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Q-Series

Active vs Passive: How Will the World of Investing Evolve? (part 1 of 2)

Equities

Global
Quantitative

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Tectonic shift taking place but not entirely for broadcasted reasons

It is not new that in aggregate, actively managed equity funds have been underperforming and losing market share, whilst index funds and ETFs have gained share. The common explanation is normally associated with lower cost structure and higher operational scalability; however, this is not the full story. The reality is that technology has driven both market efficiency and a proliferation of choice which have allowed investors to specifically select the exposures they are comfortable with at the right price. This is causing a fundamental shift in how investors think about capital allocation, track risk adjusted returns and remunerate underlying managers.

The rationale for active managers underperforming is multi-dimensional

In a nutshell, active managers tend to outperform when dispersion of returns is high, and correlation of returns is low, hence allowing for unique insights to be used into the investment process. We explicitly show that only in top quintile of dispersion and bottom quintile of correlation environments have active managers in aggregate beaten their respective benchmarks. Unfortunately for active managers, since 2007 macro factor risk has driven correlation to historically high levels. We believe the ingredients are in place for potential future outperformance.

Active management to add even more value in the brave new world

As a consequence of ageing demographics leading to a world of low earnings growth, as well as living in a very unpredictable geopolitical environment, we believe that equity market returns are likely to be subdued over the next ten years, and as a result return dispersion is likely to remain high. Accordingly, superior active managers should continue to earn an economic rent. The trend of AUM shifting might still continue, however, active management will only grow in importance, as the passive ecosystem needs active management for efficiency.

What to invest in?

In this environment, (to reaffirm) we prefer active exposures over passive exposures. Strategies that are likely to perform well are: high quality growth, high quality income, sector specialist funds, and hedge funds (in particular, equity, quantitative, merger arbitrage, macro, and volatility).

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Introduction

The evolution in the asset management industry has picked up pace in recent years. Beyond any shorter term rotation across sectors and asset classes, it is nothing new that a much longer term trend has been taking place in the industry, as index funds and ETFs have significantly (and consistently) increased their share of assets under management, since their first appearance in the US in 1975 (index funds), and the mid 1990's (ETFs).

The benefits of these vehicles (e.g., cost structure, tax implications, flexibility, etc) have been broadly elaborated, but despite having been around for over 20 years, investors still have fundamental questions with regards to the impact that index funds and ETFs will further have in markets. The following is a short sample of hundreds of questions on this topic recently collected from clients.

(1) *How are passive managers adding to bubble formation dynamics?*

(2) *Given that ETFs operate over a different market micro-structure (i.e., Authorized Participants, ETF agents,…), what will be the impact on volatility and correlation behaviours going forward?*

(3) *At what point will the shift in AUM from Active to Passive stabilize?*

(4) *For the less liquid instruments (e.g., high yield bonds), has the ETF system been tested through enough cycles to be deemed safe?*

(5) *Are the ETF associated capital dynamics fully understood by the regulators, especially under another potential Black-Swan scenario?*

(6) *Is there still competitive space for net-of-fees performance for active managers and can they still add value?*

We could go on and on… In this report (the first of a series) we shed some light on the last question of this list. More specifically, we will examine why many active equity mutual funds have underperformed passive strategies. We will zoom in to the specific market situations which make active managers better equipped to outperform passive strategies and, ultimately, why both vehicles need to coexist for a well-functioning market.

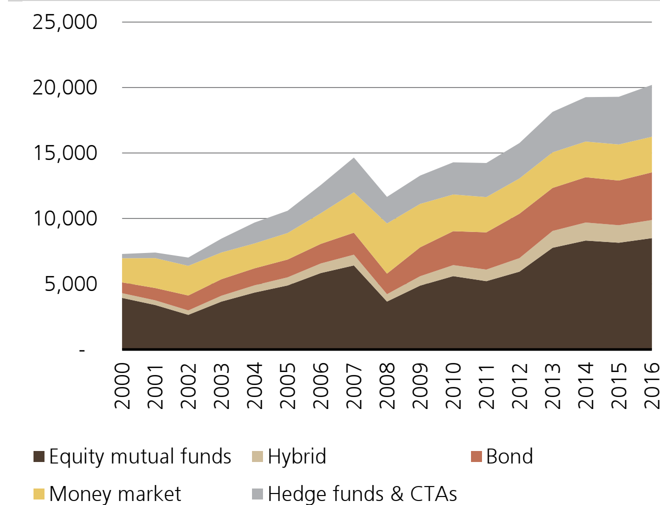
The real story is not only about technology and different cost structures. It is much more fundamental. It is linked to a proliferation of choice when it comes to exposures, and as a consequence, asset owners becoming more discerning as to the exposures that they choose to construct their overall portfolios, splitting risks into beta, macro factor, sector, style and idiosyncratic risk.

Before we go any further, we'd like to thank Professor Russ Wermers and Dr. Anna Von Reibnitz for their insights and assistance with this note.

Flow has been king (or the proof is in the pudding)

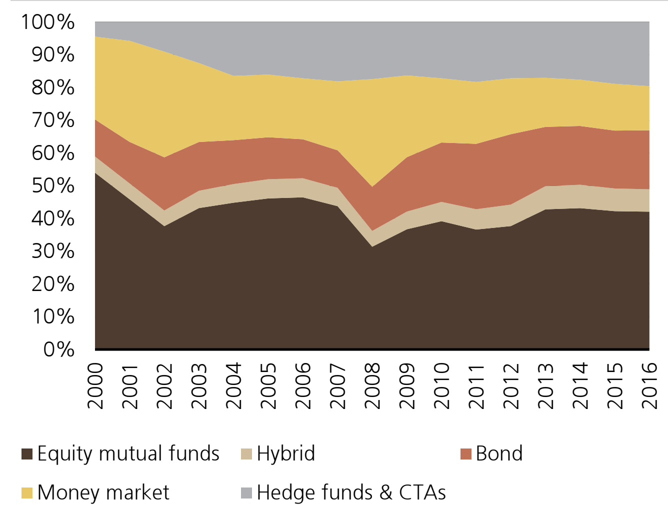
Across the asset management industry, with the exception of money market funds, all strategies have gained assets in nominal terms over the past seven years. However, when we assess the long term share of assets, we note that equity funds (including index, ETFs and active funds) have given up share to both bond funds and hedge funds.

Figure 1: Net assets by asset class (U$ bn)



Source: Investment Company Institute, Barclayhedge, UBS Quant

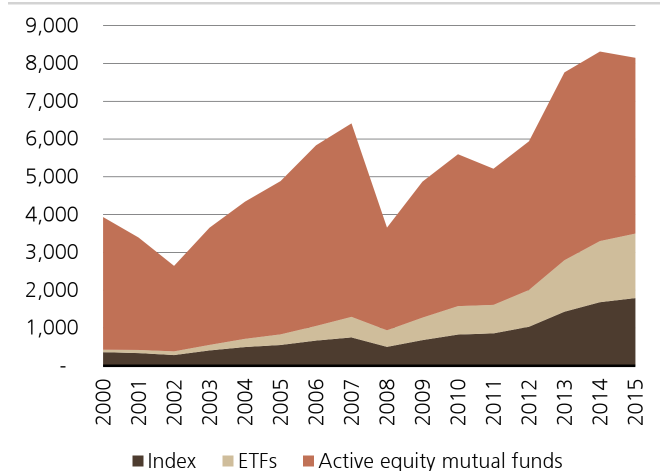
Figure 2: Share of net assets by asset class



Source: Investment Company Institute, Barclayhedge, UBS Quant

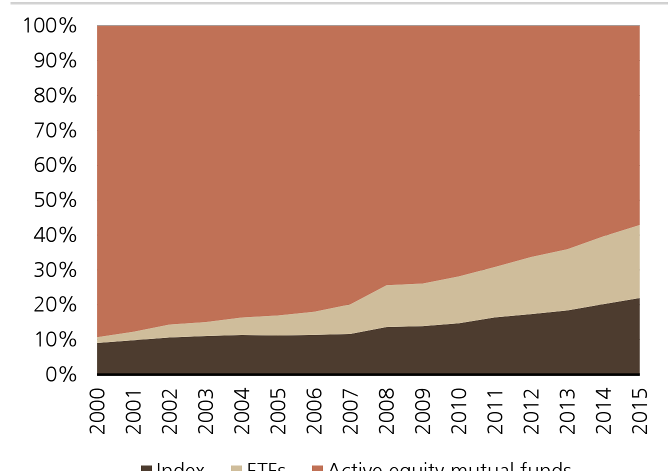
Within equity funds, whilst assets under management have grown over the past 16 years, the share of assets allocated to ETFs and Index Funds has increased significantly to 43% in 2015 from 11% in 2000 (index funds are up to 22% from 9% and ETFs are up to 21% from 2%).

Figure 3: Equity net assets by fund type (U$ bn)



Source: Investment Company Institute, Barclayhedge, UBS Quant

Figure 4: Share of equity net assets by fund type



Source: Investment Company Institute, Barclayhedge, UBS Quant

Note: Net asset data is from the Investment Company Institute and Barclayhedge, and is for all funds globally.
Data is up to Q3 2016.

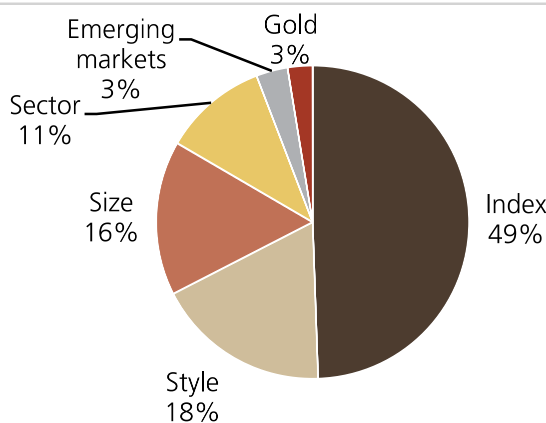
ETF does not equal passive

ETFs represent mostly active exposures within the market on either: beta, macro factors, sectors or styles

Despite observing concurrent growth paths, we argue that Index and ETF funds deploy very different investment philosophies (see the appendix for detailed product definition). Whilst index funds are purely passive, ETFs represent mostly active exposures within the market either on beta, macro factors, sectors or styles. Whilst ETFs may be managed in a similar manner to passive (index) funds (through structured rebalancing, for instance), we regard ETFs as 'active' exposures because they represent portfolio 'tilts' that investors are actively seeking. As such, there seems to be a misconception that most ETF capital resides within Index ETFs and can be regarded as passive.

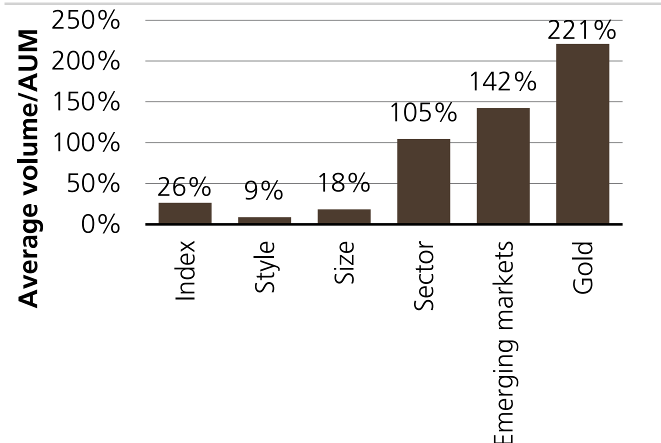
To further highlight the point, only 49% of ETF equity assets under management are in Index ETFs (figure 5 below), the remainder are in style, size, sector, Emerging Markets, or Gold ETFs, all of which represent 'active' exposures. Furthermore, when we consider the liquidity of various ETF strategies, we find that size, style and sectors seem to represent fairly permanent portfolio tilts. Sector, Emerging Market and Gold tilts seem to be far more 'active' as evidenced by the liquidity of the strategies (in figure 6). Index ETFs trade at around 26% liquidity (volume/AUM) indicating that whilst a portion of Index ETF investors are 'passive' investors, there is also a share of Index ETF investors that are taking an 'active' exposure to beta.

Figure 5: Share of AUM by strategy



Source: ETFDB, UBS Quant

Figure 6: Liquidity of ETF strategies



Source: ETFDB, UBS Quant

A more fundamental rationale

The move away from active equity mutual funds and into index funds, ETFs and hedge funds is being driven largely by investors' desire to move away from funds that provide a total market exposure, and into funds that provide exposure to beta, macro factors, sector, style and idiosyncratic risks separately, packaged together as required, and importantly, at a conservative price.

The advantage of doing this is that it's possible to understand which risks a portfolio is exposed to and only take on risks that are likely to yield compensation. It is also possible to understand how each exposure is performing over time and how the manager is performing. For example, for a simple beta exposure, what the tracking error of the portfolio against the benchmark is. Or alternately, in the

instance of a market neutral hedge fund, what the return and Sharpe ratio versus the cross-sectional volatility and pairwise correlation of the market are.

As a consequence of this shift, we have witnessed an increase in assets in: (a) beta exposures (index funds); (b) sector and style exposures (ETFs); and, (c) macro, quantitative, and idiosyncratic exposures (hedge funds). There has also been a significant increase in sector specialist funds where high levels of idiosyncratic risk are observed (e.g., small caps, technology, healthcare, energy, and resources). And finally, quantitative funds have seen significant inflows as they typically work at the cutting edge of technology and so drive both market efficiency gains and are also well versed in decomposing and isolating risks within the market, therefore are logical choices for investors wanting bespoke solutions.

Does active management add value?

The theory:

Following Jensen's seminal study (1968), numerous reports have reached virtually the same conclusion: the average actively managed mutual fund does not capture alpha, net of fees and expenses. So why do we need active managers?

The average actively managed mutual fund does not capture alpha, net of fees and expenses.

There are a few considerations here. Firstly, Active investors may be thought of as a proxy for informed traders. Their research and active trading style helps to keep prices reflective of fundamental information on firms. On the other hand, passive funds are similar to uninformed traders. They do not produce information, and they depend on price efficiency. These funds may also be thought of as being similar to noise traders, for whom demand does not depend on observed prices. In a market universally populated by indexed investors it is likely that market prices would be overly noisy (inefficient). Alternatively, in a market comprised entirely of active traders, individuals may become unduly concerned with a perceived information advantage held by others, leading to a lack of liquidity (a different inefficiency). Neither of these market environments is optimal, and accordingly there is a place for both indexed and active participants in the markets.

So, whilst market enthusiasm for passive investing is growing, this is a natural outcome of increasing market efficiency, reflecting investors' search for low-cost execution. However, there is a concern over the relationship between the share of passive investing and the efficiency of stock prices. How much passive can we have and still maintain an efficiently operating market?

Index funds require the market presence of active investors, who provide the liquidity necessary to adjust portfolio positions. This requirement is particularly evident in the less liquid areas of the market. A study by Grossman and Stiglitz (1980) shows that markets must be "mostly but not completely efficient", to encourage investors to gather and analyse information. Thus, markets will always be comprised of both active and passive investors.

Index funds require the market presence of active investors

Another perspective on this comes from Garleanu and Pedersen (2016) in which they postulate that in a market where information about assets is costly and managers charge an endogenous fee, small investors should be passive, but large and sophisticated investors benefit from searching for informed active managers since their search costs are low relative to their capital. Hence, managers with larger and more sophisticated investors are expected to outperform.

The greater level of passive management in recent years is consistent with a market equilibrium that reflects a lower cost of gathering and processing information, that is, fewer active managers are required to make the market efficient.[1]

The greater level of passive management is consistent with a lower cost of information

The optimal active to passive mix

The answer to whether there is an optimal mix of active versus passive unfortunately is: it depends on how efficient the active component of the market is. As the cost of information decreases, fewer active managers are required to

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[1] See Wermers, Russ and Yao, Tong, "Active vs. Passive Investing and the Efficiency of. Individual Stock Prices".

maintain market efficiency. The increase in passive management in recent years reflects this trend. It could be argued that currently the market is in equilibrium with the 'right' amount of passive management.

However, as technology, new data sources and new modelling techniques continue to evolve it is likely that active managers who outperform and hence drive efficiency gains are likely to gain assets, and as a consequence of the market becoming more efficient, it is likely that passive management will also gain assets.

So, who wins? In our view, winners will be either: (a) funds that evolve using technology, data and modelling techniques; and (b) funds that focus on areas that technology can't perform well in, that is, markets where idiosyncratic risk is high. For example, small caps, technology, healthcare, energy, resources, and newly opened markets such as China. To quote Jack L. Treynor, active managers will always be required to consider ideas that require 'reflection, judgement, and special expertise' ('Long-term Investing' by Jack Treynor).

There is more to this than a simple efficiency story

There are points in time when active managers in aggregate outperform

Independently of the argument above, there are points in time when active managers in aggregate outperform, and there are points in the macro-economic cycle when only certain types of active managers outperform, making active manager selection critical.

Active managers outperform when there is an opportunity to outperform…

We can measure the opportunity window for when active managers are more likely to perform by using cross-sectional volatility (return dispersion) and pairwise correlation (the correlation of every stock with every other stock in the market).

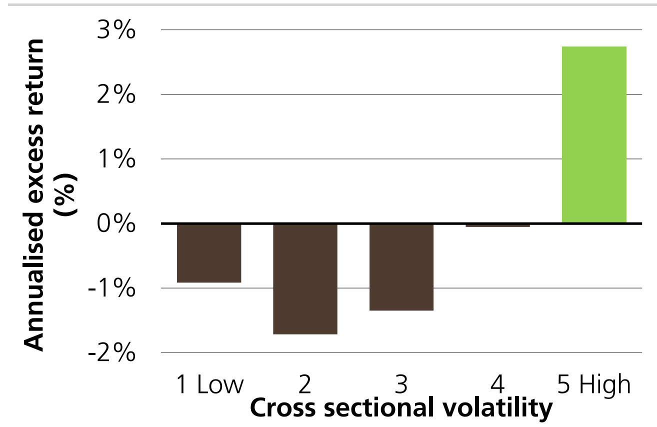
… when cross sectional volatility is high

Firstly, on cross sectional volatility… This measures the dispersion of returns in a given month, with **low dispersion realising a low impact of active exposures, and high dispersion realising a high impact of active exposures**. Overall, we find that active managers only outperform when cross sectional volatility is high (quintile 5 in figure 7 below)[2].

Note: excess returns used are post fees and are for all active US equity mutual funds and is survivor bias free. The sample period is 1972 to 2016.

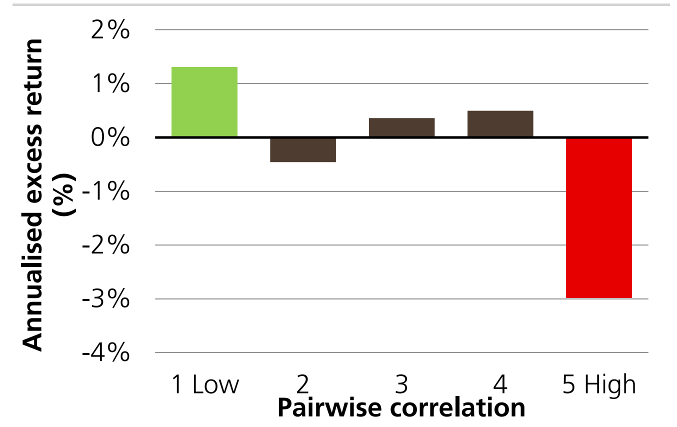
[2] See von Reibnitz, Anna, 'When Opportunity Knocks: Cross-Sectional Return Dispersion and Active Fund Performance'

Figure 7: Cross sectional volatility and excess returns to active management



Source: Dr Anna von Reibnitz (ANU), Factset, UBS Quant

Figure 8: Pairwise correlation and excess returns to active management



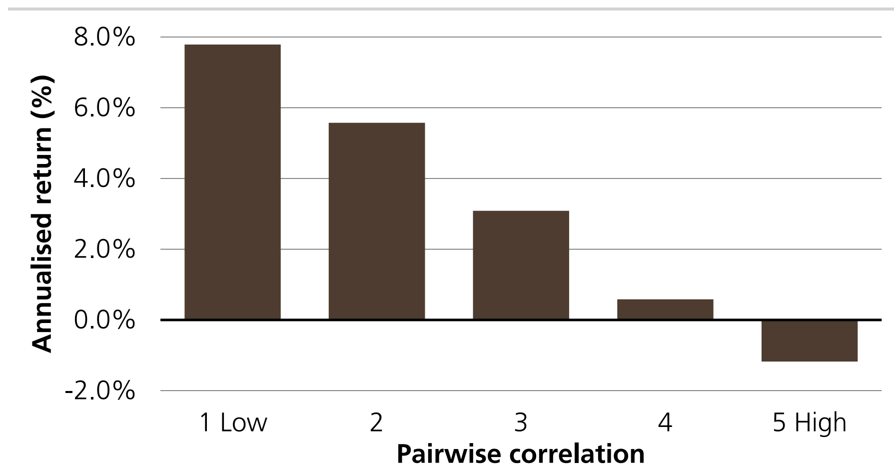
Source: Dr Anna von Reibnitz (ANU), Factset, UBS Quant

In a world where pairwise correlation is high it is difficult to outperform.

Secondly, on pairwise correlation... This measures the extent to which stocks are driven by common factors. Why does this matter? In a world where stocks are being driven by a common factor it is difficult to outperform. Overall, we find that active managers outperform when correlation is low (quintile 1 of figure 8) and underperform when correlation is high (quintile 5 of figure 8).

Taking this analysis one step further, what happens when the dispersion of returns is high (quintile 5 in figure 7), and we condition the returns on pairwise correlation? Below, we find that the lower the pairwise correlation, the higher the excess returns, and vice versa.

Figure 9: Pairwise correlation and excess returns to quintile 5 of active management (green bar in figure 7)



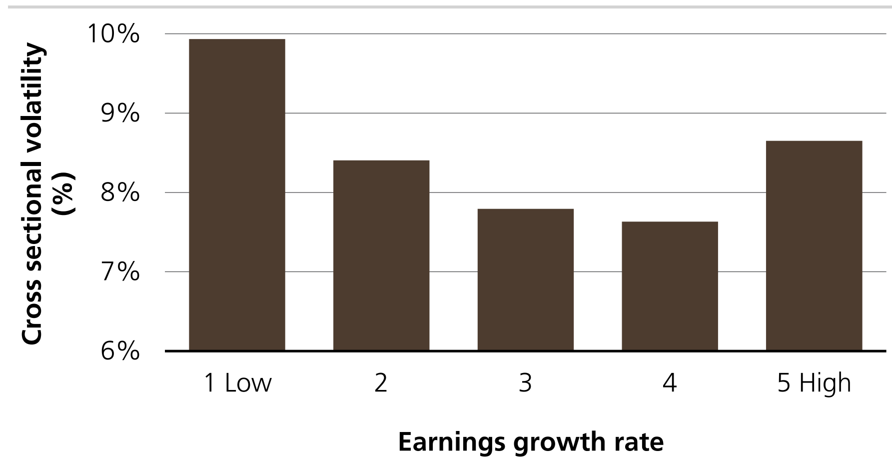
Source: Dr Anna von Reibnitz (ANU), Factset, UBS Quant

Drivers of cross sectional volatility and pairwise correlation

Ultimately, return dispersion is driven primarily by certainty in the underlying earnings of the market, which in turn is a function of the market earnings growth rate. (see 'Why does increasing volatility matter?' Winter). So in a world of structurally lower growth, we should also expect a world of higher return dispersion.

Earnings growth rates drive cross sectional volatility

Figure 10: Earnings growth rate and cross sectional volatility

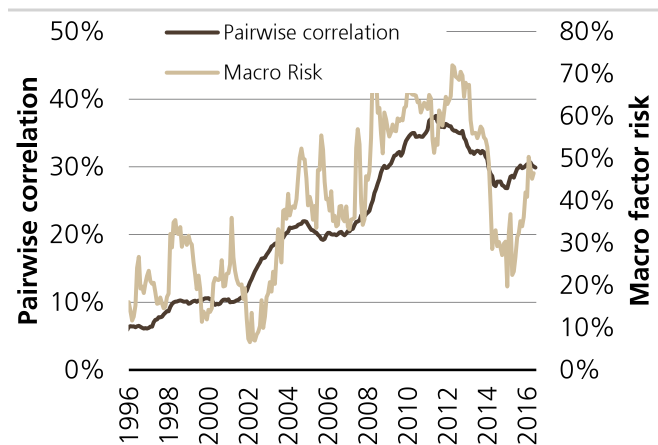


Source: Factset, UBS Quant

Pairwise correlation on the other hand is driven by common factors driving the market. These tend to be macro-economic factors. In figures 11 and 12 below, we illustrate the evolution of macro factors and pairwise correlation over the past 20 years.

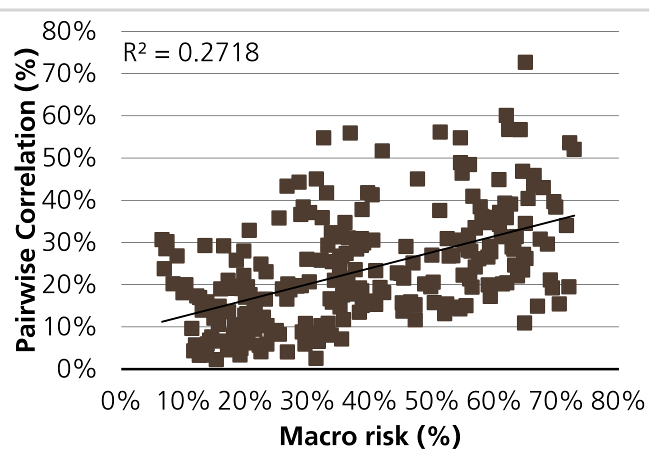
In recent times, macro-economic factors have driven pairwise correlation higher

Figure 11: Macro factor risk and pairwise correlation (3y)



Source: Factset, UBS Quant. Macro factor risk is calculated as a pooled regression of macro factors against the S&P500 1996 - 2016

Figure 12: Macro factor risk and pairwise correlation



Source: Factset, UBS Quant. Macro factor risk is calculated as a pooled regression of macro factors against the S&P500 1996 - 2016

Despite the fact that earnings growth rates have been tepid and as a consequence dispersion in the market has been reasonable, active managers have struggled to outperform due to the significance of macro factors driving high levels of correlation in the market.

This highlights a few important points:

1. It is important to evaluate active managers over a long horizon (including periods of negative earnings growth, or recessions) in order to evaluate their ability to outperform.

2. We think of macro risks as falling into two buckets, those that active managers are able to generate alpha from (forecastable risk), typically currency and interest rates, and those that are not. Ultimately if a manager is going to outperform they need to be taking on risks for which they are going to be compensated, and not taking on risks which will likely add volatility to their portfolio without any return compensation. Unfortunately, the macro factors that have been driving markets more recently are those that are difficult to forecast (e.g., UK's exit from the European Union and the US elections). Consequently, many active managers have struggled in recent times.

It's important to only take on macro risks for which you are likely to be compensated

Our portfolio risk model allows you to understand the macro factor exposures within your portfolio. Please click here for an introduction to our Portfolio Analysis System (PAS) or contact your UBS salesperson for more information.

Where to deploy active mandates

With the aim of identifying superior active managers, normal due diligence examination points such as portfolio holdings, macro-economic climate, manager and management company characteristics, and advanced analysis of past performance represent four necessary inputs into the process.

However, other factors are critically important. For instance, funds that take bigger 'active' positions relative to their benchmark (when used in conjunction with other factors) tend to outperform. In addition, contrarian managers tend to outperform managers who adopt a more consensus view (see 'Uncommon Value' by Russ Wermers). More specifically, several academic studies have found other drivers normally overlooked:

Active Funds

There is a large and growing body of evidence that the managers that pursue the most active strategies outperform, where activeness is derived from either return based measures such as tracking error, or fund portfolio holdings using 'active share'. More recent studies have utilised R^2 to gauge activeness (Titman and Tiu (2011)), and most recently 'Contrarian' scores using trade direction (Wei, Wermers, Yao (2014)). More 'active' funds tend to pursue strategies that cause greater deviation from benchmark factors. This results in greater excess returns and fund alphas.

Specialist Funds

Furthermore, concentrated funds tend to outperform diversified funds. Kacperczyk, Sialm and Zheng (2007) found that managers of diversified funds hold portfolios that largely resemble the index, whilst managers of more concentrated funds tend to overweight small cap growth stocks in specific industries. Given that concentrated funds tend to outperform diversified funds, this supports the conclusion that managers of concentrated funds have investment skills linked to those industries.

Similarly, Banegas, Gillen, Timmerman and Wermers (2012) found that both sector-specific and country-specific managers tend to outperform diversified managers due to a combination of specialized knowledge and an information asymmetry at specific points in the business cycle favouring industry specialists.

Idiosyncratic risks

Fundamental funds have an advantage in the idiosyncratic space, in particular markets that are less well covered such as small caps, emerging markets (in particular China), and sectors that carry a high degree of idiosyncratic risk that are by definition are difficult to capture systematically such as technology, healthcare, energy and resources.

Technology

Quantitative funds have generally performed well for two reasons: firstly, Quantitative funds are continually operating at the cutting edge of technology and incorporating new data sets into their processes. As such they are continually evolving their models and helping to make the markets more efficient, faster. As a result, their operating costs generally reflect their ability to generate alpha.

Secondly, Quantitative funds tend to be good at decomposing risks and offering clients specific opportunities that they are likely to be compensated for. For example, Quantitative funds typically offer clients a breakdown with a price for each risk separating out beta, systematic macro, sector, and factor tilts.

In summary…

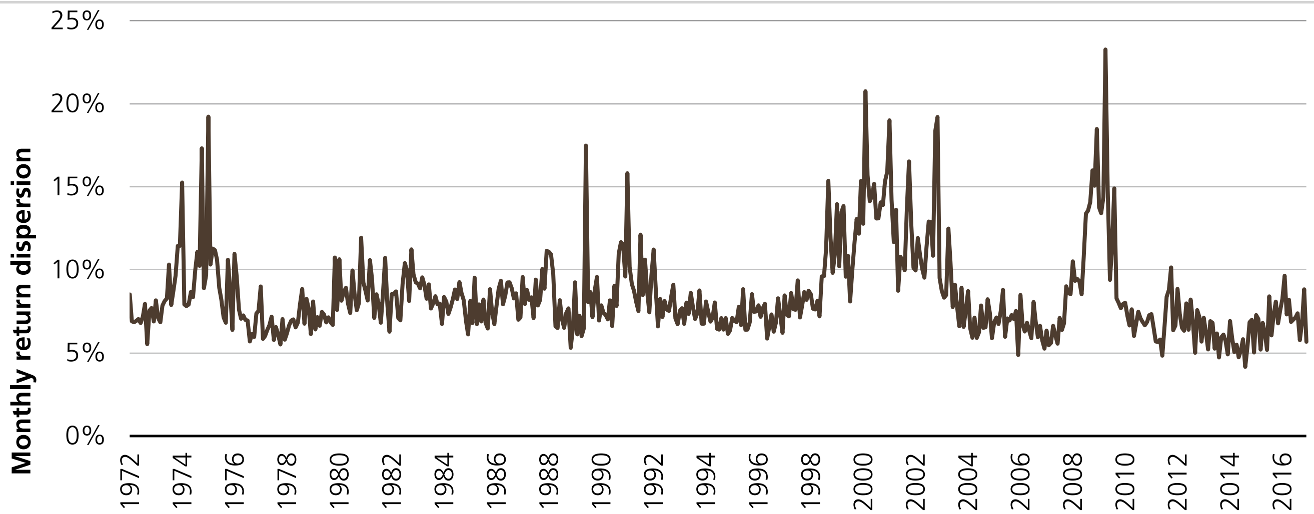
In a world of structurally low growth and lower expected returns, an environment we expect to be in for the next decade, passive investments are unlikely to meet the returns asset owners require. However, in a world of low growth, return dispersion is likely to be higher, creating opportunities for active management. As a consequence, active managers are likely to have a greater opportunity to outperform in the future than they have in the past. The key to success lies in manager selection. Strategies that we believe are likely to perform well are: high quality growth, high quality income, sector and country specialist funds, and hedge funds (in particular, quantitative, equity, merger arbitrage, macro, and volatility).

How much active risk should investors include in their portfolios? Clearly the answer is going to be determined by the return profile required. However, the key is to only take on risks that are likely to be compensated.

As always, we are happy to help asset owners with this challenge. If you are interested in discussing this further, please feel free to contact us.

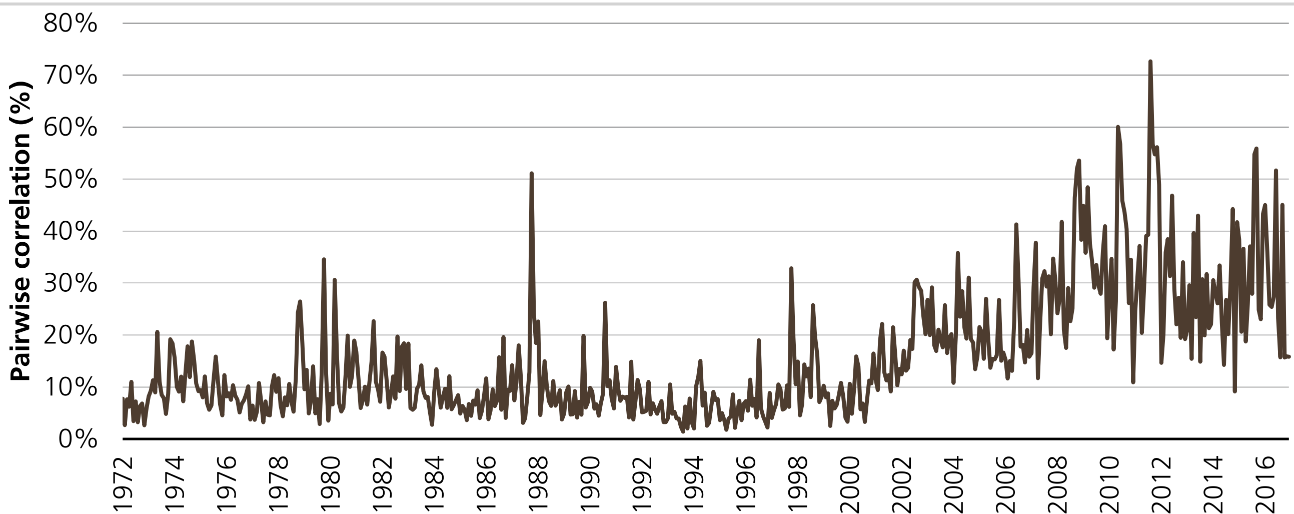
Appendix 1:

Figure 13: Cross sectional volatility of the United States



Source: Factset, UBS Quant, Universe: Russell 1000

Figure 14: Pairwise correlation in the United States



Source: Factset, UBS Quant, Universe: Russell 1000

Appendix 2: Product definitions

Equity mutual funds:

Equity funds are mutual funds that invest principally in equities. They can be passively (index mutual funds) or actively managed (active equity mutual funds). Equity mutual funds are typically categorised by size, the style and geography.

Index mutual funds:

A mutual fund with a portfolio of equities constructed to track the components of an equity market index, such as the S&P 500 Index. Index mutual funds provide broad market exposure; have low operating expenses and low turnover. As a consequence, they represent an inexpensive equity market exposure.

Active equity mutual funds:

A mutual fund with a portfolio of equities selected to outperform an underlying benchmark through sector, style and geographic tilts. Active equity mutual funds provide concentrated market exposure; have higher operating expenses and higher turnover.

Exchange traded funds (ETFs):

Exchange-traded funds (ETFs) are funds that are traded on stock exchanges, in a similar manner to equities. An ETF holds assets such as equities, bonds or commodities. ETFs typically track an underlying index and will trade close to their net asset value during the trading day. ETFs generally represent a cost effect exposure to an index, sector, style or geography.

References

Banegas, Ayelen and Gillen, Benjamin J. and Timmermann, Allan G. and Wermers, Russ, The Cross-Section of Conditional Mutual Fund Performance in European Stock Markets (September 3, 2012)

Cremers, Martijn, and Antii Petajisto. 2009. "How Active is Your Fund Manager? A New Measure That Predicts Performance." Review of Financial Studies, vol. 22, no. 9 (September):3329-3365.

Garleanu, Nicolae and Pedersen, Lasse Heje, Efficiently Inefficient Markets for Assets and Asset Management (September 2016).

Grossman, Stanford J., and Joseph E. Stiglitz. 1980. "On the Impossibility of Informationally Efficient Markets." American Economic Review, vol. 70, no. 3 (June):393- 408

Jensen, Michael C. 1968. "The Performance of Mutual Funds in the Period 1945-1964." Journal of Finance, vol. 23, no. 2 (May):389-416

Jones, Robert C., and Russ Wermers. 2011. "Active Management in Mostly Efficient Markets." Financial Analysts Journal, vol. 67, no. 6 (November/December)

Kacperczyk, Marcin T. and Sialm, Clemens and Zheng, Lu, On the Industry Concentration of Actively Managed Equity Mutual Funds. AFA 2005

Petajisto, Antti, Active Share and Mutual Fund Performance (January 15, 2013).

Roll, R. 1978. "Ambiguity when Performance is Measured by the Securities Line." J. Finance 33:2051-69.

Titman, Sheridan and Tiu, Cristian Ioan, Do the Best Hedge Funds Hedge? (September 2011)

Treynor, Jack, 1976. "Long-Term Investing." Financial Analysts Journal, May-June 1976.

von Reibnitz, Anna Helen, When Opportunity Knocks: Cross-Sectional Return Dispersion and Active Fund Performance (September 14, 2015). Critical Finance Review, Forthcoming; 26th Australasian Finance and Banking Conference 2013.

Wei, Kelsey D. and Wermers, Russ and Yao, Tong, Uncommon Value: The Characteristics and Investment Performance of Contrarian Funds (April 20, 2012).

Wermers, R. 2011. "Performance Measurement of Mutual Funds, Hedge Funds, and Institutional Accounts." Annual Review of Financial Economics 3:537-74.

Wermers, Russ and Yao, Tong, "Active vs. Passive Investing and the Efficiency of. Individual Stock Prices".

Data:

We'd like to thank the following for allowing us to use their data:

Investment Company Institute. 2016. 2016 Investment Company Fact Book: A Review of Trends and Activities in the US Investment Company Industry. Washington, DC: Investment Company Institute. Available at www.icifactbook.org

Barclayhedge. 2016. www.barclayhedge.com

ETFGI 2016. www.etfgi.com

ETFDB 2016, www.etfdb.com

UBS Equity Quantitative Research publications

Monographs, Keys and Q-Series

Title	Date
What will demographics mean for growth and stock market returns?	Jan-17
How to pick stocks in China's domestic market	Jan-17
Systematic Strategies for Single-Stock Futures	Oct-16
Irrational asset management	Oct-16
China domestic market – alpha for quantitative investors	Oct-16
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Do low-volatility stocks have interest-rate risk?	Sep-16
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Sell	FSR is > 6% below the MRA.	15%	16%
Short-Term Rating	**Definition**	**Coverage[3]**	**IB Services[4]**
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 31 December 2016.
1:Percentage of companies under coverage globally within the 12-month rating category.
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