THE LONG AND THE SHORT OF IT:

The Quant Shorting Advantage

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ABOUT QMA

Serving investors since 1975, QMA targets superior risk-adjusted returns by combining research-driven quantitative investment processes built on economic and behavioral foundations with judgment from experienced market practitioners. Ultimately, each portfolio is constructed to meet the individual financial needs of the client. An independent boutique backed by the capabilities of one of the world's largest asset managers, QMA is the quantitative equity and global multi-asset solutions business of PGIM, the global investment management businesses of Prudential Financial, Inc. As of 3/31/2018, we manage approximately $128 billion in assets for a wide range of global clients.

FOR MORE INFORMATION

To learn more about QMA's shorting-enabled equity capabilities, please contact Gavin Smith at Gavin.Smith@qmallc.com or 973.367.4569.

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Driven by increased breadth in the viable investment opportunity set, along with investor demand for products with certain excess return/risk attributes, short selling is now common in several types of investment products—such as equity market neutral, equity long-short, and active extension. The lure of short selling for investors is that it can be a powerful tool to broaden the set of alpha opportunities, with some shorting-enabled products even lowering overall portfolio risk and helping preserve capital during market drawdowns.

Short selling involves borrowing and selling shares of a stock that an investor believes will soon decline in price. If the stock does in fact decline, the investor can buy back the shares at a lower price, and deliver the shares back to the lender. The profit for the short seller, if he/she is correct in predicting a price decline, comes from the difference in price from the time the stock was sold to the time it was bought back.

While the concept of short selling is straightforward, proper implementation of a short selling strategy is not trivial. Because shorting comes with its own risks and costs, and involves the challenge of identifying attractive short selling opportunities, investors are best served with a disciplined and skilled manager at the helm.

Compared to traditional active managers offering equity long-short strategies, quantitative approaches have inherent advantages. We believe QMA's approach in particular is ideally suited for adding value through shorting.

Before exploring the advantages of quantitative approaches when it comes to short selling, it is worthwhile to discuss why shorting-enabled products can unlock additional alpha opportunities and potentially deliver higher risk-adjusted performance.

Why Utilize Short Selling?

In a long-only portfolio, when an investor does not have a favorable view on a stock, the best they can do to reflect this view is to underweight or not purchase the stock. Therefore, not being able to short sell a stock means an investor cannot take full advantage of potentially key investment insights. Broadly, a long-only strategy would focus on alpha opportunities an investment manager finds attractive and underweight, or not hold, those stocks which are viewed as most unattractive. As a result, by not shorting stocks, alpha is left on the table. Relaxing the long-only constraint opens up opportunities to finding alpha in often overlooked places.

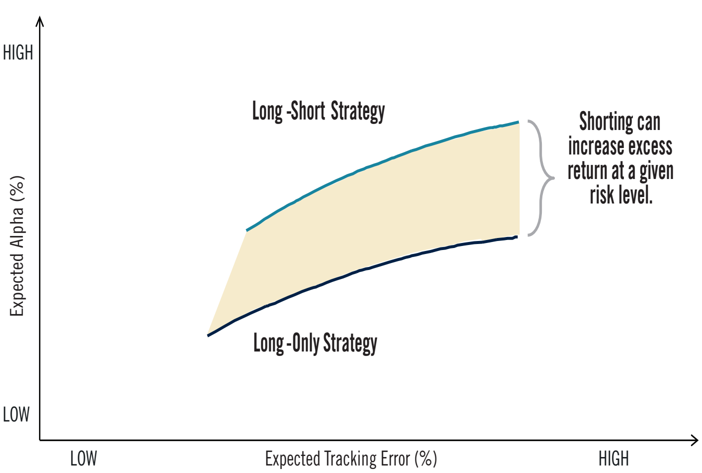
As Figure 1 illustrates, shorting allows an investment manager to expand the investment opportunity set, expanding the efficient frontier and increasing the relative return potential at a given risk level.

Being able to fully utilize information possessed by an investment manager is only one benefit of short selling. Short selling stocks also provides managers with more capital to overweight those attractive stocks in the long-only component of the portfolio. In an active extension product, cash proceeds from the short sale of the stock can be used to extend holdings in attractive stocks, substantially increasing active exposures in a portfolio.

Figure 2 illustrates the additional long exposure for attractive names that can be achieved when shorting is simultaneously employed. Here, we see active exposures relative to the Russell 1000® Index for two hypothetical portfolios sorted by market cap rank in the benchmark. Both portfolios have 100% net market exposure. In other words, short selling allows an investment manager to transfer more investment insights into their portfolio, expanding the investment opportunity set, and increasing the possibility of better investment outcomes.

Short selling also provides risk mitigation benefits—specifically allowing an investment manager to reduce the market exposure of a portfolio. The additional short names provide diversification benefits to the overall portfolio, adding value in various market conditions—particularly during times of falling prices, when gains from short positions can reduce overall portfolio volatility by offsetting losses from long positions and help preserve capital. To highlight this last point, Figure 3 shows the maximum drawdown over 12 years for the Hedge Fund Research Index (HFRI) Equity Market Neutral Index, HFRI Equity Hedge (Total) Index, and the S&P 500 Index. For instance, during the financial crisis of 2008, the market was down over 50%, as represented by the S&P 500, whereas the Equity Hedge Index was down around 30% and the Market Neutral Index only declined approximately 10%. Across short strategies that target a beta exposure of less than one, the potential drawdown protection afforded by the ability to short sell is apparent.

Figure 1. Short Selling Can Improve the Risk-Return Trade-off
Relative Efficient Frontier



Source: QMA.
Shown for illustrative purposes only and not indicative of any actual QMA portfolio.

Further, more sophisticated short sellers can also look to vary the level of short selling through time to correspond with different market conditions. If at times they expect a higher likelihood of a market decline, they may increase the level of short selling in their portfolio. At other times, they have the option to scale back their short selling. In this setting, short selling can be used to dynamically or tactically adjust a portfolio's market exposure.

It is important for an investor to understand that short selling is no free lunch. While short selling can give a significant alpha edge, there is an asymmetrical risk associated with such a strategy. When buying a stock, the maximum downside risk is 100%. In contrast, when short selling a stock the downside risk is theoretically infinite. As discussed later, quantitative managers generally have more tools at their disposal to diversify this downside risk of individual short positions.

How Is Shorting Used in Different Products?

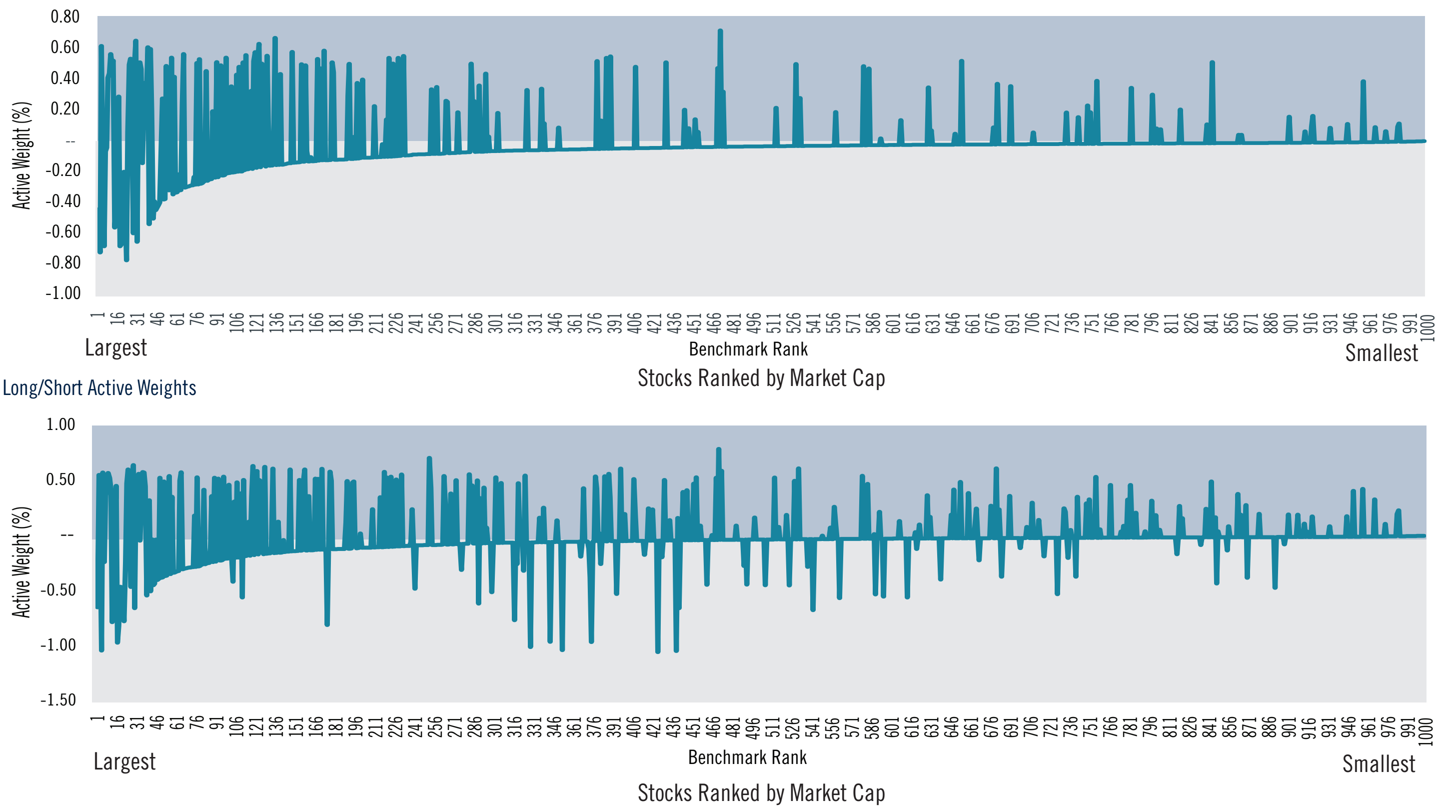
There are three main categories of shorting-enabled equity products, as shown in Figure 4. They vary based on the level of market exposure provided and expected alpha.

First are the products known as equity long-short. These products will typically look to partially hedge market exposure, resulting in a net exposure that may range between 20% and 80%. The level of short selling will vary to deliver this net exposure target. This variation will be a function of market conditions. The end result is ideally an equity-like return stream, but with less volatility.

The next category consinsts of active extension products that offer complete market exposure, or in other words, have a beta of one (or very close to one). These products may go by more specific names such as 130/30. The premise of these strategies is to sell short a certain percentage of the portfolio, for instance 30%, and invest the proceeds from these short sales into additional long positions that take the portfolio's long positions to 130% of initial capital. On a net basis, the portfolio is still 100% long—with full market exposure—but it also has a gross exposure of 160% (130% in long positions and 30% in short positions), increasing the active exposures and the alpha opportunities.

The last category of shorting-enabled products consists of equity market neutral portfolios, which seek to completely hedge market exposure (i.e., 0% net market exposure), with alpha being the sole driver of overall return. Ideally, they should generate a return stream that has low or no correlation with equity markets.

Figure 2. Adding Shorts Increases Exposure to Most Attractive Stocks
Long-Only Active Weights



As of 12/31/2017.
Sources: QMA and FactSet. Shown for illustrative purposes only. Representative Russell 1000® benchmarked portfolio. Holdings are subject to change.

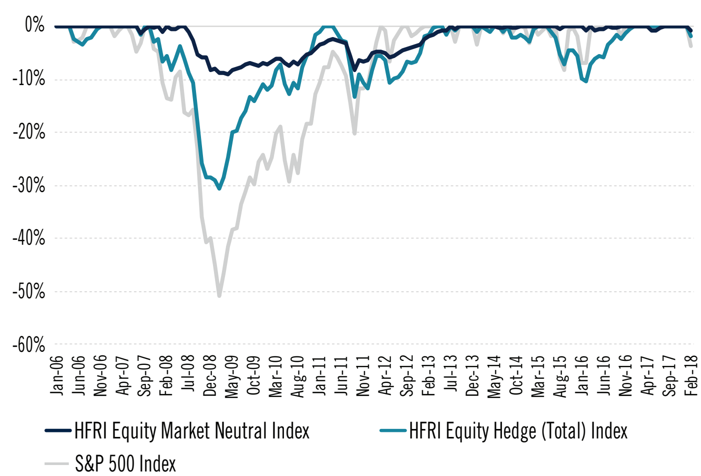
What Makes Each of These Shorting Enabled Products Attractive Today?

Each of these three products can be attractive for investors at any particular time given investors' varied investment objectives and needs. That said, each of the three categories of shorting-enabled products can help address distinct issues facing investors in the current environment.

Starting with equity long-short strategies, while economic fundamentals remain strong equity markets are likely to be considerably more volatile going forward than the record low volatility of recent years. Some think that the current bull market could still grind higher but with a heightened risk of a market drawdown. In these conditions, equity long-short strategies are attractive because they aim to deliver performance comparable to current equity return expectations, while offering downside protection in the event of a market pullback.

Admittedly, if the market stages another surge, as it did in 2017, an equity long-short strategy will lag, but that would be a reflection of the intentional lower market exposure. Investors

Figure 3. Max Drawdown of Market Neutral and Equity Long-Short Products
Comparison to Drawdown of S&P 500



As of 2/28/2018.
Source: QMA, Thomson Reuters Datastream, Standard & Poor's, HFRI.
Shown for illustrative purposes only. Maximum drawdown is the peak-to-trough decline during a specific record period. Please see notes to disclosure for important disclosures. Subject to change. An investment cannot be made directly in an index.

who want to maintain full market exposure may be better served with the active extension strategies, which target a beta around one, but have higher potential alpha due to the increased active share through additional long and short positions. Meanwhile, today's higher starting valuations only strengthen the view that over the long term we are in a low-return environment with single-digit returns on the more distant horizon for equities. In this environment, any additional return above market averages will be particularly valuable.

As for equity market neutral strategies, in the current environment they are being viewed as an alternative to a fixed income allocation. With yields still low and bond prices becoming more unsettled, equity market neutral offers a more stable equity-derived return stream that has a low correlation to both equity and fixed income markets.

In General, When Are Shorting Enabled Products More Effective?

People normally think stock prices need to decline in value for short selling to be effective. That is ideal, but the reality is the number of stocks that decline in value varies greatly through time. For instance, during the financial crisis in 2008, 93% of stocks in the S&P 500 declined in value. In contrast, during the bull market in 2014, only 20% of stocks in the S&P 500 declined in value.

Any shorting-enabled product aiming to profit from absolute price declines can face challenges through time, depending upon the number of stocks that decline in value. Many investment managers actually use short selling to capture value from insights on relative performance between two stocks, or groups of stocks, with certain attributes. For example, if in a market neutral strategy, an investor has insights on two stocks and thinks that Stock A will increase by 20% whereas Stock B will increase by 8%, the investor can buy A and short sell B to capture an expected return of 12% without exposure to the general market.

This idea can be extended to stock attributes. If cheaper stocks typically outperform expensive stocks, an investor can buy a basket of cheap stocks and short sell the basket of expensive stocks, capturing the return difference between the two baskets.

For shorting-enabled products that aim to capture the relative performance between stocks, this approach is most effective when there is dispersion in stock returns—a meaningful spread in the return between the best performing stocks and worst performing stocks in the market.

Looking back over the past 20 years, there has typically been a reasonable level of dispersion within the market. In recent years, return dispersion has been somewhat lower relative to history, but in 2018 it has been picking up in conjunction with volatility, adding to the opportunity for short-enabled products.

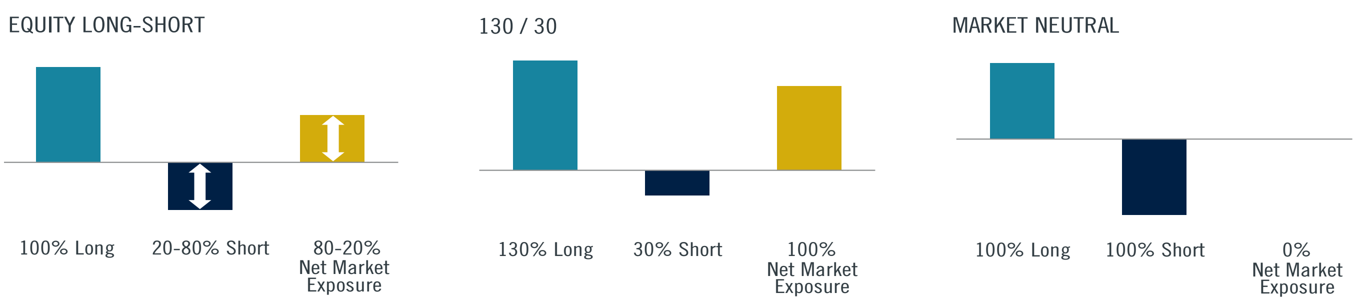
The Quant Shorting Advantage

When it comes to implementing a strategy involving short selling, a quantitative approach like the one developed at QMA has inherent advantages. These advantages relate to enhanced stock selection, risk management and cost control.

First, a quantitative stock selection strategy is typically symmetrical. This means that quantitative investors not only rank every stock in a universe, but that they may be equally effective at identifying profitable long and short selling opportunities. QMA has been successful at doing this over time. Figure 5 shows the 230 basis points per quarter spread between the lowest and highest ranked stocks in QMA's stock selection model, on an equal weight basis, since 1998.

What makes a quantitative process successful at identifying long and short opportunities is that it is a systematic implementation of an investment philosophy. On a daily basis, quantitative processes consume all relevant information on each stock across a broad universe to update each stock's ranking. This systematic approach means quantitative investors are not

Figure 4. Comparing Long-Short Equity Exposures at QMA
Three Main Categories

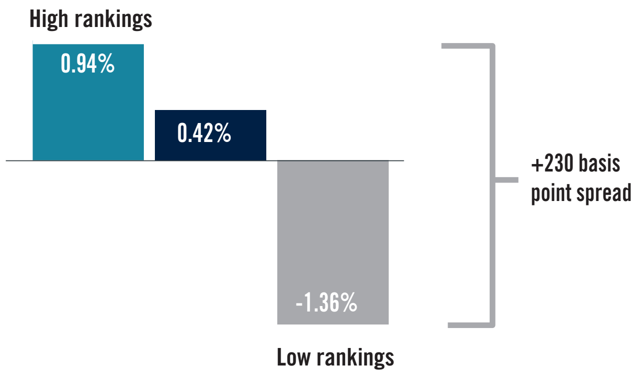


	Long Only	Equity Long/Short	130 / 30	Market Neutral
Equity Exposure "Beta"	1.0	Varies	1.0	0.0
Benchmark	S&P 500	Varies	S&P 500	Cash +
% Shorts	0%	Varies	30%	100%

Source: QMA.
Shown for illustrative purposes only.

Figure 5. Expanding the Opportunities for Alpha

Quarterly Excess Return (on Average)[1]- US Stock Universe[2]



[1]Based on the difference between each group of stocks' returns and the average of all stocks' returns.
[2]Average quarterly equal-weighted market-adjusted gross returns for all stocks in universe (largest 3,000 US stocks), 1/1/1998 through 12/31/2017.
Source: QMA, using data provided by FactSet. Returns are gross of management fees and are only used to illustrate the information implicit in our stock selection methodology.
Past performance is not a guarantee or a reliable indicator of future results.

resource-constrained in the task of identifying investment opportunities. Quantitative investors can identify the best and worst opportunities across the whole investment universe. With increased breadth, quantitative investment managers have more opportunities to apply their stock-picking skill, increasing the likelihood of strategy success.

A further feature that facilitates return symmetry is the way information is processed. As information changes, the evaluation of a stock will change. Behavioral biases and human limitations do not interfere with the collection and processing of information. The systematic nature of a quantitative process allows for a quick, unemotional reaction to new information allowing for higher return capture for long and short opportunities.

Beyond their return symmetry, quantitative investors are better equipped to manage the unique risks associated with shorting. Instead of making fewer, larger short sales, quantitative investors maintain a highly diversified portfolio of short positions across sectors and industries. This lessens the impact of one or a few losing short positions. It also minimizes unintended exposures in the portfolio—exposures or effects that are sensitive to macro shocks and to changes in risk sentiment that can produce unpredictable performance—further enabling quantitative investors to control the asymmetric risks inherent in short selling.

Finally, integration of shorting costs is a natural extension of the quantitative portfolio construction process. For both long and short positions, costs of trading can be integrated to determine a "cost-adjusted alpha" before investing. With shorting, the additional costs associated with borrowing stock can be seamlessly taken into consideration and carefully analyzed before transacting. This ensures that quantitative investors identify not only the most attractive long and short alpha opportunities, but also alpha opportunities that can actually be realized in a portfolio.

It is important to note that fundamental and quantitative investors will typically aim to identify short sale candidates that have similar attributes—unattractive valuations, fundamental weakness, along with deteriorating growth prospects and sentiment. The main difference comes down to implementation—how each investor goes about processing information and translating that into a risk- and cost-controlled portfolio.

In Short…

Because shorting-enabled strategies come with their own costs and risk, investors are best served with a disciplined and skilled manager at the helm. At QMA, we have extensive experience implementing successful shorting strategies. Our well-tenured teams of portfolio managers and traders have implemented shorting strategies for close to a dozen years, including throughout 2008's financial crisis. This track record, combined with the accumulated knowledge and expertise our investment team has gained from navigating multiple market cycles, allows for a distinctive and grounded approach for managing long-short portfolios.

Our combination of symmetrical stock selection, cost-aware implementation, risk management and experience has led QMA to successfully manage a suite of shorting-enabled equity portfolios, each designed to address different investment challenges.

- **US Long-Short Equity** is designed to achieve equity-like returns with lower than market volatility. The strategy is long 100% equity, and short anywhere between 20-80%. The "net long" is adjusted based on our market outlook.
- **US Core Equity Extended** provides additional long and short exposures while maintaining a 100% net equity exposure.
- **US Market Neutral Equity** holds equal proportions of long and short positions resulting in a 0% net equity exposure, with portfolio performance a pure function of alpha. The strategy targets 3-5% long-term volatility.
- **US Market Neutral Levered Equity** also holds equal long (levered) and short positions resulting in 0% net market exposure, but more than twice the active exposure of the US Market Neutral Equity strategy. The strategy also targets a higher long-term volatility of 6-10%.

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