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Chasing Your Own Tail (Risk)

Five Alternatives to the High Cost of Tail-Hedging

In the wake of 2008, investors are now painfully aware of tail risk – the risk of unexpectedly large losses. Today many institutional investors are insuring against tail risk *directly,* often by purchasing puts or structuring collars. Unfortunately, experience and financial theory suggest that the long-term cost of such insurance strategies will be larger than the payouts. No surprise, really. The expected return for perpetual insurance buyers is negative, and conversely positive for insurance sellers (see: the entire insurance industry). Arguably, relatively risk-tolerant investors should be selling tail-risk insurance rather than buying it.

Our recommendation, if reducing tail risk is deemed necessary, is to approach tail risk *fundamentally,* primarily by modifying the portfolio structure itself and by addressing risk management policy. This paper considers five approaches, which we think are most effective when used in combination:

1. Diversify by risk, not just by assets
2. Actively manage volatility
3. Embrace uncorrelated alternatives
4. Take advantage of low-beta equities
5. Have a crisis plan before you need one

We think these approaches lead to better-constructed portfolios for all investors, not just those concerned with tail risk. For investors who are unable to pursue these approaches, we think the best way to reduce tail risk is to reduce total market exposure rather than to buy insurance.

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Please read important disclosures at the end of this paper.

The Cost of Insurance

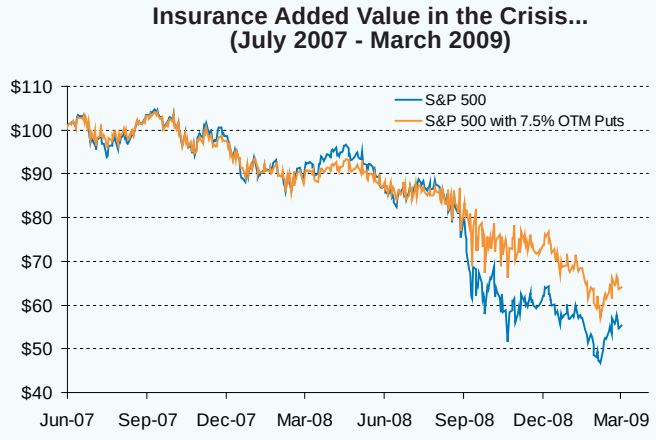
Though insurance worked during the financial crisis, over the longer term it has led to significantly lower portfolio returns (Exhibit A).

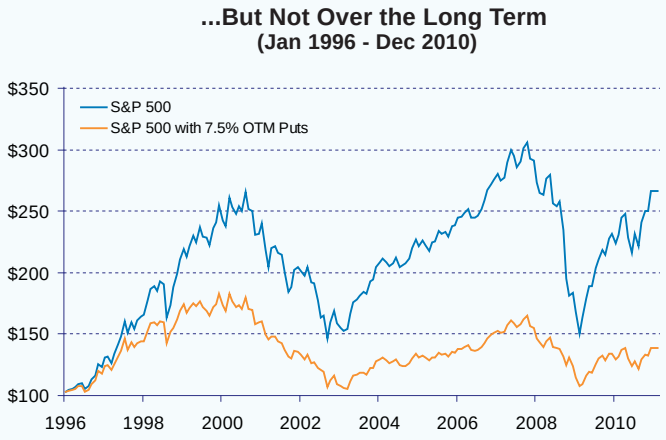
Beyond the cost of insurance itself, a successful program imposes a number of implementation challenges. Investors must determine how much they are comfortable losing (and over what period) in order to size their hedge appropriately. They must also ensure they receive fair pricing, manage transaction costs, and understand and manage counterparty risk and documentation. Finally, it may be difficult for investors to stick to an insurance program after years of negative performance. All of these add to the cost of an insurance program, even for funds with substantial experience in trading derivatives and the right oversight board.

We acknowledge that some investors might buy insurance for reasons other than reducing tail risk. For example, insurance can provide a cash buffer in times of market distress, potentially allowing investors to take advantage of fire-sales and other market dislocations. However, depending on the magnitude and frequency of the dislocations (and the manager's ability to identify them), this opportunistic approach still might not make up for the negative expected returns from buying insurance. Other investors might occasionally have a tactical view that insurance is conditionally cheap. However, this is simply market timing in another form, and this decision should be made (and sized) in the context of other tactical views in the portfolio. Finally, some investors might be forced into insurance strategies for Board or plan governance reasons independent of tail risks, but related to risk tolerances. In this case, investors might be better served by reducing overall portfolio risk before buying insurance.[1]

We think that the most efficient way to reduce tail risk is by making a few changes to portfolio construction and risk management policies, as described in the following pages.

Exhibit A: Insurance Is Not A Long-Term Solution





Source: AQR. S&P 500 with 7.5% OTM Puts was built by purchasing 7.5% out-of-the money puts with quarterly expiration on the S&P 500. The puts are rebalanced one month before expiration and assume no transactions costs.

[1] See Litterman (2011) for more on reducing risk in a portfolio, and the case for institutional investors selling insurance rather than buying it.

1) Diversify by Risk, Not Just Assets

One of investors' main takeaways from the financial crisis was that "diversification failed". We think that the implementation of diversification failed, not diversification itself. In a portfolio dominated by a single asset class, a tail event in that asset class becomes a tail event for the entire portfolio. The traditional equity concentration in most institutional portfolios means that a bad year for equities will be a bad year for the portfolio, and a very bad year for equities – which lately seems to come along every decade or so – will have severe long-term impact.

Institutional portfolios are dominated by equity risk (Exhibit B). Having exposures to multiple asset classes may seem diversifying (left chart), but since equities are riskier than other assets, most of the risk in institutional portfolios is equity risk (middle chart). Other asset classes – bonds, credit, commodities, alternatives – won't really matter much, even if they have extraordinary results.

Our recommendation is to create a portfolio that is better risk-balanced by reducing equity in favor of other return sources, including: nominal interest rate exposure; exposure to inflation-sensitive assets such as commodities, real estate and inflation-linked bonds; and a range of credit exposures including corporate, mortgage and emerging markets. Importantly, adding new risk sources does not mean that total portfolio risk increases; rather the portfolio's concentration risk is reduced. In other words, the portfolio is better diversified. The table below shows the performance of a traditional 60/40 portfolio and a risk-diversified portfolio in the last two crises.

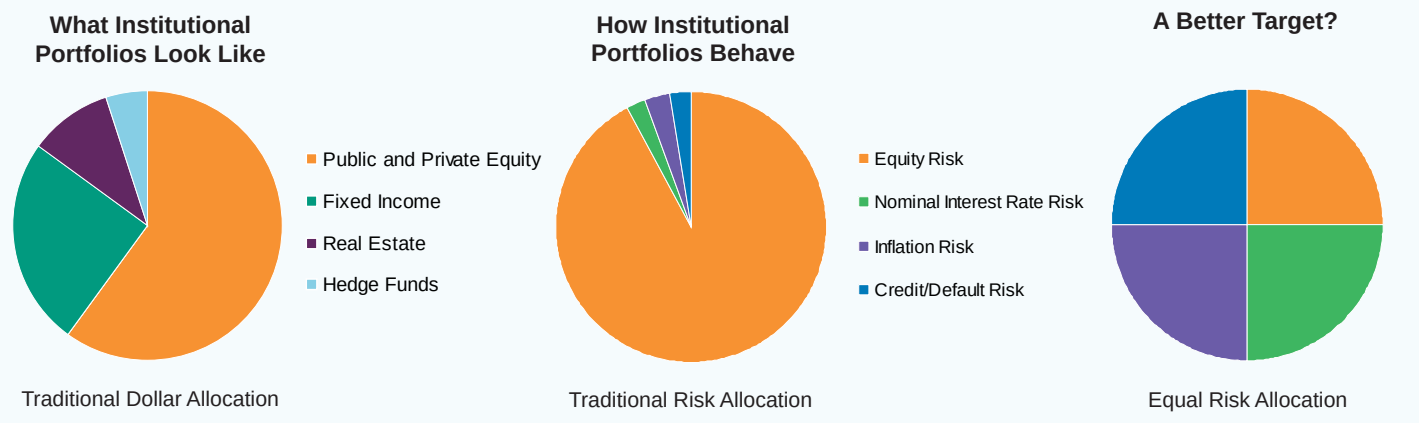
Two Approaches in Recent Crises

	60/40 Portfolio*	Equal Risk Allocation*
Tech Bust (4/00 - 2/03)	-17.6%	+27.2%
Financial Crunch (7/07 - 3/09)	-26.0%	-0.9%

*60/40 Portfolio is 60% the S&P 500 Index and 40% the Barclays Capital Aggregate. The Equal Risk Allocation is a simple risk parity model, using the S&P 500 index, the Barclays US Government Index, and the GSCI.

The above results are not specific to the tech bust and financial crisis; the worst years for a 60/40 portfolio are worse than the worst years for a risk-diversified portfolio. And even if the end result is not a completely balanced portfolio (right chart), any steps in this direction may reduce the portfolio's overall tail risk.

Exhibit B: Multiple Asset Classes Do Not Guarantee Diversification



Charts are for illustrative purposes only, and are based on AQR volatility and correlation estimates. Please see important disclosures at the end of this paper.

2) Actively Manage Volatility

Most portfolios are managed to a target asset allocation. In the simple case of a 60/40 portfolio,[2] if markets become turbulent, then an investor may choose to rebalance, and if so, most likely shifts capital back toward the 60/40 target.

This approach fails to reflect the changing riskiness of assets. While investors construct their portfolios as if asset volatilities are stable, these volatilities are not, and exhibit significant peaks and troughs over shorter periods (Exhibit C). Since 1970, equity volatility has averaged 16% (gray line), but has had several extreme periods (orange line), with 3-month realized volatility ranging from 7% to 60%.

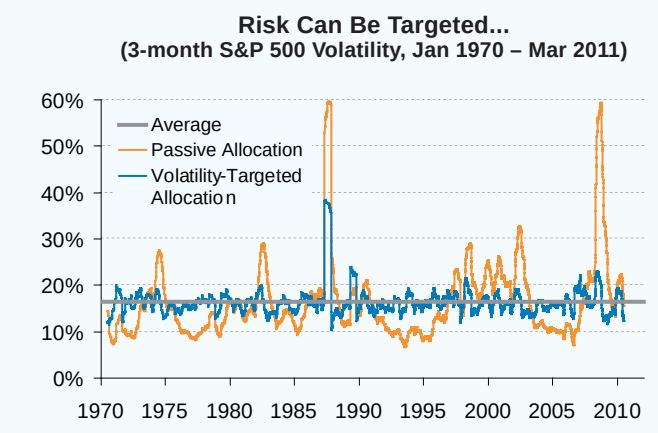
Tail events are typically associated with periods of heightened volatility. When the volatility of a given asset spikes, investors who rebalance to the previous capital allocation, or who don't rebalance at all, are essentially doubling down on the risk of that asset. Dollar exposure may stay about the same, but risk exposure – i.e., the amount of money likely to be made or lost on a given day – has increased.

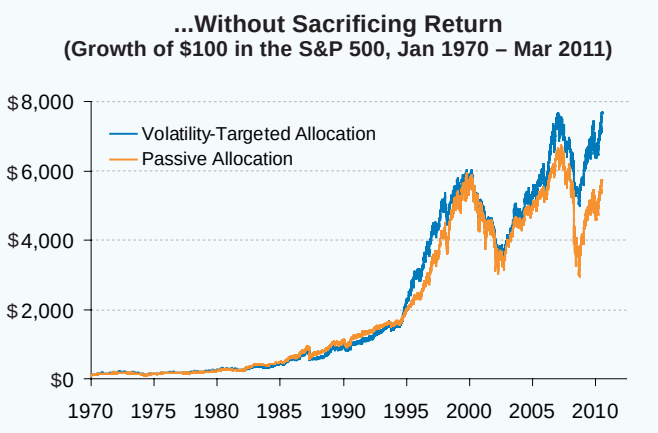
Portfolios with constant asset allocation are not diversified through time; the volatile periods will have an outsized effect on long-term results. By contrast, portfolios whose volatility is actively managed to a steady level will reduce dollar exposures during volatile periods, seeking to maintain the same risk exposure through time (blue line).[3]

To do this, investors need to forecast market volatility. Fortunately, even fairly simple risk models can give useful predictions of volatility. This month's stock market return tells us little about next month's return, but this month's risk characteristics give us important information about next month's risk.[4] In the exhibit below we build a simplified volatility-targeted portfolio (blue line) by estimating forward S&P 500 volatility with the volatility over the preceding three months. We then size a position in the S&P 500 to target a constant volatility, rather than a target dollar exposure.

Some investors may ask whether reducing exposures in periods of heightened volatility (and increasing exposures in placid markets) means selling low and buying high. Their argument is that as markets decline, volatility increases and so risk-targeted strategies must sell on the way down.[5] This argument misses a larger point: the risk-adjusted return of equities does not increase when equity volatility increases. Investors who maintain a static capital allocation when equities become more volatile are increasing their risk exposure to an asset with the same or lower risk-adjusted return – an inferior policy. Our research suggests portfolios that maintain steady risk (or even reduce risk) when forecast volatility is high may earn higher risk-adjusted returns. Unlike purchasing insurance, active volatility management can reduce tail risk, with the possibility of some outperformance (right chart).

Exhibit C: Volatility Can — And Should — Be Targeted





[2]A 60% allocation to equities, and a 40% allocation to bonds. The examples on this page use the S&P 500 for equities.
[3]Some investors may argue that this approach isn't feasible for them. Extremely large plans may be constrained in the amount of rebalancing they can accomplish relative to their total assets, but we think they may benefit at the margin from the strategy's impact not just on their returns but also on their overall risk management approach. Meanwhile, smaller investors, who may not have the infrastructure to implement this type of rebalancing policy, can take advantage of volatility-managed index funds and external managers who offer volatility-managed strategies.
[4]Markets rarely shift from volatile to placid over a day or a week. On occasion, they do shift from placid to volatile quite quickly, though our research suggests that large changes in risk in either direction are much more likely to happen with some market warning. In almost all periods of unusually high equity risk, volatility builds slowly, gathering steam as markets veer toward a crisis. Even a relatively sudden event like the crash of 1987 was preceded by several weeks of increasing market turbulence, enough warning for actively risk-managed portfolios to make some helpful adjustments (left chart, blue line).
[5]This is not necessarily how markets behave – for example, market gains can be accompanied by increases in volatility.

3) Embrace Low-Correlated Alternatives

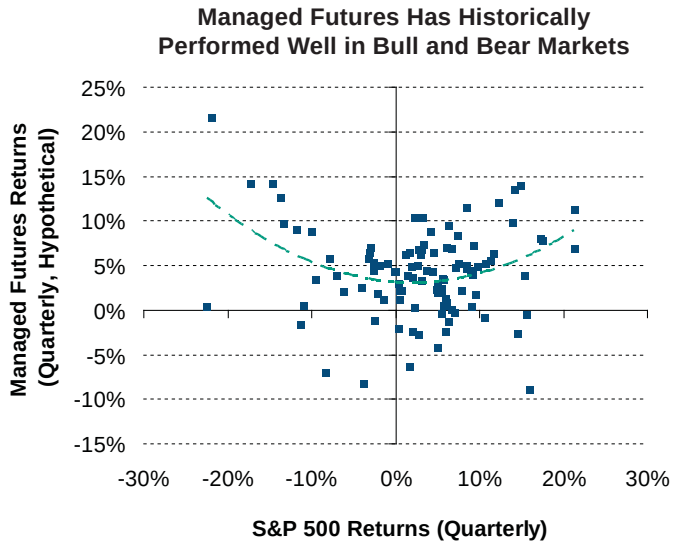
Increasing exposure to alternative investments is another way to reduce tail risk. Granted, finding strategies that are truly uncorrelated to major asset classes is not easy; many "alternatives" – like hedge funds and private equity – can be highly correlated to equity markets. That said, truly diversifying managers and strategies can have a role in mitigating tail risks. Alternative strategies such as global macro, equity market neutral, statistical arbitrage, and other relative-value strategies have historically fulfilled this role for institutional investors.

One strategy that has come into the spotlight recently is managed futures, which has exhibited a low overall correlation to equity markets and a negative correlation in bear markets. Managed futures strategies seek to profit from markets' tendency to exhibit trends. There is considerable research pointing to links between investors' behavioral biases and under-reaction in market prices.[6] If prices initially under-react to either good or bad news, trends tend to continue as prices slowly move to fully reflect changes in fundamental value. These trends have the potential to continue even further to the extent investors herd (chase trends), which can cause prices to over-react and move beyond fundamental value after the initial under-reaction.

Historically, when equities have suffered prolonged declines, managed futures strategies have done well. Most extreme bear markets do not happen overnight, but instead occur as the result of prolonged economic deterioration. Managed futures strategies position themselves short as markets begin to decline, and can profit if markets continue to fall. Because price trends can be positive or negative, managed futures portfolios – unlike many other investments in institutional portfolios – have historically delivered strong performance in both up and down markets (Exhibit D). However, managed futures strategies are generally not expected to perform well in markets that are range-bound with no price trends, and markets that exhibit extremely sharp reversals in trends.

Other alternative strategies, such as global macro, global tactical asset allocation, and volatility arbitrage may also play a role in reducing tail risk. For many of these strategies, the benefit comes if managers are able to identify crises in advance and position their portfolios appropriately. But if managers forecast incorrectly, the downside risk can be significant.

Exhibit D: Alternative Strategies May Help Address Tail Risks



Source: AQR. The managed futures returns shown above are based on a simplified strategy.

[6]Some of the most-cited studies related to this pattern are: Edwards (1968) and Tversky and Kahneman (1974), who find that people anchor their views to historical data and adjust views insufficiently to new information; Shefrin and Statman (1985) and Frazzini (2006), who find that people tend to sell winners too early and hold on to losers too long, which slows upward and downward price adjustments; and De Long et al. (1990) and Bikhchandani et al. (1992), who examine the "bandwagon" effect and herding among investors.

4) Take Advantage of Low-Beta Equities

Another approach to reducing tail risk is to lower the intrinsic risk of the equity investments themselves. Low-beta stock selection underlies many "defensive equity" strategies, which seek to reduce tail risk while preserving much of equities' upside.

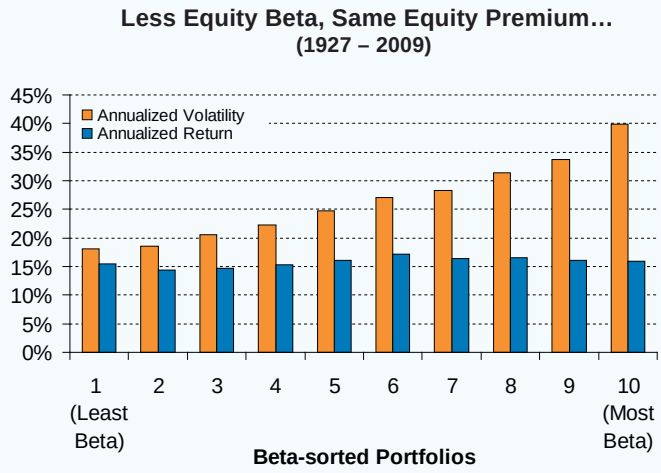
"Beta" describes how a security's price varies with the market. A stock with a beta of 1.5 has historically been expected to gain or lose 1.5 times what the market gains or loses. Investors seeking ambitious returns tend to favor high-beta stocks, those with greater risk and greater expected reward.

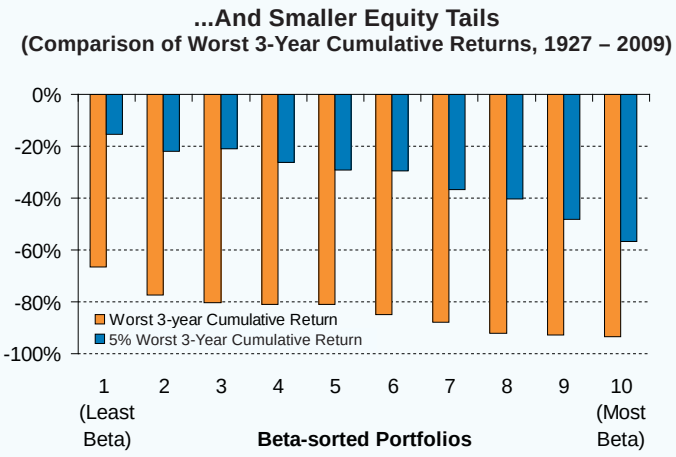
It would seem that the only way to achieve such returns with low-beta stocks would be to use leverage, a tactic few investors are currently embracing. However, since high-beta equities are the preferred way to get higher expected returns, their prices tend to be bid higher than they otherwise should be. Conversely, low-beta equities are relatively unloved, and with less demand trade at lower prices relative to their fundamentals. This market distortion creates an opportunity: a portfolio of low-beta stocks that has roughly the same return as the overall market.

The data is consistent with the theory. The left chart in Exhibit E shows the returns of 10 portfolios sorted by beta. High-beta stocks are more volatile, but contrary to conventional wisdom, there is not a direct relationship between beta and return. This suggests that investors can reduce their exposure to equity risk without reducing their exposure to equity returns. The worst 3-year performance of these portfolios is shown on the right chart below. Both the worst and 5th-percentile worst periods for the low-beta portfolios are meaningfully better than for the high-beta portfolios. These findings aren't limited to US stocks. In 19 other developed stock markets, low-beta stocks tend to outperform high-beta stocks on a risk-adjusted basis.[7]

Many "defensive equity" strategies use low-beta stocks in building a portfolio. In addition to using beta, many defensive equity managers will also look for "quality" companies – ones that are expected to withstand crises better than their peers. There are various ways that managers will measure "quality", including return on equity, debt-to-capital, and earnings variability. We believe combining these quantitative (low-beta) and fundamental (quality) measures can provide equity investors with less-severe drawdowns while still providing exposure to the equity premium.

Exhibit E: Less Equity Beta, Same Equity Premium





Source: AQR. Data includes all available common stocks on the Center for Research in Security Prices (CRSP) from January 1926 to December 2009. Betas are calculated with respect to the CRSP value-weighted market index.

[7]Frazzini and Pedersen (2011). For a historical perspective on this phenomenon, see Black (1972, 1973), Brennan (1971) and Mehrling (2005).

5) Have a Tail Event Plan…Before the Tail Event

In theory, long-term investors are supposed to be able to ride out a crisis better than short-term investors. We don't believe that's what actually happens. Although long-term investors may try to maintain market exposures in a crisis, every investor has a breaking point at which the pressure to cut risk becomes insurmountable. Research suggests that when faced with losses, most investors hold a deteriorating portfolio for too long, reluctant to cut positions that are getting cheaper. The decision to finally cut risk often comes too late – that is, at or near the bottom. Compounding the problem, investors tend to add exposure back too slowly, missing out on much of the recovery.

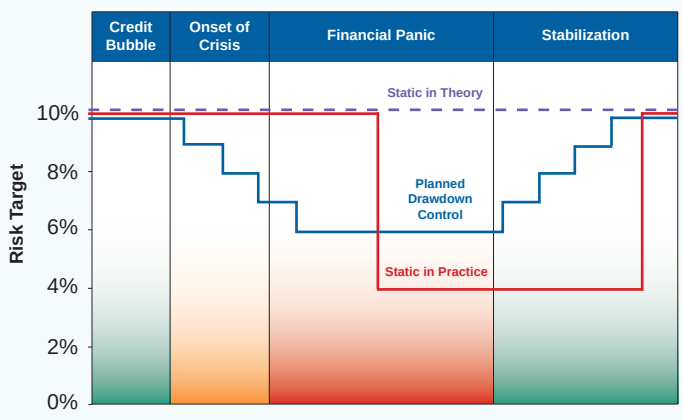
Although investors cannot avoid crises completely, they can choose ahead of time to have a plan of action. We believe a pre-determined, systematic risk management plan – from a simple stop loss to a more complex drawdown control system – can prevent investors from being forced into an imprudent market exit.

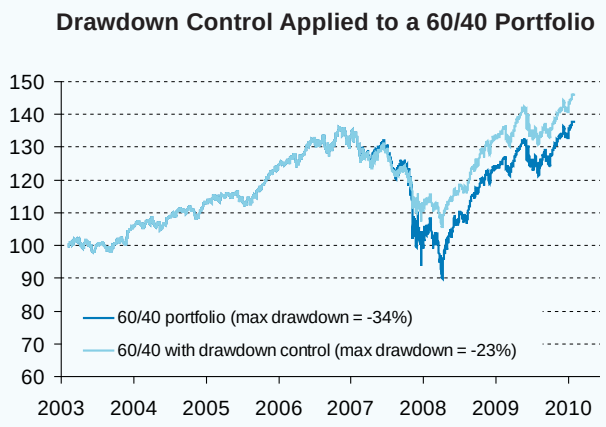
Our preference is a discipline that reduces biases and limits the potential for emotional decision-making in times of turmoil (Exhibit F). Specifically, we seek to avoid the common pattern of under-reacting initially, over-reacting when portfolios have suffered, and then failing to reinvest until too late (red line). A better risk management program should be triggered infrequently and implemented gradually, but, to the extent possible, should take effect before large tail events occur (blue line).

Implementing a suitable risk management program requires substantial changes to current systems and structures. For many institutional investors, the risk management role is focused on creating reports and studies. An effective risk manager must be empowered to act – at least under specific circumstances – in order to reduce or hedge the portfolio's exposures in periods of stress. Reporting, titles and job functions must all serve the long-term goal of ensuring that the portfolio's holdings are responsive to changing market conditions.

This type of risk management is not always costless. A strategy that reduces exposures before the worst of a tail event by definition begins to cut risk before a full-blown crisis. 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 (right chart) 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.

Exhibit F: Have a Plan for Exiting a Crisis – And for Getting Back Into the Market





Source: AQR. The drawdown control system described above will not always be successful at controlling a fund's risk or limiting portfolio losses. This process may be subject to revision.

Conclusion:

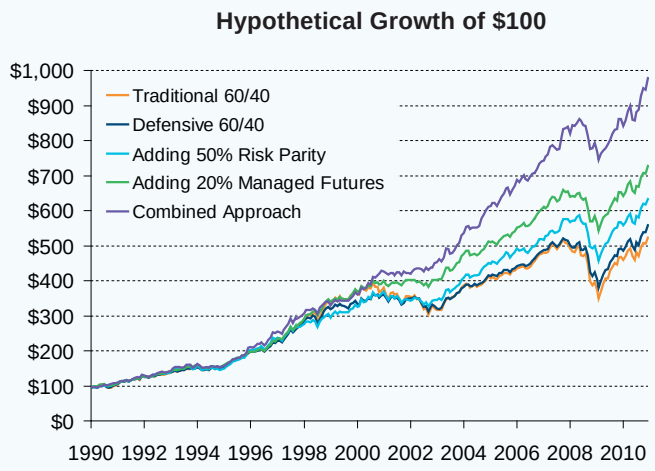
Financial markets are not normally distributed and tail risks do exist. Investors are right to focus on tail risk, since large short-term losses can prevent a portfolio from meeting its long-term return objective, not just from its effect on compound returns, but from the bad investor behavior it can induce. However, a myopic focus on tail risk – buying insurance – is rarely the right long-term investment policy for several reasons: the amount to insure against is not a static figure; the cost of insurance is a drag to long-term performance; and costs tend to increase when insurance is most needed.[8]

We prefer a more fundamental approach, one that reduces tail risk by enhancing the portfolio's overall risk-return characteristics. Often this approach will blend several distinct strategies: broader diversification, volatility-based risk management and drawdown control, perhaps combined with active-management strategies such as managed futures or low-beta equities. Many of these strategies already play an important role in risk parity portfolios.

The left chart below shows the performance of five portfolios, with a traditional 60/40 as a baseline (orange line). Replacing half of the equity allocation with a low-beta equity strategy would have reduced portfolio drawdown modestly (dark blue line). Adopting a risk parity approach for half of the assets would also have offered attractive protection (light blue). Making a 20% allocation to managed futures from equities (green) would have further improved performance in recent crises.

Combining these approaches would yield a portfolio that would have offered a good defense through the financial crisis and into the recovery (purple). We believe that the recent period may look especially good for these strategies, but the longer-term evidence for each strategy, and particularly in some combination, is compelling. This is in contrast to hedging strategies, which performed well during the crisis, but which are not expected to perform well over time. In our view, each of the approaches outlined in this paper represents a more fundamental way for investors to address tail risk, without the long-term cost of an insurance program.

Exhibit G: Protecting the Downside Without Sacrificing Performance



Largest Hypothetical Peak to Troughs

	Traditional 60/40	Defensive 60/40	Adding 50% Risk Parity	Adding 20% Managed Futures	Combined Approach
Tech Bust (4/00 - 2/03)	-23%	-14%	-11%	-5%	-3%
Financial Crisis (7/07 - 3/09)	-33%	-27%	-22%	-18%	-13%

Source: AQR. The traditional 60/40 Portfolio is built using the S&P 500 Index and the Barclays Aggregate Bond Index, rebalanced monthly. The "Defensive 60/40" portfolio is a 30/40/30 allocation to the S&P 500 Index, the Barclays Aggregate Index, and a US Defensive Equity Strategy backtest that is based on AQR models of hypothetical portfolios; net of transaction costs, financing costs, and a 25bps annual management fee. These are not the returns to an actual portfolio and are for illustrative purposes only. The "Adding 50% Risk Parity" portfolio is a 30/20/50 allocation to the S&P 500 Index, the Barclays Aggregate Index, and a simplified risk parity strategy (which is built from the S&P 500, the Barclays Government Bond Index, and the GSCI). The "Adding 20% Managed Futures" portfolio is a 40/40/20 allocation to the S&P 500 Index, the Barclays Aggregate, and a simplified managed futures strategy. Finally, the "Combined Approach" portfolio is a 30/50/20 allocation to the Defensive Equity Strategy backtest, the simplified risk parity strategy, and the simplified managed futures strategy.

[8]In addition, investors (or Boards) who have diligently paid for insurance over a period of years following a crisis may be tempted to give it up after a protracted period of market calm, even if that calm is setting the stage for a future crash.

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Past performance is not an indication of future performance.

Simple Managed Futures Strategy: This hypothetical strategy trades 60 highly liquid futures and currency forwards during the period from January 1985 to December 2010. To determine the direction of the trend in each asset, the strategy considers the excess return over cash of each asset for the prior 12 months. The portfolio takes a long position if the return was positive and a short position if the return was negative. The strategy always holds positions in each of 24 commodity futures, 9 equity index futures, 15 bond futures and 12 currency forwards. The size of each position is determined by volatility, with a target of 0.60% annualized volatility for each asset (this target volatility was selected to yield an average portfolio volatility of around 9-10%. The model estimates future volatility for each asset based on the most recent 60 days). This yields a portfolio that is equal risk weighted across the instruments to provide diversification and to limit the portfolio risk from any one asset. (See Ooi and Pedersen (2009) for further details on the strategy.) The portfolio is rebalanced at the end of each month.

The Simple Risk Parity Strategy is a simulated portfolio based on the MSCI World Index, the Barclays US Aggregate Government Index, and the S&P GSCI Index, representing exposures to equities, bonds, and commodities, respectively. This simulated portfolio targets an equal amount of volatility from each asset class every month.

The simulated portfolio performance included herein is based on publicly available index data for the indices disclosed and is not based on actual portfolios being traded. They are presented for illustrative purposes only. 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 simulated performance results and the actual results subsequently realized by any particular trading program.

Gross performance results do not reflect the deduction of investment advisory fees, which would reduce an investor's actual return. For example, assume that $1 million is invested in an account with the Firm, and this account achieves a 10% compounded annualized return, gross of fees, for five years. At the end of five years that account would grow to $1,610,510 before the deduction of management fees. Assuming management fees of 1.00% per year are deducted monthly from the account, the value of the account at the end offive years would be $1,532,886 and the annualized rate of return would be

8.92%. For a ten-year period, the ending dollar values before and after fees would be $2,593,742 and $2,349,739, respectively. AQR's asset based fees may range up to 2.85% of assets under management, and are generally billed monthly or quarterly at the commencement of the calendar month or quarter during which AQR will perform the services to which the fees relate. Performance fees are generally equal to 20% of net realized and unrealized profits each year, after restoration of any losses carried forward from prior years. In addition, AQR funds incur expenses (including start-up, legal, accounting, audit, administrative and regulatory expenses) and may have redemption or withdrawal charges up to 2% based on gross redemption or withdrawal proceeds. Please refer to AQR 's ADV Part 2A, for more information on fees. Consultants supplied with gross results are to use this data in accordance with SEC, CFTC, NFA or the applicable jurisdiction's guidelines.

Hypothetical performance results (e.g., quantitative backtests) 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 adhere to a particular trading program in spite of trading losses are material points 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. 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. Discounting factors may be applied to reduce suspected anomalies. Hypothetical performance results are presented for illustrative purposes only.

There is a risk of substantial loss associated with trading commodities, futures, options, derivatives and other financial instruments. Before trading, investors should carefully consider their financial position and risk tolerance to determine if the proposed trading style is appropriate. Investors should realize that when trading futures, commodities, options, derivatives and other financial instruments one could lose the full balance of their account. It is also possible to lose more than the initial deposit when trading derivatives or using leverage. All funds committed to such a trading strategy should be purely risk capital.