or-nothing decision,[15] we also evaluate how it complements a traditional 60/40 portfolio (last column). Over this eight-year period, we find a simple 50/50 combination of risk parity and 60/40 has performed in-line with 60/40, in terms of returns, volatility, and Sharpe ratio — while realizing less sensitivity to equity market risk (last line).

10 For instance, the correlation of a 60/40 stock/bond portfolio to a 100% stocks portfolio was 0.98, from Feb. 1926 to Dec. 2017 (using S&P 500 and US 10-year Treasury data from Robert Shiller's data library). Thus, poor returns for equities have almost always meant poor times for even seemingly "balanced" investors (see 3Q2018 Alternative Thinking for more.)

11 For more on this type of portfolio construction, see Hurst, Johnson and Ooi (2011). Diversification does not eliminate the risk of experiencing investment losses.

12 Compared to history from August 1946 through June 2019, the past eight years for a US 60/40 portfolio are 83rd percentile in terms of return, 4th percentile in terms of volatility and 92nd percentile in terms of risk-adjusted returns (as measured by the Sharpe ratio). Global data has been directionally similar (though less extreme) over this same period, with returns that were 76th percentile versus history, volatility that was 34th, and a Sharpe ratio that was 82nd.

13 Our simplified risk parity (SRP) targets equal volatility targets across three asset classes: Global Stocks (MSCI World), Global Bonds (Barclays Global Aggregate), and Commodities (GSCI). Volatility estimates are calculated using rolling 12-month annualized standard deviation. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

14 The higher volatility is not an accident: the risk parity strategy used here targets a 10% volatility (which is roughly the long-term average volatility of a 60/40 portfolio). Because the 60/40 portfolio realized historically low volatility over this period, it's not surprising a volatility-targeted strategy would have had volatility that was higher — and more in line with historical norms.

15 See Cliff's Perspective "Risk Parity Is Even Better Than We Thought" (June 2015).

Looking ahead, even though both stocks and bonds are expensive by historical measures,[16] bonds are often cited as the reason that risk parity — while potentially attractive *generally* — isn't attractive *today*.[17]

Our research indicates that low yields alone[18] or even the expectation of rising yields aren't reason enough to dismiss the benefits of having risk parity as a diversifying strategy in a portfolio:

- **Can Risk Parity Outperform If Yields Rise?**[19] Over the past few decades, a secular fall in yields has given a boost to bond returns, and thus risk parity returns. This paper investigates risk parity's performance when bond yields *rise*, finding risk parity's edge has held up historically, even during long periods of moderately rising interest rates and even if that cumulative rise in rates is substantial.

Exhibit 3 - Comparison of Returns

(July 1, 2011 - June 30, 2019)

	Global Stocks	Global Bonds	Commodities	Global 60/40 (60/40)	Simple Risk Parity (SRP)	50/50 Combo of 60/40 and SRP
Average Return	9.0%	4.0%	-7.1%	7.0%	7.2%	**7.1%**
Volatility	12.5%	2.5%	13.0%	7.5%	8.4%	**7.4%**
Sharpe Ratio	0.68	1.38	-0.59	0.86	0.79	**0.88**
Equity Beta	1.00	-0.02	0.55	0.59	0.47	**0.53**

Source: AQR. Global Stocks is the MSCI World, Global Bonds is the Barclays Global Aggregate, and Commodities is the GSCI. The Simple Risk Parity strategy targets equal volatility targets across these three asset classes. Volatility estimates are calculated using rolling 12-month annualized standard deviation. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

16 See AQR Alternative Thinking 1Q19.
17 Flat and inverted yield curves are other issues, which we cover in AQR's Alternative Thinking 3Q19, finding inverted yield curves to be a generally bearish signal for economic growth, a weakly bearish signal for stocks and bonds, but overall a very noisy indicator of prospective returns.
18 Huss, Maloney, Mees, and Mendelson (2017).
19 Hurst, Mendelson, and Ooi (2013).

Low Correlated Alternatives: Managed Futures

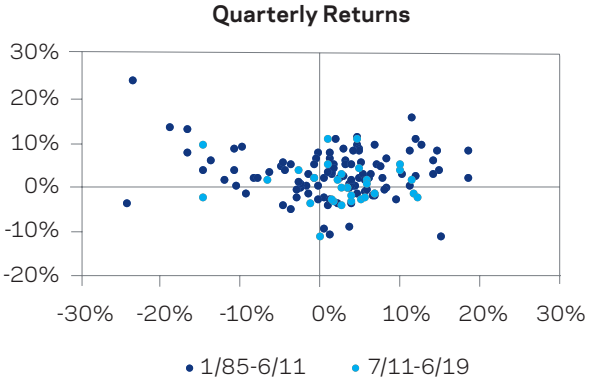
We've written for decades that the alternatives industry overall has given investors more of what they already have: returns that can be largely attributed to equity risk. Investors who want to mitigate their downside risk should thus focus their alternatives allocation to strategies that are most diversifying to equity markets.

One of the strategies we focused on eight years ago was trend following, or managed futures; highlighting the reasons it might hold up especially well in bear markets. Since then, we can add more data to our original chart (below), finding recent behavior that fits with the original evidence: a tendency to do especially well when equities do poorly, and overall lowly correlated returns.[20]

However, compared to its long-term history, trend following has posted lower than average returns lately,[21] leading some investors to question whether it's been a bad time for a good strategy, or a good strategy gone bad. Some of our recent research has been spent answering this question.

- **You Can't Always Trend When You Want**[22]: We find the recent performance of trend following can be attributed to the fact that there have been fewer-than-typical large moves across markets. This suggests the unusually benign environment of the past few years has largely driven the strategy's results and that more typical markets may lead to better expected performance.

Exhibit 4 – "New" Data Fits the General Pattern



	Original Sample 1/85-6/11		Out of Sample 7/11-6/19	
	S&P 500	Trend-Following	S&P 500	Trend-Following
Quarterly Performance	1.8%	2.8%	3.1%	1.7%
... when equities returned < -2%		3.6%		2.9%
... when equities returned > 2%		3.0%		0.3%
Correlation	-0.12		-0.11	

Source: AQR. Returns shown are the arithmetic quarterly returns of S&P 500 and Simple Trend Following for the periods shown. See appendix for details on Simple Trend Following. All returns are gross of fees. Simple Trend Following is net of trading costs. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

20 Since then, many investors focused on reducing tail risk have also begun to incorporate "defensive" versions of trend following. A couple examples are by constraining the portfolio from being net long equities and introducing asymmetric exposure sizing (to be positioned more defensively). For more on these, see AQR Alternative Thinking 3Q2018.
21 As evidenced by the SG Trend Index and the simple, hypothetical trend-following strategy described herein.
22 Babu, Levine, Ooi, Schroeder, and Stamelos (2019).

Other research over the past eight years has uncovered new evidence and new ways to implement trend following:

- **A Century of Evidence on Trend-Following Investing**[23]: Our original data set covered the period 1985 through June 2011. Since then, we've tested many more decades, both to evaluate the strategy's consistency and to see how the recent period stacks up to history.
- **Trends Everywhere**[24]: This paper extends previous research by uncovering trends in 156 assets, more than half of which were not previously studied. The authors document an attractive return profile for these "new" asset trends, along with low correlations to stock and bond markets. They also show complementarity to trend-following in "traditional" assets, and benefits in combining the two.
- **A Half Century of Macro Momentum**[25]**:** Trend-following strategies are traditionally driven by price trends. This paper finds that trends in *fundamentals* may also generate positive returns. As with price-based strategies, fundamental trends may also do particularly well amid deteriorating market environments.

Additionally, trend-following strategies might be an ideal diversifier for investors in less-liquid asset classes, such as Private Equity (PE). Given the well-documented smoothing of PE returns, poor periods for that asset class tend to be those that don't have quick reversals — which are natural environments for trend-following to be positioned short. Indeed, an analysis of the worst periods for PE have tended to be favorable for trend-following and vice versa (see Exhibit 5).[26]

Exhibit 5 – Trend-Following and Private Equity: Natural Complements?

	Worst Quarters for Private Equity			Worst Quarters for Trend	
	PE	Trend		Trend	PE
4Q2008	-18.3%	+20.3%	2Q2009	-11.5%	+5.9%
3Q2008	-9.6%	-1.6%	**2Q2015**	**-10.1%**	**+5.3%**
1Q2001	-6.7%	+5.8%	2Q2004	-9.6%	+4.3%
3Q2001	-5.9%	+6.6%	1Q1999	-8.5%	+4.0%
3Q2011	**-5.8%**	**+7.6%**	3Q2007	-6.8%	+2.5%

Note: Highlighted quarters are ones that occurred since the publication of the original "Chasing Your Own Tail (Risk)" paper, and thus can be seen as "out of sample" periods.

Sources: AQR, Cambridge Associates. Private equity is a 70/30 combination of the Cambridge Associates U.S. Private Equity Index and the Cambridge Associates Global Ex-U.S. Developed Markets Private Equity Index. Trend is a combination of 1/3/12 month trend-following strategies across global equities, fixed income, commodities, and currencies scaled to 10% volatility as described in Hurst, Ooi and Pedersen (2014). Trend is net of trading costs, a simulated 2% annual management fee and a 20% performance fee (to be consistent with Ooi and Pedersen [2014]). For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

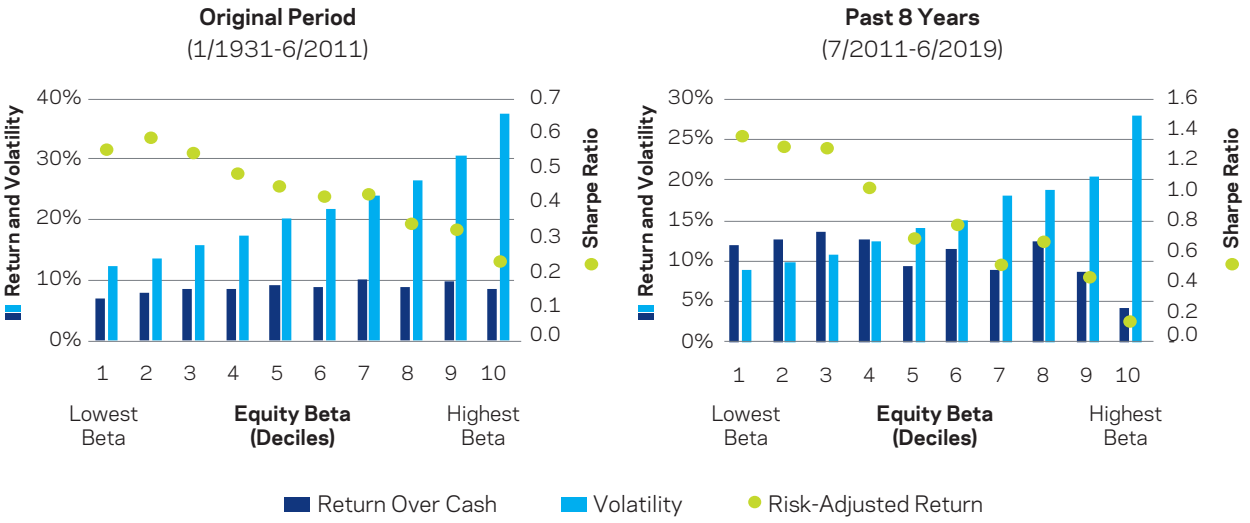
23 Hurst, Ooi, and Pedersen (2017).
24 Babu, Levine, Ooi, Pedersen, and Stamelos (2019).
25 Brooks (2017).
26 For more on complementing private equity with trend-following, see AQR Alternative Thinking 3Q2015.

Defensive Equities[27]

Defensive investing has been known in academia for nearly 50 years,[28] and investors such as Warren Buffett have been pursuing it for decades.[29] But for many investors, defensive investing has come into the limelight only recently — due in large part to its strong performance since the Global Financial Crisis.

In the eight years since we published "Chasing Your Own Tail (Risk)," defensive stocks, as measured by beta, or market sensitivity, have delivered what they had historically (see Exhibit 6 below): higher risk-adjusted returns (green dots) than their higher-beta peers. In fact, over this period they've done even better than we would expect long term: lower-risk stocks have also had higher *total* returns than high-risk stocks (see right chart below, dark blue bars).[30]

Exhbit 6 – The Defensive Premium



Source: AQR. Data includes all available common stocks on the CRSP database, and trailing 5-year betas are calculated with respected to the CRSP value-weighted market index. Decile portfolios are formed by sorting stocks on trailing five-year beta. Returns are average annual returns in excess of 3-month Treasuries, and Risk-Adjusted returns are excess returns divided by volatility. Past performance is not a guarantee of future performance. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed in the appendix.

27 We focus here on traditional (i.e., long-only) defensive equities, but other relevant strategies may include long/short equity strategies, covered calls, and buy-write strategies, among others.
28 See, for example, Fischer, Jensen, and Scholes (1972).
29 Frazzini, Kabiller, and Pedersen (2018).
30 We evaluate only one facet of defensive investing here – low beta – but note that defensive investing can take many forms, such as "low volatility" (see Baker, Bradley and Wurgler [2010]), and "high quality" (see Asness, Frazzini and Pedersen [2019]). Of special note here, "quality" has shown a tendency to deliver particularly *strong* returns amid poor periods for equities (see AQR Alternative Thinking 3Q15). Additionally, the two newest factors in Fama and French's (now) five-factor model are also related to quality: the profitability factor (stocks with a high operating profitability versus those with low) and the investment factor (stocks of companies with low total asset growth versus those with high).

AQR research since then has found defensive investing might be useful for more than just equity investors.

- **Betting Against Beta**[31]: Defensive investing is tested across 55,600 stocks covering 20 countries, 19 developed equity markets, nine developed bond markets, nine currencies, within US Treasuries, in credit indices by duration, corporate bonds by rating, and 25 commodities.

- **Do Factor Premia Vary over Time? A Century of Evidence**[32]: This study builds the longest dataset to date for defensive investing (along with value, momentum and carry) across multiple asset classes and countries, establishing these as robust, long-term sources of returns.

But for many investors, the recent outperformance and popularity of defensive investing has also brought with it a big concern: is low-risk now a "crowded trade"? This is also a topic we've taken up:

- **Are Defensive Stocks Expensive?**[33]: This paper shows the weak linkage between the cheapness or expensiveness of low-risk stocks and their future returns. One conclusion is that trying to tactically time an allocation to defensive investing is an unlikely way to outperform.

31 Frazzini and Pedersen (2014). See also Asness, Frazzini, and Pedersen (2014) which shows the effectiveness of low-risk equity investing within industries.
32 Ilmanen, Israel, Moskowitz, Thapar, and Wang (2019).
33 Ilmanen, Nielsen, and Chandra (2015).

Conclusion: Lower Equity Risk Doesn't Have to Mean Lower Returns (Even in a Bull Market)

Investing is about taking compensated risks. And while diversified portfolios have many types of risks, the one that tends to matter most — by a long shot — is equity risk. Whether your goal is to de-risk a portfolio, mitigate "left tails," or adopt a more defensive posture, your allocation to equity markets should be front and center in the discussion.

Our recommendation today for dealing with the risk of severely declining portfolio wealth is the same as it was in our 2011 paper: rather than try to Band-Aid the problem via portfolio insurance, instead reduce your equity risk and complement the portfolio with underutilized sources of returns.

So, how'd we do? Every one of the ideas we suggested eight years ago was successful in reducing a traditional portfolio's exposure to equity risk (beta, see bottom line of Exhibit 7). And although the amount of risk reduction will depend on how big the changes to the portfolio are (the table below uses the same allocations as from eight years ago), it's interesting to note the reduction in equity risk was about as much as purchasing options to hedge that risk.[34]

What about returns? Over the past eight years, only one strategy's incremental impact to 60/40 was to dampen returns,[35] but compared to buying puts (second column), each came out well ahead. That said, we don't expect every one of these strategies to help in every environment, and we have always advocated an approach that diversifies across them. In that sense, the truest "out of sample" test of our ideas is the final column, which combines the strategies at the same weights we showed in our 2011 paper. This combined approach kept up with 60/40 during a great period for traditional portfolios and with meaningfully less equity risk.

With all the talk these days of stretched stock and bond valuations, how late we are in the business cycle, and a slew of lurking macroeconomic risks, a renewed focus on asset allocation seems appropriate — and we have eight more years of evidence behind strategies that can help when investors need it most.

34 Here using monthly 5% OTM options to fully hedge the portfolio's equity exposure.
35 Though due to its diversification properties, the 60/40 portfolio with a 20% allocation to trend also had lower volatility and posted slightly *higher* risk-adjusted returns over this period.

Exhibit 7 – Eight Years Later, Still Looking Good Against Conventional Approaches

Portfolio Weights	Global 60/40	Put-Protected 60/40	Defensive Equity Tilt	Incorporate Risk Parity	Trend-following	Combined
Global Equities	60%		30%	30%	48%	
Global Bonds	40%	40%	40%	20%	32%	
Global Equities w/5% OTM puts*		60%				
Defensive Equities			30%			30%
Simple Risk Parity				50%		50%
Trend-following					20%	20%
Out-of-Sample Performance (7/2011-6/2019)						
Average Return	7.0%	5.0%	7.1%	7.1%	6.1%	6.9%
Volatility	7.5%	6.6%	6.7%	7.4%	6.0%	6.8%
Sharpe Ratio	0.86	0.66	0.98	0.88	0.92	0.93
Equity Exposure (beta)	0.59	0.50	0.53	0.53	0.44	0.44

Source: AQR. "Global Bonds" is the Barclays Global Aggregate Bond Index and "Global Equities" is the MSCI World Index. "Global Equities w/ 5% OTM puts" is Global Stocks plus the difference between the CBOE's PPUT Index and the S&P 500 (to proxy for the returns of options-based portfolio insurance). All returns are gross of fees. Trend-Following is net of trading costs. See appendix for construction of the simplified Defensive Equities, Simple Risk Parity, and Trend-Following strategies. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations some of which are explained ion the Appendix.

Appendix: Risk Management Techniques

Our original paper covered five ideas for dealing with downside risk: three were investment strategies, and two were risk management techniques. For completeness, here we cover how the risk management techniques did over the past eight years here.

Volatility Targeting

Risk is not stable. Regardless of how investors measure it, there's broad agreement that every investment goes through periods of higher-than-average and lower-than-average risk. And while returns are notoriously hard to predict, many measures of risk — such as volatility — are much easier.[36]

Volatility-targeted portfolios are designed to reduce positions when risk is high and increase positions when risk is low, which can lead to a more stable risk-taking through time (see Exhibit 8). By reducing positions in high-risk times, volatility-targeted portfolios might also mitigate the impact of large asset class drawdowns ("Comparison of Drawdowns" table). On the flip side, in low-risk environments, a volatility-targeted portfolio will typically use leverage to reach a desired volatility target. This can result in investors having "more chips on the table" during quiet times to garner additional returns.

The past eight years have provided strong evidence of the last point. Market risk was generally low by historical standards at the same time as compensation for market risk was higher than average. In other words, traditional investors likely took less risk when there was a particularly high opportunity cost to do so. In contrast, a risk-targeted portfolio over this period would have had more exposure to markets and thus higher returns. The third table quantifies this difference for the period preceding our original paper, since publication, and for the full sample.[37]

Our research since then has focused on improvements to forecasting risk.

- **Risk Everywhere: Modeling and Managing Volatility**[38]: Higher-frequency datasets spanning multiple asset classes are used to measure commonalities in risks, which are used to improve traditional risk models.

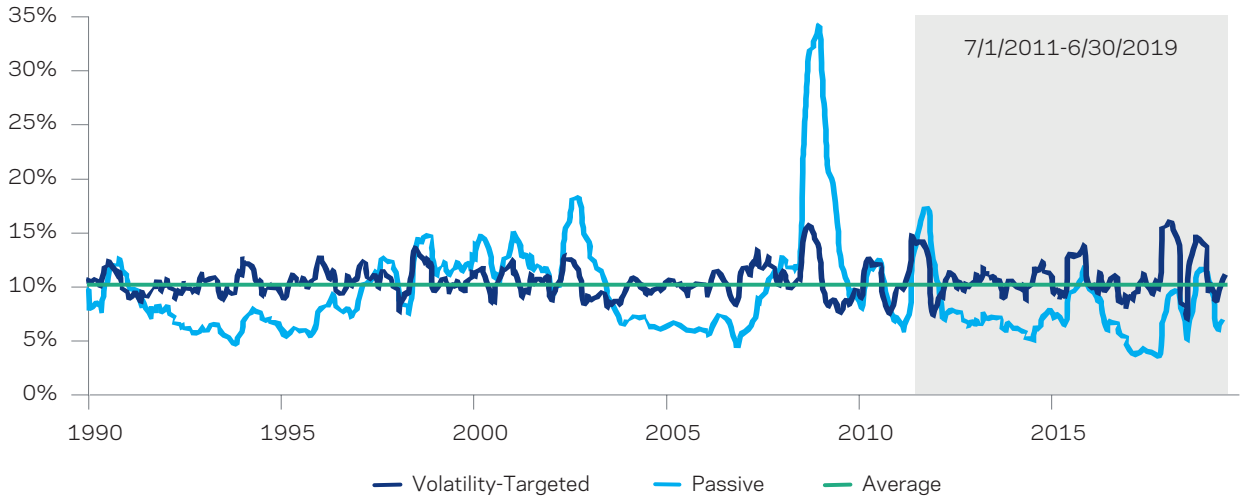
36 Risk is not a number, and volatility is not the same as risk (see Asness (2014) for a brief description of "volatility" versus "permanent loss of capital" as definitions of risk]. Still, we find many risk metrics that investors care about can be improved when a strategy's volatility is targeted.

37 This may actually understate the benefit. Arguably, an investor who sizes exposures based on a specific level of acceptable loss may choose to leverage the benefit of a more stable risk profile by targeting even higher volatility on average and further improving expected returns.

38 Bollerslev, Hood, Huss, and Pedersen (2017).

Exhibit 8 – Steadier as She Goes: Passive and Volatility-Targeted Approaches

Hypothetical US 60/40 Volatility, January 1990 – June 2019



Comparison of Drawdowns

(January 1990 – June 2019)

	Passive	Vol-Targeted
Fifth percentile	-17%	-16%
First percentile	-24%	-21%
Worst	-34%	-25%

Summary Statistics for US 60/40

	Original Sample 1/1/1990-6/30/2011		Out-of-Sample 7/1/2011-6/30/2019		All Data 1/1/1990-6/30/2019	
	Passive	Vol-Targeted	Passive	Vol-Targeted	Passive	Vol-Targeted
Average Return	9.6%	9.8%	8.9%	11.4%	9.4%	10.3%
Volatility	11.0%	10.6%	8.4%	11.4%	10.3%	10.7%
Sharpe Ratio	0.35	0.39	0.96	0.94	0.45	0.51

Notes: Our original paper used only US equities in this section. For this paper, we chose to use 60/40, which is closer to most investor portfolios, but due to data limitations means the start date is now 1990, rather than 1980 (results are consistent had we stuck with showing US equities only). The above calculations use daily returns. "Volatility-Targeted" is a simplified strategy that targets a 10% annualized volatility, using the trailing 63-day (i.e., three-month) volatility as the prediction for future volatility. When the risk-targeted portfolio has less/more than 100 percent notional value in equities and bonds, the rest is allocated to/funded from cash. The portfolio is rebalanced every 400 days, as well as on days when existing weights deviate from target weights by more than 10%. The average leverage for the risk-targeted portfolio over the Original Sample, Out-of-Sample, and Full Period are 119%, 153% and 128% respectively. For illustrative purposes only and not representative of any portfolio that AQR currently manages; simulations are gross of all fees and transaction costs. Hypothetical data has inherent limitations some of which are explained ion the Appendix.

Dynamic Risk Management

We believe long-term investors have a breaking point. Even if an investment staff has the resolve to hold on to positions during a major drawdown, the decision to cut risk may be imposed on them — it could be from their end investors, their board, or any of the pressures their stakeholders face (peers, press, etc.). Dynamic risk management techniques such as "drawdown control" are about having a plan for how to act in severely stressful markets rather than coming up with the plan only when forced to.

Any drawdown control system should ideally work in two directions: 1) a plan for when and how to reduce exposures in deteriorating markets, and 2) a plan for when and how to increase exposures back to strategic targets. We also believe drawdown control should be calibrated to "kick in" infrequently — that is, only when market conditions imply higher likelihoods of crises.

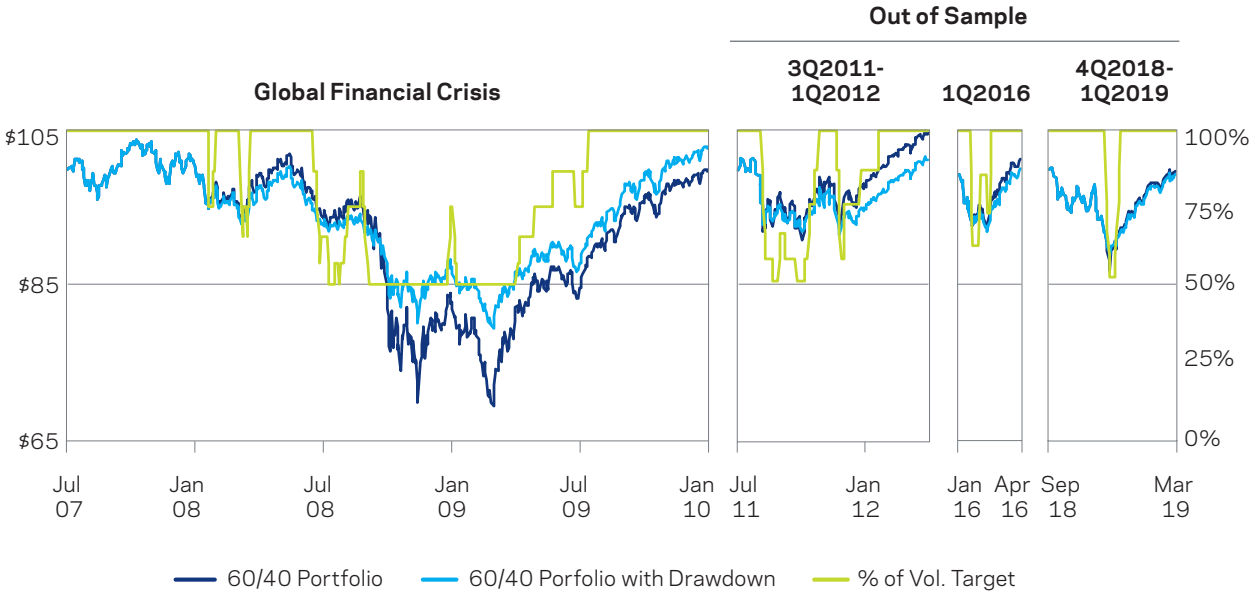
Eight years ago, we used a simplified drawdown control process to show how it could mitigate losses in the Global Financial Crisis (See Exhibit 9, left graph). Since then, we haven't seen anything like the depth and length of that drawdown, resulting in that process to kick in only three times in the following eight years (see the "Out of Sample" graphs).

So, how did we do since the original paper? About in line with the expectations put forth at the time: "This type of risk management is not costless… At times there will be false alarms, where positions are cut but the market quickly recovers — and the portfolio suffers because it is not fully exposed to the recovery. The recent period (the GFC) may have been especially kind to a drawdown control form of risk management. We expect the long-term benefit to be in preventing imprudent decisions from being made in the midst of a crisis."

The past eight years have included only these "false alarms," with comparatively shallow drawdowns and quick recoveries (the heights and widths of the graphs are scaled the same). With not much risk to reduce, the volatilities and peak-to-trough drawdowns of the two 60/40 portfolios were similar, but they did differ in average returns.

Exhibit 9 – Comparison of Drawdowns

Cumulative Return of Hypothetical 60/40 Portfolio During Various Drawdowns



Source: AQR. US 60/40 is 60% S&P 500 and 40% Bloomberg Barclays U.S. Aggregate Bond Index. See complete description of this simplified drawdown control process in the appendix (the same process was applied throughout this section). The risk control process discussed will not always be successful at controlling risk or limiting portfolio losses. For illustrative purposes only and not representative of any portfolio that AQR currently manages. Hypothetical data has inherent limitations, some of which are disclosed herein.

1/2004-6/2011	60/40	With Drawdown Control
Average Return	6.4%	6.1%
Volatility	12.5%	9.0%
Drawdowns		
Fifth percentile	-23%	-18%
First percentile	-28%	-21%
Worst	-34%	-24%

7/2011-6/2019	60/40	With Drawdown Control
Average Return	8.9%	8.2%
Volatility	8.4%	7.7%
Drawdowns		
Fifth percentile	-6%	-7%
First percentile	-9%	-9%
Worst	-14%	-12%

Source: AQR. The above calculations use daily returns. The drawdowns above are independently calculated to give a fairer comparison (i.e., the timing of the drawdowns isn't forced to be identical).

References

Asness, Cliff (2014). "My Top 10 Peeves." AQR Cliff's Perspective.

Asness, Cliff (2015). "Risk Parity Is Even Better Than We Thought." AQR Cliff's Perspectives.

Asness, Cliff, Frazzini, Andrea, and Pedersen, Lasse (2014). "Low-Risk Investing Without Industry Bets." *Financial Analysts Journal*.

Asness, Cliff, Frazzini, Andrea, and Pedersen, Lasse (2019). "Quality Minus Junk." AQR Working Paper.

Babu, Abhilash; Levine, Ari; Ooi, Yao Hua; Schroeder, Sarah; and Stamelos, Erik (2019). "You Can't Always Trend When You Want." AQR White Paper.

Baker, Malcolm; Wurgler, Jeffrey; and Bradley, Brendan (2010). "A Behavioral Finance Explanation for Success of Low Volatility Portfolios." NYU Working Paper.

Berger, Adam; Nielsen, Lars; and Villalon, Daniel (2011). "Chasing Your Own Tail (Risk)." AQR White Paper.

Black, Fischer; Jensen, Michael; and Scholes, Myron (1972). "The Capital Asset Pricing Model: Some Empirical Tests." *Studies in the Theory of Capital Markets*.

Bollerslev, Tim; Hood, Benjamin; Huss, John; Pedersen, Lasse (2017). "Risk Everywhere: Modeling and Managing Volatility."

Brooks, Jordan (2017). "A Half Century of Macro Momentum." AQR White Paper.

Fader, Jonathan and Mees, Zachary (2019). "Late Cycle Syndrome." AQR Chief Investment Quarterly.

Frazzini, Andrea and Pedersen, Lasse (2014). "Betting Against Beta." *Journal of Financial Economics*.

Frazzini, Andrea; Kabiller, David; and Pedersen, Lasse (2013). "Buffett's Alpha." *Financial Analysts Journal*.

Hurst, Brian; Mendelson, Michael; and Ooi, Yao Hua (2013). "Can Risk Parity Outperform If Yields Rise?" AQR White Paper.

Hurst, Brian; Ooi, Yao Hua; and Pedersen, Lasse (2017). "A Century of Evidence on Trend-Following Investing." *Journal of Portfolio Management*.

Hurst, Brian; Johnson, Bryan; Ooi, Yao Hua (2010). "Understanding Risk Parity." AQR White Paper.

Huss, John; Maloney, Thomas; Mees, Zachary; and Mendelson, Michael (2017). "Asset Allocation in a Low-Yield Environment." AQR White Paper.

Ilmanen, Antti; Israel, Ronen; Moskowitz, Tobias; Thapar, Ashwin; and Wang, Franklin (2019). "Factor Premia and Factor Timing: A Century of Evidence." AQR Working Paper.

Ilmanen, Antti; Nielsen, Lars; and Chandra, Swati (2015). "Are Defensive Stocks Expensive? A Closer Look at Value Spreads." AQR White Paper.

Israelov, Roni (2017). "Pathetic Protection: The Elusive Benefits of Protective Puts." *Journal of Alternative Investments*.

Israelov, Roni and Nielsen, Lars (2015). "Still Not Cheap: Portfolio Protection in Calm Markets." *Journal of Portfolio Management*.

Israelov, Roni and Tummala, Harsha (2018). "Being Right Is Not Enough: Buying Options to Bet on Higher Realized Volatility." AQR Working Paper.

Israelov, Roni; Klein, Matthew; and Tummala, Harsha (2017). "Covering the World: Global Evidence on Covered Calls." AQR Working Paper.

Israelov, Roni; Nielsen, Lars; and Villalon, Daniel (2017). "Embracing Downside Risk." *Journal of Alternative Investments*.

Portfolio Solutions Group (2015). "Good Strategies for Tough Times." AQR Alternative Thinking.

Portfolio Solutions Group (2018). "It Was the Worst of Times: Diversification During a Century of Drawdowns." AQR Alternative Thinking.

Portfolio Solutions Group (2019). "Capital Market Assumptions for Major Asset Classes." AQR Alternative Thinking.

Portfolio Solutions Group (2019). "Inversion Anxiety: Yield Curves, Economic Growth, and Asset Prices." AQR Alternative Thinking.

Disclosures

Simplified Drawdown Control Process

The simplified drawdown control process reduces portfolio exposure (in increments of 14%, down to 50% minimum exposure) when the average of four drawdown measures (the trailing month-to-date, year-to-date, trailing 1-year, and trailing 1-year average drawdown) near a -10% drawdown floor. The process gradually increases exposure up to 100% when drawdown measures are above the drawdown floor.

Trend-Following Strategy

Limitations of Backtested Performance. The returns presented reflect hypothetical performance an investor would have obtained had it invested in the manner shown and does not represents returns that any investor actually attained. The information presented is based upon the following hypothetical assumptions:

The Hypothetical Trend-Following Strategy model uses data from January 1880 onward. The investment strategy is based on trend-following investing which involves going long markets that have been rising and going short markets that have been falling, betting that those trends over the examined look-back periods will continue. The strategy was constructed with an equal-weighted combination of 1-month, 3-month, and 12-month trend-following strategies for 67 markets across 4 major asset classes: 29 commodities, 11 equity indices, 15 bond markets, and 12 currency pairs. Since not all markets have return data going back to 1880, we construct the strategies using the largest number of assets for which return data exist at each point in time. We use futures returns when they are available. Prior to the availability of futures data, we rely on cash index returns financed at local short rates for each country. Please see Figure 2 for additional details. The strategy targets a long-term volatility target of 10% but does not limit volatility during periods where realized volatility may be higher or lower than this number.

Hypothetical performance is gross of advisory fees and net of transaction costs, unless stated otherwise. In order to calculate net-of-fee returns, we subtracted a 2% annual management fee and a 20% performance fee from the gross-of-fee, net-of-transaction-cost returns to the strategy. Actual fees may vary depending on, among other things, the applicable fee schedule. AQR's fees are available upon request and also may be found in Part 2A of its Form ADV. The transactions costs used in the strategy are based on AQR's estimates of average transaction costs for each of the four asset classes, including market impact and commissions. The transaction costs are assumed to be twice as high from 1993 to 2002 and six times as high from 1880–1992. The transaction costs used are shown in Figure 1.

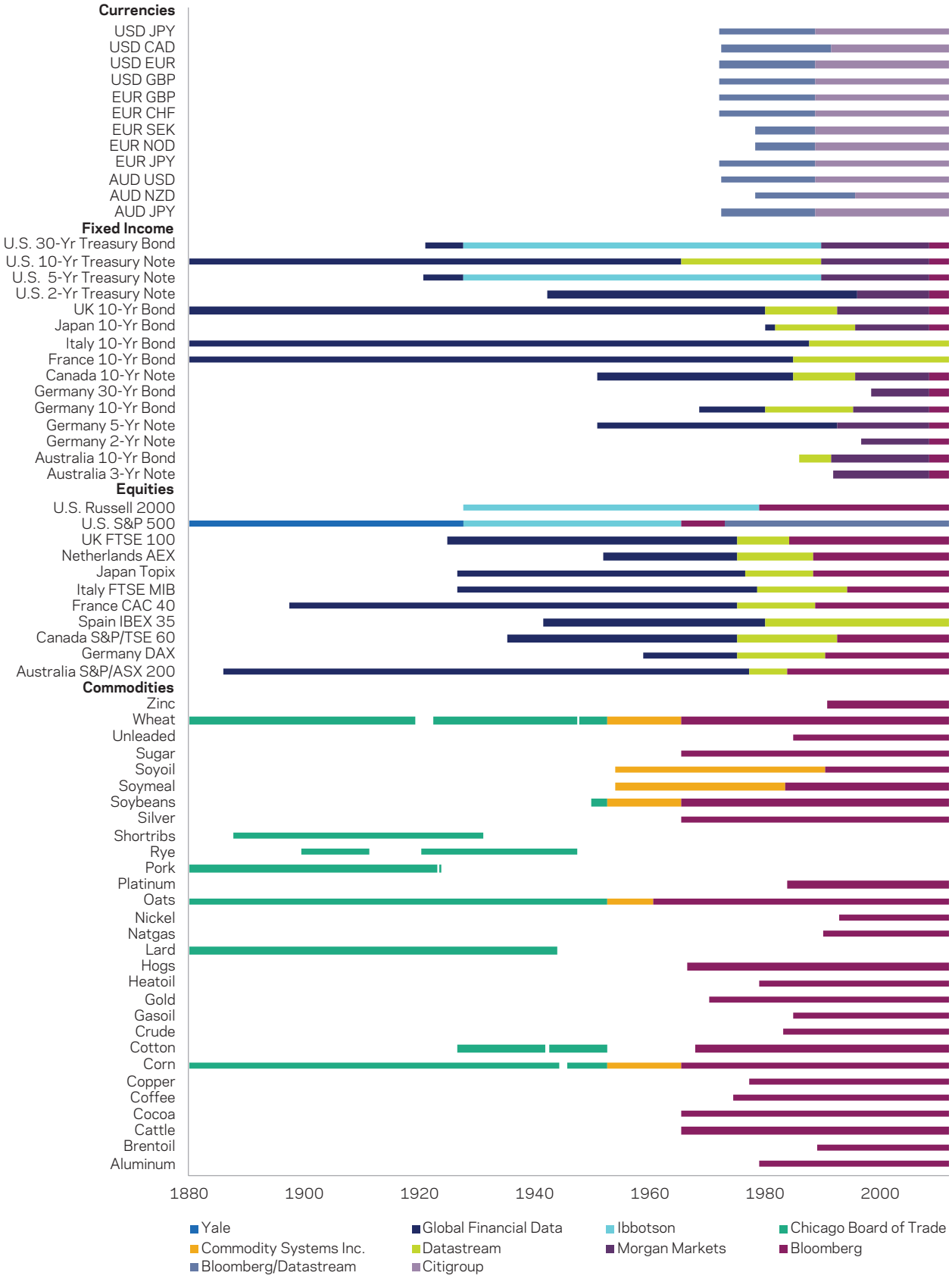
This model is not based on an actual portfolio AQR manages.

The benchmark and relevant cash rate is assumed to be 3-month Treasury bills. Prior to 1929 when 3-month Treasury bills became available, the benchmark and relevant cash rate is assumed to be the NYSE call money rates (the rates for collateralized loans) through 1920, and returns on short-term government debt (certificates of indebtedness) from 1920 until 1929.

Figure 1

Asset Class	Time Period	One-Way Transaction Costs (as a % of notional traded)
Equities	1880-1992	0.34%
	1993-2002	0.11%
	2003-Present	0.06%
Fixed Income	1880-1992	0.06%
	1993-2002	0.02%
	2003-Present	0.01%
Currencies	1880-1992	0.18%
	1993-2002	0.06%
	2003-Present	0.03%
Commodities	1880-1992	0.58%
	1993-2002	0.19%
	2003-Present	0.10%

Figure 2


Currencies
USD JPY
USD CAD
USD EUR
USD GBP
EUR GBP
EUR CHF
EUR SEK
EUR NOD
EUR JPY
AUD USD
AUD NZD
AUD JPY
Fixed Income
U.S. 30-Yr Treasury Bond
U.S. 10-Yr Treasury Note
U.S. 5-Yr Treasury Note
U.S. 2-Yr Treasury Note
UK 10-Yr Bond
Japan 10-Yr Bond
Italy 10-Yr Bond
France 10-Yr Bond
Canada 10-Yr Note
Germany 30-Yr Bond
Germany 10-Yr Bond
Germany 5-Yr Note
Germany 2-Yr Note
Australia 10-Yr Bond
Australia 3-Yr Note
Equities
U.S. Russell 2000
U.S. S&P 500
UK FTSE 100
Netherlands AEX
Japan Topix
Italy FTSE MIB
France CAC 40
Spain IBEX 35
Canada S&P/TSE 60
Germany DAX
Australia S&P/ASX 200
Commodities
Zinc
Wheat
Unleaded
Sugar
Soyoil
Soymeal
Soybeans
Silver
Shortribs
Rye
Pork
Platinum
Oats
Nickel
Natgas
Lard
Hogs
Heatoil
Gold
Gasoil
Crude
Cotton
Corn
Copper
Coffee
Cocoa
Cattle
Brentoil
Aluminum
1880
1900
1920
1940
1960
1980
2000
Yale
Global Financial Data
Ibbotson
Chicago Board of Trade
Commodity Systems Inc.
Datastream
Morgan Markets
Bloomberg
Bloomberg/Datastream
Citigroup

Defensive Equity Strategy

The defensive equity strategy used in this paper is a hypothetical, simplified strategy that combines 90% long-only "Unlevered Betting Against Beta" with 10% long-only "Quality Minus Junk", which are described below.

Universe:

Pricing and accounting data are from the union of the CRSP and the Compustat/XpressFeed Global database. The domestic data include all available common stocks in the merged CRSP/XpressFeed data. The international data include all available common stocks on the Compustat/XpressFeed Global database for 23 developed markets.

Portfolio construction follows Fama and French (1992, 1993, 1996), Asness and Frazzini (2013), and Asness, Frazzini and Pedersen (2013). Aggregates are computed by weighting each country's portfolio by the country's total lagged (t-1) market capitalization.

The "Global" aggregate consists of Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Singapore, Sweden, and the United States.

The "North America" aggregate consists of the United States and Canada.

The "Pacific" aggregate consists of Australia, Hong Kong, Japan, New Zealand, and Singapore.

The "Europe" aggregate consists of Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Israel, Italy, Netherlands, Norway, Portugal, and Sweden.

The "**Unlevered Betting Against Beta Factor"** is a beta ranked, market capitalization-weighted factor that is long low-beta securities. All securities in a country are ranked in ascending order on the basis of their estimated beta and then assigned to one of two portfolios: low-beta and high-beta.

The **"Quality-Minus-Junk"** factor is a value-weighted factor that is long high quality, as defined in Asness, Frazzini and Pedersen (2014). Quality is calculated as the average of four aspects of quality: Profitability, Growth, Safety and Payout. We use a broad set of measures to compute each of four aspects of quality; the score for each aspect is the average of the individual z-scores of the underlying measure. Each variable is converted each month into ranks and standardized to obtain the z-score. 1) Profitability is measured by: Gross profits over assets, return on equity, return on assets, cash flow over assets, gross margin, and the fraction of earnings composed of cash. 2) Growth is measured by: The five-year prior growth in profitability, averaged across the measures of profitability. 3) Safety is defined as: Companies with low beta, low idiosyncratic volatility, low leverage, low bankruptcy risk and low ROE volatility. 4) Payout is defined using: Equity and debt net issuance and total net payout over profits. We form one set of portfolios in each country and compute global portfolios based on each country's market capitalization. We assign stocks to quality and low quality (junk) within capitalization groups (large or small cap).

There can be no assurance that an investment strategy will be successful. Historic market trends are not reliable indicators of actual future market behavior or future performance of any particular investment which may differ materially, and should not be relied upon as such. Target allocations contained herein are subject to change. There is no assurance that the target allocations will be achieved, and actual allocations may be significantly different than that shown here. This presentation should not be viewed as a current or past recommendation or a solicitation of an offer to buy or sell any securities or to adopt any investment strategy.

The information in this presentation may contain projections or other forward-looking statements regarding future events, targets, forecasts or expectations regarding the strategies described herein, and is only current as of the date indicated. There is no assurance that such events or targets will be achieved, and may be significantly different from that shown here. The information in this presentation, including statements concerning financial market trends, is based on current market conditions, which will fluctuate and may be superseded by subsequent market events or for other reasons. Performance of all cited indices is calculated on a total return basis with dividends reinvested.

HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH, BUT NOT ALL, ARE DESCRIBED HEREIN. NO REPRESENTATION IS BEING MADE THAT ANY FUND OR ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN HEREIN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY REALIZED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS THAT CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM, WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS, ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The hypothetical performance results contained herein represent the application of the quantitative models as currently in effect on the date first written above, and there can be no assurance that the models will remain the same in the future or that an application of the current models in the future will produce similar results because the relevant market and economic conditions that prevailed during the hypothetical performance period will not necessarily recur. Discounting factors may be applied to reduce suspected anomalies. This backtest's return, for this period, may vary depending on the date it is run. Hypothetical performance results are presented for illustrative purposes only. In addition, our transaction cost assumptions utilized in backtests, where noted, are based on AQR Capital Management, LLC's ("AQR's"), historical realized transaction costs and market data. Certain of the assumptions have been made for modeling purposes and are unlikely to be realized. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the returns have been stated or fully considered. Changes in the assumptions may have a material impact on the hypothetical returns presented. Actual advisory fees for products offering this strategy may vary.

Diversification does not eliminate the risk of experiencing investment losses. Broad-based securities indices are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index.

The investment strategy and themes discussed herein may be unsuitable for investors depending on their specific investment objectives and financial situation. Please note that changes in the rate of exchange of a currency may affect the value, price or income of an investment adversely.

Neither AQR nor the author assumes any duty to, nor undertakes to update forward looking statements. No representation or warranty, express or implied, is made or given by or on behalf of AQR, the author or any other person as to the accuracy and completeness or fairness of the information contained in this presentation, and no responsibility or liability is accepted for any such information. By accepting this presentation in its entirety, the recipient acknowledges its understanding and acceptance of the foregoing statement.

AQR Capital Management, LLC is exempt from the requirement to hold an Australian Financial Services License under the Corporations Act 2001 (Cth). AQR Capital Management, LLC is regulated by the Securities and Exchange Commission ("SEC") under United States of America laws, which differ from Australian laws. Please note that this document has been prepared in accordance with SEC requirements and not Australian laws. Canadian recipients of fund information: These materials are provided by AQR Capital Management (Canada), LLC, Canadian placement agent for the AQR funds. Please note for materials distributed through AQR Capital Management (Asia) This presentation may not be copied, reproduced, republished, posted, transmitted, disclosed, distributed or disseminated, in whole or in part, in any way without the prior written consent of AQR Capital Management (Asia) Limited (together with its affiliates, "AQR") or as required by applicable law. This presentation and the information contained herein are for educational and informational purposes only and do not constitute and should not be construed as an offering of advisory services or as an invitation, inducement or offer to sell or solicitation of an offer to buy any securities, related financial instruments or financial products in any jurisdiction. Investments described herein will involve significant risk factors which will be set out in the offering documents for such investments and are not described in this presentation. The information in this presentation is general only and you should refer to the final private information memorandum for complete information. To the extent of any conflict between this presentation and the private information memorandum, the private information memorandum shall prevail. The contents of this presentation have not been reviewed by any regulatory authority in Hong Kong. You are advised to exercise caution and if you are in any doubt about any of the contents of this presentation, you should obtain independent professional advice. The information set forth herein has been prepared and issued by AQR Capital Management (Europe) LLP, a U.K. limited liability partnership with its registered office at Charles House 5-11 Regent St. London, SW1Y 4LR, which is authorized by the U.K. Financial Conduct Authority ("FCA") .This [factsheet/presentation] is a financial promotion and has been approved by AQR Capital Management (Europe) LLP. AQR, a German limited liability company (Gesellschaft mit beschränkter Haftung; "GmbH"), is authorized by the German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, „BaFin") to provide the services of investment advice (Anlageberatung) and investment broking (Anlagevermittlung) pursuant to the German Banking Act (Kreditwesengesetz; "KWG"). The Complaint Handling Policy for German investors can be found here: https://ucits.aqr.com/.

284037

www.aqr.com

AQR Capital Management, LLC Two Greenwich Plaza, Greenwich, CT 06830 **P** +1.203.742.3600 **F** +1.203.742.3100