

Man Group Client White Paper

Quantitative Credit

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Preface

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Given that this is the first of these client papers, we thought it worth setting out a few broad thoughts about what we are hoping to achieve here and in the future. Firstly, we want to make clear that this is not a marketing document, nor is it intended to promulgate any specific product or point of view. The only aims are to educate and interest our readers. We have drawn on expertise from within Man Group's investment engines and beyond, but we hope to privilege original content over received thought and to highlight subjects and strategies that we feel are yet to receive sufficient coverage from research desks or the press. It is noteworthy that there is practically no investment bank research on quant credit strategies and very little content from market participants. We use academic research liberally but seek to render it in a fashion that is straightforward and jargon-free.

We intend this material to be comprehensible to an educated generalist but to contain enough depth and analytical insight to engage specialists. We do not seek here to answer every question pertaining to the subject under consideration, but hope that we are at least able to ask the majority of questions that investors and their investment committees will ask, and to suggest possible solutions and modes of approach where we are not able to be definitive.

We are driven always by curiosity and the wish to share knowledge. We recognise that the financial services industry does not have a good record when it comes to the elegance or simplicity of the content it produces. We hope, eventually, to do a small amount to change this.

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Executive Summary

Quant credit¹ remains a relatively niche investment area compared to quant equity; one data provider stated that last year in the US less than \$150 billion bonds were transacted electronically by quantitative investors.² The reasons for the lack of progress in the space are numerous, but most come down to the differences in transaction mechanisms for bonds and equities. Bonds are still largely traded over-the-counter, meaning that they are less liquid, that prices are less visible and transaction costs higher than for equities. This is all changing as the electronic trading of fixed income becomes increasingly prevalent.

The attraction of quant credit is clear. Fixed income is still dominated by large, slow-moving, buy-and-hold money and unlike equity markets it is not yet heavily trawled by quant managers. Consequently, it is a market rife with inefficiencies and quant strategies exist to harvest the opportunities that such inefficiencies throw off. Quantitative investment strategies are increasingly using the growing amount of data generated by the fixed income and credit markets to deliver uncorrelated returns and eliminate the human biases to which discretionary investors are susceptible.

This paper takes the reader on the following journey:

- Sections 1 & 2 compare the rise of quant equity and quant credit in more detail.
- Section 3 looks at the mechanical differences between credit instruments and the dynamics of trading and execution.
- Sections 4 and 5 look at the interrelated subjects of risk management and portfolio construction. We ask how managers should think about the unique

challenges posed by corporate bonds and how to combine portfolio constraints and risk models to drive portfolios towards the efficient frontier.

- In Section 6 we consider the problem of transaction costs modelling and how this can be navigated.
- Sections 7 & 8 look at the application of factors and data to credit investing. We review style factors associated with quant credit, evaluating the academic research and historical data available to support or discredit specific factors. We look at the use of alternative data in quantitative investing and consider how this might give an edge to quant credit strategies.
- Sections 9 & 10 look at specialist applications and opportunities: ESG & Fallen Angels. We map the development of ESG as a new style factor and consider whether advances in quant credit may drive greater adoption of responsible investing by the broader fixed income markets. We consider “Fallen Angels” as a potential source of attractive risk-adjusted returns.
- Section 11 ends the paper with a discussion of what the future of quant credit might hold. We believe that the growth of quant credit is both inevitable and to be welcomed. The impediments that previously stood in the way of quant credit following equities to become a dominant investment approach have begun to fall away. However, we believe this will occur at a measured pace, leaving us confident that this will be an exciting space for investors to generate uncorrelated and above average risk adjusted returns for many years to come. We hope the research in this document will play a part in increasing the knowledge and acceptance of this strategy and prompt further questions and insight.

1. From here on we shall refer to the topic of this paper exclusively as quant credit for brevity and on the understanding that it also covers commonly used terms like algorithmic credit, systematic credit, scientific credit etc; we shall also refer to quantitative investing to mean all quant, scientific, automated and systematic strategies.

2. <https://www.businessinsider.com/investors-bond-trading-systematic-fixed-income-quants-aqr-point72-blackstone-2020-12?r=US&IR=T>

1.

The Rise of Quantitative Investing in Equities

Key points

- Trading from quant equity strategies now outweighs discretionary in the US.
- Electronic trading drove widespread adoption.



Equities were ideally suited for the deployment of algorithmic trading strategies; they were highly liquid, electronically traded, had low transaction costs and a significant and readily available amount of relevant data.³

Quantitative investing has radically altered the investment landscape in equities. This evolution was partly driven by the move from over-the-counter to electronic trading of equities in the 1980s and 90s. Since then, the growth of algorithmic approaches to investment has rocketed. In 2019, across the US stock market value (of more than \$30 trillion) less than one quarter of shares were held by human-managed funds. The balance, over 75%, was held by quantitative investing styles (through a combination of ETFs, which are essentially passive quant investing, and more than one third by funds pursuing more active quantitative investing mandates).³

Equities were ideally suited for the deployment of algorithmic trading strategies; they were highly liquid, electronically traded, had low transaction costs and a significant and readily available amount of relevant data. Quant investing in equities offered investors a compelling alternative to traditional discretionary management, one that used a series of transparent, back-tested and rules-based models to construct the algorithms that drove investment decisions.

The chart below shows the significant growth in AUM of the 50 leading quant equity funds, 2009-2020.

Asset Growth of 50 Leading Quant Equity Strategies, 2009-2020 (\$M)



Source: Bloomberg. Date range: 1 March 2009 to 31 July 2020.

³. <https://www.top-tal.com/finance/stock-market-experts/quant-fund-performance#:~:text=As%20of%202019%2C%20ETFs%20and,%25%20of%20human%2Dmanaged%20funds.>

Key points

- Quant credit has been slow to follow in quant equity's footsteps for several reasons.
- We believe that we are on the cusp of significant growth in the strategy class.
- There are currently a host of inefficiencies in the credit markets whose presence creates opportunities that early movers in quant strategies may be able to capture.

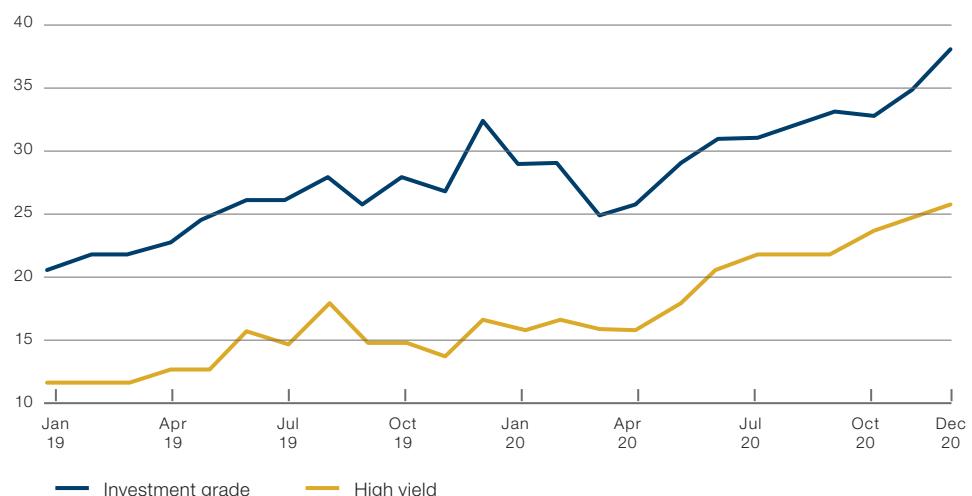
It was always thought that credit would follow swiftly on the tails of the equity market in developing a substantial quant investment universe. That this hasn't happened is down to a number of factors, which we will cover briefly here and then address in greater depth later in this paper. Firstly, the Global Financial Crisis was born in the credit markets and specifically in the more innovative quarters of that market – ABS, CDOs, CDS etc. This necessarily put a damper on further innovation for some time. Quant credit would, at least in theory, benefit from a full and highly liquid CDS market, but a combination of the GFC and the continued low-spread environment has meant that CDS has never quite developed into the market it might have given a more supportive backdrop.

It should also be pointed out, as politely as possible, that the bond markets are not known for their openness to innovation. It is an investment universe dominated by large, slow-moving, buy-and-hold investors. And, indeed, investors to whom the credit risk component of their investments is only one risk among many. These are managers who are often negotiating liability-matched payment profiles (for instance pension funds). They are juggling interest rate risk and convexity. They have currency risk and may be invested across numerous other credit products outside of corporate bonds. All this is to say that quant credit's focus on isolating and trading credit risk means that it is profoundly different from traditional fixed income investing. Successful development of quant credit strategies requires a deep understanding of the nuances of the credit asset class combined with sophisticated technical skills that have been timetested and developed in other arenas such as equities.

There are other impediments to the development of quant credit that need to be addressed. What is inelegantly referred to as the "electronification" of the credit markets has been a halting process, but appears finally to have gained momentum in the past few years. As the chart below shows, the percentage of trades being executed on electronic platforms has grown substantially in recent years, with MarketAxess's Open Trading platform alone securing a sizeable proportion of this. While investment grade credit remains more active than high yield or distressed, we expect a continuation of this move away from cumbersome over-the-counter trading towards more efficient electronic trading and "straight-through processing" (STP).

Taking this one step further, more sophisticated market makers are investing heavily in algorithmic market making, where dealers continuously stream quotes directly to the market. This is a paradigm shift relative to MarketAxess's predominantly Request for Quotation (RFQ)-based process, giving credit investors more real-time price discovery and improved liquidity in corporate bonds.

Percentage share of electronic bond trading



Source: Greenwich MarketView. Date range: 27 December 2018 to 27 December 2020.

“

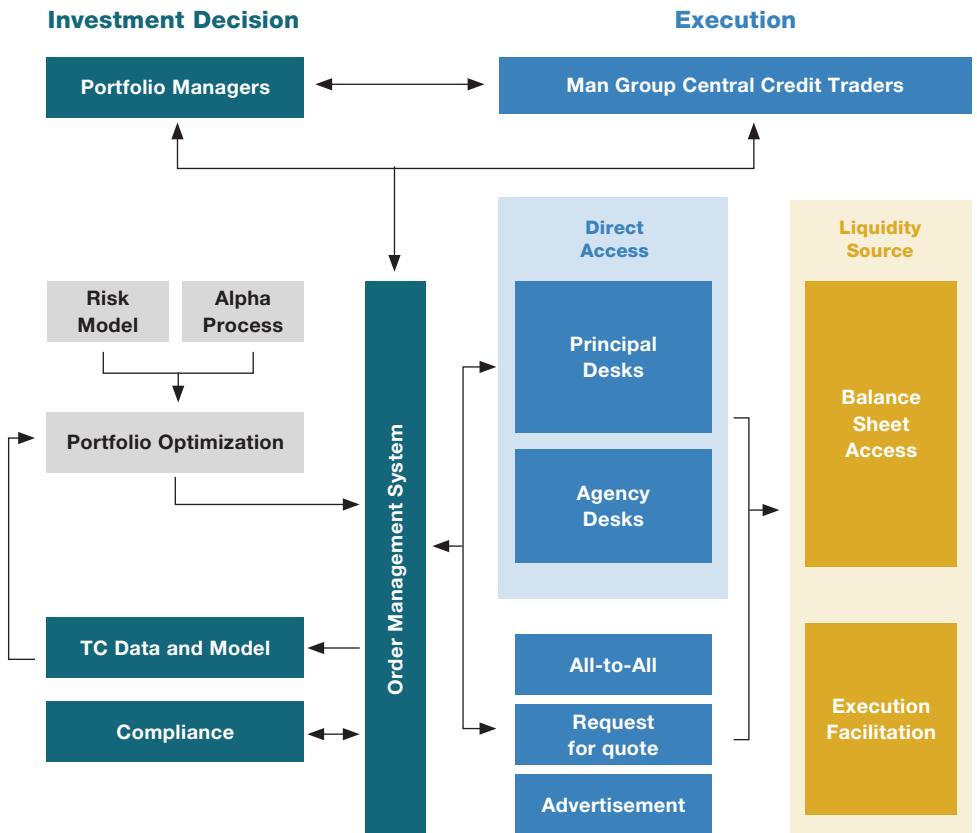
The rise of quant credit will drive greater liquidity and wider participation in electronic trading platforms, while larger players in quant credit have begun to make markets on the all-to-all electronic platforms, meaning that they are price makers as well as price takers.”

Liquidity is also one of the major hurdles that quant credit has had to overcome. Partly due to the cumbersome trading process, partly because bond investors have traditionally taken a buy-and-hold approach and partly due to the complexity of bonds compared to the homogeneity of equities (something we'll return to later), bond markets have historically been less liquid than equities. This has been a significant problem for the rise of quant credit, given that quantitative strategies require visible and actionable trading levels. Until the advent of all-to-all electronic trading platforms, bond investors were reliant on liquidity offered by investment bank trading desks. As we saw in the GFC and to a lesser extent during the March 2020 coronacrisis, this liquidity can disappear when it is most needed. Clearly liquidity has improved dramatically since the GFC and recent central bank bond buying programmes have given dealers comfort that there exists a dependable source of liquidity outside of the traditional market. The point here, of course, is that there's an interesting positive feedback loop. The rise of quant credit drive greater liquidity and wider participation in electronic trading platforms, while larger players in quant credit have begun to make markets on the all-to-all electronic platforms, meaning that they are price makers as well as price takers.

Ensuring best execution as a quant credit manager still requires a recognition of the continued and significant presence of principal desks and the use of dealer balance sheet, while engaging equally with the growth of electronic trading. There is currently a great deal of hype around electronic access, but to best manage credit portfolios now and for years to come, it takes data and careful analysis to route orders to the best venues. It's a moving target as the sizes of these venues evolve, and at every point requires a careful approach not only to venue selection but to the actual portfolio optimization process itself. An optimized portfolio solution is not optimal if you cannot trade it.

The chart below provides a comprehensive overview of our own investment and execution process, illustrating the complex interrelatedness of each stage of the portfolio management and implementation procedure.

Investment Process



Schematic illustration.

We will discuss transaction cost modelling later in this document, but it's worth stressing here that modelling the cost is challenging in credit because there is simply less data. There are fewer trades that tend to be larger in size with much less well-defined intraday reference prices. On top of that, the access to liquidity, especially historically, has been relationship-driven, not commoditised as it is in equities. Furthermore, whereas you can model the concept of probability of fill in quant equity strategies with fairly simple heuristics for fill rates, the concept is decidedly far more challenging in credit given the time varying nature of liquidity and a fairly large illiquid tail.

Also, it's not just that we require visible and actionable trading levels to execute transactions. Part of the core value proposition around quant approaches includes continuously pushing towards an optimal portfolio, minimizing transaction costs, and taking advantage of the full breadth of an investable universe: this all generally points to larger amounts of smaller-sized trades compared to discretionary approaches. This has meant that quant strategies have had to and continue to adapt to where liquidity/best execution is in the market.

The complexity of bonds is another impediment that quant credit has had to address. Whereas one stock is much like any other, bonds are issued in a range of different maturities, as fixed rate or floaters, and with diverse structures and legal documentation. It's simpler to know what equity to buy than what bond to buy if you want to take exposure to Microsoft. Even though many bonds in the same capital structure do have related returns, there are additional dimensions of risk and liquidity to consider to pick the "right" bond. Just as in CDS contracts there is the concept of cheapest-to-deliver bonds, there could be an element of negative selection in the construction of quant credit portfolios whereby the least liquid bonds of an issuer are referenced. There are furthermore issues like subordination, callability and coupon ratchet mechanisms that will all need to be taken into consideration by quant credit investors when building their models. The high yield market tends to be even more heterogeneous than the investment grade space, with bonds typically having covenants that introduce further complexity to any attempt to build a comprehensive picture of the investable universe. Again, careful data capture and scrubbing are the solution to this issue, with the increased sophistication of bond market data and data delivery firms like Refinitiv and ICE meaning that the mapping of security and issuer-level information for credit, while still challenging, is now more achievable than ever before.



It seems to us both logical and inevitable that quantitative strategies will develop into a major component of the credit markets. “

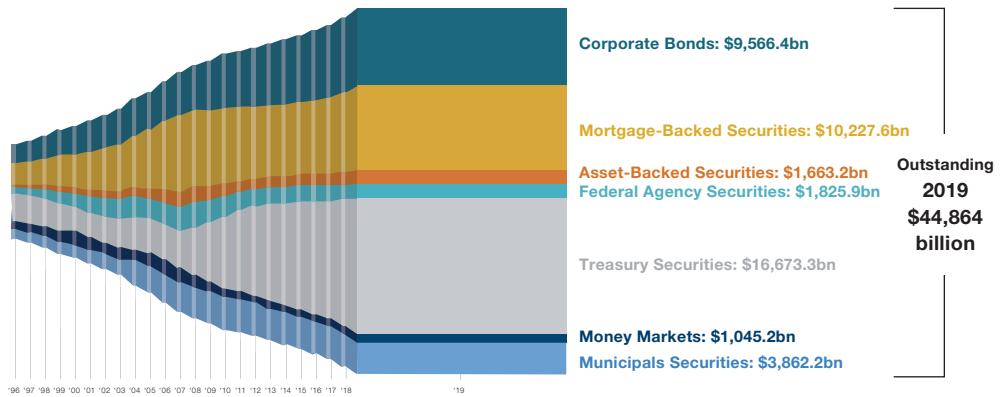
It may appear strange that we have begun our introduction to the strategy class with a list of the headwinds that quant credit faces. We think of it differently: it seems to us both logical and inevitable that quantitative strategies will develop into a major component of the credit markets. We have outlined above the issues faced by the market as a way of explaining why quant credit has not yet attained the size and reach of quant equity. We have also outlined why we think these impediments will not stand in the way of the market's development much longer; indeed, we are confident that the next five years will see dramatic growth and increasing breadth in terms of the size and scope of quant strategies in the fixed income world.

As far as the quant credit market goes now, there are a few boutique hedge funds involved; but it is largely dominated by a handful of complex quantitative/multi-strategy asset managers investors. As far as numbers go, it's hard to get an accurate sense of the size of the market, although it's clear that it remains a tiny fraction of both the quant equity market and the overall fixed income market. There was \$116.5 billion traded on MarketAxess's Open Trading platform via quant funds during the first three quarters of 2020, a 150% increase from the same period a year ago. In Europe, the London Stock Exchange Group's MTS BondsPro has seen the number of quant strategies deployed on the trading venue double each year since 2017.⁴

It is worth pointing out how vast the corporate credit markets are, with almost \$11 trillion of non-financial corporate debt outstanding in the U.S. alone at the end of 2020.⁵ The obvious point to make is this: the size and breadth of the market lends itself naturally to a rigorous, rules-based, quantitative approach. We believe that it is only a matter of time before this happens in a dramatic way.

4. <https://www.businessinsider.com/investors-bond-trading-systematic-fixed-income-quants-aqr-point72-blackstone-2020-12?r=US&IR=T> **5.** [https://www.sp-global.com/ratings/en/research/articles/200625-credit-trends-global-corporate-debt-market-state-of-play-in-2020-11546901#:~:text=As%20of%20the%20end%20of,financial%20and%20nonfinancial%20corporate%20issuers\).](https://www.sp-global.com/ratings/en/research/articles/200625-credit-trends-global-corporate-debt-market-state-of-play-in-2020-11546901#:~:text=As%20of%20the%20end%20of,financial%20and%20nonfinancial%20corporate%20issuers).)

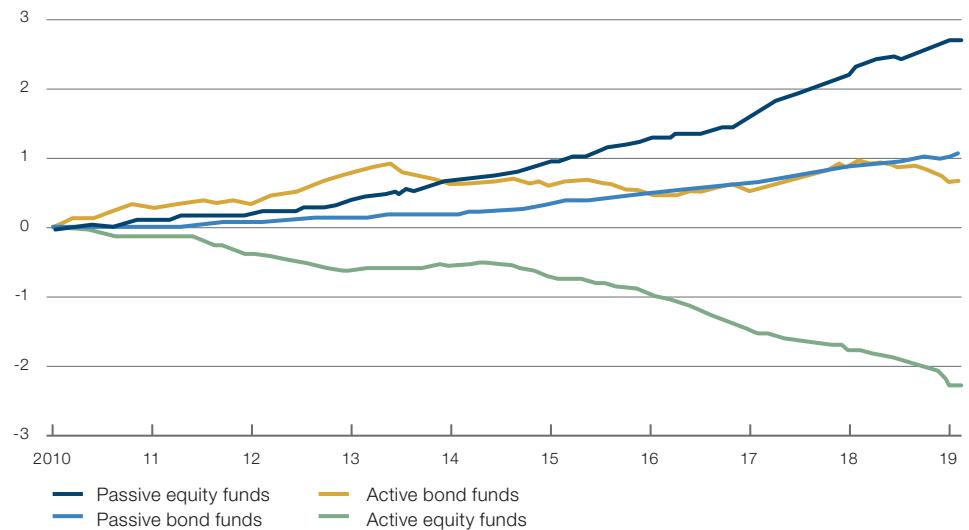
Fixed Income Outstanding in US



Schematic illustration. Source: www.sifma.org/resources/research/fixed-income-chart/

One final point: we are witnessing the early days of a strategy class that we believe is due to grow exponentially. There are currently a host of inefficiencies in the bond markets, a result of the profile of the traditional investor base, embedded human biases (given the current dominance of discretionary strategies) and the absence of widespread adoption of alternative data and data science. The rise of passive bond ETFs has potentially created further distortions that will drive pricing away from fundamentals and produce opportunities for active investment strategies.

The Rise of Passive ETFs



Source: EPFR. Date range: 12 December 2009 to 2 February 2019.

If you look at the early days of quant equity investment, those hedge funds that moved into the space early produced significant alpha. It is no secret that alpha in quantitative equity strategies is now more difficult to capture, since a) it is diluted over a larger pool of managers and b) inefficiencies are more fleeting in nature. We believe that early-mover opportunities will persist in credit for some time to come but alpha will naturally reduce as more money flows into the space.⁶

6. We address the future shape of the strategy class in the final chapter of this paper.

Key points

- Quant credit strategies isolate the credit risk component of a portfolio of bonds and seek to differentiate between improving and deteriorating credit profiles.
 - Although exposure can be taken either through CDS or cash bonds, breadth of opportunity set is an important differentiator of cash bonds.
 - Gaining short exposure via cash bonds, previously manual and ad hoc, has become an efficient and automated process.
-

The mechanics of isolating the credit risk premium of a portfolio of bonds and constructing both long-only and long-short strategies are worth outlining in detail. We will look at how these portfolios are then optimised relative to a variety of factors in Chapter 5. Firstly, it is worth reiterating that quant credit seeks to distil the credit risk premium, generally neutralising interest rate risk. The credit risk premium is a reflection of the market's estimation of the default risk of a particular bond, taking into account any potential recovery, such that the credit spread over the risk free rate paid to an investor in a bond should on average compensate an investor for potential loss given default (LGD).⁷ At a basic level, an investor wants to be long (overweight) a portfolio of bonds whose credit spreads tighten over time and short (underweight) a portfolio of bonds whose credit spreads widen. First, though, other risks must be isolated and hedged out.

In order to remove the interest rate risk from a credit portfolio, quantitative investors have two choices. The first is to take exposure – either long or short – via CDS. Since CDS protect credit risk directly, there is only a minimal interest rate element to hedge out. The second option, and one that we generally employ, is to establish the interest rate sensitivity of the relevant specified benchmark through measures like duration and key rate exposures. We then match our bond portfolio exposures to the benchmark exposures to neutralise this risk. In matching the benchmark's rate risk, even when rates have large moves overall in the total return space, it is not a performance driver of our benchmark-relative returns.

While CDS seems to offer a less convoluted means of achieving exposures, there are several limitations to a synthetic strategy. The first is that the CDS market is both smaller and less liquid than the cash market it references. Using the US markets as an example, there are only just over 100 US CDS names that trade with great regularity and a wider universe of perhaps 200 more that trade sporadically.

7. It should be noted that, in practice, other factors remain within the credit spread even after the interest rate risk is removed, including liquidity and general market risk.

This contrasts with the universe of cash bonds, which stands at north of 10,000 instruments outstanding from close to 2,000 issuers. What's more, CDS has run into trouble with the legal definition of default, such that several hedge funds have manufactured credit events that create distortions between the fundamentals of the companies and the traded credit spreads. Until such problems are ironed out, we believe that cash bonds will be the approach of choice for most quantitative investors, above all because breadth is key for quant strategies and is simply not available in synthetic form yet.

Size also provides a barrier to entry for smaller players, given that bonds trade in clip sizes that make accessing them difficult for smaller players, while larger clips often trade with tighter bid-offer spreads. Electronification is slowly changing this, but it will be some time before there is a level playing field for large and small investors alike.

Alongside the application of style factors, quant credit managers must decide whether to apply leverage to their portfolio and if so what degree of leverage to use,⁸ the credit quality they wish to target – investment grade and/or high yield – and whether they are expressing their views through a long-only strategy or long-short. Long-short strategies employ leverage more often than long-only funds. We observe that typical leverage for long-short strategies currently active in the market starts at 4-5x and extends to levels comparable to the most leveraged quant equity managers. While high yield long-short strategies are typically less levered, this is not always the case.

There has been some scepticism expressed about the ease with which corporate bonds can be shorted; our experience in executing live trades in the market has been positive so far and we believe short liquidity will continue to improve and fees will remain attractively low. Prime Broker security lending desks now provide daily feeds with firm borrow availability and fees across the entire investable cash bond universe. This was largely unheard of even a few years ago when all cash bond security lending was essentially manual and ad hoc.

It's important to note that while discretionary and quant strategies differ in many mechanical aspects, the essential motivation behind them is similar: to avoid defaults and downgrades and to capture spread tightening and avoid spread widening. Discretionary managers, who tend to have larger positions in a smaller number of names, try to achieve outperformance through deep fundamental analysis. Quantitative strategies, which are exposed to a more diversified portfolio with smaller position sizes on average, seek to outperform by capturing as much data as possible, and using this data to build optimised portfolios. Diversification and risk management are key for quant credit – understanding both quant factor risk and idiosyncratic risk, ensuring that there is disciplined position management at issue- as well as issuer-level. ”



Diversification and risk management are key for quant credit – understanding both quant factor risk and idiosyncratic risk, ensuring that there is disciplined position management at issue- as well as issuer-level. ”

8. Leverage is achieved through a relationship with a prime broker, who keeps the bond portfolio on balance sheet and requires a commitment fee and margin posting in order to assume the risk.

We can see, using the chart below, which shows the average spread of a portfolio of investment grade bonds over the course of 2020, that an investor who launched their fund at the start of the year would have suffered a significant mark-to-market loss in March, which they would have largely recouped by the end of the year. Conversely, an investor lucky enough to ramp up in March and April would have benefitted from the substantial spread tightening over the course of 2020.

Investment Grade Spread Performance 2020-21



Source: Bloomberg.

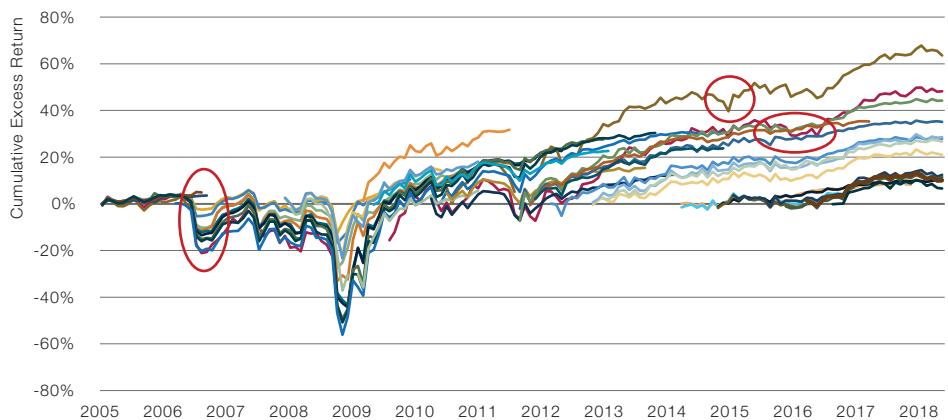
Key points

- Corporate bond portfolios present specific challenges from a risk modelling perspective; we adapt quantitative models to address the nuances of credit.
- Statistical risk models work particularly well when it comes to corporate bonds.
- Risk models should be used in harmony with portfolio constraints.

The goal of model-driven risk management techniques is to minimize the risk of the portfolio relative to a benchmark in a long-only strategy, or the long positions relative to the short positions in a long-short strategy. We further decompose a portfolio's risk into unintended factor exposures and idiosyncratic risk. In order to minimize each of these components, we must be able to define the volatility and correlation structure of the universe in a quantitative fashion. We seek to adapt traditional quantitative risk management techniques to address the unique challenges of corporate bonds.

The first thing to say about risk management in corporate bonds is that there is a wide dispersion in the volatility of bonds, particularly in high yield names. The fact that betas (market sensitivity) of bonds are less concentrated around the mean than for equities necessitates a different approach to risk management, one that takes into account the idiosyncratic nature of bonds and the varying forces that impact their volatility. So it is that any approach to managing the risk of a portfolio of corporate bonds must encompass such diverse features as callability, duration and subordination, all of which can have a profound impact on returns. The chart below shows the historical returns for different bonds issued by the same company, illustrating how significantly these diverge over time.

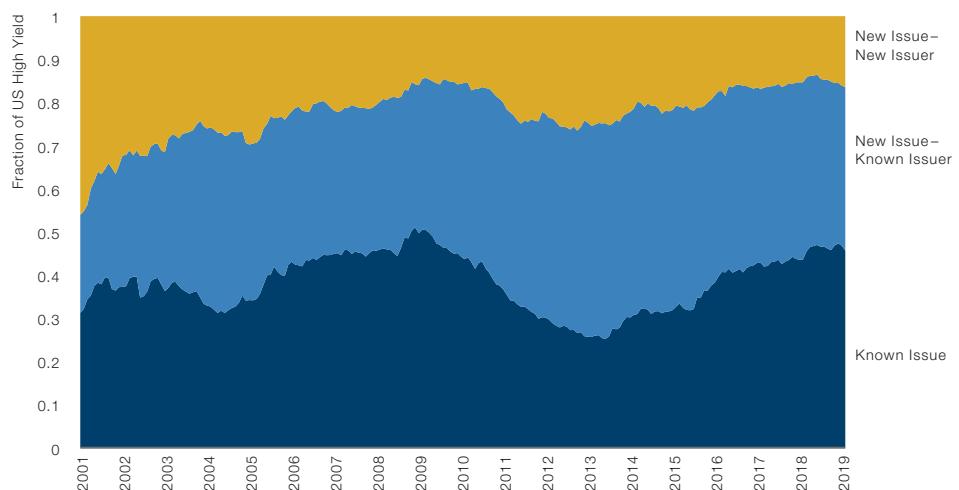
Volatility of Corporate Bonds – Volatility Can Vary Within an Issuer



Source: ICE BofAML excess returns taken as total returns less key rate duration matched sovereign return.

Risk models need to be broad enough to incorporate this variety of different inputs and also need to have the flexibility to adapt to changes in market dynamics on an ongoing basis. There is furthermore the issue of bonds having finite lives and experiencing cycles of issuance and redemption. Unlike equities, a significant fraction of bonds are newly-issued with limited historical data on which to base expected volatility assumptions. It is therefore necessary for risk models to predicate volatility expectations on previously-issued bonds of the same issuer, notwithstanding the divergence in returns expressed above. A greater problem still is posed by new issuance from new issuers. The chart below illustrates how much of the high yield index is composed either of new issues from known issuers, or of new issues from new issuers. The clear message here is that it is not enough for risk models in credit to rely on historical volatility in formulating their outputs. Models must be sophisticated enough to be forward-looking, dynamic and adaptive.

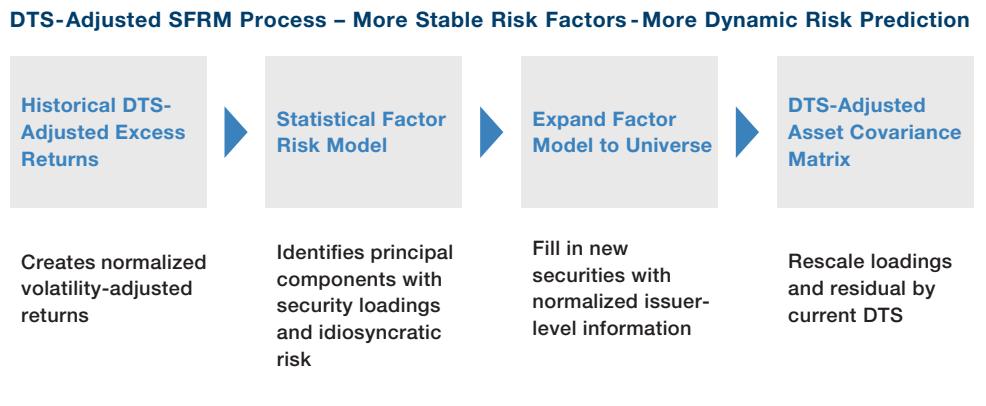
Volatility of Corporate Bonds – Lack of Historical Returns for New Issues



Source: Based on ICE BofAML US High Yield Benchmark H0A0.

Another problem when modelling risk in credit is that of shadowing – the way that historical periods of volatility cast long shadows over less volatile periods. The credit markets tend to exhibit relatively lower volatility than equities, but recent blow-outs relating to the Global Financial Crisis and the coronavirus pandemic would lead models to over-estimate volatility and need to be adjusted in order to provide a more realistic forward-looking measure of risk..

It is worth noting, these challenges are not unique to one type of risk modelling: both fundamental risk models with predefined risk factors as well as statistically based model with dynamic risk factors can suffer from the problems noted above. Both types of risk models can be adapted to address these challenges, but we find statistically based risk models to be particularly beneficial in capturing the changing nature of the credit markets. We therefore adjust our statistical factor risk model (SFRM) with Duration Times Spread (DTS) in order to take into account the various issues referenced above. Such an approach, we believe, provides a more accurate ex-ante predictor of volatility, while being instantaneously specified and able to adapt both to new issuance and issuer-specific idiosyncrasies. The diagram below shows how we move from a traditional statistical model to the more nuanced version that incorporates DTS.



Schematic illustration.

Moving beyond a baseline SFRM shown in the second box, to adding the first pre-processing step and two post-processing steps elegantly addresses the challenges noted above, and more importantly, we find provides a more accurate estimate of future risk. Incorporating a more accurate measure of risk into the overall objective function ultimately then allows for more effective implementation with lower tracking error for long-only strategies and lower overall volatility for long-short strategies. Using a risk modelling approach like this along with carefully constructed portfolio constraints and monitoring processes can help ensure portfolios stay that much closer to the efficient frontier.

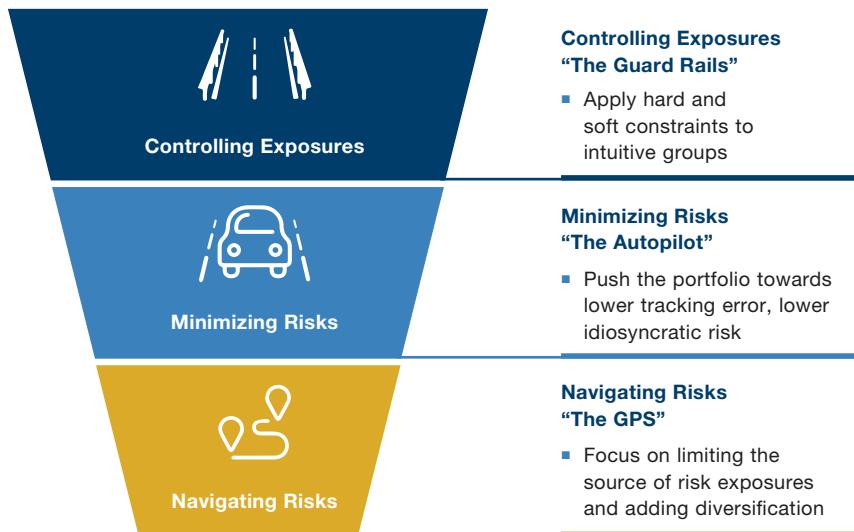
Key points

- Portfolio construction should be viewed as working alongside and in tune with risk management.
 - Portfolios are constructed with the aim of avoiding traditional human biases.
 - We seek to balance theoretical robustness with practical implementability.
-

Both discretionary and quantitative managers are driven by the concept of the efficient frontier – the highest return for a specified level of risk – as a central goal of portfolio construction. Layered over this are further refinements, including the minimising of transaction costs and, crucially, ensuring that there is as little tracking error as possible. Liquidity in credit has improved significantly in recent years, as we have highlighted over the course of this paper, but there remains a clear disconnect between what is theoretically optimal and what is actually achievable in terms of portfolio construction. Realism and pragmatism when it comes to implementation risk are key skills that investors should look for in the managers of quant credit strategies.

It's worth remembering the driving impulse behind quant credit: that discretionary managers are prone to human biases that pull their portfolios away from the efficient frontier. These biases may manifest as preferences for particular companies or sectors, or in more traditional behavioural traits such as confirmation bias, overconfidence or anchoring. We believe that these biases are more prevalent in the credit markets than in equities, largely due to the make-up of each investor base. Given that the magnitude of transaction costs are significantly higher in credit than other liquid asset classes, it can be especially difficult for discretionary managers to balance capturing uncertain expected returns while incurring realized costs in trading corporate bonds. Algorithmic trading models seek to balance these opposing forces, removing human bias and remaining as close to the efficient frontier as is possible.

The diagram below illustrates the multi-layered approach we take to incorporate various elements of risk into our portfolio construction process. What's key to understand is that, given the wide breadth of volatility and asymmetric nature of jump risk in credit, we have found credit strategies need far more refined and granular approaches to each of these layers than other asset classes. The ability to balance and satisfy all of the granularity in these layers is a strength of systematic approaches.



Schematic illustration.

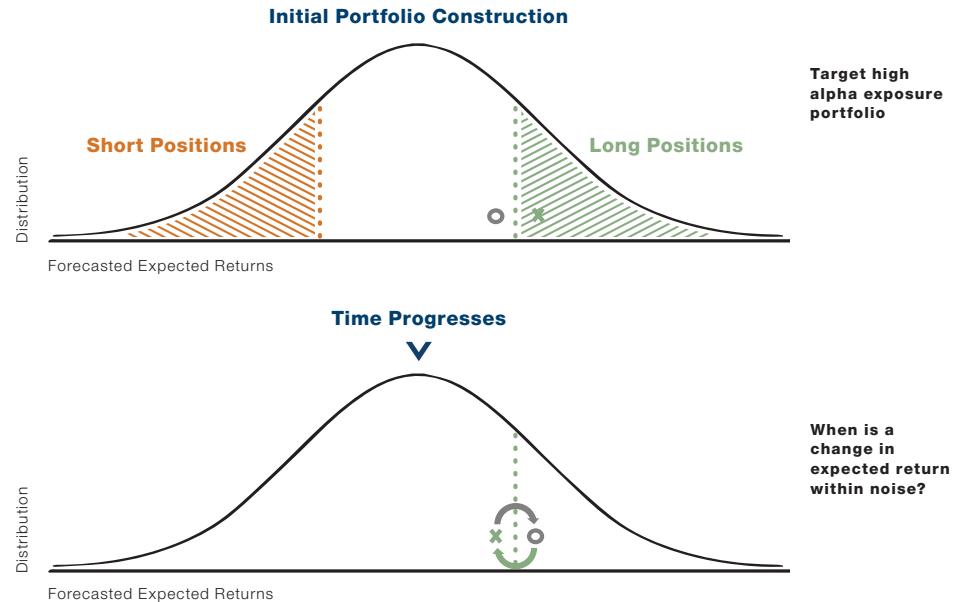
The first step in the portfolio construction process is establishing the “guard rails” – hard and soft constraints to define the specific exposures the portfolio should target. These can be specifications around volatility, rating, sector or issuer-specific, but each decision must be justifiable relative to the required risk and return characteristics of the portfolio. Once this step has been implemented, we move to the second stage of the process – the “autopilot” – where our objective function pushes the portfolio towards the efficient frontier and minimises both concentration risks (to which discretionary managers are particularly prone) and other unintended risk factors, while also seeking to minimise transaction costs. We call the final layer the “GPS” – the ongoing and dynamic guiding process by which the portfolio is refined over time, always seeking to maintain diversity and to limit sources of risk.

Moving beyond risk considerations, managing alpha uncertainty is particularly important in systematic credit strategies due to the higher realized costs to buy and sell corporate bonds. There is a great deal of academic research on the subject of alpha uncertainty – across all of finance there is always an element of estimation at play and there are limitations to the precision of forecasting future returns. The charts below illustrate the way we think about alpha uncertainty.

Securities like the green X may initially be in the most attractive tail of the distribution and included in a portfolio, but as time progresses may look less attractive compared with securities like the grey O. How large of an expected alpha difference must there be for this to not be noise within the alpha estimation uncertainty?

The way we get around this is to build into the portfolio a degree of headroom to allow for such uncertainty, making the objective function differentiate whether the security is already held or not.

Handling Alpha Uncertainty – Reducing Noise and Turnover in the Process



Illustrative example of a cross-section of forecasted expected returns for an example corporate bond universe.

To summarise, we seek to balance theoretical robustness with practical executability, to mitigate alpha uncertainty and maximise the transfer coefficient. We seek to navigate the idiosyncrasies of the credit market and to minimise transaction costs while always steering towards the efficient frontier. We believe that good portfolio management is about understanding the nexus of risks that a credit portfolio faces, both external risks – idiosyncratic and systematic default risk, downgrades and spread volatility – and internal risks – those risks to efficiency posed by implementing a highly efficient model on a less than perfect market. We continue to be convinced, however, that a well-executed quant strategy, which is able to look past so many of the human biases over which discretionary strategies stumble, is the optimal way of accessing the credit markets , and in fact one of the biggest sources of opportunity for systematic approach to add value.

Key points

- The correct modelling of transaction costs and liquidity availability is crucial to a robust approach to quant credit.
- There are explicit and implicit costs to be taken into account when calculating modelled returns.
- Strategies with lower churn will necessarily encounter lower transaction costs.

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We cannot overstate the importance of transaction cost and liquidity modelling for quant credit participants, particularly in a market where spreads are at such universally tight levels and where transaction costs can easily wipe out the potential profitability of a trade.”

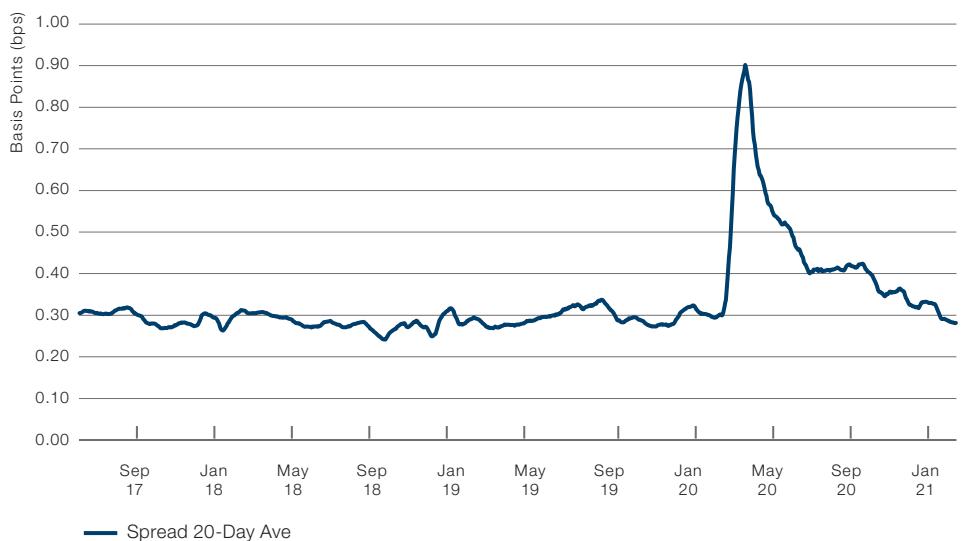
We have lamented above the archaic nature of trading methods in fixed income. Unlike equities, where liquidity is almost universally visible and available and where bid-ask spreads are kept extremely tight, the bond market is structured around a Request for Quotation (RFQ) process that has hardly changed for decades. Corporate bond bid/ask prices are indicated by dealer runs that are not firm and actionable and therefore market participants often find that trades that appear profitable in practice are unprofitable once transaction costs are factored in. Indeed it is something of an indictment of the market that there exists the notion of “if filled” trades – i.e. transactions whose profitability or otherwise is left to the whim of an inconsistent market.

We cannot overstate the importance of transaction cost and liquidity modelling for quant credit participants, particularly in a market where spreads are at such universally tight levels and where transaction costs can easily wipe out the potential profitability of a trade. What's more, when probability of fill is not 100%, and portfolio optimisers choose certain bonds, the solution the optimiser comes up with is no longer really optimal if that bond is not available for purchase. In addition, unfilled orders can lead to unintended and potentially unmodelled risk exposures.

For quantitative credit strategies, the higher the turnover of the strategy, the more the results rely upon the accuracy of the modelled transaction costs and the availability of liquidity. Within classic quant, Momentum tends to have the highest turnover of any factor approach while both Size and Quality see the least churn. In addition to turnover instigated by changes in data and factor scores, it must be remembered that bond portfolios have a natural element of turnover inherent within them, given the issuance and redemption cycles.

It's worth noting that much of the academic literature, even research written within the past few years, relies on estimates of transaction costs taken from Chen, Lesmond and Wei's 2007 study. In that paper, the bid-ask spread for AAA-rated corporate bonds was estimated at 25bps, while for CCC-rated bonds it was 180bps. Both of these figures would be markedly tighter in the current market. Indeed, both the increasing liquidity of the credit markets and the advent of electronification have driven bid-offer spreads significantly tighter in recent years. And, as the chart below illustrates, while bid-offer spreads gap out in times of crisis like February/March 2020, levels swiftly return to normal as the trading ecosystem is both broad and deep enough to accommodate new patterns of supply and demand.

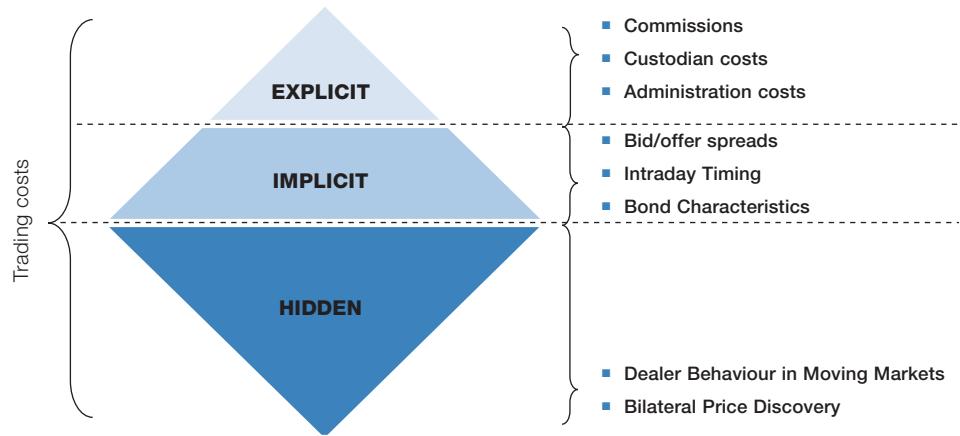
High-Yield Bid-Ask Spreads (20-day average)



Source: Bloomberg. Date range: 1 July 2017 to 2 February 2021.

The graphic below shows the tripartite make-up of trading costs in corporate bonds. The further one moves away from explicit and towards hidden costs, the more difficult these costs are to model. It is necessary to combine information from a number of different data sources in order to build up a picture of the price landscape in the credit markets. These include data from market runs, electronic platforms, TRACE data and dealer information.

Why execution matters: total cost of accessing a market

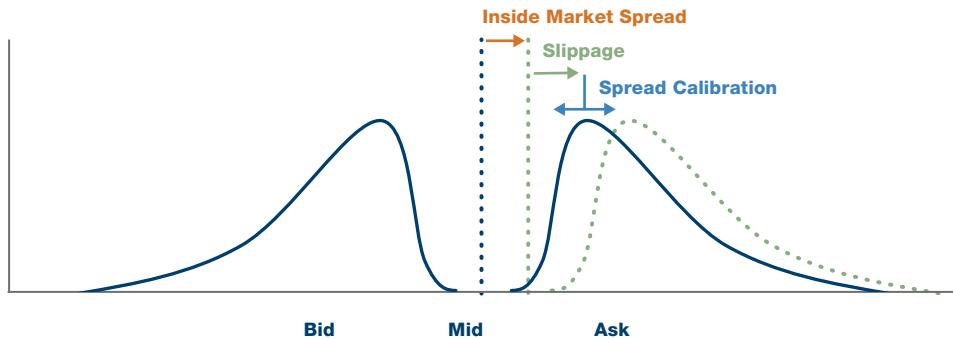


Schematic illustration. Source: Man Group Data

Once theoretical price levels have been established, it is necessary to estimate how much distance there will be between theoretical prices and those actionable in the market. We do this through a three-tiered system that seeks to acknowledge the different areas in which transaction costs may exceed modelled costs. The chart below details our approach.

Transaction Costs Modelling

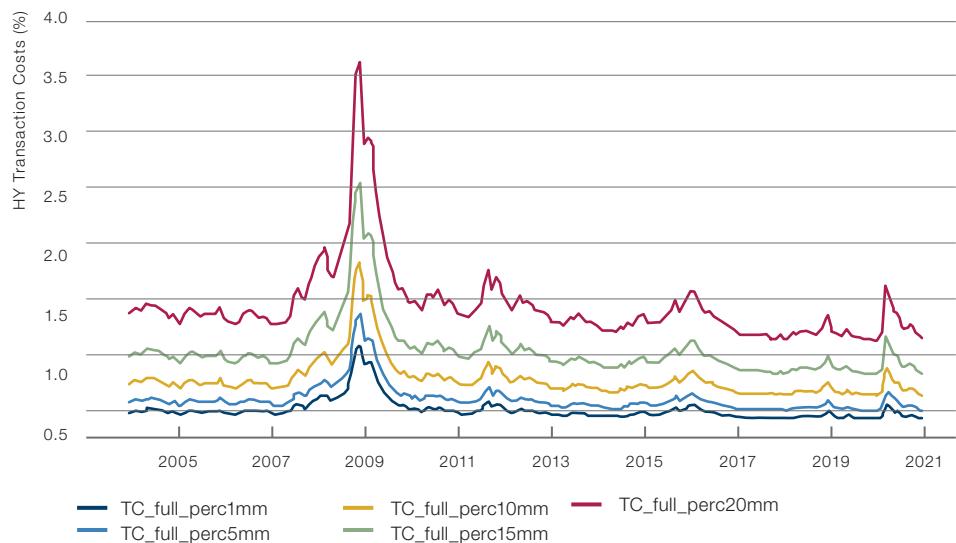
$$TC = \text{Inside Market Spread} + \text{Slippage} + \text{Spread Calibration}$$



Schematic illustration. Source: Man Group Data

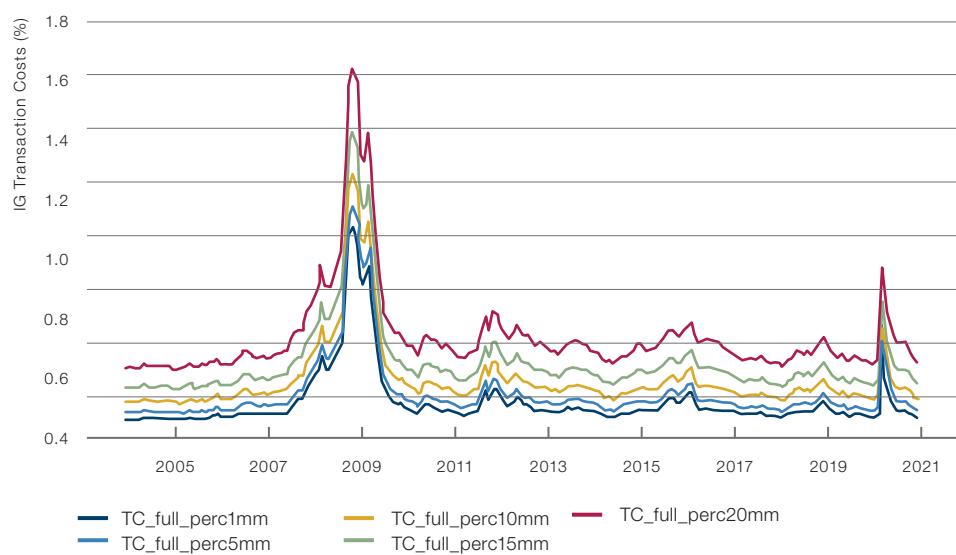
We take dealer spreads – the best quoted bid/offer in the case above – and then adjust for slippage – the cost of trading accounting for bond characteristics as well as for information leakage during the period in which the trade is being carried out. We then apply a further modification to take into account spread calibration – reflecting whether dealers tend to fade from or improve their runs (this can be modelled with data from TRACE). Following this scrubbing process, we arrive at what we believe to be actionable levels. We calculate returns using this number. The charts below show how trading costs in both high yield and investment grade have fluctuated through time.

High Yield Transaction Costs



Date range: 1 January 2004 to 2 February 2021.

Investment Grade Transaction Costs



Source: Man Group Data. Date range: 1 January 2004 to 2 February 2021.

Key points

- Factors are the building blocks of many quantitative strategies.
- Combining factors into a multi-factor model gives a more robust and responsive signal.
- Factor models can be simple or sophisticated; we believe the latter will prove more durable and dynamic.



As with equities, academic research has shown that the majority of returns can be attributed to style factors in credit.”

Quantitative equity investment provides a useful model for talking about quant credit – it is significantly larger, more developed and able to draw on a far greater amount of performance data. At the same time, we should not blindly apply the lessons of the equity markets to credit, hoping that the results will be the same. The leading style factor types used in quant equity are also prevalent in the credit markets (although with some key differentiating elements). And, as with equities, academic research has shown that the majority of returns can be attributed to style factors in credit.⁹

Style factors emerged from the investigation of market anomalies – strategies that appeared to generate consistently above-market returns. All factors seek to do is to capture that anomaly. So, in the equity markets, Value looks for firms whose stocks are undervalued relative to some consistent financial metric – price/book or price/earnings; Momentum looks for firms whose shares have been rising in value and seeks to ride that wave; Size attempts to exploit the fact that smaller firms have historically tended to outperform larger companies. When it comes to quant credit, style factors are somewhat different, as we shall see.

⁹. See 'The Illusion of Active Fixed Income Alpha', AQR Alternative Thinking, 10/2017, in which the authors state: "Across multiple categories of active FI managers, we detect little evidence of manager skill – either in aggregate or individually."

We now set out the most common style factors employed in quant credit and how they differ from those used in the equity markets.

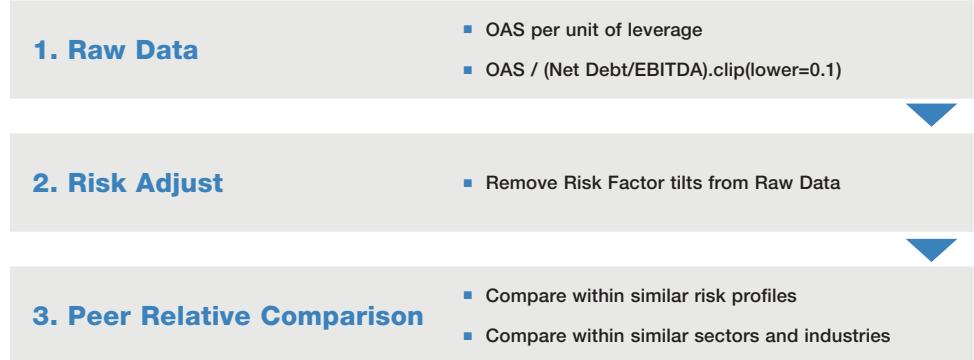
a. Value

One of the principal fundamentally-driven style factors, Value looks for bonds that are undervalued relative to other bonds judged by a specific financial metric. At its simplest, Value selects cheaper (higher spread) bonds over more expensive (lower spread) for the same underlying credit rating. We could also calculate a theoretical fair spread level by estimating the probability of default and recovery rates and establishing whether the market is correctly rewarding us for the risk of loss.

In more sophisticated models, managers move beyond credit ratings, which tend to be backward-looking and lagging indicators of fundamental credit quality and seek to develop proprietary models that control for characteristics such as industry, quality, issuer fundamentals and duration. Only once these control mechanisms have been implemented can we develop a true picture of bonds whose Option Adjusted Spreads (OAS – a measure of spread that adjusts for embedded optionality such as callability within a bond's structure) are wider than is justified by their fundamental credit risk. There have been a number of attempts to define consistent measures of Value in credit investing, including both ESP (excess spread to peers) and SPiDER (spread per unit of debt to earnings ratio).¹⁰

We use the second of these approaches in the schematic below, which illustrates the methodology involved in constructing a factor model or signal targeting leverage. There is a spectrum of signal refinement in quant approaches that can span from more raw factors to more highly-refined factors. We characterise this figure as being more on the highly-refined side. We begin by processing the raw data for the investment universe, looking at OAS per unit of leverage measured as Net Debt to EBITDA. The second step is to further refine our signal by risk-adjusting the output for measures such as issuer size, probability of default and volatility. We then adjust the results to make sure that data are cross-sectionally comparable across ratings categories, industries and sub-sectors.

Signal Transformation



Schematic illustration.

¹⁰. Both described in Ben Dor, Desclée, Dynkin and Hayman, 2021

“

It has been noted by several studies that Value has performed better as an investment strategy in credit markets than it has in equities.”

It has been noted by several studies¹¹ that Value has performed better as an investment strategy in credit markets than it has in equities. This appears particularly to be the case over the past decade. While the concept of buying cheap securities can be applied across asset classes, we find Value as a factor requires entirely new model specifications compared with equities. Cheap equity does not imply cheap bond and vice versa. It's worth noting also that Value stands out as being particularly CUSIP-specific, that is to say that within the same capital structure, even after accounting for liquidity, subordination, duration, etc., mispricing can remain.

b. Momentum

Again, when we come to Momentum, there is a basic definition that cleaves closely to the version employed by quant equity. This seeks to follow price trends for bonds, looking at price movements over 3, 6 or 12-month periods and investing in those securities that have outperformed over the specified time horizon. It is worth highlighting that we find greater overlap between equity and credit Momentum than in other factors. We generally find trends to be consistent across a capital structure and indeed across broader groups/ecosystems as well; these trends therefore tend to be less issue-specific and more at an issuer-level.

As noted above, however, the bond markets are significantly more price-inefficient than equities due to the buy-and-hold approach of many of the largest players. This means that looking at bond prices alone is deemed insufficiently robust as far as signal construction goes, particularly when it comes to investment grade credit. Research by Khang and King (2004) and Gebhardt, Hvidkjaer and Swaminathan (2005) indicated that bonds had a tendency to revert to mean pricing levels over time, while further analysis by Jostova et al. (2013) indicated minimal effects from following Momentum strategies in investment grade, but a more meaningful impact in the high yield market. This superior performance of Momentum strategies in high yield is confirmed in research by Pospisil and Zhang (2010).

We believe, however, that to develop a more powerful Momentum signal, one should look at price information from across a firm's capital structure, given that stock prices tend to move more swiftly and meaningfully as a result of new information and equity performance often has a spillover into bond pricing. Ben Dor et al. (2021) define EMC (Equity Momentum in credit) as a measure that seeks to use past equity returns to identify debt issuers likely to out- or underperform their peers.

Momentum strategies also take into account the historical speed that fundamental information disseminates within a firm's broader ecosystem, seeking to invest in the bonds of firms whose securities have historically underreacted to strong fundamental performance. There is a vast amount of information quant approaches can use to not only look at historical security returns but to identify and go long issuers with favourable business trends and to avoid or go short issuers experiencing contraction.

¹¹. Correia et al.; van Dijk; Norden; Israel et al.

c. Other Factors: Size, Carry, Quality, Low-Risk, Informed Investor

There are a number of other style factors employed in quant credit that are worth mentioning here. It should be noted that many of these intersect with Value and/or Momentum, or with each other, such that factors can be thought of as overlapping Venn diagrams rather than conceptually discrete. As the quant credit investment world grows and matures, we expect these style factors to become more clearly defined and to have a greater degree of statistical corroboration.

Size privileges smaller companies based on the market value of their outstanding bonds. There is little academic analysis of Size as a factor, with only Houweling and Van Zundert (2017) suggesting that there is a positive Size premium in corporate bonds while Alquist, Israel and Moskowitz (2018) argued that the Size effect was either immaterial or marginally negative for bonds. We have seen little evidence to suggest that Size is a meaningful factor in quant credit, especially after transaction costs; we certainly do recognise that it can be a driver of volatility (i.e. it is a clear risk factor). There can be fairly meaningful market-relative returns both positive and negative to a Size factor.

Like Value, Carry is a factor that will be familiar to discretionary market participants. Kojen et al. (2018) analysed Carry in a variety of asset classes, including corporate bonds. They define Carry as the “return of an asset assuming that prices stay the same”. Notwithstanding the higher risk implied by higher yields, Kojen et al. find that the Carry factor has, on average, positive returns, with Sharpe ratios between 0.4 and 0.5. Over the long run, Carry appears to offer a significant premium, but with incredibly high volatility of returns. This lack of consistency means that Carry as a signal can have fantastic years and also very poor years in terms of benchmark relative performance.

Quality in credit is similar to the Quality factor in equities, save that the metrics specified tend to be leverage/interest coverage related. It's interesting that credit quality analysis forms such a significant element of most discretionary managers' approach to portfolio selection and yet, as shown in research by Henke, Kaufmann, Messow and Fang-Klingler (2020), Quality bears very little relation to performance, at least in investment grade credit. Bender, Briand, Melas and Subramanian (2013) suggest that there is some evidence that applying a Quality factor can reduce risk and improve risk-adjusted returns in a 60/40 equity/bond portfolio.

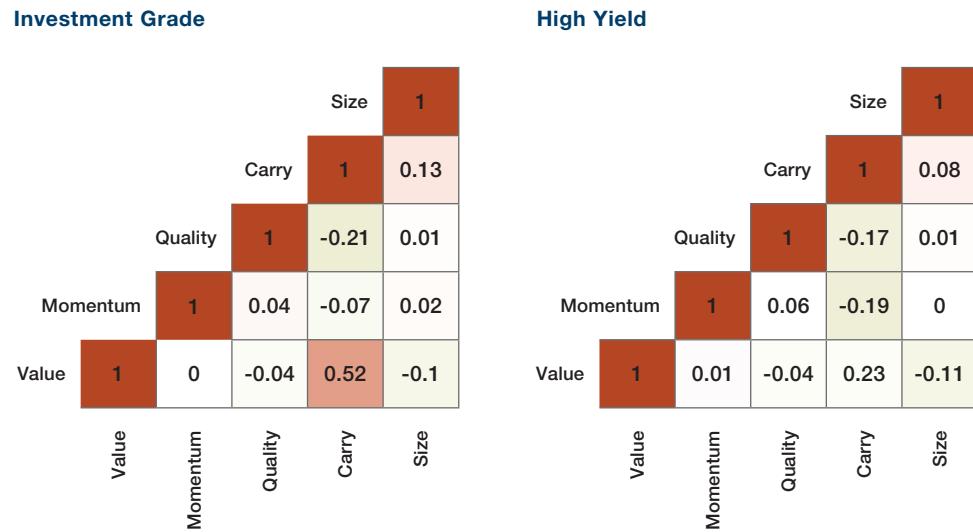
Low-risk strategies (which are often expressed as a sub-set of the Quality factor) exploit the observation that bonds that exhibit lower volatility tend to perform better over time. This reflects the fact that – unlike equities – bonds tend to experience more volatility on the downside than on the upside: the tightening of a bond on the upside to risk free rates is typically asymmetrically smaller than the jump to recovery in situations of distress. Low-risk factor signals target shorter-dated, higher-rated bonds.



It has become clear that no single style factor is sufficient to address the different faces of the markets. ”

The Informed Investor style factor looks to exploit information about investor activity to drive investment decisions, working along a ‘wisdom of crowds’ thesis. This harnesses data points such as short interest and call/put positioning to build a picture of investor activity across markets. While this factor is hampered by the slow-moving nature of the traditional bond-buying investor base, there is some evidence (Illmanen, 2011) to show that it delivers superior returns, particularly when employed in combination with other style factors.

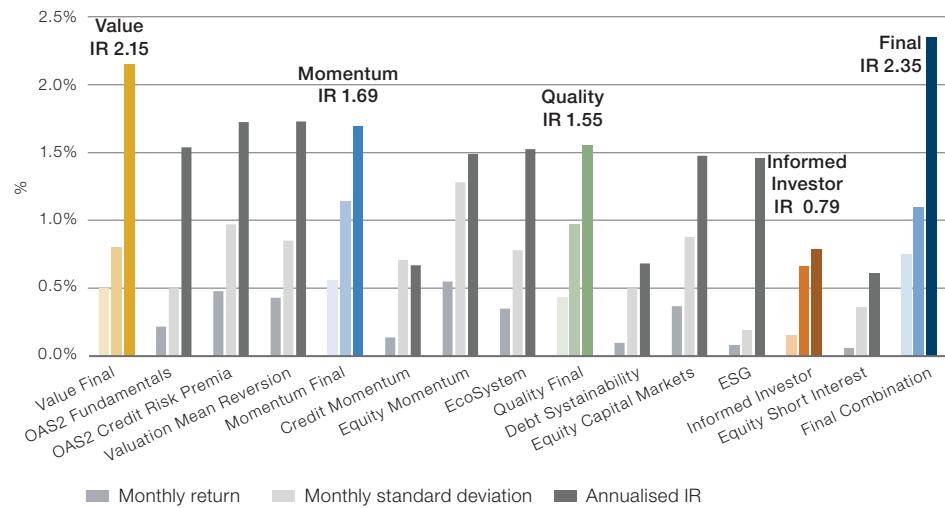
This later point segues nicely into the conclusion of this chapter on style factors. In quant equity, it has become clear that no single style factor is sufficient to address the different faces of the markets. As such, investors are increasingly using multi-factor models that seek to achieve two distinct goals: to deliver strong returns in a variety of different market conditions and to deliver excess returns in a manner that is uncorrelated with both the corporate bond market indices and with equities. The chart below, from Henke et al. (2020) shows pairwise correlations across various style factors. The low or negative nature of these correlations means that a multi-factor portfolio substantially increases the risk-adjusted return while reducing volatility.



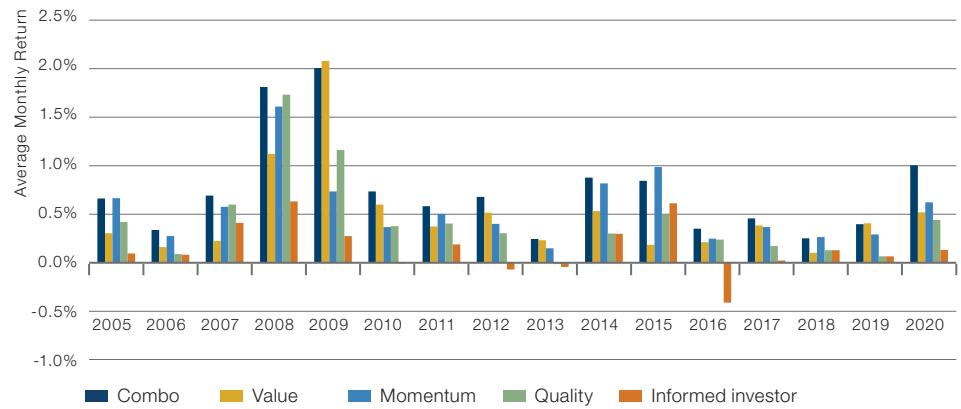
‘Factor Investing in Credit’, Henke, Kaufmann, Messow, Fang-Klinger; 2020

The most sophisticated investors will create their own proprietary models that adapt traditional factor models and deploy them in varying combinations based on the market environment. The chart below illustrates model returns for a variety of different factors and demonstrates again the superior risk-adjusted performance of a multi-factor portfolio (“combo” and “final” in the charts) relative to any single factor style.

Decile Return and IR Summary for US IG and HY



Average Monthly Decile Return by Year¹²



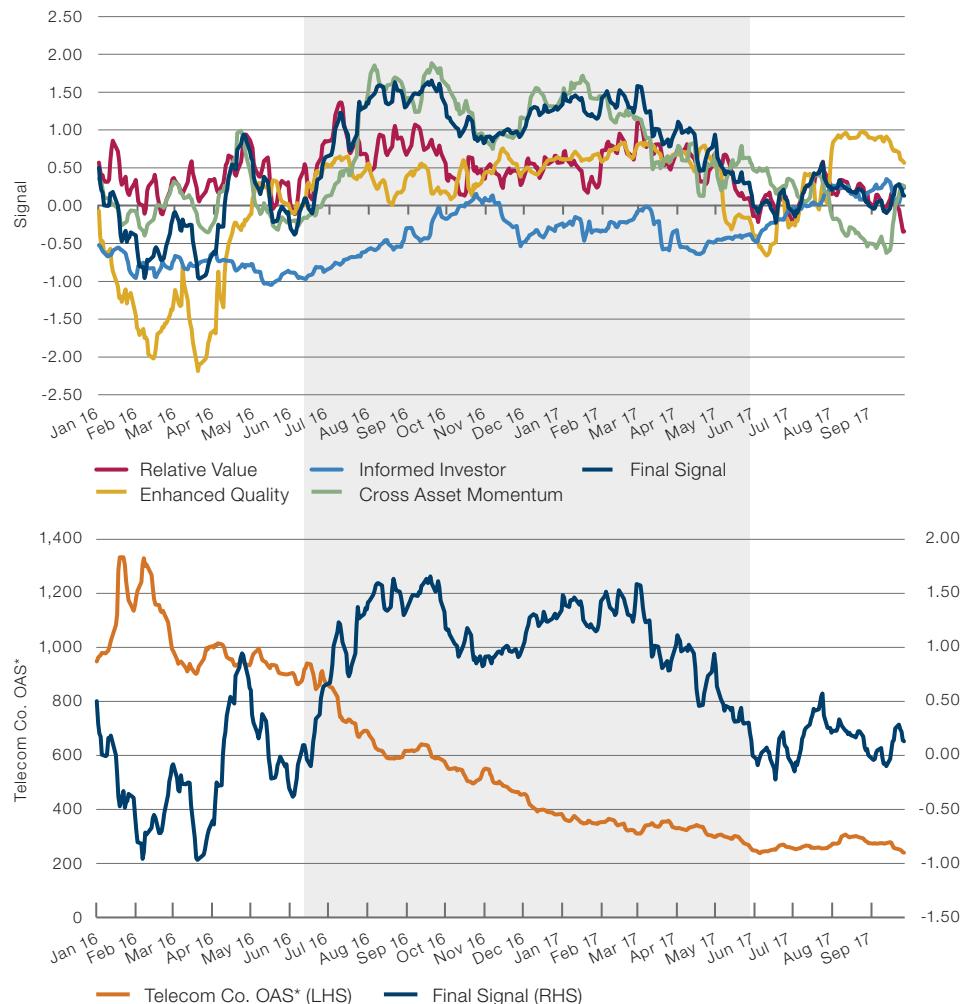
Source: Man Numeric. For illustrative purposes only.

¹². Simulated performance is not indicative of future results. Returns may increase or decrease as a result of currency fluctuations. Table data: January 1, 2005 December 31, 2020, computed using USD returns. For illustrative purposes only. This chart contains hypothetical back test returns which have certain inherent limitations. Unlike an actual performance record, simulated results do not represent actual trading. These results do not directly account for liquidity, transaction costs, and borrow costs. Simulated trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. There exist limitations inherent with model results. The return data shown is based on preliminary research and is subject to change. The Synthetic track record has been created by ‘back testing’ a systematic trading model to historic data. Performance is subject to change without notice as models develop over time. Please note that this information shows model returns and does not represent a standalone investment product. Source: Numeric Investors LLC.

Below we show a real-world historical example of a multi-factor model applied to a telecoms company. The graph shows the interplay of four different factors and how these signals combined to give a strong message about the improving credit profile of the company. It should be noted that while each individual factor imparts some degree of meaningful signal, it is only when they are combined into a multi-factor model that the signal becomes pronounced enough to impart a clear indication to trade.

	2016	2017
Company Event	Customer retention stabilizes, Telecom Company relieves liquidity concerns, 500mm of Cost Cutting achieved	Company achieves FCF breakeven, EBITDA Margins expands from 25% to 30%
Signals	<ul style="list-style-type: none"> ■ Value and Quality strengthens based on improving leverage, FCF profile, EBITDA margins from distressed levels ■ Informed Investor becomes cautiously more optimistic based on Bond and Equity Short Interest ■ Cross Asset Momentum turns positive based on the firm's ecosystem of customers and competitors and improved analysts' forecasts 	<ul style="list-style-type: none"> ■ Value, Quality and Momentum monetizes positive alpha as OAS (Option adjusted spread) reaches their tights while fundamentals remain uncertain (Continued high leverage and weak FCF) ■ Informed Investor remains low – short thesis improved with recovering business profile

Signal and Spread Performance for Telecoms Company, 2016-2017



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Our belief is that the quant credit space will necessarily follow quant equity by increasing in complexity and sophistication and that the simplistic models will find that they are overtaken by those firms with the modelling skills and data analysis expertise that allow them to execute with greater precision and speed.”

Source: Man Numeric. *OAS = Option-adjusted Spread.

We will conclude this section with a few thoughts about complexity. We recently participated in a survey of quant credit managers by the Dutch pension fund PGGM. They published their results in an article entitled ‘Will corona be a watershed moment for credit factor investing?’¹³. They broke managers in the quant credit space down into those who were more sophisticated as far as both model construction and data usage went, and those whose engagement is more simplistic – what PGGM refer to as the “KISS” model (“Keep it simple, stupid”). On the one hand, simple models tend to experience faster alpha decay (as we have seen in the equity markets). On the other hand (as PGGM highlighted) more sophisticated models may expose themselves to overfitting and a loss in transparency. Our belief is that the quant credit space will necessarily follow quant equity by increasing in complexity and sophistication and that the simplistic models will find that they are overtaken by those firms with the modelling skills and data analysis expertise that allow them to execute with greater precision and speed. Overfitting is always a risk in quant strategies but can be mitigated by best practice in research and analysis of model inputs and outputs.

¹³. <https://www.ippe.com/reports/factor-investing-will-corona-be-a-watershed-moment-for-credit-factor-investing/10045314.article>

Key points

- Quantitative strategies depend heavily on the use and quality of data.
 - Accordingly, we believe that the growth of quant credit will be driven by the increased quality and availability of data.
 - Alternative data will provide further areas of growth and alpha for those managers with the skills to exploit them.
-

Quant strategies are only as good as the data upon which they base their investment decisions. One of the major impediments to the development of quant credit so far has been the relative paucity of available price and reference data. The advent of electronic exchanges has significantly improved the visibility of trade data as has the availability of FINRA's Trade Reporting and Compliance Engine (TRACE) data which track OTC bond transactions by registered broker-dealers in the US. This includes date, time, quantity (capped/uncapped), price, direction and other fields.

In order for quantitative strategies to function they need to be rigorously backtested. With greater availability and quality of data, there will be a greater number of reliable and robustly evidenced models to deploy into the credit markets. This pricing data needs to be supplemented with a complete and up-to-date database of issuer and security-specific information that will permit quant credit managers to ensure that their models specify the correct bonds when carrying out their strategies and are able to map a variety of datasets at both issue- and issuer-level. As we stated above, the heterogeneity of bonds is a clear issue for the further development of quant credit and can only be addressed by careful and comprehensive data management.

It is important that quant credit managers also have extensive data on equity market activity. Firstly, there is much greater price visibility in equity markets. Secondly, there is the concept of equity lead-lag, whereby activity in equity factors can be used to drive investment decisions in the corporate bond market. Analysis from Houweling et al. (2016) indicates that, when applied to credit, all equity factors generate positive alphas and Sharpe ratios higher than those of the corporate bond indices, but the only spill-over to achieve meaningful statistical significance is equity Momentum, which generates a higher alpha than corporate bond Momentum itself.¹⁴

¹⁴. According to research by Bektic et al. (2016) this is merely due to the fact that fundamental performance is reflected more swiftly in equities than in bonds.

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Alt data gives managers with sophisticated machine learning capabilities the opportunity to discover new sources of superior returns.”

Alternative data applied to credit investing is still nascent in its development. In the quant equity space it is a driver of returns of growing importance. Given the squeeze on alpha in quant equity, alt data gives managers with sophisticated machine learning capabilities the opportunity to discover new sources of superior returns. We believe that we will see the swift adoption of alt data in the quant credit space as it is recognised that financial information alone is not sufficient to capture all of the factors that drive bond pricing. Harnessing newsflows, weather data, social media patterns and more will be a new and differentiated means of informing investment decisions and improving factor models.

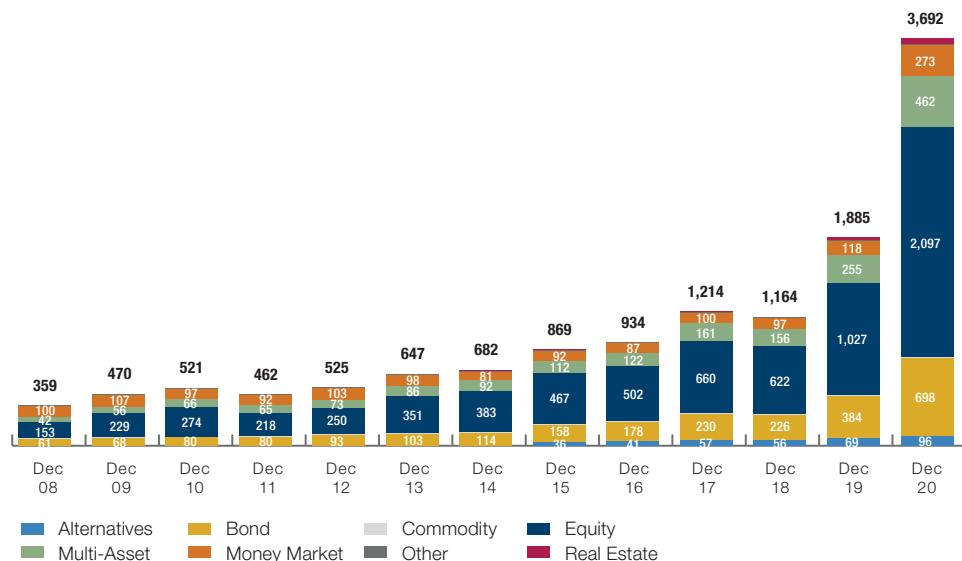
The relatively few alternative data approaches that we have seen applied to quant credit strategies thus far include: analysing company linkages (suppliers and customers) from the Revere dataset (Bloomberg also offers a competing dataset); bond short interest information; text-mining credit analysts' reports. We expect the breadth and depth of these alternative data sources and approaches to increase dramatically with time.

Key points

- ESG (environmental, social, governance) investing is still growing, and it is yet to penetrate fixed income in the way it has equities.
- There is significant scope for the integration of ESG factors into quant credit strategies.
- For meaningful ESG engagement, we believe it is necessary to also take a top-down approach to stewardship.

2020 was the year in which ESG investment went mainstream in the equity markets. The charts below show the dramatic inflows into ESG-related funds, particularly in the US. In the course of a year, we have gone from a situation where management teams were largely able to ignore or underplay their commitment to ESG obligations, to a corporate landscape where those firms that do not prioritise their environmental, social and governance responsibilities risk being left behind.

Assets Invested in ESG Strategies (\$ bn)



Source: Bloomberg, J.P. Morgan, Lipper, based on public AUM data as of December 2020.

ESG has not yet impacted the world of fixed income to the same extent as the equity markets. At the end of 2019, only around 20% of global ESG-related investments were in fixed income.¹⁵ Partly this is a facet of the fact that shareholders have voting rights and usually greater ability to influence management

15. <https://www.camradata.com/2020/08/27/esg-in-fixed-income-press-release-august-2020/>

behaviour. There is also the potential of significant upside for the shareholders of those firms who can turn the current focus on ESG to their advantage. However, we still believe that ESG will increasingly become an important consideration for fixed income investors as the credit risk associated with them grows: ESG impacts the whole enterprise value not just the equity. Initially there will be inevitable spill-over from the equity markets, where ESG considerations are increasingly driving corporate behaviour. Longer term, we believe ESG risks will be considered as part of credit risk.

The identification and management of ESG-related risks is a form of enterprise risk management. We believe that it will increasingly be the case that firms who fail to address environmental, social and governance issues face being punished by their customers, regulators and investors. This may have significant ramifications for bondholders with the potential for such events to have a material adverse impact on a firm's credit quality. We are already seeing increasing recognition from credit ratings agencies of the magnitude of potential ESG-related incidents and their ability to impact a company's credit profile. With the advent of green bonds, ESG-focused fixed income funds that go beyond mere exclusion lists, and an increasing availability of tools and data to help fixed income investors make informed decisions about ESG factors affecting the companies they invest in, we expect to see continued interest and growth in ESG-focused fixed income in the coming years.



We believe that ESG is both material enough and discrete enough to be considered a unique factor and can be usefully applied to portfolios to generate alpha. „

There has for some time been a lively debate in the academic circles of quant equity investing as to whether ESG can be considered a factor in itself. Typically, a factor needs to fulfil the following characteristics:

- Each factor has a solid rationale for the existence of a return premium;
- There is significant historical empirical evidence to support the premium;
- They exhibit low correlation with other factors;
- They can be implemented at scale.

While there are certainly overlaps between ESG and other style factors (particularly Momentum and Quality), and there is perhaps not yet sufficient historical data to fully justify the designation, we believe that ESG is both material enough and discrete enough to be considered a unique factor and can be usefully applied to portfolios to generate alpha. The matrix below outlines the correlation of Man Numeric's own proprietary ESG factor with other factors.

ESG is Complementary to Existing Signals

	NI ESG Score	Value	Momentum	Quality	Informed Investor
NI ESG Score	1.00	0.01	0.00	-0.03	-0.05
Value	0.01	1.00	-0.01	0.24	0.05
Momentum	0.00	-0.01	1.00	0.10	0.04
Quality	-0.03	0.24	0.10	1.00	0.08
Informed Investor	-0.05	0.05	0.04	0.08	1.00

Schematic illustration. Source: Man Numeric. Date range: 1 January 2016 to 1 September 2019.

While there is a larger amount of research providing evidence of the performance of ESG style factors in the equity markets, there have also been a number of compelling studies of its role in fixed income, including Polbennikov et al. (2016), Dynkin et al. (2018) and Ben Dor et al. (2021). The latter studied the performance of bonds issued by companies with ratings from the two major ESG data vendors, MSCI and Sustainalytics. They note that while in 2018 around 90% of the USD and EUR investment grade corporate indices by market value were covered, this level of coverage drops off fairly swiftly when one moves back in time. They also note that the high yield indices suffers from much poorer coverage, given the number of private companies within the index as well as the usually smaller size of issuer, meaning that data vendors have not prioritised them in the roll out of their ratings.

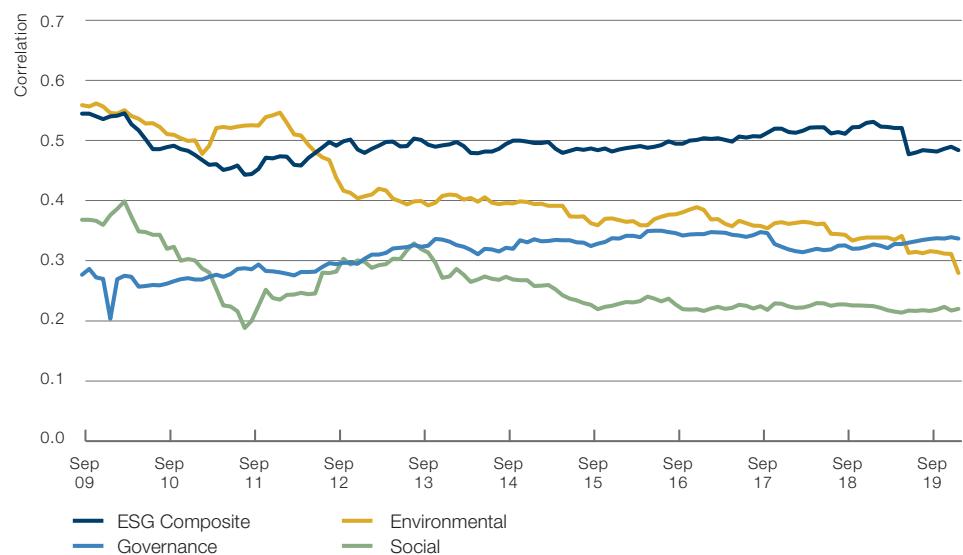
The study by Ben Dor et al. made several interesting observations about the performance of corporate bonds when ESG style factors are applied. The first is that there is the possibility of unintentional biases being established in a portfolio. They found that an ESG-tilted portfolio of investment grade bonds had an average spread that was less than half that of a portfolio scoring poorly on ESG-related metrics. Thus a portfolio that does not control for portfolio risk characteristics when implementing an ESG factor tilt may produce unanticipated returns because of a quant bias towards higher-quality, lower-spread issuers. They also note that there is a positive correlation between credit ratings and ESG scores, with a particularly high overlap between environmental scores and ratings.

As far as how to accommodate these observations in portfolio construction, there are two possible lines to take: managers either pursue a peer-relative/best-in-class ESG approach, or otherwise address ESG more in absolute terms, working exclusion lists into their strategy (e.g. completely removing the energy sector). For quant strategies, again breadth is key, and we do tend to see strong ESG leaders in all industries. For this reason, although quant strategies can certainly accommodate redefined benchmarks or broad restriction lists, we tend to favour a peer-relative, best in class approach.

Just as in quant credit we are only at the beginning of the market's evolution and expect to see significant development in the coming years, the integration of ESG factors into quant investing is still only in its infancy. ESG investment and quant strategies ought to be happy bedfellows. Quant investing loves data, and often the messier the data the better. The quality of both the raw data surrounding ESG performance and the reliability and sophistication of the ratings system are seen as impediments to the continued growth of broader ESG investment. Here, though, is an area where quant strategies ought to be able to help. Fixed income markets will become more efficient when their inefficiencies are subjected to the clarifying attention of quant investors. Similarly, we expect the increasing focus from quant strategies on ESG will drive improvements in the quality of data vendor ratings. As the chart below shows, the correlation between ESG scores from MSCI and Sustainalytics are currently problematically low, reflecting the very different methodologies and priorities at each firm.¹⁶

16. For comparison, credit ratings tend to be around 95% correlated.

MSCI v. Sustainalytics Correlation within Numeric Global Universe¹⁷



Source: MSCI, Sustainalytics Man Numeric. Date range: 1 September 2009 to 24 September 2019.

There are a number of other points worth considering when thinking about the intersection of quant credit and ESG. The first is that as well as being a factor in its own right, other factors can be given an ESG tilt – some investors have incorporated green patent data in Value strategies or corporate culture information in Quality. The broader point here is that sophisticated managers in quant credit will be able to create their own proprietary ESG factor models and also integrate ESG elements into other style factors.

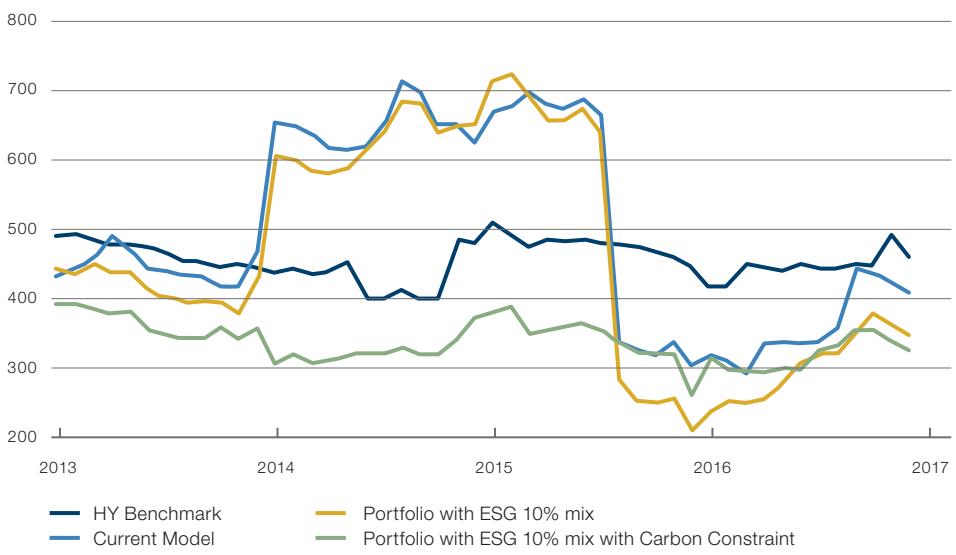
There's also the question of the breadth of ESG as a concept – one criticism some investors have levelled at ESG-focused funds is that it is possible for companies with poor environmental records to be included in supposedly responsible portfolios if their performance in social and governance metrics is deemed an adequate counterbalance. This kind of selection error can be addressed by adding a further constraint to portfolios that specifically take into account environmental factors. The chart below shows that a portfolio with an ESG tilt may end up with significantly greater exposure to carbon emissions than the underlying index. This can be mitigated by adding an additional constraint that maintains carbon exposure below 80% of the index average. In a world where there is questionable data, it is important to think about how the intelligent use of data can deliver portfolios that cleave more closely to investor requirements.

¹⁷. MSCI ESG: MSCI World ESG Universal index. MSCI Env, MSCI Social and MSCI Gov are three sub-components of the MSCI World ESG Universal index. As of December 2019.

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It could be that the strides made in quantitative ESG strategies in credit pave the way for a wider acceptance of responsible investment in fixed income more broadly.”

Total Carbon Score with Carbon Constraint



Source: Man Numeric

It is merely a quirk of timing that the rise of quant credit should coincide with the explosion of ESG investment. We believe, however, that the two worlds will continue to intersect and grow together. Fixed income has been slower than equity markets to embrace ESG, but there is a clear and compelling rationale behind the use of ESG data in quant credit. Indeed it could be that the strides made in quantitative ESG strategies in credit pave the way for a wider acceptance of responsible investment in fixed income more broadly.

We conclude with the observation that stewardship lies at the heart of any credible ESG strategy. The model-driven investment process of quant strategies does not preclude a deep engagement with stewardship. We believe that all stakeholders should be presenting management teams with a consistent and coherent message regarding their ESG obligations. This is why we address ESG from a corporate level at Man Group, whereby a top-down approach ensures a coordinated response in which equity and bondholders are united in their approach to driving change at the companies in which the firm invests.

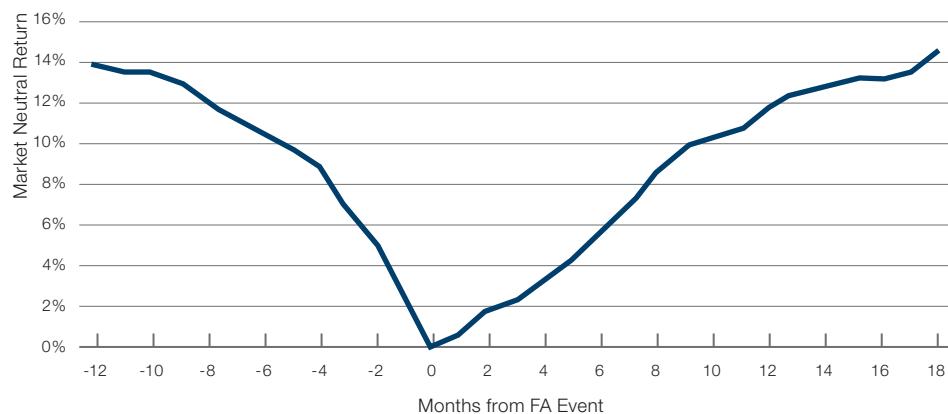
Key points

- Fallen angels are formerly high-grade companies that have been downgraded to sub-investment grade.
- Similar to widely publicised event studies in equities (e.g. around dividends, index inclusions etc.) we observe reliable patterns of performance leading up to and following a fallen angel event.
- We believe this is one area in which quant strategies can be employed to generate above-market returns. Moreover, it is a statistical event propelled by the supply and demand of different corporate credit investor bases that drives the price dynamic and therefore it is best captured through a diverse and repeatable quant process rather than trying to pick specific fallen angel events that look particularly attractive (and where adverse selection risks abound).

One area of the credit markets that we believe it is worth paying particular attention to is that of “fallen angels” – those previously investment grade companies that have fallen into high yield territory. We believe that the fallen angel space is an area of promise for quant strategies, with traditional market dynamics leading to inefficiencies and therefore the possibility of excess returns. Many typical fixed income investors have explicit constraints on the ratings of the bonds they are permitted to hold, often benchmarked to the investment grade indices. Insurance companies are required to hold significantly more capital against speculative grade bonds than they hold against investment grade positions. When a company is downgraded to below investment grade status by the ratings agencies, it drops out of the index at the next monthly rebalancing and there is a significant wave of forced selling around the event.

Fallen angels have come to represent a significant proportion of the overall high yield market, rising to as much as a quarter of the total market value outstanding in some years. There has been significant analysis that shows that fallen angels tend to see their prices depressed to levels lower than would be justified by whatever deterioration led to the downgrade. This pricing pressure reverses once the forced selling has abated, making this a clear example of temporary price distortion. In the chart below, we illustrate this phenomenon, showing how the price of a bond deteriorates swiftly in the lead-up to a downgrade below investment grade¹⁸ before largely recovering as the company's bonds find their place in the high yield market.

Fallen Angels Avg Cumulative Market Neutral Returns



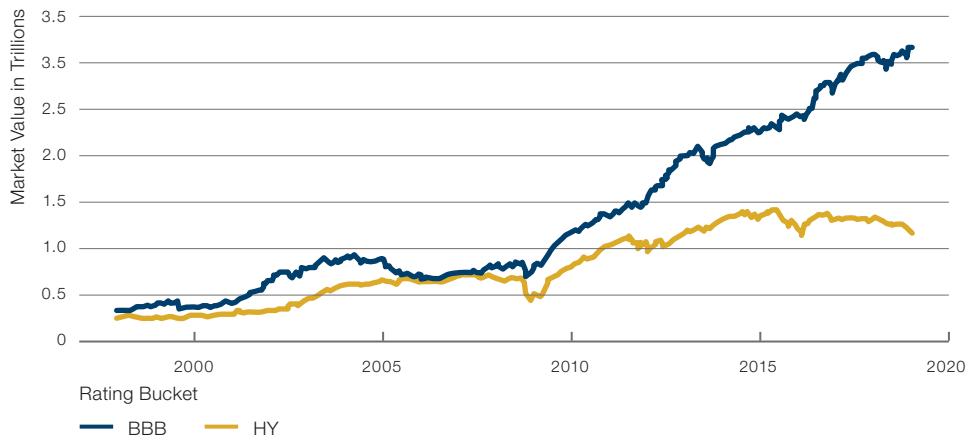
Source: Man Numeric, Bloomberg

We have established that fallen angels tend to outperform the high yield market by an average of 12% in the first 12 months following the fallen angel event.¹⁹

There has been a gradual downward trend in ratings over the past several decades. As such, BBB-rated companies have been increasing as a percentage of the total investment grade issuers, with almost 50% of the universe now rated BBB+ or below. The market value of BBB-rated bonds is around 2.75x the total high yield universe. 4.6% of BBB-rated companies on average are downgraded each year. This produces a consistent supply of alpha-generating opportunities as previously BBB-rated companies become fallen angels.

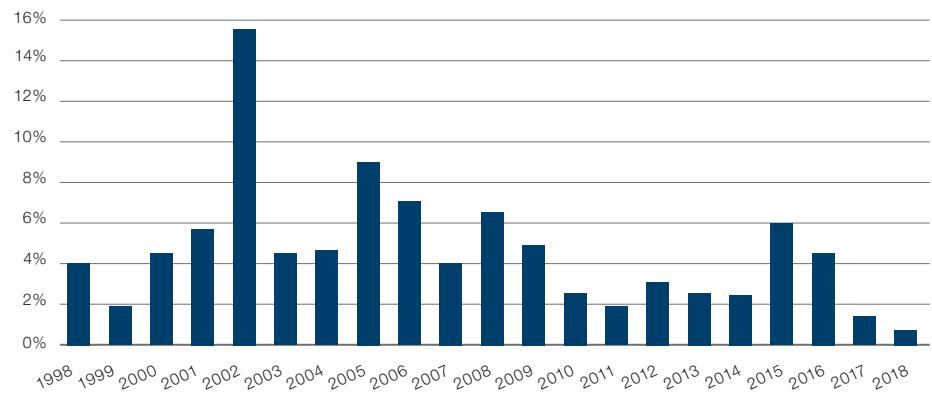
18. If it seems counterintuitive that there should be selling in the run-up to a downgrade, it must be remembered that ratings are put on review for downgrade/creditwatch negative prior to being downgraded. Some funds will not be permitted to hold bonds on review for downgrade at the lowest investment grade ratings, while others will seek to sell out of positions as the date for a potential downgrade approaches with the specific aim of avoiding the kind of price action we describe above. **19.** This analysis is supported by research from Ellii et al. (2011) and Ng and Phelps (2011).

BBB vs HY Market Size



Date range: 1 July 1997 to 6 August 2019.

Percent of BBB Market Value Downgraded



Source: ICE BAML Index. Date range: 1 January 1998 to 31 December 2018.

We applied a multi-factor model to a portfolio of fallen angel bonds and found that it delivered impressive excess returns. Another point with fallen angels is that even though there is certainly a differentiated forward return path based on the interaction of our multi-factor model, the return path prior to the event looks quite similar. This is to say that we do not look merely for bonds that have underperformed prior to the event and are capturing a stronger rebound post the event; we are seeking to capture positively differentiated credit momentum subsequent to the downgrade. We expect fallen angels to be an area of increasing focus for quant credit investors.

Key points

- We believe that quant credit is here to stay; growth and sophistication will only increase with time.
 - Today there appears to be significant alpha in the fixed income space – and a combination of testing and realised results supports the argument that above average return on capital and risk-reward are available for early investors.
 - Total dollar alpha may actually grow as the market develops, as more instruments and volume move to electronic venues and – for example – if transaction costs fall; ultimately though we would expect this to be spread over more quant investors and returns on capital to normalise. We expect this process to evolve materially over this decade/several years.
 - Quant-credit strategies will likely evolve to target securities other than corporate bonds and will increasingly seek relative value across capital structures.
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We are writing this paper at a fascinating time in the evolution of the quant credit market. What has been a niche and marginal enclave of greater interest to academics than investors is moving into the mainstream. The main takeaway is this: we believe that quant credit strategies will come to dominate the world of fixed income as quant equity has for several years dominated the stock markets. The future of quant credit will be one of increasing data sophistication, of the increasing use of machine learning; it will be one in which more fixed income products are transacted through quant strategies and there is greater cross-capital structure relative value. We expect more and more traditional quant equity players to move into the quant credit space.

Here are several areas that we think worthy of particular attention:

1) **Other Credit Instruments:**

- a. **Loans and Convertible Bonds.** We believe that we will see increasingly sophisticated and differentiated strategies, with funds targeting opportunities in leveraged loans and, particularly, convertible bonds, where we see the potential for significant alpha. While loans and other private credit instruments are obviously problematic from a data availability perspective at present, we believe that the momentum of quant activity in other areas of the fixed income markets will drive innovation and transparency in these historically opaque areas. Already both Refinitiv and IHS Markit are providing daily pricing on 6,500 loan facilities.



The momentum behind quantitative approaches to the fixed income markets has increased exponentially in the past few years and that the product now stands on the cusp of enormous growth.”

- b. **Sub-asset classes.** Quant credit will likely evolve beyond corporate bonds and loans to other sub-asset classes of fixed income – eventually spanning the rest of the fixed income indices, including sovereigns, MBS, ABS.
 - c. **Emerging market debt.** EM is a clear area of potential growth for quant credit strategies, as is the Chinese corporate debt market. Issue of data availability and market liquidity are endemic here today, but we expect both of these areas to be addressed by the increasing electronification of markets.
 - d. **Distressed.** Quant credit is yet to move into distressed debt – this is a high-touch asset class that requires a significant degree of human intervention, but further data capture and analysis around restructurings and recovery may make this possible.
- 2) **LDI.** Beyond the range of different securities covered, quant credit can also broaden investor capabilities to address more idiosyncratic portfolio construction problems. There is further room to expand into short term cash management strategies. Liability Driven Investment (LDI), with its specific key rate profiles can easily be solved for and managed in a risk and transaction cost aware manner.
- 3) **Alternative data.** As we mentioned earlier, we believe that the increasing use of alternative data sources in the credit markets will be particularly evident in quant credit strategies. There are numerous areas where alt data is able to provide information about a company's fundamentals that is yet to be evidenced in corporate filings or credit ratings and we believe that the most sophisticated quant credit managers will take advantage of this to steal a march on the broader market. This might include everything from crowd-sourced social media sentiment to the web scraping of data relating to a company's pricing, inventory and sales from public retail sites.
- 4) **Capital structure arbitrage.** We envisage the increasing integration of quant credit and equity strategies, such that firms are viewed on an ecosystem basis with quant funds seeking not only to identify relative value opportunities between different companies but also within a firm's own capital structure. This will require strong data processing skills as well as sophisticated models able to judge the relative attractiveness of a variety of different securities, and particularly the ability to manage risk across asset classes (risk models are often single-asset class only).

Precisely how and when these aspects of quant credit play out is unclear, but one thing seems to us irrefutable: that the momentum behind quantitative approaches to the fixed income markets has increased exponentially in the past few years and that the product now stands on the cusp of enormous growth. Investors who understand the dynamics of quant credit, its risks and rewards and its potential evolution, will have an edge over others and are well-positioned to benefit most as more capital flows into the space.

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