Fact or Fiction

Investigating Factors in Corporate Credit

Quantitative Credit Research
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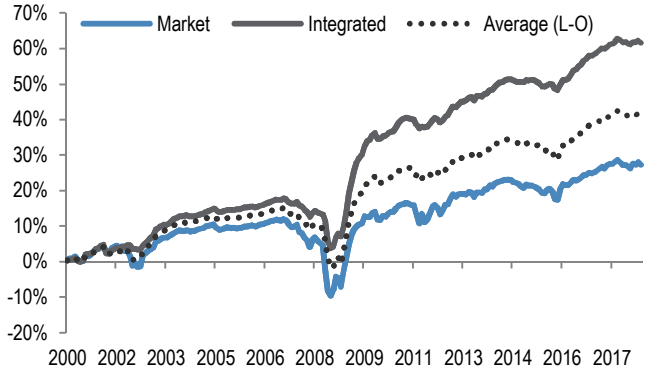
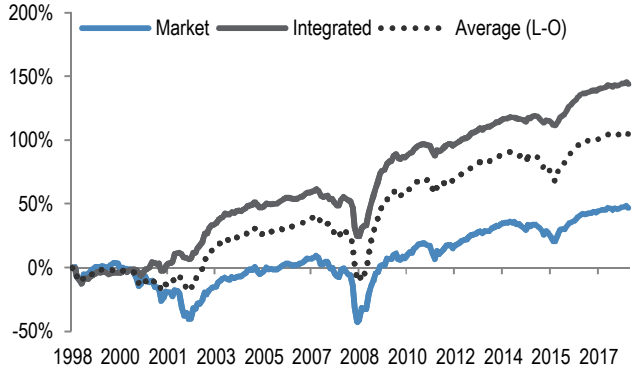
- Factor investing and smart beta have gained increasing attention recently as investors weigh the benefit of passive versus active management. Better data, digitisation of trading, and transparency of pricing and returns have contributed to the significant rise in low-cost passive funds. We see factor investing as the middle ground between passive and active management, allowing macro asset allocators to efficiently access uncorrelated risk premia while at the same time allowing active managers to better understand long-term risks and returns.
- Despite a wealth of literature and academic research into factors in the equity markets over the past 50 years, minimal research has been conducted into factors in the corporate bond market. This has begun to change recently as academics and market participants apply the techniques refined in the equity market to fixed-income investing. Over the past couple of years, funds have been set up to exploit factors in credit market while an increasing number of market participants are employing factor analysis in their portfolio decisions.
- We investigate factor investing in corporate credit markets with a focus on USD Investment Grade and High Yield where data availability is greatest. In particular, we investigate the commonly cited factors of Low Risk, Carry, Value, Momentum and Size. We consider these factors in isolation as well as in an Integrated portfolio that incorporates all these factors together.
- Our results show that investors can earn up to 237bp (543bp) of annual alpha in USD investment grade (high yield), (Figure 1 and Figure 2). Under conservative cost and turnover assumptions, the alpha is lower but remains a positive 91bp (257bp). The returns show low correlation with Government Bonds and Equities and are therefore additive to a traditional multi-asset or multi-factor portfolio.

Figure 1: Credit Returns – High Grade
Gross Returns, Monthly Rebalance



Source: J.P. Morgan. Market is USD IG Sen Bonds, Average (L-O) is average of Long Only Factor top decile portfolios, Integrated is integrated top decile portfolio.

Figure 2: Credit Returns – High Yield
Gross Returns, Monthly Rebalance



Source: J.P. Morgan. Market is USD HY Sen Non Fin Bonds, Average (L-O) is average of Long Only Factor top decile portfolios, Integrated is integrated top decile portfolio.

See page 50 for analyst certification and important disclosures.

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We would like to thank Shivam Ghosh for his contribution to this report

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An introduction to factor investing

Beta

The idea of "beta" was introduced by William Sharpe in 1964 as part of the Capital Asset Pricing Model (CAPM). The basic idea is that the expected return from an asset class is a function of and compensation for the single risk premium of the asset class. The expected return of any individual security within the asset class is simply a scaling of this risk premium by the beta of the security. A higher expected return is the result of a higher beta relative to the asset class, or market, beta of 1. In this framework, the optimal risk-reward strategy is simply to hold the market portfolio i.e. to capture the single risk premium of the asset class while diversifying the risks. This mindset embodies the case for passive investing.

Empirical studies however have failed to support the hypothesis of a single, proportionally shared, risk premium for individual securities. More convincing evidence has been found in support of the hypothesis that there are multiple risk premia that are not equally shared across securities and which can be traced back to behavioural or structural market features. For example, a liquidity risk premium may not be shared equally across all securities in an asset class but may be more prevalent in certain stocks.

Seminal research in the equity market in the 1990s by Fama and French, among others, suggested that stock returns were better explained by factors unrelated to beta, namely value (companies with higher book-to-market ratio) and size (smaller market capitalisation). That is to say that the return from a portfolio of securities is a function not only of the beta of the firm relative to the single risk premium for the asset class, but also of risk premia that are common in stocks ranked by value and size. The Value and Size factors attempt to capture these other risk premia.

It is important to note that we are not necessarily searching for market inefficiencies but rather additional common risk premia. For example investing in small firms may provide higher long-term returns because they are more cyclical i.e. their value may decrease by more at a time when investors are worried about their own economic prospects. The result is that investor may demand additional return to assume this cyclical risk.

Factor investing involves identifying factors, other than the beta, that determine the return of securities. The Fama-French 3-factor model of 1993 found that for US Equities in addition to the CAPM beta, there were 2 additional sources of risk – 'Size' and 'Value' that could explain the cross-section of equity returns. The Size effect arises from smaller firms outperforming larger ones and the Value premia is related to going long the cheapest firms and short the expensive ones. Additionally, Jegadeesh & Titman (1993) found 'Momentum' – buying past winners and selling past losers – to have significant ex-ante returns. All these factors, that have equities as building blocks, have had strong empirical performance across several decades, have risks that are mutually uncorrelated (or better still, negatively correlated), and have been shown to deliver consistent risk-adjusted returns.

Credit and Default

The study of factors in the corporate bond market is not new. Along with identifying factors in equities, Fama and French's work in the 1990s also identified risk premia

in the government and corporate bond market, namely term and default factors. The term factor describes the effect of maturity in determining a bonds return, while the default factor describes the excess return an investor earns for buying a risky bond. Longer-dated bonds and lower-rated bonds earn returns in excess of their market beta.

The growth in the corporate bond market and improved data availability over the past few years means that we are now able to assess whether corporate bond returns can be decomposed into additional risk factors. Similar to equities, factors in the credit market are risk premia which have historically shown excess return versus the credit market return. The aim is to show that once we remove the credit market return (and rates return) from a bond, we can define additional factors which explain the excess return.

To begin our hunt for factors in the credit universe, we will take hints from the equity markets, but adapt factor definitions to make them more applicable to credit markets. For example, Value in the equity markets is typically determined by the Price to Book ratio i.e. how cheap/rich is the equity relative to assets less liabilities. In the credit markets this measure is unlikely to indicate value as it does not consider the rich/cheapness of the yield of the corporate debt.

Instead, a metric that compares a bond's cheapness/dearness relative to the issuing firm's default risk will likely turn out to be a better measure of Value in credit. Our definition for credit factors will therefore need to encompass bond market metrics, and also firm-specific balance sheet and income statement variables, while adjusting for all credit market 'betas' – dispersions across ratings, maturities, seniority and capital structure.

Risk Premia versus Inefficiencies

Although important, it is not necessary to identify the exact origin of the factor premia – i.e. the source of the risk or market anomaly that a credit factor investor is being compensated for. Some credit factors like Size may have a direct correlation to illiquidity premia; other factors like Value and Momentum might have their origins in specifics of the market micro-structure and flow of information in the credit markets. Since we are unable to trace the origin of all credit factor premia, we will rely heavily on empirical evidence for the existence and continued persistence of credit factor performance.

This framework also gives rise to the search for alternative risk premia or excess return strategies. While early work into factor investing focused on explaining excess returns based on risk factors, the investment community is more focused on earning excess returns. To some degree recent work has shifted some of the focus from finding risk premia to finding long-term excess return strategies that are uncorrelated with other market returns.

Previous Research

In the credit markets we have found that a variety of instruments are able to offer investors long-term sources of excess returns. In the corporate bond space, we published *What Your Great-Grandfather Should Have Bought* in 2010 which looked at a century of asset returns across major asset classes and concluded that credit showed impressive long term risk-adjusted performance. Prior to this, we also published *Carry-to-Risk in Credit*, Nov 2006, and *Carry-to-Risk for Credit Indices*,

Sep 2007, which looked at systematically investing in credit through CDS single names and indices on a risk-adjusted basis.

Alternative Credit Risk premia are also available through other products in the credit market and our work on benchmark and alpha strategies in the credit derivatives market is an example of this (*iTraxx Alpha Strategies*, Oct 2012 and *When VICI met CARI,* Apr 2013). Additionally *CD Player: Alternative Credit Risk Premia*, May 2017, looked at how alternative credit risk premia, available thorough J.P. Morgan's Investible Indices (JCRE), individually and collectively were both diversifying and return additive.

From Factor Investing to Smart Beta

The distinction between factor investing and smart beta is not always clear cut. While factor investing involves the search for long-term risk premia, we see smart beta as a means of constructing portfolios of securities that do not take exposure to the full market but rather optimise exposure to one or more of risk premia. A simple example from the equities space illustrates this: if we invest an equal notional in all securities rather than a market value amount, we are giving more weight to smaller companies and therefore taking advantage of the size factor. This should enable us to earn higher long-term returns.

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Defining Factors in Credit Markets

Building on academic work in both the credit and equity markets, we define the following five factors – **Low Risk**, **Carry**, **Value**, **Momentum** and **Size** – and show that combining of these factors allows investors to earn persistent superior long-term excess returns. This note extends the existing literature we are aware of in two ways: first, we incorporated a wide breadth of balance sheet and income statement variables without reducing the cross-section of bonds in the universe, and second, we present results using integrated rather than simple averaged portfolios.

We have chosen to start with a broad number of factors to investigate but acknowledge that the correlation between some of the factors means that they may be capturing the same risk premia. In particular, we find that Carry adds little to portfolio returns unless it is overlaid with Value type features. Our experience in credit markets informs us that risk premia in credit are different to those in equities and that the factors should incorporate both market and balance sheet variables. We find that the combinations of these lead to stronger and more robust factor definitions, which translates to stronger empirical factor performance.

Our desire to incorporate a combination of fundamental[1], bond-specific and market information means that we need a solution to dealing with companies that do not report all their fundamental data or have no listed equity. Our solution is to fill in the blank metrics based on the available bond-specific and cross-sectional data[2]. This ensures that we use the widest available bond universe[3].

Our study covers bonds in both the USD Investment Grade (iBoxx) and High Yield (ICE/BAML) universes using data from Jan 2000 to Oct 2018 and Jan 1998 to Oct 2018, respectively. We have excluded Subordinated debt in this study and Financial debt in High Yield. These universes have grown from $375bn (463 bonds) and $107bn (506 bonds) to $4,159bn (3,961 bonds) and $822bn (1,355 bonds) for IG and HY, respectively. Key statistics of the universe can be found in Table 1.

Table 1: Key Universe Statistics

	Investment Grade		High Yield	
Index Provider	iBoxx		ICE/BAML	
Date	30/06/2000	31/10/2018	30/06/1998	31/10/2018
Notional ($million)	374,527	4,158,639	106,738	821,550
Market Size ($million)	363,343	4,113,760	105,516	798,879
Number of Bonds	463	3961	506	1,355
Average Spread	52	109	292	366
Average Yield	7.84	4.28	8.91	6.82
Average Duration	5.10	6.77	4.82	4.24
Total Raturn (p.a)		5.63%		6.00%
Excess Return (p.a)		1.48%		2.30%
% Financials	45%	34%		0%
AAA	3%	2%		
AA	14%	10%		
A	58%	42%		
BBB	26%	46%		
BB			51%	49%
B			41%	41%
CCC			9%	11%

Source: J.P. Morgan.

[1] Sourced from S&P Capital IG
[2] In practice, the ranked z-score for the metric is the average of the reported metrics and zero.
[3] In Investment Grade this allows us to increase coverage from 78% to 94% and more importantly it allows us to increase High Yield coverage 44% to 73%.

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For each factor investigated, we rank the bonds in the universe according to the factor identified; we treat investment grade and high yield separately as is common market practice. Based on this ranking we create portfolios of bonds, deciles in IG and quintiles in HY, consisting of the bonds that score highest to lowest according to the factor. The performance metrics we report are based on these portfolios with a focus on the top and bottom deciles/quintiles.

We start with a brief description of the factors with a fuller description of the calculations and alternative measures in *Factor Calculations and Portfolios*.

Low Risk

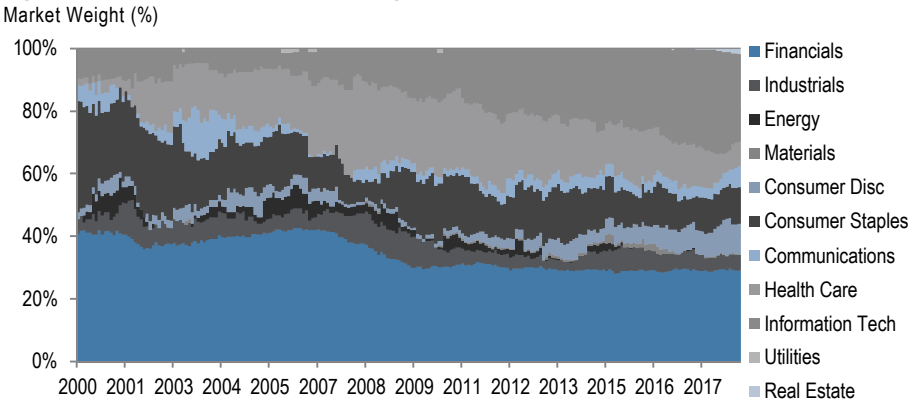
The first factor we consider is **Low Risk** – investing in profitable, relatively safe, low-risk firms. As creditors of a company, our focus is on investing in companies that are likely to pay back their debt. While easy to define, this factor is difficult to calculate in practice. Fundamental analysis is dedicated to trying to determine the companies that are most likely to pay back their debt and there are multiple nuances across sectors and markets.

For corporate bond investors, there are two broad ways to measure low risk – fundamental or instrument based. The former uses balance sheet variables to select high-quality companies, akin to the scores provided by Rating Agencies, while the latter selects bonds that are defensive based on their remaining maturity. Our definition of Low Risk encompasses both of these measures and recognises that we cannot use the same fundamental metrics for both Financials and Non-Financials.

The first measure, Profitable/Safe, ranks bonds based on the issuer balance sheet metrics (leverage, free cash flow etc.) with the universe partitioned between Financials and Non-Financials. The second measure, Short Maturity, ranks bonds according to the shortest time to maturity for bonds rated A- and higher and B- and higher for IG and HY respectively. The final rank is an average of the Profitable/Safe and Short Maturity ranks.

The current Low Risk IG top decile portfolio is skewed towards Information Technology (IT) (Figure 3). These firms exhibit high RoE and low leverage. As IT has grown in the Low Risk factor, Healthcare and Consumer Staples have declined as these companies have taken on increasing amounts of leverage. Utilities, Energy and Materials are largely absent given their lower ratings. Financials are currently 31% of the portfolio by construction given the sectors weight in the overall universe.

Figure 3: Low Risk Top Decile Sector Weights



Source: J.P. Morgan.

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Carry

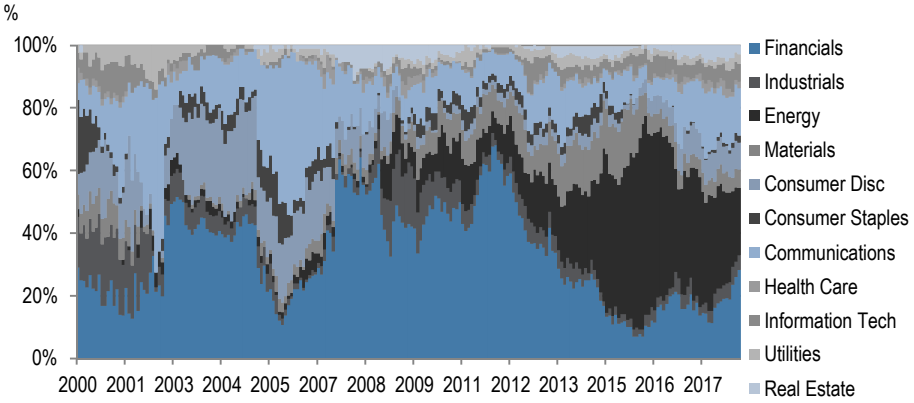
By construction, the Low Risk measure ignores the market pricing of debt. Market pricing is introduced through **Carry** – buying bonds with the highest spread level. Carry could be considered the opposite end of the spectrum to Low Risk and simply picks the highest spread corporates. This factor follows the belief that credit spreads overcompensate for default risk, so high spread names offer the most over compensation.

A simple approach to carry would pick the highest spread names in the universe, which in the typical upward-sloping spread environment would skew towards longer-dated bonds. To correct for this, we decompose the universe into deciles (quintiles) in IG (HY) and rank the bonds within these deciles (quintiles). We do not distinguish between Financials and Non-Financials.

We have included Carry in our factor descriptions but find little evidence that it works well on its own (risk-adjusted returns are poor) or adds to a diversified portfolio (correlation is high with other factors). Nevertheless, we have included it to inform the discussion.

Financials persistently feature in this factor albeit to a lesser degree than following the financial crisis and European sovereign crisis. Heavy issuance by Communications in the early part of the century saw high spreads in this space; these companies once again screen highly on the Carry measure. The sell-off in Energy in 2015 caused bonds in this sector to top the list of carry issuers for some time.

Figure 4: Carry top decile Sector weights



Source: J.P. Morgan.

Value

Value brings together **Low Risk** and **Carry**. It expresses the view that one cannot simply look at either relatively safe or high spread issuers but needs to combine these into high compensation for the risks taken. We determine value in two ways; the first looks at spreads relative to maturity and rating (Equation 1), while the second looks at spreads relative to a proxy for default probabilities (Equation 2). In both cases, we look at cross-sectional relative value –i.e. which bonds offer the highest spread relative to the expected model implied spread. We incorporate both measures into our factor as the former uses fundamental company data while the latter incorporates market data based on realised equity price volatility.

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Our first method essentially implies that credit ratings encompass the known fundamental data for a company. Given that changes in spreads may preempt changes in rating, following *Houweling and Zundert*[4], we introduce a correction term that incorporates whether spreads have moved wider over the past three months (Equation 1). The second method follows *Bharath and Shumway*[5] and uses a Merton model style proxy for distance-to-default based on equity pricing. In both cases, we look for bonds that overcompensate in carry for risk taken.

The introduction of the correction for spread data pre-empting ratings data results in portfolios that skews towards higher-rated bonds in a sell-off and lower-rated bonds in a rally. This is because the change in spread is taken as an absolute change in spread and therefore drives pricing in higher beta names. To mitigate this, we divide the universe into five duration × spread buckets and rank the bonds within these buckets.

Equation 1: First Determination of Value

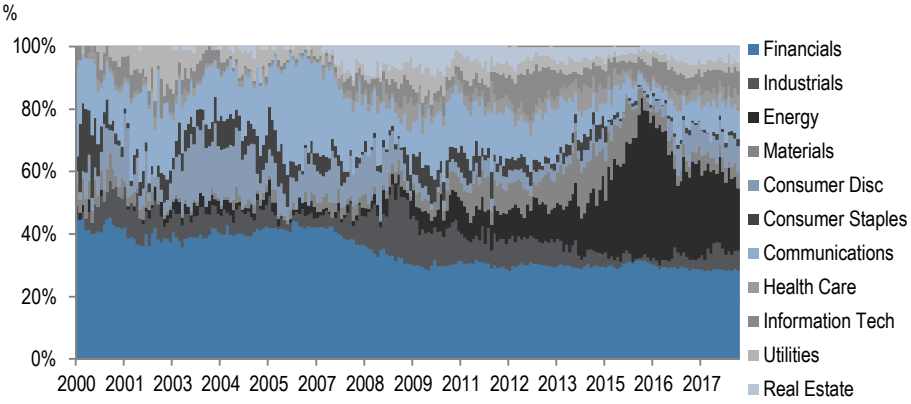
$$OAS_i(bps) = c + \beta_{mat} m_i(years) + \beta_{rating} r_i + \beta_s \Delta OAS_i + \varepsilon_i$$

Equation 2 Second Determination of Value

$$logOAS_i = c_i + \beta_{DD} \log(naive\ DD) + \beta_m \log(years\ to\ maturity) + \varepsilon_i$$

Sector-wise, the sector distribution of bonds in the top decile is similar to that of the Carry metric except that we have fixed the proportion of Financials in the index. The current portfolio has a greater weighting to Industrials and Real Estate and lower exposure to Communications than does the Carry portfolio.

Figure 5: Value top decile Sector weights



Source: J.P. Morgan.

Momentum

Momentum describes the markets' tendency to trend in a given direction. This can be attributed to either investor psychology, as market participants extrapolate trends, or the tendency of sectors to experience periods of growth and contraction. The long-term alpha from momentum may be due to the propensity for abrupt and large mean reversion trends when momentum stocks turn.

[4] *Factor Investing in the Corporate Bond Market.* Patrick Houweling and Jeroen van Zundert. Financial Analysts Journal, 2017, Vol. 73, No. 2.
[5] Forecasting Default with the KMV-Merton Model, Sreedhar Bharath and Tyler Shumway. Review of Financial Studies 21(3), 1339–1369.

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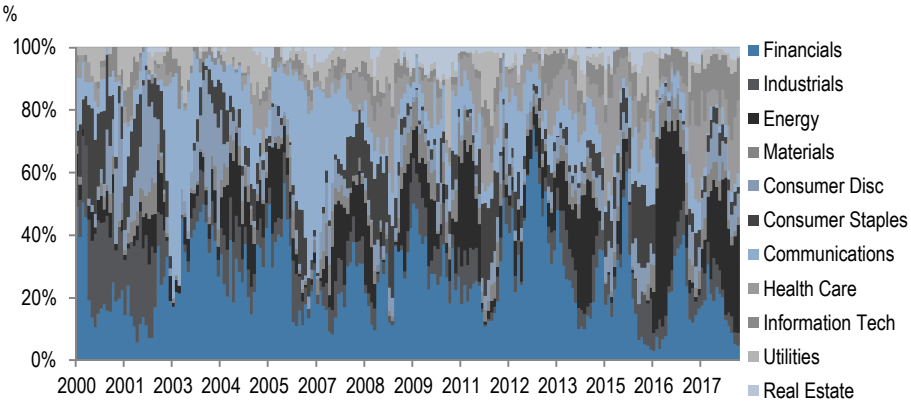
Our Momentum measure for ranking bonds is a composite of credit and equity return momentum over the past 6m. Both credit and equity returns are calculated using a 1m implementation lag to allow for mean reversion effects[6]. We incorporate equity momentum into our Momentum factor as we see this as a proxy for balance sheet momentum.

More so than other factors, momentum stocks tend to change frequently. Financials tend to exhibit strong momentum and frequently move into the top decile portfolio (Figure 6). This then gives way to other sectors, Energy or Consumer Staples.

Figure 6: Momentum top decile sector weights



Source: J.P. Morgan.

Size

Our final factor, Size, describes the propensity for smaller companies to outperform larger companies. The size factor has typically been viewed as compensation for illiquidity as smaller companies are less transparent or more likely to default given they have fewer financing options.

We measure size using both market and fundamental variables and define it as a composite score of Total Enterprise Value, Total Assets and the market value weight of the company's bonds in the bond universe. For Financials, we do not assess Total Enterprise Value.

The sector variability is relative small compared to some of our other metrics as the size factor changes infrequently. Size appears to have greater allocation to Materials, Consumer Disc and Real Estate and less towards Health Care, Communications and Consumer Staples.

[6] *Momentum in Corporate Bond Returns.* Jostova, G., Nikolova, S., Philipov, A., and Stahel, C. W. 2013Reviewof Financial Studies 26(7), 1649–1693.

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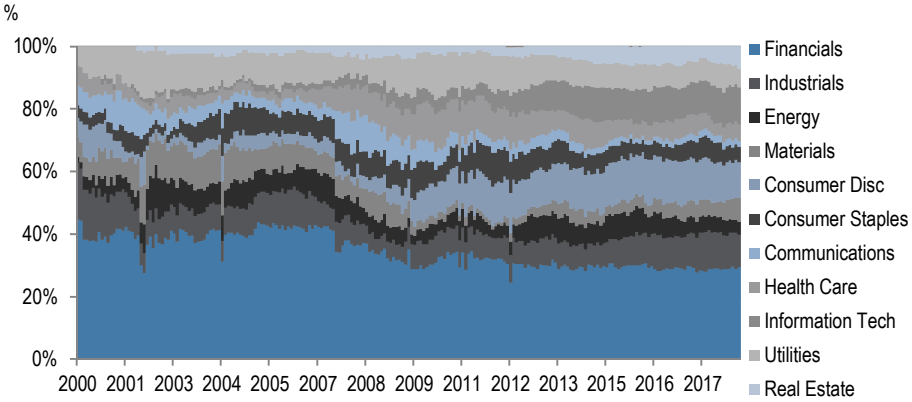
Figure 7: Size top decile sector weights



Source: J.P. Morgan.

A summary of the current top decile portfolio can be found in Table 2.

Table 2: Market Value by Sector of Top Decile – Investment Grade

October 2018

	Market	Low Risk	Carry	Value	Momentum	Size
Financials	34%	29%	28%	28%	5%	29%
Industrials	7%	5%	5%	6%	4%	11%
Energy	9%	0%	21%	20%	35%	4%
Materials	2%	0%	6%	5%	3%	8%
Consumer Disc	5%	10%	8%	8%	7%	11%
Consumer Staples	7%	12%	2%	2%	2%	5%
Communications	8%	7%	15%	9%	5%	2%
Health Care	11%	8%	2%	5%	23%	5%
Information Tech	9%	28%	6%	7%	14%	12%
Utilities	4%	0%	3%	3%	1%	6%
Real Estate	2%	2%	3%	5%	3%	7%

Source: J.P. Morgan.

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Factor Performance

Setting up the factor tests

Having defined the factors that we will investigate, we now turn our attention to testing whether these factors allow investors to earn excess returns. The basic setup is to rank each bond in the universe according to the factor being investigated on a monthly basis. We then calculate the excess credit return for each bond, defined as the total return less the duration-weighted rates return, over a defined period. Finally, we track the running return from the bonds chosen in the top and bottom deciles (quintiles in HY) for each factor.

We assess returns based on their information ratios – risk-adjusted returns – as well their CAPM alphas – return in excess of the market return. We leave the exploration of returns in excess of traditional factors for the appendix

Excess Credit Return = Total Return minus Return on Duration-matched Treasury

This section presents the results for the USD Investment Grade market; *Results for USD High Yield* shows further results.

Results

Long-Only Returns and Information Ratios

Performance for one-month holding periods, gross of transaction fees, for the period June 2000-October 2018 are shown in Figure 8 and Table 3. Before delving into the individual factors, we consider the excess credit return of the market factor – USD Investment Grade Senior bonds. The average monthly returns on an annual basis for the market factor is 1.48% – on average, over the past 18 years, an investor has been able to earn 1.48% of annual excess return by investing in the USD IG Senior market. The volatility of this return is 4.25%, giving an information ratio (IR) of 0.35. For context, the information ratio of investing in US Treasuries or US Equities was 0.56 and 0.33 over the same period, respectively.

Turning to the factor portfolios (top decile), we find that they each have a higher IR than the market portfolio IR of 0.35. Low Risk and Momentum have the highest IR at 0.71 and 0.69, respectively, followed by Value (0.61). Size has an IR of 0.49 while Carry is not far off the Market IR at 0.40. An 'equally weighted' portfolio of Value, Momentum, Low Risk and Size (Carry is omitted due to its strong correlation with Value) and has a return of 2.23% an IR of 0.66.

Table 3: Long-only Portfolios Performance gross of transaction costs

US Investment Grade Long-Only equally weighted (Jun 2000 - Oct 2018)

	Long top decile portfolios						
	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd
Returns	1.48%	3.26%	0.99%	2.86%	4.26%	1.82%	2.23%
Volatility	4.25%	5.30%	1.39%	4.16%	10.63%	3.71%	3.39%
IR	0.35	0.62	0.71	0.69	0.40	0.49	0.66
	CAPM Alpha statistics						
CAPM Adj Rsq	na	87%	78%	68%	83%	70%	88%
CAPM beta	1.00	1.16	0.29	0.81	2.29	0.74	0.75
Ann. CAPM alpha	na	1.54%	0.56%	1.66%	0.86%	0.73%	1.12%
CAPM alpha t-stat		3.05	3.42	2.79	0.72	1.28	3.70

Source: J.P. Morgan

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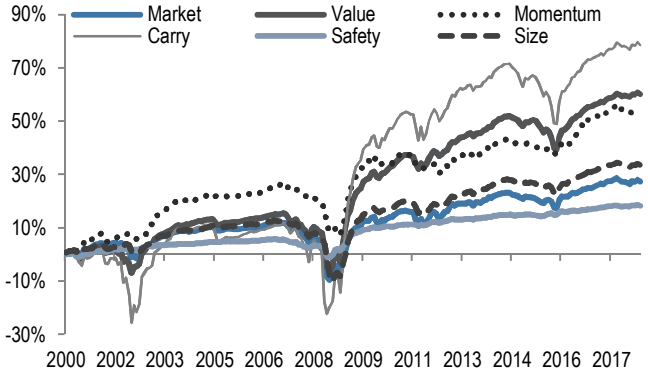
The 2007-2009 period stands out as a period of extreme volatility – large losses followed by large gains for the market and factor portfolios (Figure 8). While this period has a significant influence on our results, we don't believe that it is overly significant. To see this we analyse rolling 12m returns. We set a target volatility (5%) based on the rolling 12-month realised volatility and look at the excess return of the average factor portfolios relative to the market. Over almost 20 years, the average 12-month volatility-adjusted-return of the factor portfolios has exceeded the market 96% of the time (Figure 9). Note that in this setup, we are assuming that there is no cost to leverage; in particular, lower volatility strategies such as Low Risk outperforms as we lever up the low returns.

We can also see this in Table 4 and Table 5, which show the factor performance over a variety of periods. Even during the 2007-2009 period, all of the factor portfolios outperformed the market in both return and IR.

Figure 8: Long-only Factor portfolio returns

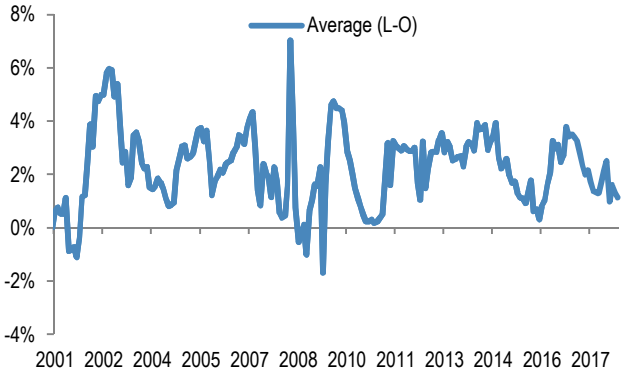
Cumulative Returns Non-Compounded



Source: J.P. Morgan.

Figure 9: Long-only Factor Portfolio Outperformance

Returns assuming 5% Target Volatility Non-Compounded



Source: J.P. Morgan.

Table 4: Long-only Portfolios Performance gross of transaction costs – Information Ratios

US Investment Grade Long-Only equally weighted (Jun 2000 - Oct 2018)

	Market	Value	Low Risk	Momentum	Carry	Size	Eq wtd	Integrated
3yrs	1.00	1.11	1.59	1.44	0.88	1.23	1.37	2.08
5yrs	0.68	0.75	1.31	1.06	0.47	0.94	1.00	1.63
7yrs	0.80	1.05	1.40	0.95	0.73	1.17	1.16	1.77
2001-2007	0.68	0.72	1.63	1.39	0.23	0.97	1.17	1.51
2007-2009	-0.02	0.35	0.36	0.32	0.45	0.05	0.27	0.67
2009-2018	0.92	1.24	1.52	1.01	0.99	1.14	1.25	1.72
10yrs	0.66	1.07	1.08	0.74	0.94	0.65	0.91	1.27
15yrs	0.32	0.64	0.69	0.56	0.48	0.45	0.61	0.98

Source: J.P. Morgan

Table 5: Long-only Portfolios Performance gross of transaction costs – Annual Returns

US Investment Grade Long-Only equally weighted (Jun 2000 - Oct 2018)

	Market	Value	Low Risk	Momentum	Carry	Size	Eq wtd	Integrated
3yrs	2.94%	5.03%	1.37%	5.00%	6.79%	3.02%	3.61%	4.32%
5yrs	1.74%	3.05%	1.01%	3.30%	3.29%	2.06%	2.36%	3.15%
7yrs	2.48%	4.10%	1.13%	3.05%	5.28%	2.64%	2.73%	3.52%
2001-2007	1.85%	2.64%	1.06%	3.76%	2.16%	1.94%	2.35%	2.75%
2007-2009	-0.12%	3.47%	1.07%	2.31%	8.59%	0.36%	1.80%	4.53%
2009-2018	3.83%	6.79%	2.01%	4.62%	10.10%	4.23%	4.41%	5.94%
10yrs	3.04%	6.09%	1.70%	3.72%	9.72%	3.00%	3.62%	5.10%
15yrs	1.39%	3.47%	1.00%	2.43%	4.95%	1.77%	2.17%	3.44%

Source: J.P. Morgan

CAPM Betas and Alphas

The long-only factor portfolios appears to offer better risk-adjusted returns relative to the market given their higher returns and lower volatility. To explore the significance of the factors, we run a CAPM regression i.e. regress the returns of the factor portfolio versus the market portfolio.

Unsurprisingly, the returns of the long-only factor portfolios are highly correlated with the market, indicated by their high CAPM Adjusted R-squared (Table 3).

To get a sense of how volatile the factors are to the market portfolio, we calculate the CAPM betas – the sensitivity (slope of the regression) of the factor to the market[7]. In the long-only framework, these betas are likely to be positive as we are always long risk. Indeed, factors like Value and Carry are more volatile than the market and have CAPM betas above 1.0, whereas our Low Risk factor has a lower beta of 0.29 to the market. Momentum also has a CAPM beta below 1 given that in a risk-off environment, the factor will tend to pick less volatile bonds.

Size presents something of an interesting case in credit markets. In equities, smaller companies would typically be associated with higher risk and volatility. In credit, we find that the Size factor (in both IG and HY) has lower volatility than the market and also has a CAPM beta less than 1. This result may point to Size being a proxy for illiquidity with the consequence that pricing data is updated less frequently.

The equally weighted portfolio (Low-Risk, Value, Momentum, Size) also has safety/defensive/low volatility characteristics with a beta less than one.

The intercept of the regression of the factor versus the market is the CAPM alpha. The CAPM alpha explains the additional return of the factor above the market returns[8]. The additional return of the factor derives from both the CAPM beta as well as the CAPM alpha. For example, the equally weighted portfolio outperforms the market portfolio by 75bp (2.23% - 1.48%). The equally weighted portfolio, however, has a CAPM beta below 1 so the added value of the strategy after adjusting for its beta is 112bp – the CAPM alpha.

We find positive CAPM alphas for all factors which are statistically significant although Carry and Size come out at the lower end of the range (Table 3).

Long-Short Performance

As we have seen, Long-Only portfolios generally exhibit a high beta and positive correlation to the market. Long-Short portfolios are purer representations of the factors since they are more effective at eliminating the polluting effects of market beta (credit spread and credit duration). If the market factor is shared across all bonds then going long the top decile and short the bottom decile of a factor ranking should isolate the return of that specific factor.

The first thing to note is that the long-short portfolios all have positive returns and information ratios, other than the Low Risk factor. This is encouraging as it means that the isolated factors appear to offer positive excess return. Furthermore, we find that the correlation of the long-short portfolios to the market is low for Value,

[7] If correlations are high, these betas are close to volatility ratios.
[8] If correlations are high, these alphas are close to volatility-adjusted excess returns.

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Momentum and Size as indicated by the CAPM Rsq, showing that they add a source of risk premia that can be positive independent of the broader market direction.

The negative return from Low Risk is likely due to the systematic negative carry of a position that is long risk low spread names and short risk high spread names. This also likely leads to the higher CAPM Rsq for Low Risk. The negative beta of Low-Risk, however, indicates that it will likely perform well in a risk-off environment.

Importantly, the CAPM alphas for the long-short portfolios are positive with the equally weighted portfolio showing an alpha of 241bp and a significant t-stat. Our simple approach to identifying factors appears to offer investors the opportunity for substantial uncorrelated excess returns.

Table 6: Long-Short Portfolios Performance gross of transaction costs

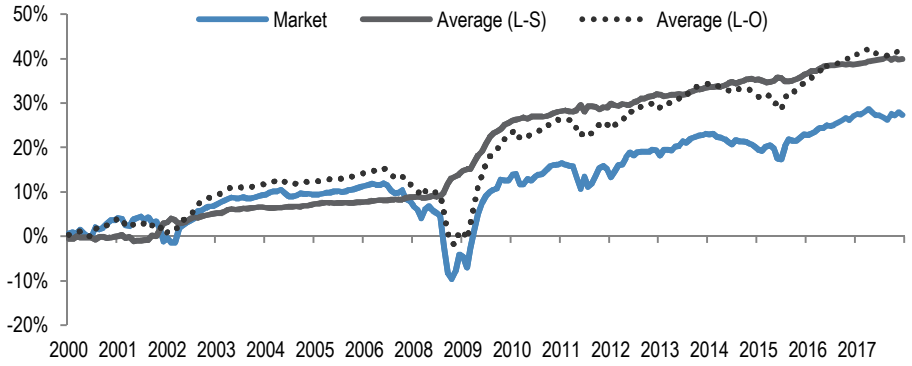
US Investment Grade Long-Short equally weighted (Jun 2000 - Oct 2018)

	Long-Short decile portfolios						
	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd
Returns		3.90%	-1.24%	3.11%	4.81%	0.26%	1.50%
Volatility		3.34%	6.01%	8.42%	9.54%	3.17%	3.14%
IR		1.17	-0.21	0.37	0.50	0.08	0.48
				CAPM Alpha statistics			
CAPM Adj Rsq		25%	80%	42%	70%	11%	67%
CAPM beta		0.40	-1.27	-1.29	1.89	-0.26	-0.61
Ann. CAPM alpha		3.31%	0.64%	5.03%	2.01%	0.64%	2.41%
CAPM alpha t-stat		3.88	0.81	3.05	1.33	0.81	5.22

Source: J.P. Morgan.

Figure 10: Performance of Long-Short vs Long-Only Portfolio

US Investment Grade Long-Short equally weighted (Jun 2000 - Oct 2018)



Source: J.P. Morgan.

Turnover and Transaction costs

So far, we have focussed on a theoretical setup where we are able to trade monthly at mid prices. Clearly this would not be possible to implement in practice given market constraints on turnover and cost. To account for less frequent turnover, we increase the holding period for each portfolio but continue with the monthly rebalancing; at any point in time we effectively have N portfolios for each factor based on the rebalancing in each of the prior N months (Figure 11).

We focus on long-only portfolios given the bond shorting constraint and leave the ability to go short through CDS to future study. The results remain significant and robust, and we find that quarterly rebalancing provides a reasonable payoff between alpha and cost with returns and information ratios that do not decline significantly.

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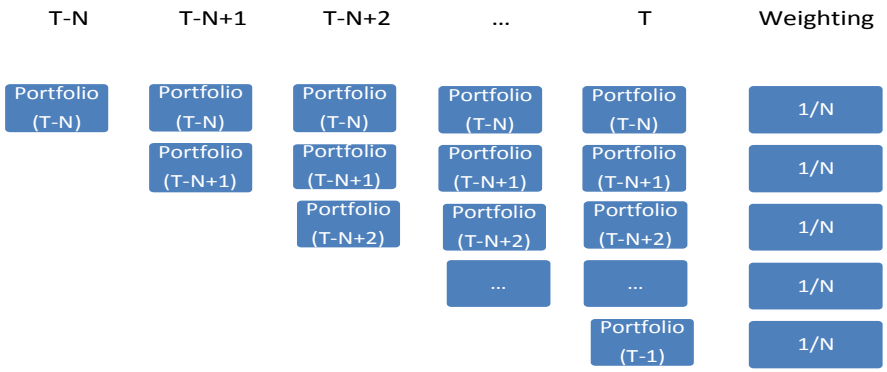
The CAPM alpha, or excess return of the series not explained by the CAPM beta, remains positive with the simple equally weighted portfolio offering 29bp of alpha from 112bp pre-costs (Table 7). We later improve this with the Integrated portfolio.

Figure 11: Portfolio construction
At any point we have N rolling portfolios



Source: J.P. Morgan.

To account for the transaction costs, we consider the annual turnover of the portfolios. The portfolio turnover is the percentage of the portfolio which needs to be changed at each rebalancing. The highest turnover comes from the Momentum factor (256%) followed by Value (196%). The weighted portfolio has a turnover of 143%. For reference, the turnover for the market portfolio is 18% (IG) and 55% (High Yield).

To convert turnover into cost, we consider the breakeven transaction costs – the ratio of factor CAPM alpha to the turnover. This tells us how high the average transaction cost can rise to offset the excess return of the factor. All breakeven transaction costs (other than Carry) are above the average bid-ask spreads of 30-40c for trading Investment Grade bonds.

We can also turn around the argument for calculating breakeven transaction costs to ask the upper bound on annualised turnover that will drive the gross alpha to zero. With a conservative 40c estimate for Investment Grade transaction costs, the breakeven turnover is 215% for the weighted portfolio; again above our empirical annualized turnover of 143%.

Finally, we consider the net alpha of the factor portfolios i.e. the alpha post transaction costs. Here, too, we see that with conservative cost assumptions, the factor portfolios continue to offer attractive returns. The equally weighted long-only multi-factor portfolio with quarterly holding period generates 29bp of annualised alpha that is robust to transaction costs.

Table 7: Performance statistics for Long only factor portfolios with quarterly rebalancing.
Equally weighted portfolios

	Value	Low Risk	Momentum	Carry	Size	Equal wtd
Gross alpha (1m Rebal)	1.54%	0.56%	1.66%	0.86%	0.73%	1.12%
Average Turnover (Ann.)	196%	80%	256%	129%	38%	143%
Breakeven transaction costs	45c	58c	53c	30c	196c	60c
Turnover Upper Bound	223%	115%	338%	98%	188%	215%
Net alpha(Ann.)	0.11%	0.14%	0.33%	-0.13%	0.60%	0.29%

Source: J.P. Morgan.

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Our conclusion is that factor investing offers market participants the opportunity to earn returns higher than the market portfolio after costs. Of our five factors, Carry appears to offer the least excess return and its correlation with Value leads us to drop it from further analysis. We find that the Size factor offers limited outright return, but we keep it as it is diversifying and offers impressive Net Alpha.

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Integrated multi-factor portfolio for USD Investment Grade and High Yield

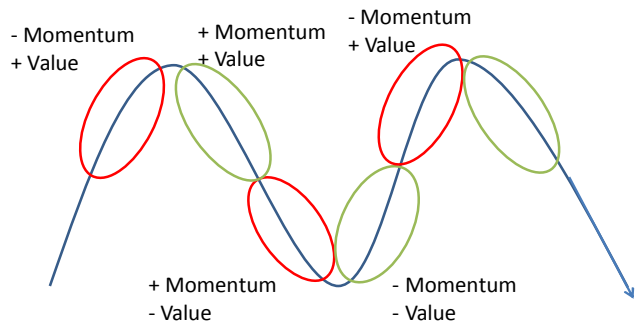
The integrated multi-factor portfolio

Having shown the alpha from the individual factors, we turn to look at combining them in a portfolio context. Our equal-weighted portfolio benefits from the diversification by employing different factors but doesn't add much to any individual factor. It also suffers from potentially buying bonds which rank high on one factor but very low on another. In some cases, a bond may be in the top decile of one factor measure but in the bottom decile of another. Our solution to this is to integrate rather than simply average; in this we follow the methodology of Fitzgibbons et al.[9]

Consider a simple portfolio which uses Value and Momentum factors for selection. Assuming a stylised mean reversion timeseries for spreads (Figure 12), at some point these factors are in agreement (positive correlation) at others they take the opposite position (negative correlation). An equally weighted portfolio between the two could be doubly exposed to some bonds at some times and long bonds that screen poorly by one factor at other times.

To correct for this, we follow the integration methodology. Essentially this involves refraining from picking bonds that score highly by one measure if they are poorly ranked by another. For example, the average portfolio contains names with either a high momentum or a high value exposure and are indicated by the orange and green dots in Figure 13. In an equally weighted portoflio, we end up picking bonds which rank low on a given measure. The integrated portfolio contains names that are not top decile rankers in their momentum or value exposure, but are somewhat attractive on both styles, these are the blue and green dots.

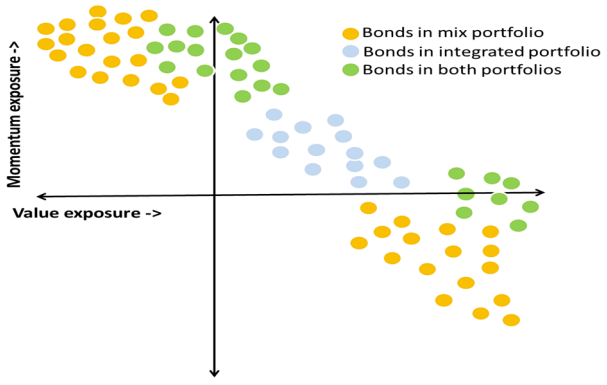
Figure 12: Stylised mean reversion time series



Source: J.P. Morgan.

Figure 13: Schematic showing distribution of bonds in the Integrated and 'mix' (equal weighted combination of standalone factors) portfolios.

Orange dots are bonds only in the mix portfolio. Blue dots are bond only in the Integrated portfolio. Green bonds are present in both portfolios.



Source: J.P. Morgan

[9] *Long-Only Style Investing: Don't Just Mix, Integrate.* S.Fitzgibbons et al. The Journal of Investing Winter 2017, 26 (4) 153-164

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The value of low correlation

One of the benefits of a multi-factor approach is that the the Information Ratios scale with the number of negatively/low correlated factors. The negative/low correlation adds diversification thereby lowering the volatility of the portfolio and improving our risk-adjusted returns.

The average pairwise credit factor correlation is -14%. Similar to equity markets, Momentum and Value exhibit a negative correlation of -65% – a well-known effect in equities where the long-term correlation between the two factors is -60%. The origin of the negative correlation between Value and Momentum within equities has been attributed to their opposite correlations with liquidity risk. Put simply, Momentum is a popular strategy where investors flock to the most crowded trades, the ones that have done well in the recent past, whereas Value is contrarian in nature and is less crowded. During a liquidity shock, investors offload the most popular stocks leading to momentum sell-offs whereas Value is less affected.

The -78% correlation between Low Risk and Carry is also interesting. Carry is buying cheap bonds irrespective of their Quality and Low Risk is investing in relatively safe, high-quality and profitable firms, irrespective of their price. The negative correlation therefore implies a quality premia, i.e. "safer" firms are more expensive than cheaper ones.

The high correlation between Value and Carry (84%) is a direct consequence of using spreads (OAS or Z-spreads) for defining both factors. Due to this high correlation, we leave out Carry from our multi-factor integrated portfolio.

The integrated portfolio shows relatively high correlation with Momentum and low correlation with Value indicating that it is profitable in both rising and falling markets.

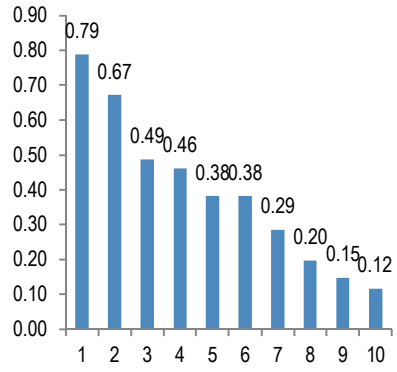
Table 8: Credit factor alpha (Long-Short) correlations computed from monthly time series (IG)

	Value	Momentum	Carry	Low Risk	Size	Integrated
Value	100%	-65%	84%	-45%	-35%	-33%
Momentum	-65%	100%	-82%	58%	47%	83%
Carry	84%	-82%	100%	-78%	-46%	-64%
Low Risk	-45%	58%	-78%	100%	21%	65%
Size	-35%	47%	-46%	21%	100%	59%
Integrated	-33%	83%	-64%	65%	59%	100%

Source: J.P. Morgan.

Figure 14: IG Integrated Portfolio Deciles

Information Ratios



Source: J.P. Morgan.

Results for USD Investment Grade and High Yield

Applying the integrated portfolio methodology to USD investment grade and high yield markets yields encouraging results. The Integrated IG portfolio has an annual excess return of 334bp, while the HY portfolio excess return is 680bp. These compare to 148bp and 237bp, respectively, for the Market portfolios in these assets (Table 9). Furthermore, we find that the Information Ratios of these factors have improved to 1.01 and 0.67, respectively, while the CAPM alphas, ie, the excess return adjusted for volatility, have risen to 237bp and 543bp.

For a quarterly rebalancing portfolio with 40c transaction fees in IG and 100c in high yield, we find net annual alphas of 91bp in IG and 257bp in HY.

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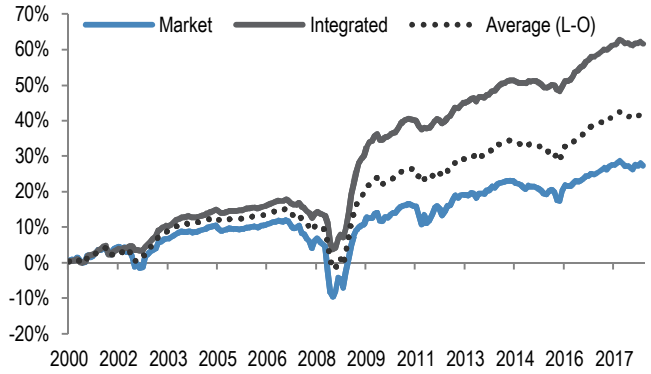
Table 9: Integrated Factor Performance

	Investment Grade			High Yield		
	Market	1M	3M incl. Costs	Market	1M	3M incl. Costs
Returns	1.48%	3.34%	2.58%	2.01%	6.80%	5.36%
Volatility	4.25%	3.30%	3.28%	10.57%	8.19%	8.02%
IR	0.35	1.01	0.79	0.19	0.83	0.67
CAPM beta	1.00	0.66	0.65	1.00	0.69	0.67
Ann. CAPM alpha		2.37%	1.61%		5.43%	4.00%
CAPM alpha t-stat		5.28	3.29		5.45	4.12
Ave Turnover (Ann.)			175%			143%
Breakeven costs			0.92%			2.80%
Net alpha(Ann.)			0.91%			2.57%

Source: J.P. Morgan.

Figure 15: Gross Returns – High Grade

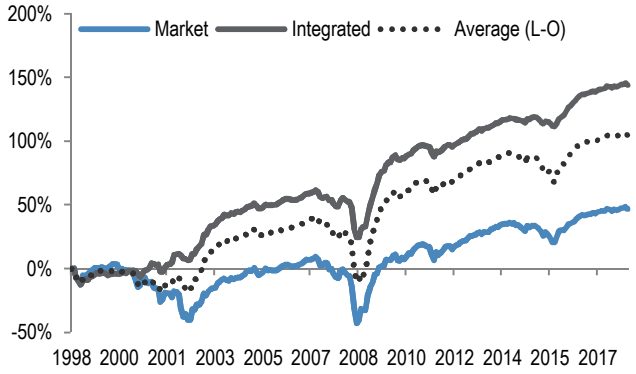
Monthly Rebalance No Cost



Source: J.P. Morgan.

Figure 16: Gross Returns – High Yield

Monthly Rebalance No Cost



Source: J.P. Morgan.

To help decode the strong performance of the Integrated factor, we analyse the sector, rating and maturity trends of the top decile bonds in the portfolio over time. In High Grade (Figure 17), sector weights have varied through time with few sectors seeming to dominate. Financials are fixed at their weight in the market by construction. The current Integrated portfolio appears to skew strongly towards Energy, Consumer Discretionary and Real Estate and is underweight most other sectors (Table 10).

From a rating perspective, the top decile portfolio is primarily invested in BBB and A bonds, with AA and AAA bonds underrepresented. The impact of the Momentum measure can clearly be seen as the portfolio skews towards higher rated bonds during periods of market stress e.g. 2008 and 2016 (Figure 18 and Table 11). From a maturity perspective, the portfolio similarly appears to be overweight the intermediate maturity bonds (3-8yrs) moving into longer-dated bonds as the market rallies and shorter-dated bonds as it sells off (Figure 19 and Table 12).

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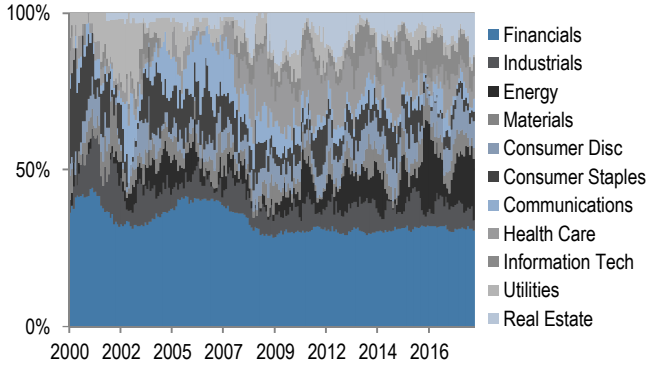
Figure 17: Sector weights for Integrated portfolio – Investment Grade
Monthly Rebalancing



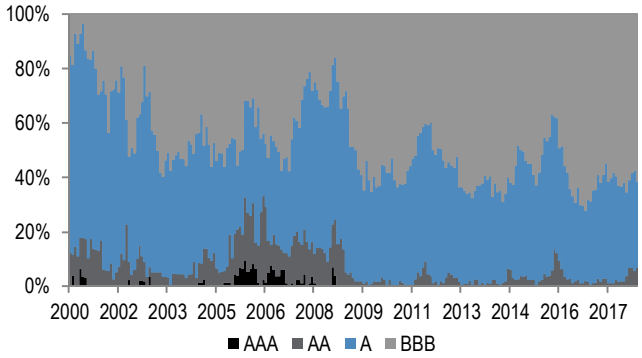
Source: J.P. Morgan.

Table 10: Sector weights for Integrated portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Sector	Market	Integrated	Difference
Financials	34%	29%	-6%
Industrials	7%	4%	-3%
Energy	9%	16%	6%
Materials	2%	3%	0%
Consumer Disc	5%	10%	6%
Consumer Staples	7%	3%	-5%
Communications	8%	5%	-3%
Health Care	11%	7%	-4%
Information Tech	9%	12%	3%
Utilities	4%	1%	-3%
Real Estate	2%	11%	9%

Source: J.P. Morgan.

Figure 18: Rating weights for Integrated portfolio – Investment Grade
Monthly Rebalancing



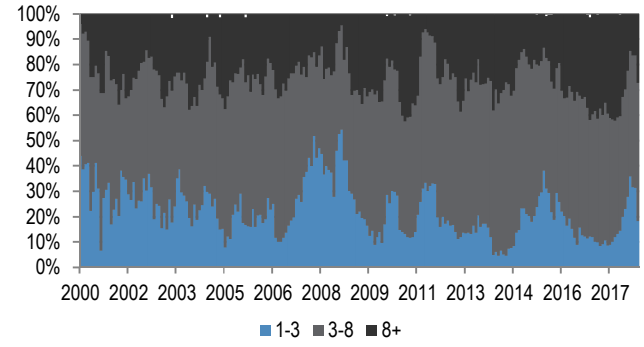
Source: J.P. Morgan.

Table 11: Rating weights for Integrated portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Rating	Market	Integrated	Difference
AAA	2%	0%	-2%
AA	10%	8%	-2%
A	42%	34%	-8%
BBB	46%	58%	12%

Source: J.P. Morgan.

Figure 19: Maturity weights for Integrated portfolio – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan.

Table 12: Maturity weights for Integrated portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Maturity	Market	Integrated	Difference
1-3	22%	17%	-5%
3-8	37%	52%	15%
8+	41%	31%	-10%

Source: J.P. Morgan.

In High Yield, the integrated portfolio has become more diversified with respect to sectors through time. A heavy weighting to Consumer Discretionary in the early part of the century has given way to Energy, Materials and Info Tech. The weighting of Communications has remained limited though time, and while it has picked up recently, the portfolio remains underweight (Figure 20 and Table 13).

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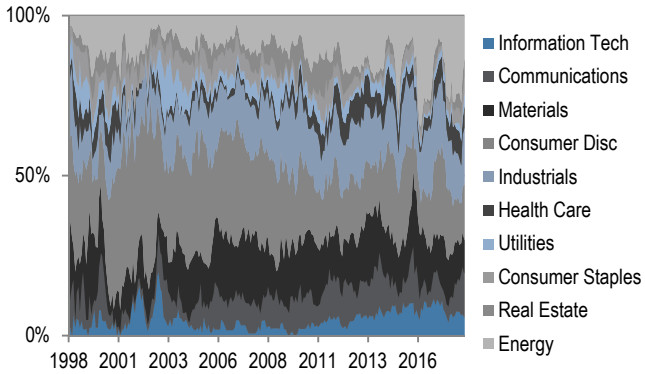
From a rating perspective, the portfolio has tended to pick lower-rated bonds with an overweight to CCC and B- (Table 14). Maturity-wise, the Integrated portfolio opts to be shorter dated and has limited exposure to 8+ tenors (Figure 22 and Table 15).

Figure 20: Sector weights for Integrated portfolio – High Yield
Monthly Rebalancing



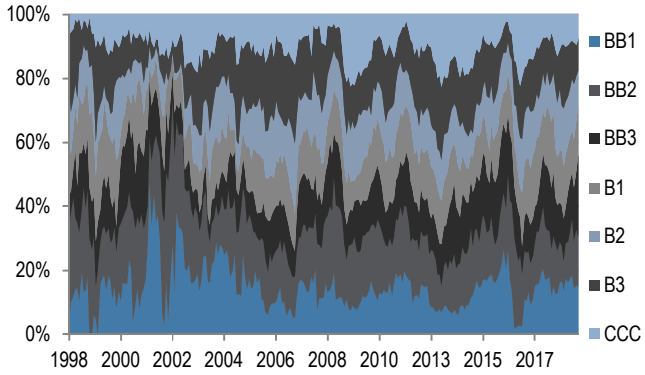
Source: J.P. Morgan.

Table 13: Sector weights for Integrated portfolio – High Yield
Monthly Rebalancing (October 2018)

Sector	Market	Size	Difference
Information Tech	7%	6%	0%
Communications	19%	13%	-6%
Materials	11%	9%	-2%
Consumer Disc	14%	12%	-1%
Industrials	12%	12%	0%
Health Care	10%	8%	-2%
Utilities	3%	3%	0%
Consumer Staples	4%	5%	1%
Real Estate	3%	4%	1%
Energy	18%	27%	9%

Source: J.P. Morgan.

Figure 21: Rating weights for Integrated portfolio – High Yield
Monthly Rebalancing



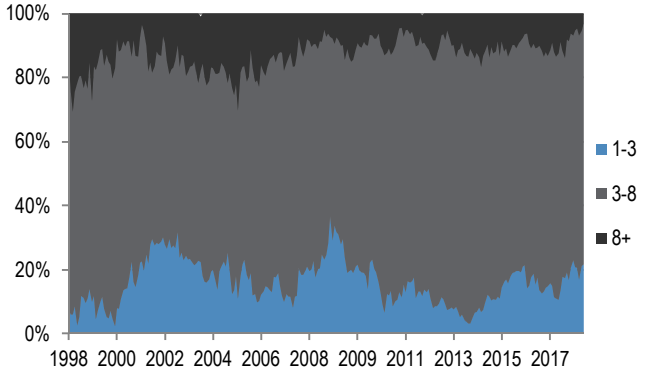
Source: J.P. Morgan.

Table 14: Rating weights for Integrated portfolio – High Yield
Monthly Rebalancing (October 2018)

Sector	Market	Low Risk	Difference
BB1	16%	14%	-1%
BB2	17%	15%	-2%
BB3	16%	16%	0%
B1	15%	15%	0%
B2	12%	18%	5%
B3	14%	13%	-1%
CCC	11%	9%	-2%

Source: J.P. Morgan.

Figure 22: Maturity weights for Integrated portfolio – High Yield
Monthly Rebalancing



Source: J.P. Morgan.

Table 15: Maturity weights for Integrated portfolio – High Yield
Monthly Rebalancing (October 2018)

Maturity	Market	Integrated	Difference
1-3	11%	17%	6%
3-8	75%	76%	1%
8+	14%	7%	-7%

Source: J.P. Morgan.

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Multi-asset portfolios

To gauge whether credit factors have an additive effect, i.e. increase risk-adjusted returns in multi-asset portfolios, we overlay factors/styles on traditional equity and credit markets to see the impact on performance.

Our starting point is a four asset class traditional portfolio of Government bonds, Investment Grade and High Yield bonds and US large-cap equities. To keep things simple, we consider an equal-weighted combination of the different asset classes in the 'Traditional' portfolio, which will also serve as our benchmark for assessing performance of factors. Table 16 shows multi-asset class portfolio performances with and without style premia in credit and equities. The traditional portfolio generates a Sharpe of 0.76 over the period from June 2000 to October 2018, compared to 0.33 for equities, and 0.56 and 0.80 for IG and HY credit, respectively. We now add equity and credit style factors to this Traditional portfolio in 3 steps.

In Step 1, labeled the 'Credit Factor' portfolio in Table 5, we replace the Investment Grade and High Yield Traditional bond portfolios with the Integrated multi-factor portfolios constructed within the IG and HY universes, keeping allocations to Government bonds and US large cap constant at 25% each. In Step 2, labeled the 'Equity Factor' portfolio, we do the same with equities – replacing traditional large-cap equities with the equity multi-factor portfolio (equal weighted combination of equity Value, Size, Momentum and Low Risk factors), keeping allocations to Government bonds and traditional IG and HY bonds constant. In our final Step 3, the 'Equity-Credit Multi-factor' portfolio, we replace allocations to traditional equities and credit with their multi-factor counterparts, keeping allocations to Government bonds constant. For all portfolios, we estimate alphas by regressing monthly returns versus the market returns of Government bonds, Equities, and Credit (IG & HY) market portfolios.

The 'Credit-Factor' portfolio shows a jump in IR to 0.99 relative to the Traditional portfolio IR of 0.76. This comes with an annualized alpha of 120bps. Similarly, the 'Equity-factor' portfolio generates an IR 0.87 with an alpha of 117bps. The substantial and statistically significant alphas show that factors both in the credit and equity universe are able to generate excess risk-adjusted return that is uncorrelated with taking on default risk in credit and going long the equity risk premium.

Finally, can a combination of factors constructed across the credit and equity markets generate an even higher IR? The 'Equity-Credit multi-factor portfolio' in Table 16 has the best performance across all portfolios, with an IR of 1.09 and a gross alpha of 238bps, 120bps of which comes from credit multi-factor integrated portfolio and the remainder from the equity multi-factor portfolio. All in all, there is strong empirical evidence to suggest that factor portfolios add substantial premia to traditional asset classes and can help generate positive risk-adjusted returns over long investment horizons.

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Table 16: Adding credit and equity risk premia to traditional asset classes

See text for definitions and details on how portfolios are built.

					Weights(%)			
	Asset Classes	Return	Volatility	IR	Traditional	Credit Factor	Equity Factor	Equity-Credit Multi-factor
Traditional Asset classes	Government bonds	3.50%	6.25%	0.56	25%	25%	25%	25%
	Investment Grade	4.98%	6.21%	0.80	25%		25%	
	High Yield	6.13%	9.70%	0.63	25%		25%	
	US Equities	4.70%	14.42%	0.33	25%	25%		
Multi-factor portfolios	Credit Inv. Grade integrated	5.48%	5.73%	0.96		25%		25%
	High Yield integrated port.	8.49%	7.21%	1.18		25%		25%
	Equity factor portfolio	9.64%	17.38%	0.55			25%	25%
	Return				4.83%	5.54%	6.06%	6.78%
	Volatility				6.37%	5.59%	6.97%	6.23%
	Sharpe Ratio				0.76	0.99	0.87	1.09
	Alpha					1.20%	1.17%	2.38%
	Alpha t-stat					4.93	2.30	3.83

Source: J.P. Morgan.

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Results for USD High Yield

Most of our discussion thus far has focused on USD Investment Grade, although we have considered USD High Yield in our integrated portfolio. In Table 17 and Table 20, we show the individual factor returns for USD High Yield. We present the results for USD Investment Grade in Table 19 and Table 21 for comparison.

Similar to our conclusion for USD IG, we find that the Carry factor offers little in the way of additional return given its correlation to the Value factor (Table 18). While the CAPM alpha for Carry is high among the factors, it has very high volatility and the T-stat for the CAPM alpha does not appear to be very significant in the Long-Only setup.

Momentum appears to be the best-performing factor in High Yield with an IR of 0.76 and a CAPM alpha of 507bp. The factor however does have high turnover, and the alpha drops to 109bp after costs and quarterly rebalancing, which is still attractive in our view. Low Risk works in High Yield (IR = 0.50) but not to the same degree as in Investment Grade (IR = 0.71) potentially because BB credits are in demand by both IG and HY investors.

The low and in many cases negative correlation between the factors (Table 18) means that a multi-factor portfolio will benefit from diversifying across the factor. The Equally Weighted portfolio has a higher IR (0.56) than the average of the individual Factor IRs. This is further improved by the Integrated portfolio, where the IR is better than the best individual Factor IR (0.83).

Table 17: High Yield Factor Results

Gross Returns assuming Monthly Rebalancing

	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd	Integrated
Long-Only top quintile portfolios								
Returns	2.01%	5.08%	3.04%	6.45%	5.82%	3.55%	4.53%	6.80%
Volatility	10.57%	9.87%	6.04%	8.49%	20.33%	9.36%	8.08%	8.19%
IR	0.19	0.51	0.50	0.76	0.29	0.38	0.56	0.83
CAPM Alpha statistics								
CAPM Adj Rsq	na	88%	84%	73%	80%	75%	87%	78%
CAPM beta	1.00	0.88	0.52	0.69	1.73	0.77	0.72	0.69
Ann. CAPM alpha	na	3.32%	1.99%	5.07%	2.34%	2.00%	3.09%	5.43%
CAPM alpha t-stat		3.90	3.12	4.64	1.03	1.73	4.18	5.45
Long-Short quintile portfolios								
Returns		4.26%	-0.77%	8.89%	6.07%	1.45%	3.46%	6.59%
Volatility		4.06%	10.41%	13.54%	16.64%	6.14%	5.57%	6.53%
IR		1.05	-0.07	0.66	0.36	0.24	0.62	1.01
CAPM Alpha statistics								
CAPM Adj Rsq		0.01%	62%	48%	64%	4%	69%	35%
CAPM beta		0.04	-0.78	-0.89	1.26	-0.13	-0.44	-0.37
Ann. CAPM alpha		4.18%	0.78%	10.68%	3.53%	1.71%	4.34%	7.32%
CAPM alpha t-stat		4.46	0.49	4.44	1.42	1.18	5.63	5.70

Source: J.P. Morgan.

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Table 18: High Yield Long-Short Alpha Correlation

	Value	Momentum	Carry	Safety	Size	Integrated
Value	100%	-16%	36%	-20%	27%	23%
Momentum	-16%	100%	-76%	65%	1%	68%
Carry	36%	-76%	100%	-89%	20%	-38%
Safety	-20%	65%	-89%	100%	-11%	50%
Size	27%	1%	20%	-11%	100%	51%
Integrated	23%	68%	-38%	50%	51%	100%

Source: J.P. Morgan.

Table 19: Investment Grade Factor Results

Gross Returns assuming Monthly Rebalancing

	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd	Integrated
Long top decile portfolios								
Returns	1.48%	3.26%	0.99%	2.86%	4.26%	1.82%	2.23%	3.34%
Volatility	4.25%	5.30%	1.39%	4.16%	10.63%	3.71%	3.39%	3.30%
IR	0.35	0.62	0.71	0.69	0.40	0.49	0.66	1.01
CAPM Alpha statistics								
CAPM Adj Rsq	na	87%	78%	68%	83%	70%	88%	72%
CAPM beta	1.00	1.16	0.29	0.81	2.29	0.74	0.75	0.66
Ann. CAPM alpha	na	1.54%	0.56%	1.66%	0.86%	0.73%	1.12%	2.37%
CAPM alpha t-stat		3.05	3.42	2.79	0.72	1.28	3.70	5.28
Long-Short decile portfolios								
Returns		3.90%	-1.24%	3.11%	4.81%	0.26%	1.50%	3.00%
Volatility		3.34%	6.01%	8.42%	9.54%	3.17%	3.14%	4.62%
IR		1.17	-0.21	0.37	0.50	0.08	0.48	0.65
CAPM Alpha statistics								
CAPM Adj Rsq		25%	80%	42%	70%	11%	67%	40%
CAPM beta		0.40	-1.27	-1.29	1.89	-0.26	-0.61	-0.69
Ann. CAPM alpha		3.31%	0.64%	5.03%	2.01%	0.64%	2.41%	4.04%
CAPM alpha t-stat		3.88	0.81	3.05	1.33	0.81	5.22	4.68

Source: J.P. Morgan.

Table 20: High Yield with Rebalancing Costs

Assumes 100c Cost

	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd	Integrated
Returns	2.01%	4.94%	2.81%	4.74%	6.74%	3.70%	4.05%	5.36%
Volatility	10.57%	9.95%	5.97%	8.54%	20.19%	9.26%	8.07%	8.02%
IR	0.19	0.50	0.47	0.56	0.33	0.40	0.50	0.67
CAPM beta	1.00	0.88	0.52	0.70	1.70	0.75	0.71	0.67
Ann. CAPM alpha	0.00%	3.17%	1.77%	3.33%	3.33%	2.18%	2.61%	4.00%
CAPM alpha t-stat	na	3.61	2.92	3.12	1.43	1.85	3.52	4.12
Average Turnover (Ann.)		174%	89%	224%	110%	54%	135%	143%
Breakeven transaction costs		1.82%	1.98%	1.48%	3.03%	4.02%	1.93%	2.80%
Net alpha(Ann.)		1.43%	0.88%	1.09%	2.23%	1.64%	1.26%	2.57%

Source: J.P. Morgan.

Table 21: Investment Grade with Rebalancing Costs

Assumes 40c Cost

	Market	Value	Low Risk	Momentum	Carry	Size	Equal wtd	Integrated
Returns	1.48%	2.62%	0.89%	2.53%	3.74%	1.80%	1.96%	2.58%
Volatility	4.25%	5.25%	1.42%	4.11%	10.27%	3.59%	3.35%	3.28%
IR	0.35	0.50	0.63	0.62	0.36	0.50	0.59	0.79
CAPM beta	1.00	1.16	0.29	0.80	2.27	0.71	0.74	0.65
Ann. CAPM alpha	0.00%	0.89%	0.46%	1.35%	0.39%	0.75%	0.86%	1.61%
CAPM alpha t-stat	na	2.07	2.50	2.22	0.39	1.37	2.87	3.29
Average Turnover (Ann.)		196%	80%	256%	129%	38%	143%	175%
Breakeven transaction costs		0.45%	0.58%	0.53%	0.30%	1.96%	0.60%	0.92%
Net alpha(Ann.)		0.11%	0.14%	0.33%	-0.13%	0.60%	0.29%	0.91%

Source: J.P. Morgan.

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Factor Calculations and Portfolios

The academic literature on factor investing in credit markets is small but growing. In this note, we have relied on three recent papers which we found useful in orientating our work.

- *Common Factors in Corporate Bond Returns* by Israel. Palhares and Richardson. Journal of Investment Management Vol. 16, No. 2, (2018), pp. 17–46.
- *Factor Investing in the Corporate Bond Market*. Houweling and Zundert. Financial Analysts Journal, 2017, Vol. 73, No. 2
- *Extending Fama–French Factors to Corporate Bond Markets*. Bektic et al.

We investigate five factors – **Low Risk**, **Carry**, **Value**, **Momentum** and **Size**. As noted earlier, for each factor we use a combination of corporate fundamental, bond specific and Credit and Equity market measures. We find that incorporating multiple measures into a single factor improves the stability of the factor.

For each measure, we assign a ranked z-score to the bonds for which data is available. If a given measure is not available for a bond (e.g. we cannot calculate equity price momentum as there is no traded equity), we give it a value equal to 50% of the average z-score for those measures that are available for that bond.

A z-score of 0 implies that the bond has the average ranking across the available bonds for a given measure. Since we do not wish to penalise a bond that ranks highly on the available measure (e.g. credit momentum) by assuming it ranks average for the missing measures (e.g. equity momentum), we fill in the missing measures with the average of the available measures and the average of the cross-section for that measure.

Before looking at the factors, we describe the Investment Grade and High Yield market portfolios in Figure 23 to Figure 28.

The composition of the USD IG index can be seen in Figure 23. The index has become more diversified with respect to sectors through time as Financials and Communications have declined while Info Tech, Healthcare and Energy have risen. Similarly in High Yield, Communications, Industrials have given way to more Energy, Healthcare and Info Tech. Note that we have excluded High Yield Financial and Subordinated debt (Figure 24)

In IG, the past few years have seen strong growth of the BBB rating bucket along with the demise of AA rated bonds (Figure 25). In High Yield, the trend has been towards increased issuance of BB2 to B1, which appears the sweet-spot for corporate issuance (Figure 26). In IG, maturities have remained relatively stable, but there has been a clear demise of long dated issuance in the HY space (Figure 27 and Figure 28).

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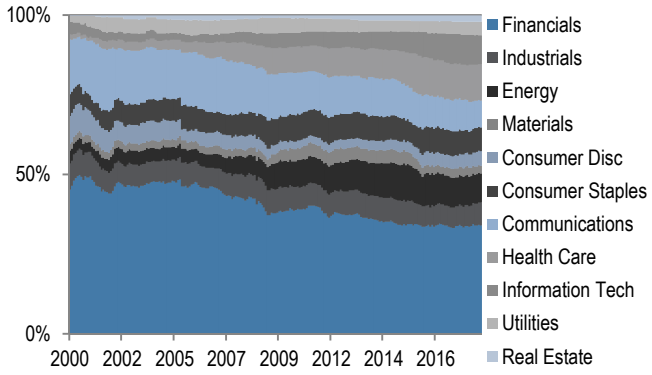
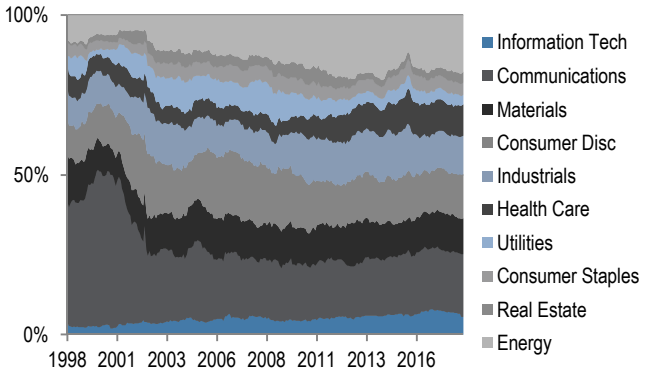
Figure 23: Sector weights for Market – Investment Grade
Monthly Rebalancing



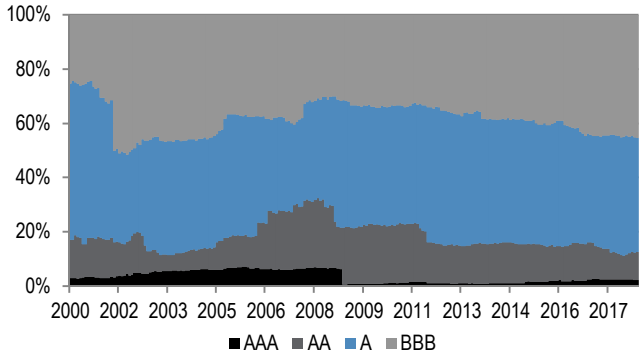
Source: J.P. Morgan. iBoxx

Figure 24: Sector weights for Market – High Yield
Monthly Rebalancing



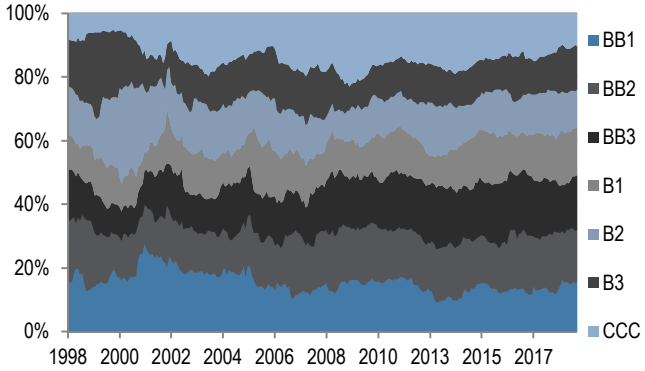
Source: J.P. Morgan, ICE/BAML.

Figure 25: Rating weights for Market – Investment Grade
Monthly Rebalancing



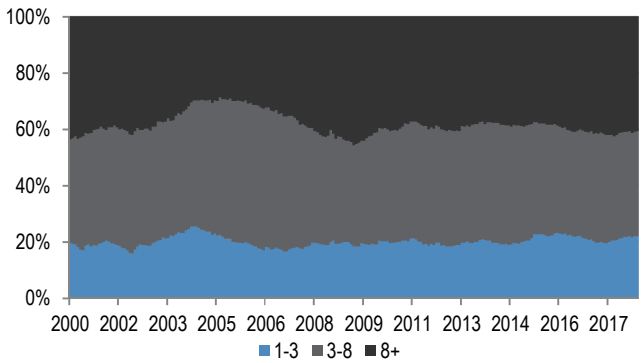
Source: J.P. Morgan. iBoxx

Figure 26: Rating weights for Market – High Yield
Monthly Rebalancing



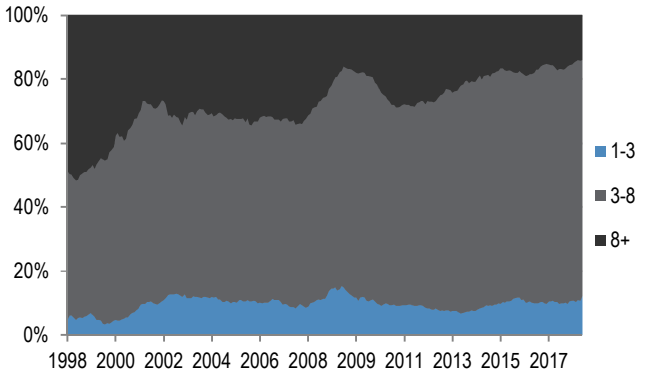
Source: J.P. Morgan. ICE/BAML

Figure 27: Maturity weights for Market – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan. iBoxx

Figure 28: Maturity weights for Market – High Yield
Monthly Rebalancing



Source: J.P. Morgan. ICE/BAML

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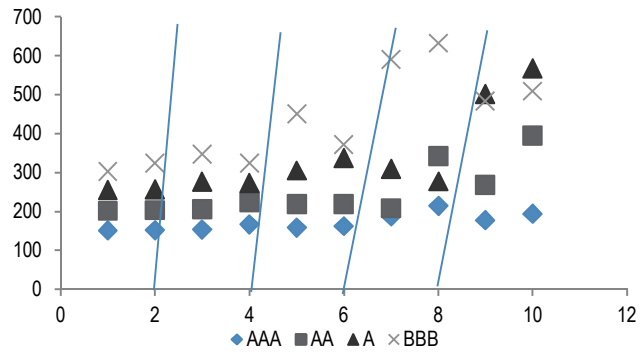
Adjusting for Credit Duration and Beta

Our analysis focusses on credit excess returns, which means that we have removed the rates duration contribution to our corporate bond returns. We are still, however, left with a volatility impact that comes from the price sensitivity of our bond to credit duration. If we pick a factor, say Carry, and select the highest spread bonds, then in a normal upward-sloping spread environment, we will likely select long-dated bonds, thereby introducing additional volatility into our portfolio selection.

To correct for this, we create maturity buckets such that the portfolios we select choose bonds across the maturity curve. We choose this division for its simplicity. It is worth considering that two alternatives to the maturity ranking present themselves:

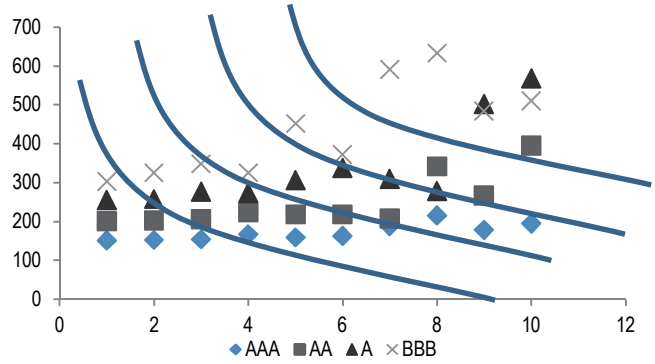
- **Ranking by duration**: This would imply comparing bonds with similar market risk exposure. We prefer not to use this measure as duration is a function of both maturity and yield. Given two bonds with the same maturity, a duration-based ranking would pick the bond with the higher yield – effectively choosing the riskier bond.
- **Ranking by duration × spread (DtS)**: This would imply picking bonds with similar market beta given that DtS is a proxy for volatility – market betas tend to scale with spreads. We believe this measure would also end up choosing riskier bonds as the DtS measure equates short duration high spread names with long duration low spread names. It is, therefore, likely to include longer duration bonds.

Figure 29: Stylised Quintiles by Duration
x-axis: Maturity, y-axis Spread



Source: J.P. Morgan.

Figure 30: Stylised Quintiles by Spread x Duration
x-axis: Maturity, y-axis Spread



Source: J.P. Morgan.

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Low Risk

A corporate bond can be low risk either because it is a) issued by a profitable/safe company or b) it is likely to be redeemed soon.

Profitable/Safe Companies

For the profitable/safe measure, we treat Financials (Equation 3) and Non-Financials (Equation 4) separately. It is reasonable to question whether we need to look at balance sheet metrics when rating agencies perform this task already. To some extent, our choice of using these balance sheet metrics is to get more granular information since we currently only have broad rating categories (AAA/AA/A/BBB) for Investment Grade.

Equation 3: Profitable/Safe for Financials

$$z(\text{RoE}) + z(\text{RoA}) + z(\text{FCF\_debt}) + z(\text{FCF\_sales}) + z(\text{leverage})$$

Equation 4: Profitable/Safe for Non-Financials

$$z(\text{RoE}) + z(\text{RoA}) + z(\text{FCF}_{\text{debt}}) + z(\text{FCF}_{\text{sales}}) + + z(\text{novy marx gross profitability}) + z(\text{leverage}) + z(\text{int coverage}) + z(\text{net debt/EBITDA})$$

Profitability	Safety
RoE: Return on Equity – Trailing 4 quarter total Net Income divided by average of Total Common Equity over the 4 quarters **RoA: Return on Assets** – Trailing 4 quarter total Net Income divided by average of firm Total Assets over the last 4 quarters **FCF_debt: Free Cash Flow over debt** – Trailing 4 quarter total Free cash flow divided by trailing 4 quarter average total debt (total debt = total long term debt + total short term debt) **FCF_sales: Free Cash flow over sales** – Trailing 4 quarter total Free Cash Flow divided by the sum of Total Revenue over the last 4 quarters. Free Cash Flow = Cash from Operations + Preferred Dividends + Capital Expenditures + Sale(Purchase) of Intangible Assets **Novy Marx Gross Profitability** – Trailing 4 quarter total Gross Profit divided by average of Total Assets over the last 4 quarters. Gross Profit = Total Revenues – Cost of Revenues	**Leverage** – Trailing 4 quarter average of net debt divided by trailing 4 quarter average of the sum of net debt and Total Common Equity. Net debt = Total Debt – Total Cash and Short term investments **int_coverage: Interest Coverage** – Trailing 4Q quarter EBIT to interest expense **Net debt/EBITDA** – Trailing 4Q net debt to EBITDA

Short Maturity

Our second measure of Low Risk is Short Maturity i.e. bonds that are close to maturity are "preferred" because they are payable before other debt in time. For this measure, we give preference to A- (B-) rated and higher bonds in IG (HY).

The ranked z-score for Low Risk is therefore:

Equation 5: Low Risk Factor

$$z\,[z(\text{Profitable/Safe}) + z(\text{Short Maturity})]$$

The results for Low Risk in IG and HY are shown in Table 22. Absolute returns are relatively low but the low beta of the factor makes it diversifying in a portfolio context. The resulting decile portfolio for Low Risk is shown in Figure 31. What we would like to see is a smooth decline in the IR for lower ranking deciles. There is a clear outperformance of the top two deciles and underperformance of the bottom two deciles; the results for the middle deciles are more mixed.

Composition-wise, Low Risk invests in higher-rated, shorter-dated bonds in both High Grade and High Yield (Figure 32 to Figure 37).

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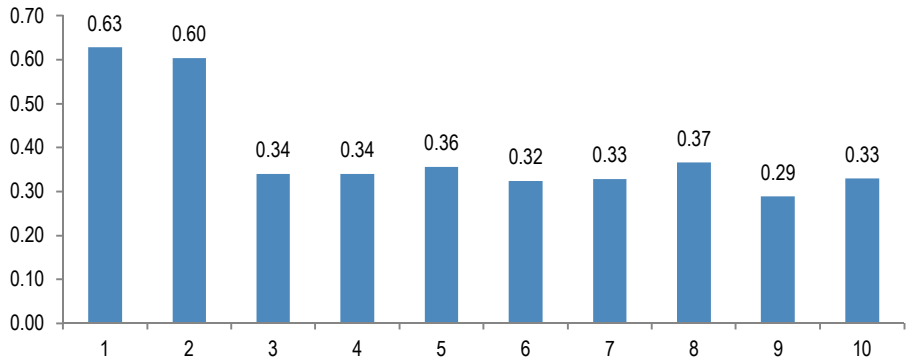
Table 22: Results for Low Risk Factor

	Investment Grade				High Yield			
	Market	1m	3m	12m	Market	1m	3m	12m
Returns	1.48%	0.99%	0.89%	0.90%	2.01%	3.04%	2.81%	3.00%
Volatility	4.25%	1.39%	1.42%	1.49%	10.57%	6.04%	5.97%	5.99%
IR	0.35	0.71	0.63	0.60	0.19	0.50	0.47	0.50
CAPM beta	1.00	0.29	0.29	0.31	1.00	0.52	0.52	0.52
Ann. CAPM alpha	0.00%	0.56%	0.46%	0.44%	0.00%	1.99%	1.77%	1.96%
CAPM alpha t-stat	na	3.42	2.50	2.26	na	3.12	2.92	3.16
Average Turnover (Ann.)			80%	48%			89%	51%
Breakeven transaction costs			0.58%	0.92%			1.98%	3.80%
Net alpha(Ann.)			0.14%	0.25%			0.88%	1.44%

Source: J.P. Morgan.

Figure 31: IG Low Risk Information Ratio by Decile

Quarterly rebalancing



Source: J.P. Morgan.

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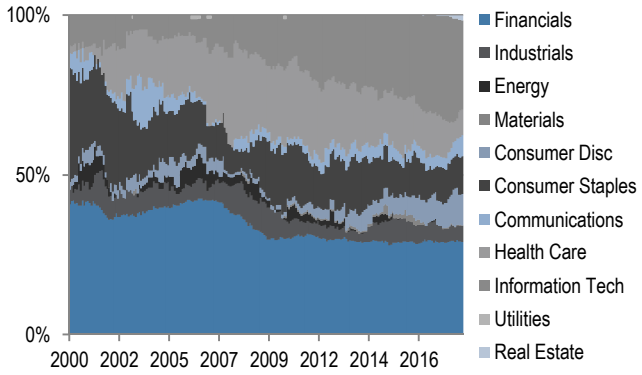
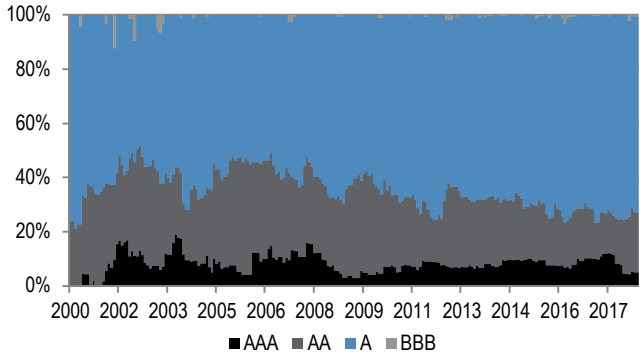
Figure 32: Sector weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing



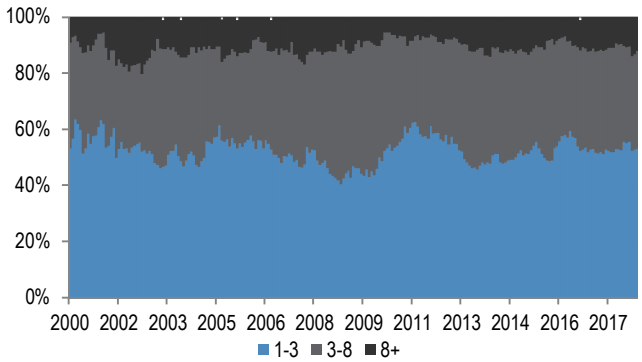
Source: J.P. Morgan.

Figure 33: Rating weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan.

Figure 34: Maturity weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan.

Table 23: Sector weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Sector	Market	Low Risk	Difference
Financials	34%	29%	-5%
Industrials	7%	5%	-2%
Energy	9%	0%	-9%
Materials	2%	0%	-2%
Consumer Disc	5%	10%	5%
Consumer Staples	7%	12%	4%
Communications	8%	7%	-2%
Health Care	11%	8%	-3%
Information Tech	9%	28%	19%
Utilities	4%	0%	-4%
Real Estate	2%	2%	0%

Source: J.P. Morgan.

Table 24: Rating weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Rating	Market	Low Risk	Difference
AAA	2%	5%	3%
AA	10%	22%	12%
A	42%	73%	31%
BBB	46%	1%	-45%

Source: J.P. Morgan.

Table 25: Maturity weights for Low Risk portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Maturity	Market	Low Risk	Difference
1-3	22%	53%	31%
3-8	37%	35%	-2%
8+	41%	12%	-29%

Source: J.P. Morgan.

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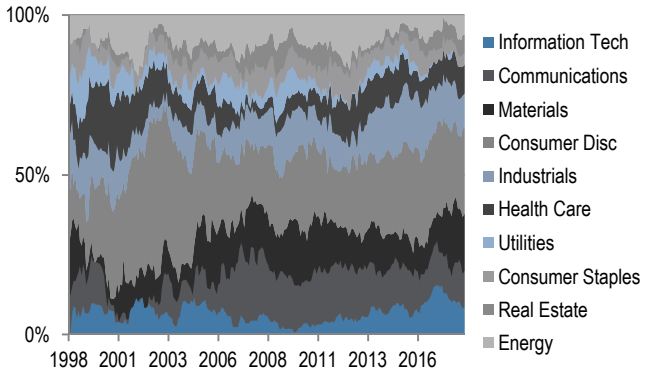
Figure 35: Sector weights for Low Risk portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 26: Sector weights for Low Risk portfolio – High Yield

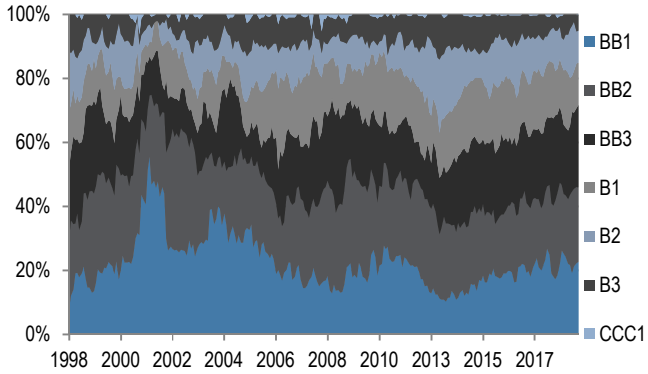
Monthly Rebalancing (October 2018)

Sector	Market	Low Risk	Difference
Information Tech	7%	9%	2%
Communications	19%	13%	-6%
Materials	11%	17%	6%
Consumer Disc	14%	23%	9%
Industrials	12%	12%	1%
Health Care	10%	10%	0%
Utilities	3%	0%	-3%
Consumer Staples	4%	3%	0%
Real Estate	3%	5%	2%
Energy	18%	8%	-10%

Source: J.P. Morgan.

Figure 36: Rating weights for Low Risk portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 27: Rating weights for Low Risk portfolio – High Yield

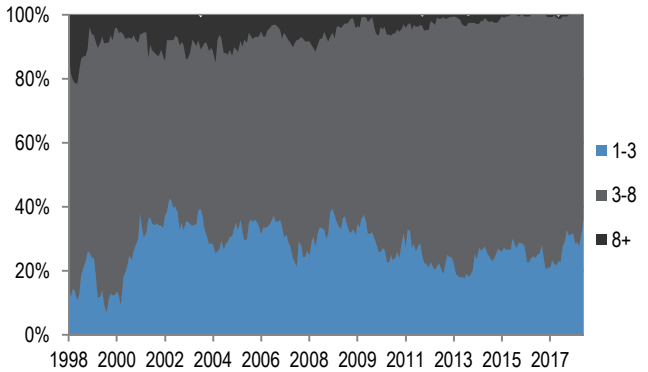
Monthly Rebalancing (October 2018)

Sector	Market	Low Risk	Difference
BB1	16%	21%	6%
BB2	17%	24%	7%
BB3	16%	24%	7%
B1	15%	13%	-2%
B2	12%	15%	3%
B3	14%	2%	-11%
CCC	11%	0%	-11%

Source: J.P. Morgan.

Figure 37: Maturity weights for Low Risk portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 28: Maturity weights for Low Risk portfolio – High Yield

Monthly Rebalancing (October 2018)

Sector	Market	Low Risk	Difference
1-3	11%	28%	17%
3-8	75%	72%	-3%
8+	14%	0%	-14%

Source: J.P. Morgan.

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Carry

The Carry score is defined by the OAS level of the bond. We divide the universe into deciles (quintiles) for IG (HY) based on maturity and pick the highest spread name in each decile (quintile).

A simple approach would be to select the highest spread bonds in the universe. This would likely bias our selection towards long maturity bonds given that credit curves tend to be upward sloping. Alternatively, we could partition the universe by duration or DtS as described earlier. In our view, the former will result in a preference for longer-dated bonds while the latter will be biased towards short-dated bonds.

Our Carry factor performs poorly, particularly in IG, and we do not include it in our Equally Weighted or Integrated portfolio (Table 29). While results in HY are better they do not appear to be statistically significant as expressed by the low t-stat and the strategy introduces a high amount of volatility into the Integrated portfolio. Additionally, the decile portfolios do not appear to be downward sloping (Figure 38).

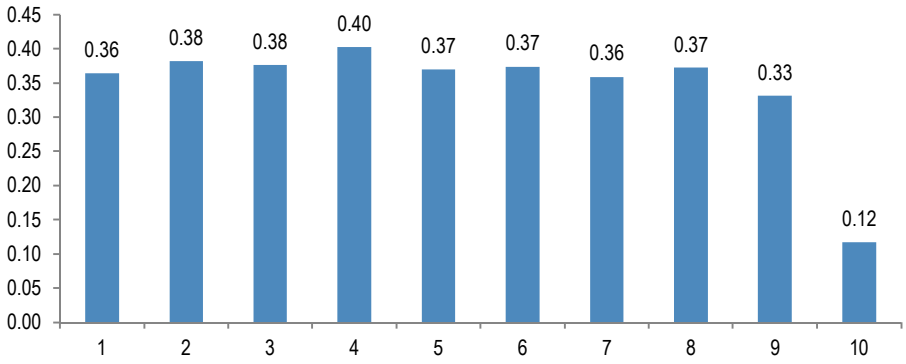
On the other extreme to Low Risk, Carry picks out low-rated bonds with a significant overweight to BBB in IG and CCC in HY (Figure 40 and Figure 43). Maturity difference to the market is limited by construction (Figure 41 and Figure 44)

Table 29: Results for Carry Factor

	Investment Grade				High Yield			
	Market	1m	3m	12m	Market	1m	3m	12m
Returns	1.48%	4.26%	3.74%	3.21%	2.01%	5.82%	6.74%	6.77%
Volatility	4.25%	10.63%	10.27%	8.75%	10.57%	20.33%	20.19%	18.25%
IR	0.35	0.40	0.36	0.37	0.19	0.29	0.33	0.37
CAPM beta	1.00	2.29	2.27	1.97	1.00	1.73	1.70	1.51
Ann. CAPM alpha	0.00%	0.86%	0.39%	0.30%	0.00%	2.34%	3.33%	3.74%
CAPM alpha t-stat	na	0.72	0.39	0.45	na	1.03	1.43	1.61
Average Turnover (Ann.)			129%	58%			110%	54%
Breakeven transaction costs			0.30%	0.51%			3.03%	6.95%
Net alpha(Ann.)			-0.13%	0.07%			2.23%	3.20%

Source: J.P. Morgan.

Figure 38: IG Carry Information Ratio by Decile
Quarterly rebalancing



Source: J.P. Morgan.

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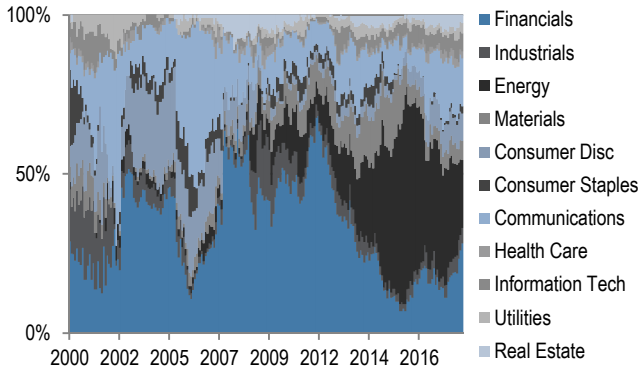
Figure 39: Sector weights for Carry portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 30: Sector weights for Carry portfolio – Investment Grade

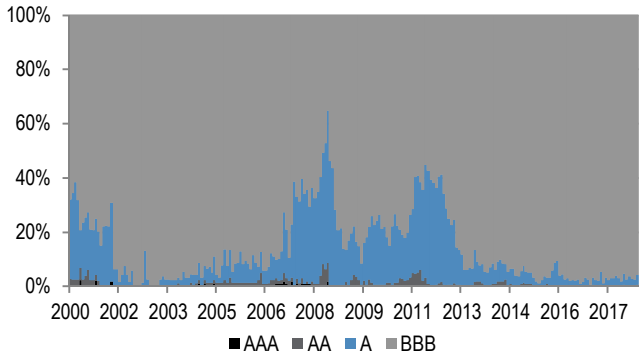
Monthly Rebalancing (October 2018)

Sector	Market	Carry	Difference
Financials	34%	28%	-6%
Industrials	7%	5%	-2%
Energy	9%	21%	12%
Materials	2%	6%	4%
Consumer Disc	5%	8%	4%
Consumer Staples	7%	2%	-5%
Communications	8%	15%	7%
Health Care	11%	2%	-9%
Information Tech	9%	6%	-3%
Utilities	4%	3%	-1%
Real Estate	2%	3%	1%

Source: J.P. Morgan.

Figure 40: Rating weights for Carry portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 31: Rating weights for Carry portfolio – Investment Grade

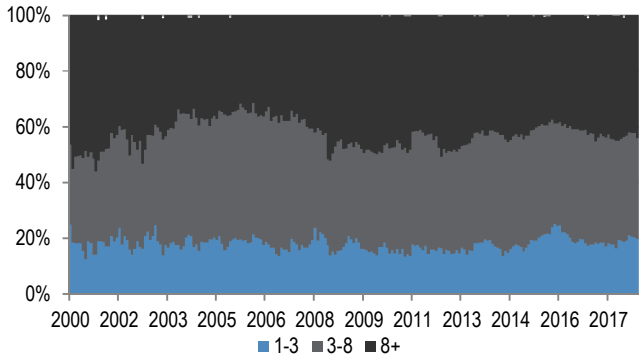
Monthly Rebalancing (October 2018)

Rating	Market	Carry	Difference
AAA	2%	0%	-2%
AA	10%	1%	-10%
A	42%	4%	-38%
BBB	46%	96%	50%

Source: J.P. Morgan.

Figure 41: Maturity weights for Carry portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 32: Maturity weights for Carry portfolio – Investment Grade

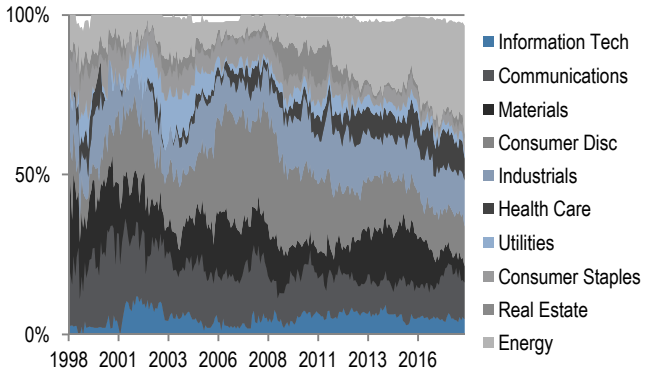
Monthly Rebalancing (October 2018)

Maturity	Market	Carry	Difference
1-3	22%	20%	-2%
3-8	37%	36%	-1%
8+	41%	44%	3%

Source: J.P. Morgan.

Figure 42: Sector weights for Carry portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 33: Sector weights for Carry portfolio – High Yield

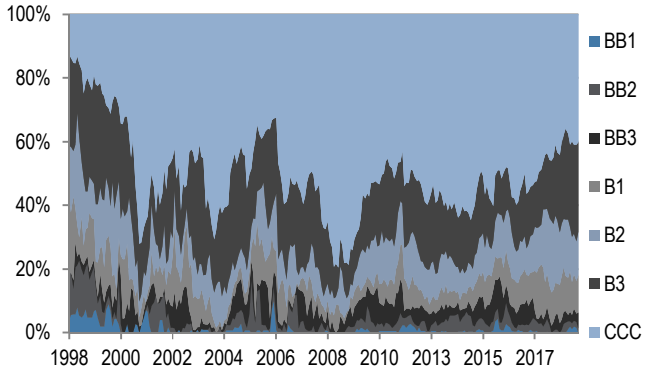
Monthly Rebalancing (October 2018)

Sector	Market	Carry	Difference
Information Tech	7%	5%	-2%
Communications	19%	12%	-7%
Materials	11%	7%	-4%
Consumer Disc	14%	13%	0%
Industrials	12%	14%	3%
Health Care	10%	10%	0%
Utilities	3%	3%	0%
Consumer Staples	4%	2%	-2%
Real Estate	3%	3%	0%
Energy	18%	29%	10%

Source: J.P. Morgan.

Figure 43: Rating weights for Carry portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 34: Rating weights for Carry portfolio – High Yield

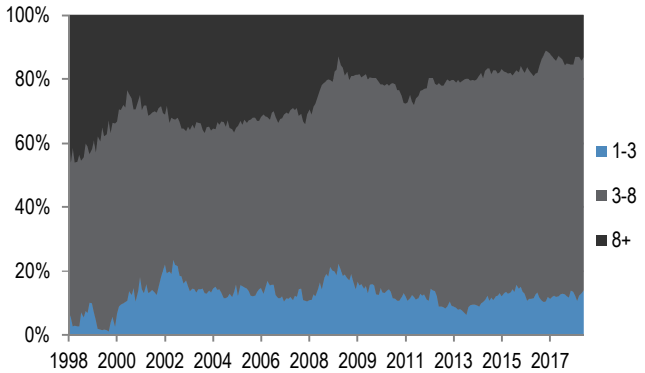
Monthly Rebalancing (October 2018)

Sector	Market	Carry	Difference
BB1	16%	2%	-14%
BB2	17%	2%	-15%
BB3	16%	4%	-13%
B1	15%	11%	-4%
B2	12%	13%	1%
B3	14%	28%	14%
CCC	11%	41%	30%

Source: J.P. Morgan.

Figure 44: Maturity weights for Carry portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 35: Maturity weights for Carry portfolio – High Yield

Monthly Rebalancing (October 2018)

Maturity	Market	Carry	Difference
1-3	11%	12%	1%
3-8	75%	75%	0%
8+	14%	13%	-1%

Source: J.P. Morgan.

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Value

Value

Value brings together Low Risk and Carry. It expresses the view that one cannot simply look at either "safe" or high spread issuers but needs to combine these into high compensation for the risks taken. We determine value in two ways; the first looks at spreads relative to maturity and rating (Equation 6), while the second looks at spreads relative to a proxy for default probabilities (Equation 7). In both cases, we look at cross-sectional relative value – i.e. which bonds offer the highest spread relative to the expected model implied spread.

Our first method implies that credit ratings encompass the known fundamental data for a company. Given that changes in spreads may preempt changes in rating, following *Houweling and Zundert*[10], we introduce a correction term that incorporates whether spreads have moved wider over the past three months. For Investment Grade, we use broad rating buckets, while for High Yield we use narrow rating buckets.

Equation 6: First Determination of Value

$$OAS_i(bps) = c + \beta_{mat} m_i(years) + \beta_{rating} r_i + \beta_s \Delta OAS_i(bps) + \varepsilon_i$$

The introduction of the correction for spread data preempting ratings data results in portfolios that skew towards higher-rated bonds in a sell-off and lower-rated bonds in a rally. This is because the change in spread is taken as an absolute change in spread and therefore drives pricing in higher beta names. To mitigate this we divide the universe into five duration × spread buckets and rank the bonds within these buckets.

The second method follows *Bharath and Shumway*[11] and uses a Merton model style proxy for distance-to-default based on equity pricing. Our approach is to compute the distance-to-default using Bharath and Shumway's naïve implementation and Correia[12]:

Equation 7: Naïve Distance to Default

$$naive\ DD = \frac{\log(V/F)}{\sigma_V \sqrt{T}}$$

We approximate, $V = E + F$, the sum of the firm's equity and debt outstanding. For E we use the firm's 'Total Common Equity' and $F = Short\ Term\ Debt + 0.5 * Long\ Term\ Debt$. We set $T = 1yr$ and the factor of 0.5 therefore is an adjustment for the 'Current Portion of Long Term Debt' i.e. the fraction of Long Term Debt maturing in the next year. All accounting variables are 6m lagged (consistent with Bektic et al. (2017)) to account for quarterly result lags and to allow bond markets time to price in earnings information. For volatility estimation, we use a 12m trailing estimate which is refreshed monthly. As a result, the volatility and balance sheet information are not contemporaneous[13].

[10] *Factor Investing in the Corporate Bond Market.* Patrick Houweling and Jeroen van Zundert. Financial Analysts Journal, 2017, Vol. 73, No. 2.
[11] Forecasting Default with the KMV-Merton Model, Sreedhar Bharath and Tyler Shumway. Review of Financial Studies 21(3), 1339–1369.
[12] *Value Investing in Credit Markets.* Correia, Maria, Scott Richardson, and İrem Tuna. 2012. "Review of Accounting Studies," vol. 17, no. 3: 572-609.
[13] *Value and Momentum Everywhere.* Assness, Moskowitz and Pedersen. The Journal of Finance Vol. 68, No. 3 (JUNE 2013), pp. 929-985

The $naive\ DD$ is our fundamental anchor for value, and a comparison of spreads versus this measure, adjusted for bond durations, will give us our second value score. We, therefore, estimate the following cross-sectional regression:

Equation 8: Second Determination of Value

$$logOAS_i = c_i + \beta_{DD}\log(naive\ DD) + \beta_m\log(years\ to\ maturity) + \varepsilon_i$$

The distance to default based value score for bond i is proportional to $\log(\frac{OAS_i}{OAS_{fair\ value}})$. The regression is done in log space to take in to account the non-linear effect of distance to default on firm value and bond spreads. The coefficient β_{DD} is negative to ensure that firm's with larger distances to default have lower spreads relative to firm's that are closer to default (have smaller values of $naive\ DD$).

In both cases, we look for bonds that overcompensate in carry for risk taken.

Carry provides one of the most impressive factor returns. The returns and IRs are noticeably higher than the market. The high turnover of the portfolio appears to lower the net alpha quite significantly but longer holding periods may mitigate this issue (Table 36). The IR deciles stack up nicely (Figure 45).

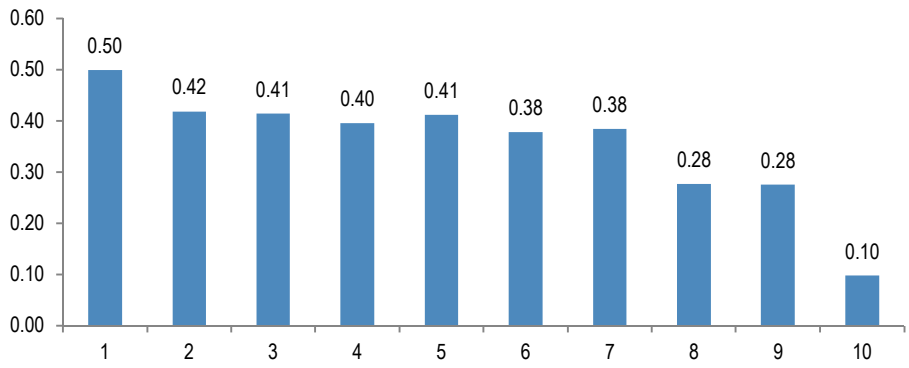
The strategy appears to pick lower-rated bonds in IG and higher-rated bonds in HY, thereby focusing on the BBB-BB ratings group (Figure 47 and Figure 50). In both cases, there is a clear preference for shorter-dated bonds (Figure 48 and Figure 51).

Table 36: Value Factor Results

	Investment Grade				High Yield			
	Market	1m	3m	12m	Market	1m	3m	12m
Returns	1.48%	3.26%	2.62%	2.13%	2.01%	5.08%	4.94%	4.11%
Volatility	4.25%	5.30%	5.25%	4.96%	10.57%	9.87%	9.95%	9.86%
IR	0.35	0.62	0.50	0.43	0.19	0.51	0.50	0.42
CAPM beta	1.00	1.16	1.16	1.11	1.00	0.88	0.88	0.86
Ann. CAPM alpha	0.00%	1.54%	0.89%	0.50%	0.00%	3.32%	3.17%	2.37%
CAPM alpha t-stat	na	3.05	2.07	1.31	na	3.90	3.61	2.50
Average Turnover (Ann.)			196%	69%			174%	66%
Breakeven transaction costs			0.45%	0.72%			1.82%	3.62%
Net alpha(Ann.)			0.11%	0.22%			1.43%	1.71%

Source: J.P. Morgan.

Figure 45: IG Value Information Ratio by Decile
Quarterly rebalancing



Source: J.P. Morgan.

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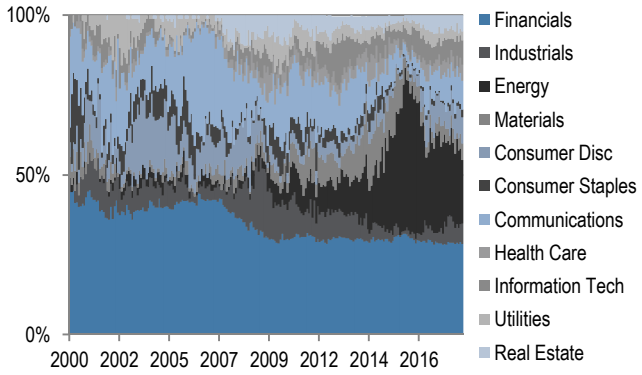
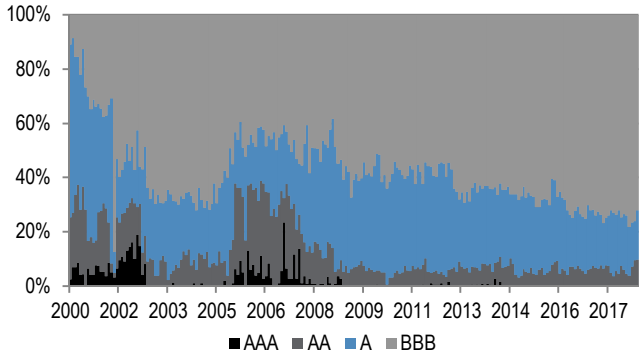
Figure 46: Sector weights for Value portfolio – Investment Grade
Monthly Rebalancing



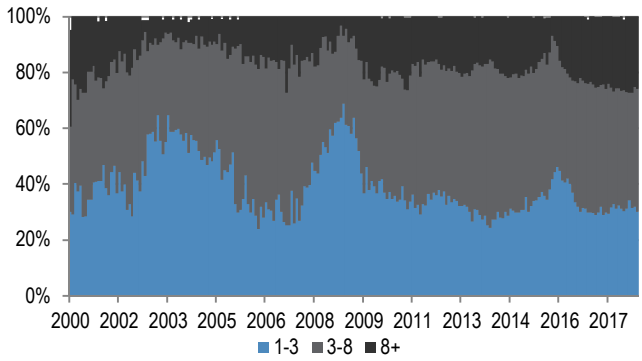
Source: J.P. Morgan.

Figure 47: Rating weights for Value portfolio – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan.

Figure 48: Maturity weights for Value portfolio – Investment Grade
Monthly Rebalancing



Source: J.P. Morgan.

Table 37: Sector weights for Value portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Sector	Market	Value	Difference
Financials	34%	28%	-6%
Industrials	7%	6%	-1%
Energy	9%	20%	11%
Materials	2%	5%	3%
Consumer Disc	5%	8%	4%
Consumer Staples	7%	2%	-5%
Communications	8%	9%	1%
Health Care	11%	5%	-6%
Information Tech	9%	7%	-2%
Utilities	4%	3%	-1%
Real Estate	2%	5%	3%

Source: J.P. Morgan.

Table 38: Rating weights for Value portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Rating	Market	Value	Difference
AAA	2%	0%	-2%
AA	10%	10%	-1%
A	42%	18%	-24%
BBB	46%	72%	27%

Source: J.P. Morgan.

Table 39: Maturity weights for Value portfolio – Investment Grade
Monthly Rebalancing (October 2018)

Maturity	Market	Value	Difference
1-3	22%	30%	8%
3-8	37%	44%	7%
8+	41%	26%	-15%

Source: J.P. Morgan.

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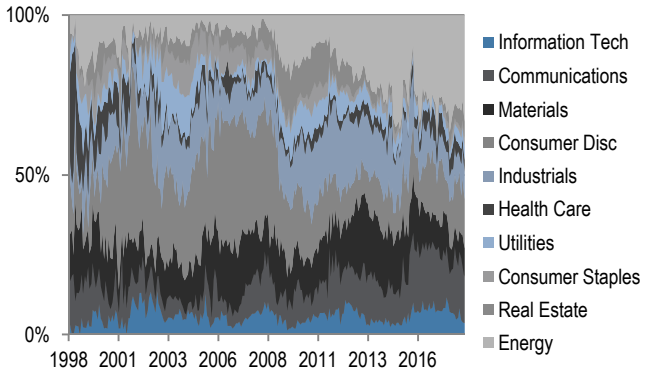
Figure 49: Sector weights for Value portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 40: Sector weights for Value portfolio – High Yield

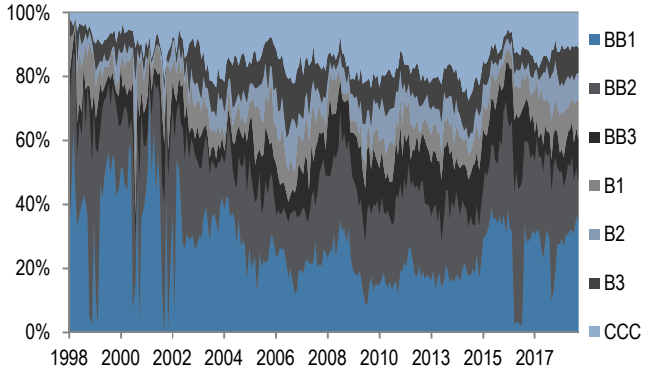
Monthly Rebalancing (October 2018)

Sector	Market	Value	Difference
Information Tech	7%	5%	-2%
Communications	19%	19%	1%
Materials	11%	7%	-4%
Consumer Disc	14%	12%	-2%
Industrials	12%	10%	-2%
Health Care	10%	5%	-5%
Utilities	3%	4%	0%
Consumer Staples	4%	2%	-1%
Real Estate	3%	6%	3%
Energy	18%	30%	12%

Source: J.P. Morgan.

Figure 50: Rating weights for Value portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 41: Rating weights for Value portfolio – High Yield

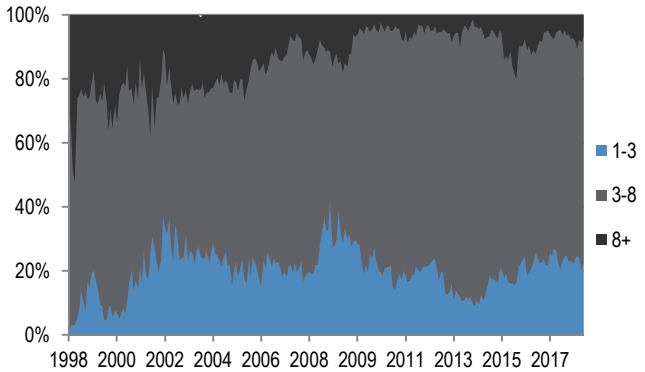
Monthly Rebalancing (October 2018)

Sector	Market	Value	Difference
BB1	16%	31%	16%
BB2	17%	17%	0%
BB3	16%	12%	-5%
B1	15%	12%	-3%
B2	12%	7%	-5%
B3	14%	10%	-4%
CCC	11%	11%	0%

Source: J.P. Morgan.

Figure 51: Maturity weights for Value portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 42: Maturity weights for Value portfolio – High Yield

Monthly Rebalancing (October 2018)

Maturity	Market	Value	Difference
1-3	11%	24%	13%
3-8	75%	68%	-7%
8+	14%	8%	-6%

Source: J.P. Morgan.

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Momentum

Our Momentum factor ranks bonds based on both credit and equity returns. We consider six-month returns using a one-month implementation lag to allow for mean reversion. Our return signal is a combination of three equally weighted measures: Credit Momentum, Credit Notional Momentum and Equity Momentum (Equation 9, Equation 10, Equation 11).

We choose to use three measures as we believe this gives a fairer ranking between bonds. Credit momentum is the typical measure of momentum and simply looks at the percentage change in the dirty price of a bond over a period. Low priced bonds will therefore have higher momentum as the credit return is relative to the price. To correct for this, we look at Credit Notional Momentum which effectively translates the Credit return into a price return (assuming an interest rate hedge). Equity momentum is a proxy for fundamental balance sheet momentum.

Equation 9: Credit Momentum for Bond i

$$\sum_{m=1}^{6} Monthly\ Credit\ Return_{i,t-m}$$

Equation 10: Credit Notional Momentum for Bond i

$$= \sum_{m=1}^{6} Clean\ Price_{i,t-m} \times Monthly\ Credit\ Return_{i,t-m}$$

Equation 11: Equity Momentum for Company I

$$= \sum_{m=1}^{6} Monthly\ Equity\ Return_{I,t-m}$$

For each metric, we calculate the cross-sectional z-score. If the z-score is unavailable, typically because the company does not have listed equity, we use a scaled amount, s, of the available metrics. We assume s = 50% i.e. the missing value is the average of the available metrics for the bond and the average of the cross-section for the missing metric.

Equation 12: Momentum Factor for Bond i

$$= s \times [z(\text{Credit Momentum}) + z(\text{Credit Notional Momentum})]/2$$

The Momentum factor appears to offer a significant pickup in returns and IR without an increase in volatility (Table 43). Unlike Value, more frequent rebalancing of the portfolio appears to offer better results despite the higher turnover. As with Value, the decile portfolios stack up well (Figure 52).

Unsurprisingly, Momentum switches between higher- and lower-rated, as well as longer- and shorter-dated bonds, preferring safety in a sell-off and risk in a rally (Figure 54, Figure 55, Figure 57 and Figure 58).

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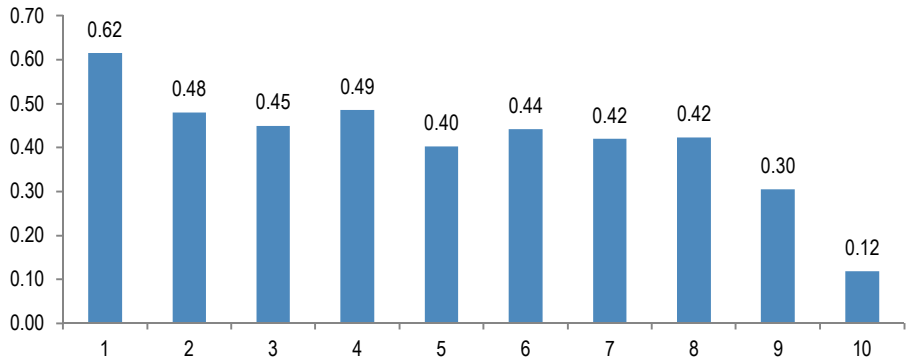
Table 43: Momentum Factor Returns

	Investment Grade				High Yield			
	Market	1m	3m	12m	Market	1m	3m	12m
Returns	1.48%	2.86%	2.53%	1.83%	2.01%	6.45%	4.74%	2.92%
Volatility	4.25%	4.16%	4.11%	3.94%	10.57%	8.49%	8.54%	8.25%
IR	0.35	0.69	0.62	0.46	0.19	0.76	0.56	0.35
CAPM beta	1.00	0.81	0.80	0.84	1.00	0.69	0.70	0.72
Ann. CAPM alpha	0.00%	1.66%	1.35%	0.58%	0.00%	5.07%	3.33%	1.47%
CAPM alpha t-stat	na	2.79	2.22	1.33	na	4.64	3.12	1.89
Average Turnover (Ann.)			256%	87%			224%	82%
Breakeven transaction costs			0.53%	0.66%			1.48%	1.78%
Net alpha(Ann.)			0.33%	0.23%			1.09%	0.65%

Source: J.P. Morgan.

Figure 52: IG Momentum Information Ratios by Deciles

Quarterly rebalancing



Source: J.P. Morgan.

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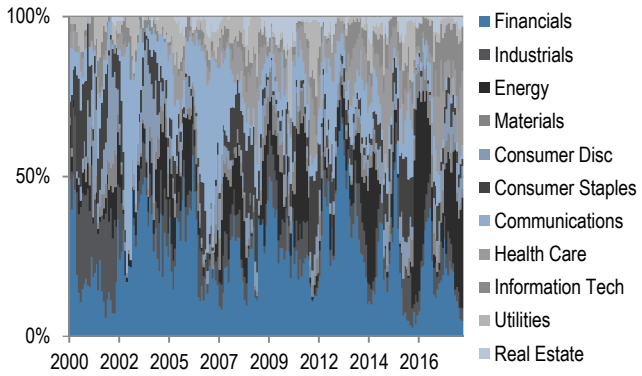
Figure 53: Sector weights for Momentum portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 44: Sector weights for Momentum portfolio – Investment Grade

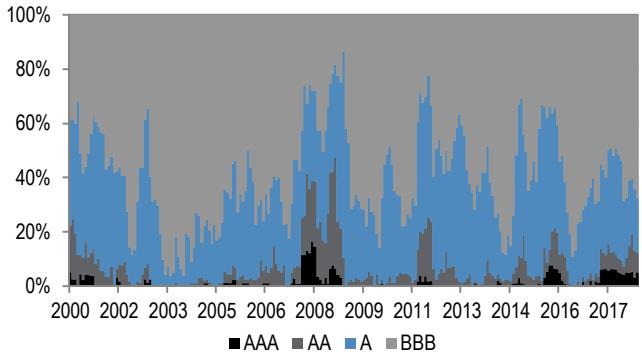
Monthly Rebalancing (October 2018)

Sector	Market	Momentum	Difference
Financials	34%	5%	-29%
Industrials	7%	4%	-3%
Energy	9%	35%	26%
Materials	2%	3%	0%
Consumer Disc	5%	7%	3%
Consumer Staples	7%	2%	-5%
Communications	8%	5%	-4%
Health Care	11%	23%	12%
Information Tech	9%	14%	5%
Utilities	4%	1%	-4%
Real Estate	2%	3%	1%

Source: J.P. Morgan.

Figure 54: Rating weights for Momentum portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 45: Rating weights for Momentum portfolio – Investment Grade

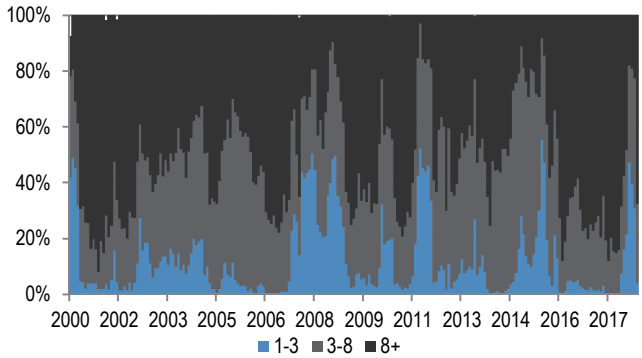
Monthly Rebalancing (October 2018)

Rating	Market	Momentum	Difference
AAA	2%	0%	-2%
AA	10%	10%	-1%
A	42%	18%	-24%
BBB	46%	72%	27%

Source: J.P. Morgan.

Figure 55: Maturity weights for Momentum portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 46: Maturity weights for Momentum portfolio – Investment Grade

Monthly Rebalancing (October 2018)

Maturity	Market	Momentum	Difference
1-3	22%	4%	-18%
3-8	37%	28%	-9%
8+	41%	68%	27%

Source: J.P. Morgan.

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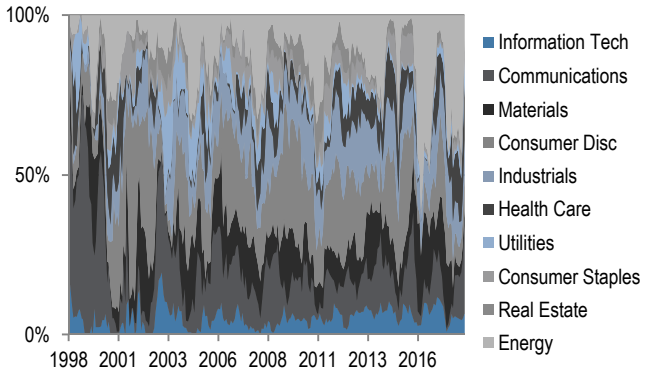
Figure 56: Sector weights for Momentum portfolio – High Yield
Monthly Rebalancing



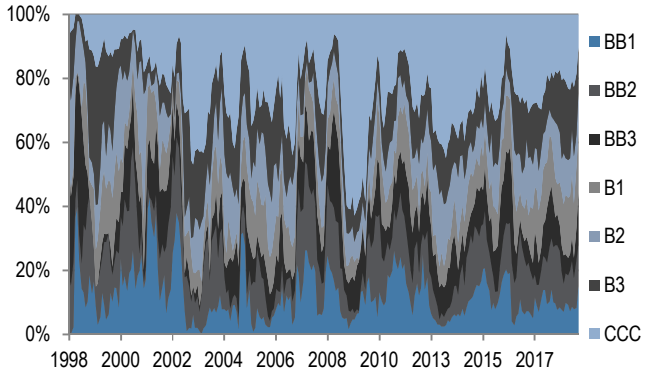
Source: J.P. Morgan.

Table 47: Sector weights for Momentum portfolio – High Yield
Monthly Rebalancing (October 2018)

Sector	Market	Momentum	Difference
Information Tech	7%	5%	-2%
Communications	19%	15%	-4%
Materials	11%	4%	-7%
Consumer Disc	14%	7%	-7%
Industrials	12%	6%	-6%
Health Care	10%	13%	3%
Utilities	3%	2%	-1%
Consumer Staples	4%	4%	1%
Real Estate	3%	1%	-2%
Energy	18%	43%	25%

Source: J.P. Morgan.

Figure 57: Rating weights for Momentum portfolio – High Yield
Monthly Rebalancing



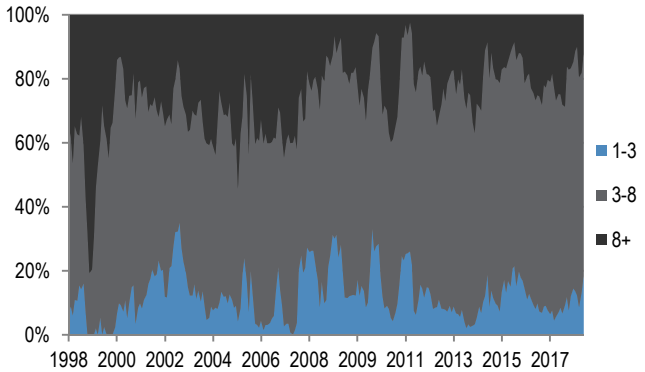
Source: J.P. Morgan.

Table 48: Rating weights for Momentum portfolio – High Yield
Monthly Rebalancing (October 2018)

Sector	Market	Momentum	Difference
BB1	16%	8%	-8%
BB2	17%	10%	-7%
BB3	16%	6%	-10%
B1	15%	17%	2%
B2	12%	15%	3%
B3	14%	22%	8%
CCC	11%	23%	12%

Source: J.P. Morgan.

Figure 58: Maturity weights for Momentum portfolio – High Yield
Monthly Rebalancing



Source: J.P. Morgan.

Table 49: Maturity weights for Momentum portfolio – High Yield
Monthly Rebalancing (October 2018)

Maturity	Market	Momentum	Difference
1-3	11%	9%	-2%
3-8	75%	72%	-3%
8+	14%	20%	5%

Source: J.P. Morgan.

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Size

We measure size using both market and fundamental variables and define it as a composite score of Total Enterprise Value, Total Assets and the market value weight of the companies bonds in the bond universe. For Financials, we do not assess Total Enterprise Value.

Total Enterprise Value = Market Capitalization + Book Value of Total Debt + Book Value of Preferred Stock + Book Value of Minority Interest – Cash and ST investments

The absolute return from Size is not significantly higher than the market (Table 50), but its low volatility and relatively limited turnover means that net alphas are attractive. The IR deciles also appear to stack up nicely (Figure 59).

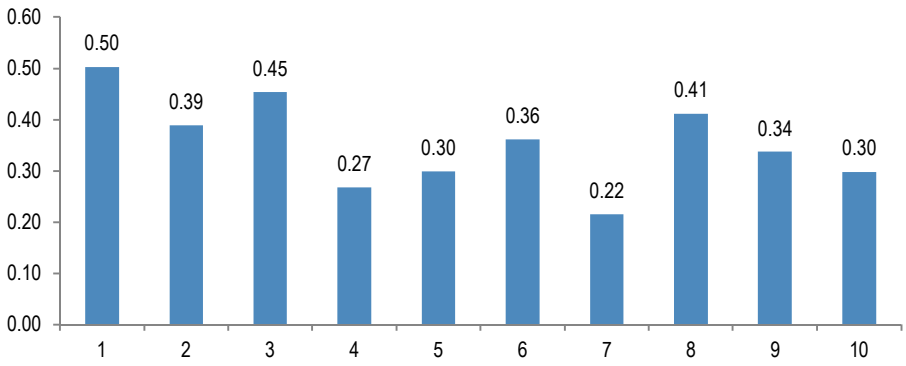
There is a clear preference for lower rated and intermediate duration credit (Figure 61, Figure 62, Figure 64 and Figure 65).

Table 50: Size Factor Returns

	Investment Grade				High Yield			
	Market	1m	3m	12m	Market	1m	3m	12m
Returns	1.48%	1.82%	1.80%	1.78%	2.01%	3.55%	3.70%	3.77%
Volatility	4.25%	3.71%	3.59%	3.57%	10.57%	9.36%	9.26%	8.69%
IR	0.35	0.49	0.50	0.50	0.19	0.38	0.40	0.43
CAPM beta	1.00	0.74	0.71	0.70	1.00	0.77	0.75	0.71
Ann. CAPM alpha	0.00%	0.73%	0.75%	0.74%	0.00%	2.00%	2.18%	2.35%
CAPM alpha t-stat	na	1.28	1.37	1.35	na	1.73	1.85	2.05
Average Turnover (Ann.)			38%	31%			54%	38%
Breakeven transaction costs			1.96%	2.42%			4.02%	6.23%
Net alpha(Ann.)			0.60%	0.62%			1.64%	1.97%

Source: J.P. Morgan.

Figure 59: IG Size Information Ratios by Deciles
Quarterly rebalancing



Source: J.P. Morgan.

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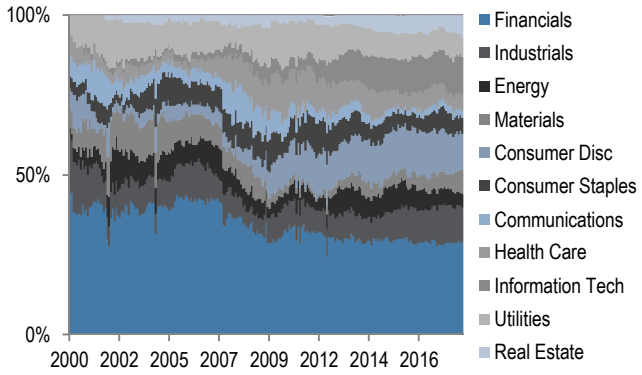
Figure 60: Sector weights for Size portfolio – Investment Grade

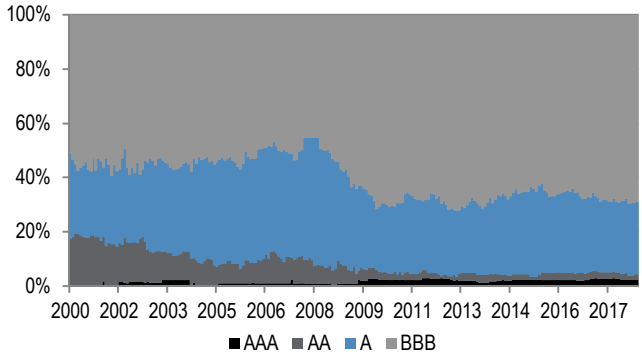
Monthly Rebalancing



Source: J.P. Morgan.

Figure 61: Rating weights for Size portfolio – Investment Grade

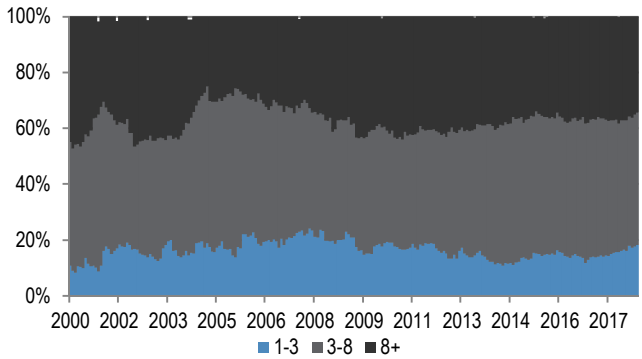
Monthly Rebalancing



Source: J.P. Morgan.

Figure 62: Maturity weights for Size portfolio – Investment Grade

Monthly Rebalancing



Source: J.P. Morgan.

Table 51: Sector weights for Size portfolio – Investment Grade

Monthly Rebalancing (October 2018)

Sector	Market	Size	Difference
Financials	34%	29%	-5%
Industrials	7%	11%	3%
Energy	9%	4%	-5%
Materials	2%	8%	5%
Consumer Disc	5%	11%	7%
Consumer Staples	7%	5%	-2%
Communications	8%	2%	-6%
Health Care	11%	5%	-6%
Information Tech	9%	12%	3%
Utilities	4%	6%	2%
Real Estate	2%	7%	5%

Source: J.P. Morgan.

Table 52: Rating weights for Size portfolio – Investment Grade

Monthly Rebalancing (October 2018)

Rating	Market	Size	Difference
AAA	2%	2%	0%
AA	10%	2%	-8%
A	42%	27%	-15%
BBB	46%	69%	23%

Source: J.P. Morgan.

Table 53: Maturity weights for Size portfolio – Investment Grade

Monthly Rebalancing (October 2018)

Maturity	Market	Size	Difference
1-3	22%	18%	-4%
3-8	37%	47%	10%
8+	41%	34%	-6%

Source: J.P. Morgan.

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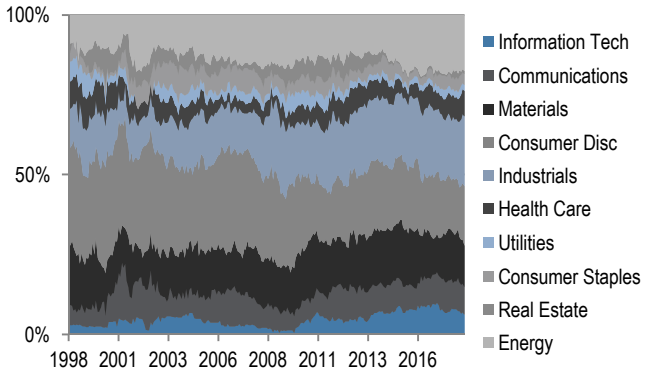
Figure 63: Sector weights for Size portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 54: Sector weights for Size portfolio – High Yield

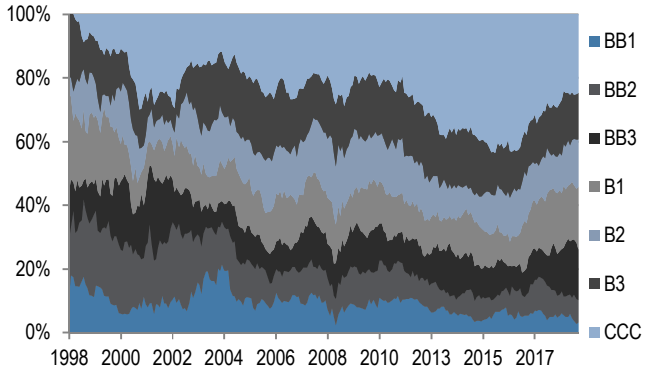
Monthly Rebalancing (October 2018)

Sector	Market	Size	Difference
Information Tech	7%	7%	0%
Communications	19%	9%	-10%
Materials	11%	14%	3%
Consumer Disc	14%	17%	3%
Industrials	12%	21%	9%
Health Care	10%	8%	-2%
Utilities	3%	3%	0%
Consumer Staples	4%	3%	0%
Real Estate	3%	1%	-2%
Energy	18%	18%	-1%

Source: J.P. Morgan.

Figure 64: Rating weights for Size portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 55: Rating weights for Size portfolio – High Yield

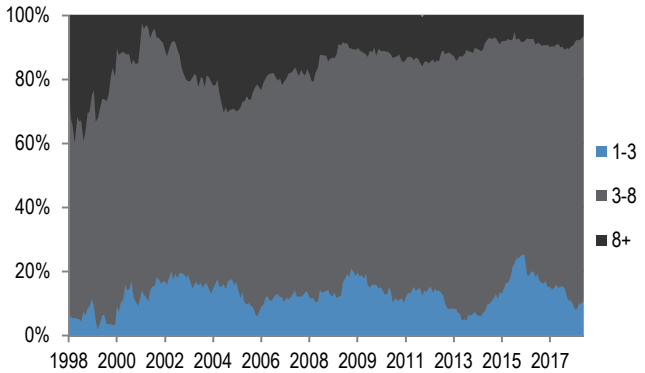
Monthly Rebalancing (October 2018)

Sector	Market	Size	Difference
BB1	16%	4%	-12%
BB2	17%	8%	-9%
BB3	16%	17%	1%
B1	15%	17%	2%
B2	12%	14%	2%
B3	14%	14%	0%
CCC	11%	25%	15%

Source: J.P. Morgan.

Figure 65: Maturity weights for Size portfolio – High Yield

Monthly Rebalancing



Source: J.P. Morgan.

Table 56: Maturity weights for Size portfolio – High Yield

Monthly Rebalancing (October 2018)

Maturity	Market	Size	Difference
1-3	11%	10%	-1%
3-8	75%	82%	7%
8+	14%	8%	-6%

Source: J.P. Morgan.

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