When VICI met CARI

Benchmark Indices for Credit Derivatives

European Credit Derivatives Strategy

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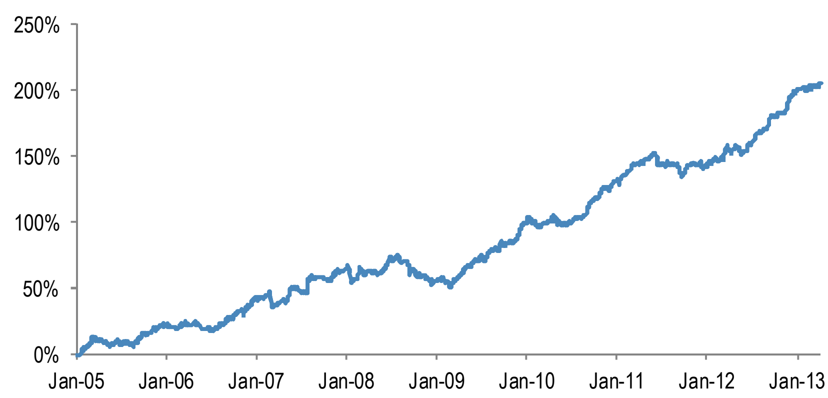
- **Illiquidity and risk premia are widespread throughout credit markets**; this is most prominently reflected in credit spreads which have greatly overestimated default rates historically. Other risk premia can be found in option, curve and tranche markets. Investors can capture these risk premia through simple credit strategies but run the risk of mark-to-market volatility from these positions.
- **In this piece we publish details of our *J.P. Morgan iTraxx Alpha Benchmarks*, which track the returns from strategies which capture risk premia in credit.** These benchmarks incorporate returns from the CDS index, curve, option and tranche markets and are based on the historical indices we first discussed in *iTraxx Alpha Strategies* (the VICI, TRACI and CURSTI indices). These benchmarks reflect the historical long-term returns from taking exposure to risk premia across credit.
- **These benchmarks are scaled using a target-volatility scaling method**; leverage is applied to each benchmark in order to target a set P&L volatility. The leverage of the benchmark will adjust for the recent volatility of the market. This approach mirrors tracking P&L of derivative strategies based on return on margin, given that the volatility of the underlying product is a significant factor in determining the size of the initial margin.
- **A broad basket of trades that capture credit risk premia has given a strong and consistent return** since the inception of the CDS index market, as measured by our *Credit Alpha Return Index* (CARI) which combines strategies in CDS indices, curves, options and tranches. This performance can be seen in Figure 1.

Figure 1: Historical Performance for Credit Alpha Return Index
P&L (%). Notional is scaled daily to target an annual P&L volatility of 10% with a one month lookback.



Source: J.P. Morgan.

See page 33 for analyst certification and important disclosures.

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Table of Contents

Appendices

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A Benchmark Index for Unfunded Credit Derivatives

Credit spreads should, in an idealised world, purely reflect the default risk inherent in the underlying instrument. In this world, we would expect the long term P&L from selling CDS protection to be zero; the losses we make from defaults would be perfectly offset by the coupons we receive. However, the markets we operate in are far from perfect. Over the history of debt markets, the compensation investors have received in the form of credit spreads has compensated them far in excess of the losses they have suffered from defaults.

The common interpretation of this discrepancy is that credit spreads price in more than straightforward default risk; **credit spreads are commonly thought to be a combination of default risk and an additional *risk premium*.**

This risk premium is a result of several different factors. Firstly, most credit investors have a large aversion to actual default events, and will demand additional spread above the rational cost of default risk in order to take on that risk. Secondly, illiquidity of certain positions means that investors require extra spread to compensate for taking on a position that can be hard to exit.

Importantly, this risk premium represents the average excess performance that can be made from being long credit risk; if we sell CDS protection on a contract trading at 100bp, of which 70bp is accounted for by default risk, then over time we would expect default risk to offset 70% of our gains from carry, leaving the investor with a residual profit of 30bp annually. However, capturing this premium on a long term basis may require the ability to withstand a large amount of mark-to-market volatility.

Our J.P. Morgan iTraxx Alpha Benchmarks track the return from standardised credit derivative products on a volatility-scaled basis, covering:

- **Indices**
- **Options**
- **Curves**
- **Tranches**

for the iTraxx indices.

These risk premia are also present in other areas of the credit markets. Historically, implied volatility in CDS index options has overcompensated investors for the underlying realised volatility. Similarly, credit curves (a typical indicator of short-term default risk) typically overestimate the likelihood of near term spikes in default risk and junior tranches overestimate the likelihood of idiosyncratic defaults.

From a valuation perspective, it is very difficult to ascertain what proportion of current credit spreads can be attributed to actual default risk and how much reflects a risk premium; historical default rates give some idea but do little to inform us about the credit environment over the remaining life of the contract or bond.

Instead, we look to calculate the historical return from capturing credit risk premia. In this piece we introduce our ***J.P. Morgan iTraxx Alpha Benchmarks***, which track the return of a range of strategies designed to capture risk premia across credit products. In particular, we include strategies based on iTraxx **indices**, **curves**, **options** and **tranches**. The historical returns of these benchmarks give an indication of the long-term profitability of these risk premium trades and the size of the premium that can be captured.

Trades that are long a credit risk premium also tend to be broadly long market risk as well; for example, sellers of protection profit from both the risk premium and any fall in default risk expectation.

As a result, **our J.P. Morgan iTraxx Alpha Benchmarks also reflect the profitability of long risk trades across different credit derivative products**.

In the process of creating these benchmarks we have used a target-volatility scaling method to size the respective components of the benchmark with respect to one another and also to scale the overall benchmark index. This method works by applying leverage to the benchmark such that the realised P&L volatility under this leverage equals a target volatility level; investors can compare the returns of each benchmark to their portfolios based on their own appetite for P&L volatility.

Given that initial margins are generally proportional to the volatility of the underlying product, this method reflects the economics of the credit derivatives market where products trade on an initial margin and the economic P&L of the trade is best expressed in terms of the return on margin.

In the first half of this piece we discuss the historical performance of the benchmarks, both for the individual iTraxx products as well as the overall Credit Alpha Return Index. In particular we find that:

- The *Credit Alpha Return Index (CARI)* has performed very strongly since 2004, showing that trades which capture risk premia have historically returned strong and consistent returns in credit.
- The CARI benchmark has outperformed equivalent benchmarks in cash credit and equities on a volatility-adjusted basis.
- Performance since 2008 has been primarily driven by the strong performance of option and curve strategies.

In the Appendices, we give details of the mathematical framework used to calculate the benchmark indices as well as discuss the implications of modifying input parameters on the historical performance of each index. We also give details on how historical performance data can be downloaded from *DataQuery*.

The structure of our J.P. Morgan iTraxx Alpha Benchmark universe is shown in Figure 2.

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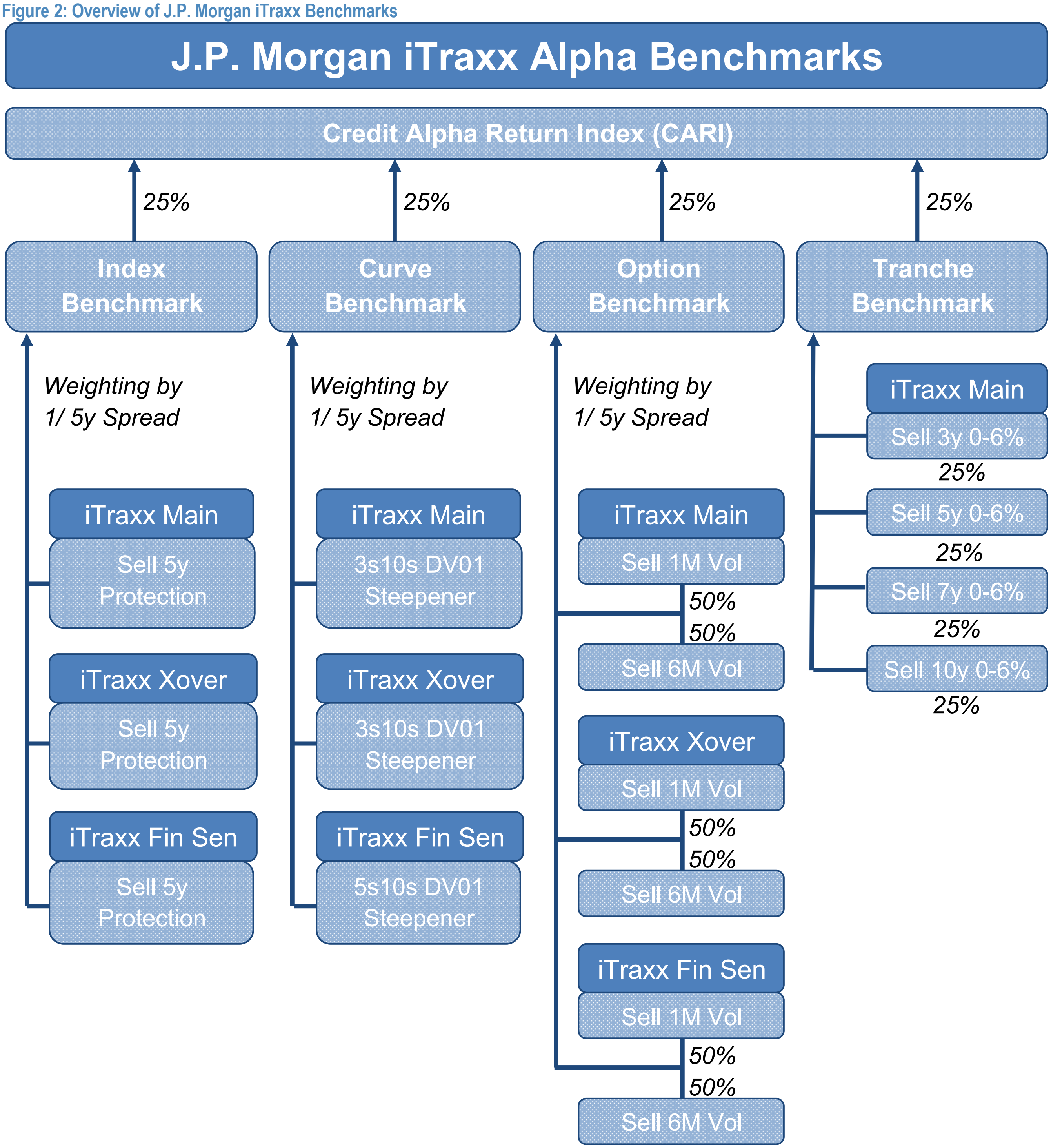
Figure 2: Overview of J.P. Morgan iTraxx Benchmarks



Source: J.P. Morgan.

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The Historical Performance of Credit Derivatives Benchmarks

In this chapter, we provide an overview of how risk premia capturing strategies using credit derivatives have performed since standardised CDS index products began trading.

The benchmarks we provide results for are volatility-scaled; they target a fixed P&L volatility[1] and so automatically adjust for the inherent volatility of the market at that time. In stable markets, the strategies will increase notional in order to achieve higher returns while in more volatile markets this leverage is reduced. This mechanism is by no means perfect; rapid changes in volatility can overwhelm the adjustment measure and lead to large deviations in the actual volatility of the strategy from the target level. We discuss this mechanism in more detail in the next chapter. The performance of the different benchmarks since inception is shown in Table 1.

Table 1: Comparison of Credit Derivative Benchmark Performance

Performance since 2005 or since start of strategy. 10% target volatility. 1 month lookback period for volatility calibration.

Benchmark	Annual P&L	Information Ratio
Credit Alpha Return Index - CARI	32.1%	2.84
Index	8.9%	0.78
Curve	19.2%	1.60
Option	35.5%	2.91
Tranche	15.0%	1.28

Source: J.P. Morgan.

In summary, we find that:

- The **Credit Alpha Return Index (CARI)**, which contains strategies covering indices, curves, options and tranches, has provided a very steady return over the past 8 years with an average annual P&L of 32% (for a target volatility of 10% and a 1 month calibration period) and an information ratio of 2.84.

- The **Index Benchmark**, which tracks the return from selling 5y protection on Main, Crossover and Senior Financials has returned an average of 8.9% annually since 2005 (against a target P&L volatility of 10% and a 1 month calibration period) with an information ratio of 0.78. Based on a 1 month calibration period the Index Benchmark was able to successfully delever quickly enough to avoid a large loss in 2007; strategies which adjusted their leverage using a longer calibration encountered a very large drawdown over this period.

- The **Curve Benchmark**, which follows the P&L from duration-weighted steepeners on Main, Crossover and Senior Financials has returned an average of 19.2% annually since 2005 with an information ratio of 1.60. The Curve Benchmark was largely flat up until 2009 but has performed impressively since then as curves steepened significantly in 2010-2012.

- The **Option Benchmark**, which follows the P&L from selling both short and long-dated volatility on Main, Crossover and Senior Financials, returning an average of 35.5% annually for a target volatility of 10% with an information ratio of 2.91. This strategy has been remarkably steady since 2008 and has profited from the historically high risk premium of implied over realised volatility.

[1] For these results we target a volatility of 10% using a calibration period of 1 month, but the results can be linearly scaled to target any other volatility level.

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- The **Tranche Benchmark**, which follows the P&L from selling protection on equity and junior mezzanine tranches on a delta-hedged basis, has returned an average of 15.0% annually since 2005 (for a target volatility of 10% and a 1 month calibration period) which equates to a information ratio of 1.28. The tranche benchmark saw an especially impressive performance in mid-2007 when correlation suddenly increased following a period of subdued P&L volatility.

We give more detail on the performance of each benchmark in each of the next sections.

Credit Alpha Return Index (CARI)

The *Credit Alpha Return Index* is designed to give an indication of the overall alpha, or excess performance, available from the standardised index-based credit derivatives markets as a whole as a result of risk premia. This benchmark is composed of individual allocations into the four separate product-based benchmarks, namely:

- 25% Index Benchmark
- 25% Curve Benchmark
- 25% Option Benchmark
- 25% Tranche Benchmark

These allocations are kept constant and the total volatility of the combined Credit Alpha Return Index strategy is then scaled to meet a target volatility; in the results below we use a target volatility of 10%. The return of CARI since 2005 is shown in Figure 3 for a target volatility of 10%. The performance of this strategy has been remarkably steady, with few major drawdowns throughout the lifetime of the strategy. This can be attributed to the uncorrelated and diversified performance of the underlying constituents; spread may have moved significantly wider from 2006 to 2009 but, as we shall see, the performance of the successful strategies was enough to offset the unprofitable strategies. Since 2009, the Credit Alpha Return Index has performed very well, driven by the strong performance of the curve, option and tranche constituents.

Table 2: Historical Return and Information Ratio for the Credit Alpha Return Index

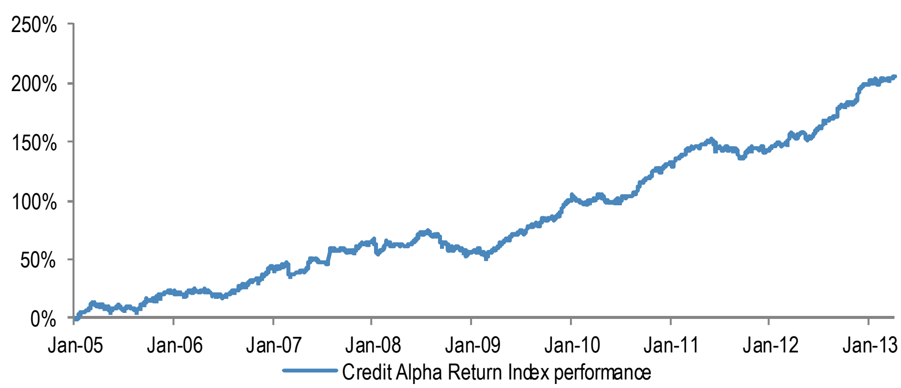
10% P&L Volatility Target.

Year	Return	IR
2012	61%	6.08
2011	15%	1.37
2010	41%	3.91
2009	70%	7.41
2008	0%	0.03
2007	16%	1.41
2006	23%	2.14
2005	23%	2.14

Source: J.P. Morgan.

Figure 3: Historical Performance of the Credit Alpha Return Index

P&L (%) based on P&L volatility target of 10%. The Credit Alpha Return Index is composed of 25% index, 25% curve, 25% option and 25% tranche benchmarks. Lookback period of 1 month for volatility calibration.



Source: J.P. Morgan.

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Index Benchmark

Table 3: Historical Return and Information Ratio for Index Benchmark

10% P&L Volatility Target.

Year	Return	IR
2012	15%	1.51
2011	-5%	-0.48
2010	-2%	-0.18
2009	15%	1.59
2008	-20%	-1.72
2007	-13%	-0.97
2006	34%	3.01
2005	25%	1.96

Source: J.P. Morgan.

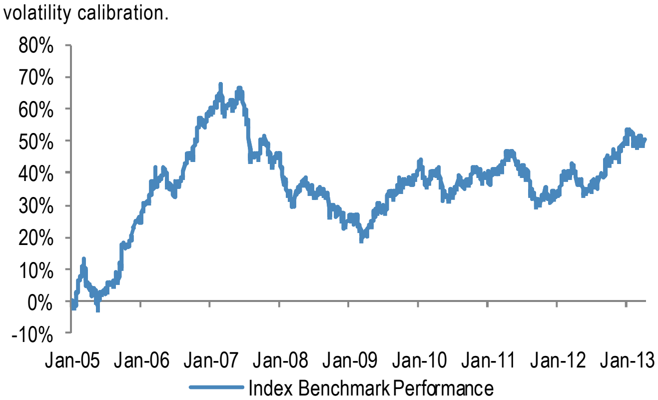
The *Index Benchmark* tracks the return from selling 5y protection on a combination of iTraxx Main, Crossover and Senior Financial indices. This benchmark can viewed as the available excess performance from being long the risk premium in credit spreads through liquid 5y CDS indices.

The performance of the Index Benchmark since 2005 can be seen in Figure 4. Selling protection on indices performed very well from 2005-2006 when volatility was low; at this point the index benchmark was adding leverage to achieve the target P&L volatility of 10%, as shown in Figure 5.

In 2007, volatility increased and credit spreads widened significantly, causing a substantial initial drawdown to the Index Benchmark as leverage was reduced before leading to a long period of poor performance as credit spreads continued to widen. These results are based on a volatility calibration period of one month; strategies using a long calibration period saw a larger drawdown in 2007 due to the delay in reducing leverage. We discuss the impact of the volatility calibration period in detail in Appendix II.

Figure 4: Historical Performance of Index Benchmark

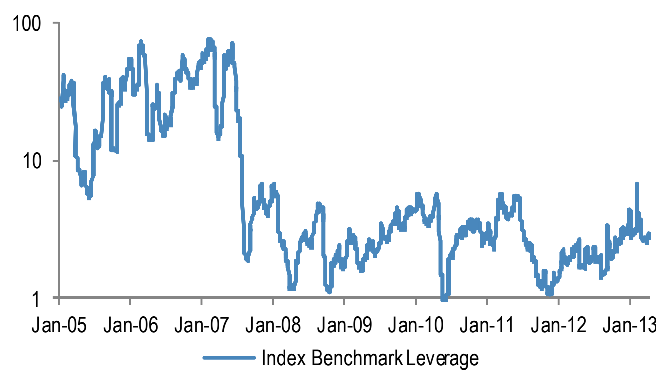
P&L (%) based on P&L volatility target of 10%. 1 month lookback period for volatility calibration.



Source: J.P. Morgan.

Figure 5: Historical Leverage of Index Benchmark

Leverage required to achieve P&L volatility target of 10%. Logarithmic scale. 1 month lookback period for volatility calibration.



Source: J.P. Morgan.

We see these results as symptomatic of the performance seen by many credit investors in the run up to the Financial Crisis; tight spreads and low volatility led many investors to add leverage in the form of CSOs, CPDOs and other structured products but led to major losses in 2007 when volatility spiked too quickly for investors to be able to reduce leverage in time.

Curve Benchmark

Table 4: Historical Return and Information Ratio for Curve Benchmark

10% P&L Volatility Target.

Year	Return	IR
2012	76%	7.02
2011	9%	0.70
2010	25%	2.19
2009	67%	5.47
2008	-20%	-1.70
2007	8%	0.65
2006	-15%	-1.19
2005	5%	0.46

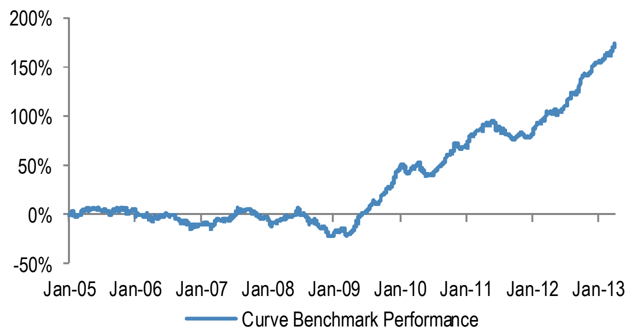
Source: J.P. Morgan.

Short-dated CDS contracts are typically used by market participants looking to hedge against short-term default risk (e.g. CVA desks). These investors often have a specific mandate to use short-dated CDS to hedge against near-term defaults, which we believe pushes curves to flatter levels than they would be solely based on default risk. Investors can take advantage of this and capture this risk premia by entering duraton-weighted steepeners. The *Curve Benchmark* tracks the returns of these strategies across iTraxx Main, Crossover and Senior Financials.

The performance of the Curve Benchmark since 2004 can be seen in Figure 6 for a target P&L volatility of 10%. The Curve Benchmark had a flat return from 2004 until the end of 2008 and did not see the large negative drawdown associated with the Index Benchmark. This is a result of the more consistent leverage in the curve space; leverage did not rapidly accelerate into the Financial Crisis and did not see a very large reduction in leverage in the aftermath (Figure 7). Since 2008, the steady steepening of curves in credit indices has seen the Curve Benchmark record a highly impressive return, returning 178%.

Figure 6: Historical Performance of Curve Benchmark

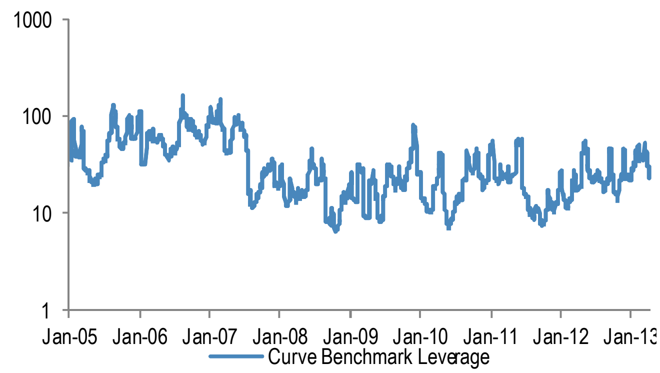
P&L (%) based on P&L volatility target of 10%. 1 month volatility calibration period.



Source: J.P. Morgan.

Figure 7: Historical Leverage of Curve Benchmark

Leverage required to achieve P&L volatility target of 10%. Logarithmic scale. 1 month volatility calibration period.



Source: J.P. Morgan.

The potential for similar impressive returns in the near future for the Curve Benchmark is limited; curves have now steepened to the point where the time value from these positions is greatly reduced compared to previous years and the potential for further steepening from here appears limited.

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Option Benchmark

Our *Option Benchmark* tracks the return from selling both short-dated (0-1 month) and longer-dated (3-6 month) volatility on iTraxx Main, Crossover and Senior Financials. We then apply leverage to the benchmark to target a set P&L volatility. The Options Benchmark tracks the return from the being long the risk premium of implied volatility over realised volatility both in short and longer dated options.

Table 5: Historical Return and Information Ratio for Option Benchmark

10% P&L Volatility Target.

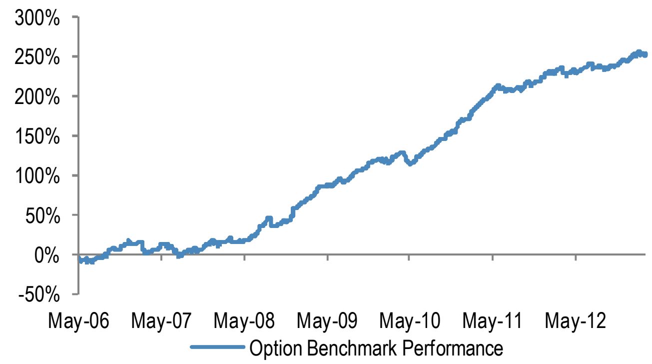
Year	Return	IR
2012	22%	1.93
2011	54%	4.93
2010	49%	4.17
2009	62%	6.66
2008	41%	2.57
2007	0%	0.01
2006	20%	1.83

Source: J.P. Morgan.

Figure 8 shows the historical performance of the Options Benchmark, scaled for a target volatility of 10%. The return of this strategy has been very impressive since 2008; the main driver of this performance has been the large premium of implied volatility over realised (Figure 10), as we have highlighted previously in our VICI indices[2].

Figure 8: Historical Performance of Option Benchmark

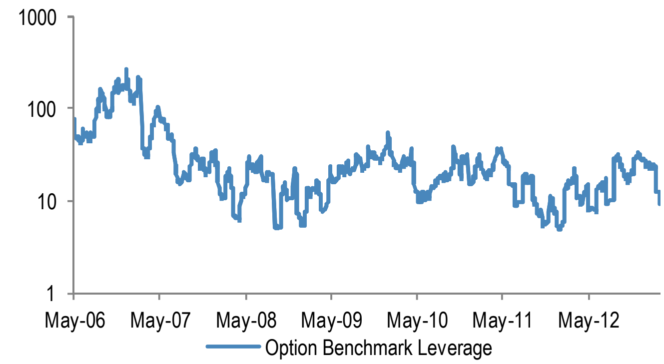
P&L (%) based on P&L volatility target of 10%.



Source: J.P. Morgan.

Figure 9: Historical Leverage of Option Benchmark

Leverage required to achieve P&L volatility target of 10%. Logarithmic scale.



Source: J.P. Morgan.

The Options Benchmark avoided a large drawdown in performance in 2008, partly due to the resilient performance of the underlying VICI indices (as seen in Figure 11) but also due to the strategy successfully deleveraging at a steady rate over the course of 2007 (as shown in Figure 9), rather than being subjected to the rapid deleveraging seen in the Index Benchmark.

Going forward, we expect the performance of the VICI benchmark to be reduced compared to recent years; implied and realised volatility have converged in the past twelve months due to an increased awareness of the attractiveness of being short volatility as well as the departure of several historical buyers of credit volatility from the market[3].

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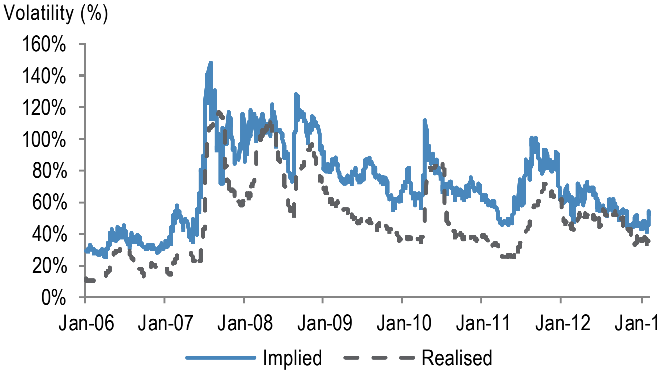
[2] See *Credit Volatility Indices*, D. White, 29th March 2011.

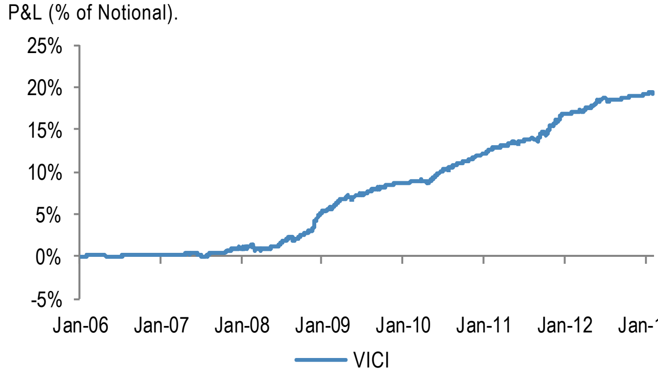
[3] In particular loan desks and correlation desks have both reduced their use of CDS options in the past year. Overall volumes in options however have increased due to an increased take-up by hedge funds and the real money community.

Figure 10: Historical iTraxx Main Implied and Realised Volatility



Source: J.P. Morgan.

Figure 11: VICI: P&L from selling 1 month straddles on iTraxx Main and delta-hedging daily



Source: J.P. Morgan.

Tranche Benchmark

The *Tranche Benchmark* tracks the return from selling protection on the most junior part of the capital structure, namely the 0-6% tranche (a combination of the 0-3% and 3-6% tranches), for a range of tenors. The Tranche Benchmark tracks the return from the risk premium associated with leveraged idiosyncratic default risk.

The historical performance of the Tranche Benchmark can be seen in Figure 13. The performance in the past eight years is dominated by the sudden jump in P&L in mid-2007. This is a result of the onset of the Subprime crisis and the sudden increase in implied correlation that accompanied it. When correlation increased this led to a outperformance of junior tranches, leading to the high return of the Tranche Benchmark. The performance since 2007 has also been solid as junior tranches have benefited from the low rate of realised defaults in Europe.

The historical leverage of the Tranche Benchmark can be seen in Figure 13. Low volatility before the subprime crisis led to a large build-up in leverage, which was rapidly reduced following the sudden spike in volatility in 2007.

Table 6: Historical Return and Information Ratio for Tranche Benchmark

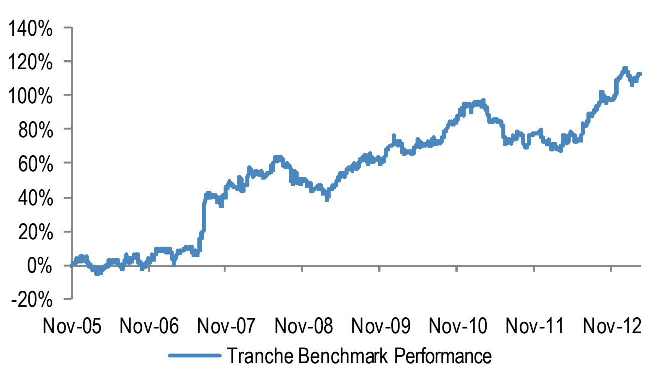
10% P&L Volatility Target.

Year	Return	IR
2012	42%	3.82
2011	-22%	-1.80
2010	23%	2.02
2009	26%	2.65
2008	0%	-0.02
2007	36%	2.64
2006	6%	0.61

Source: J.P. Morgan.

Figure 12: Historical Performance of Option Benchmark

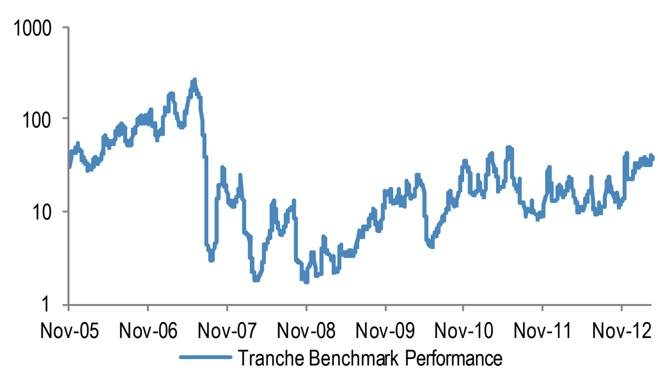
P&L (%) based on P&L volatility target of 10%.



Source: J.P. Morgan.

Figure 13: Historical Leverage of Tranche Benchmark

Leverage required to achieve P&L volatility target of 10%. Logarithmic scale.



Source: J.P. Morgan.

Comparison with other Asset Classes

The creation of a credit derivatives benchmark allows us to compare the performance of credit derivatives to that of other asset classes. By constantly re-scaling the notional of each asset class to target a fixed annual P&L volatility we can directly compare the performance of our credit derivatives benchmarks with that of other assets.

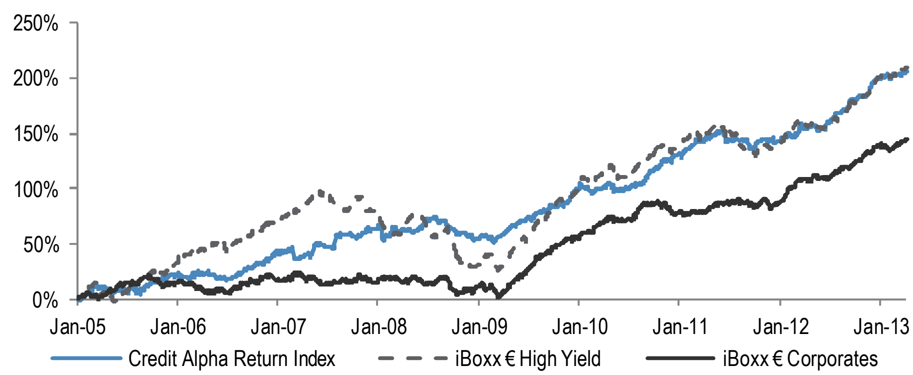
The *Credit Alpha Return Index* has outperformed other benchmarks including HG credit, HY credit and equities since 2004 when measured on a volatility-scaled basis.

Figure 14 compares the performance of our Credit Alpha Return Index with the volatility-scaled performance of the iBoxx € Corporates index and an iBoxx € High Yield index. CARI has outperformed the high grade index by a large margin and shows a slight improvement over the high yield index, but with a significantly lower drawdown in 2007-08 than the high yield benchmark.

This means that a basket of long risk premia credit derivatives trades has been more profitable over the past nine years than either high grade or high yield credit for an investor willing to tolerate a set amount of annual volatility.

Figure 14: Comparison of Credit Alpha Return Index with Volatility-Scaled Performance for iBoxx € Corporates and iBoxx € High Yield

P&L (%). Notionals for each index are constantly re-scaled to target an annual P&L volatility of 10%. iBoxx € Main Non-Financial High Yield Cum Crossover index is used.



Source: J.P. Morgan.

It is also useful to examine the correlation between the returns of the Credit Alpha Return Index and those of High Grade and High Yield credit. A high correlation would suggest that CARI simply replicates the performance of cash credit, with there being little benefit in using credit derivatives as an overlay as far as diversification goes. Figure 15 and Figure 16 show the historical correlation between the Credit Alpha Return Index and iBoxx € Corps/Liquid High Yield respectively.

The correlation between the Credit Alpha Return Index and High Grade credit (Figure 15) has averaged -9% over the past year (based on the 3 month correlation of weekly returns) suggesting that the two time series have largely been uncorrelated over the last eight years. By comparison, there has been a higher correlation between the High Yield index and CARI (averaging 40%). This difference between HG and HY credit can be interpreted as the greater influence of interest rate movements on the returns of high grade funds.

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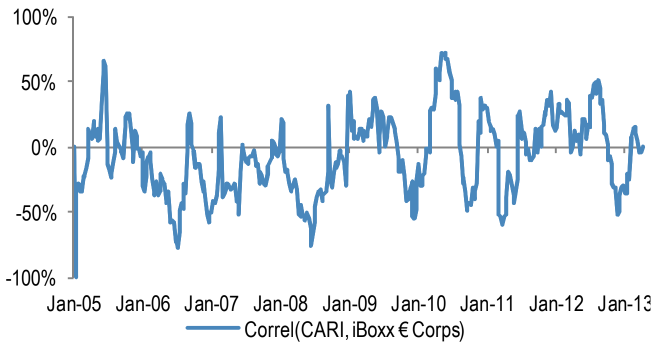
Figure 15: Correlation of iBoxx € Corps and Credit Alpha Return Index

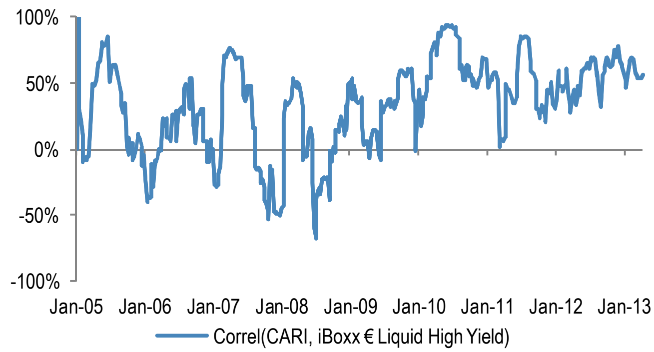
6 Month Correlation of Weekly Returns. Average Correlation = -10%



Source: J.P. Morgan.

Figure 16: Correlation of iBoxx € Liquid High Yield and Credit Alpha Return Index

6 Month Correlation of Weekly Returns. Average Correlation = 40%



Source: J.P. Morgan.

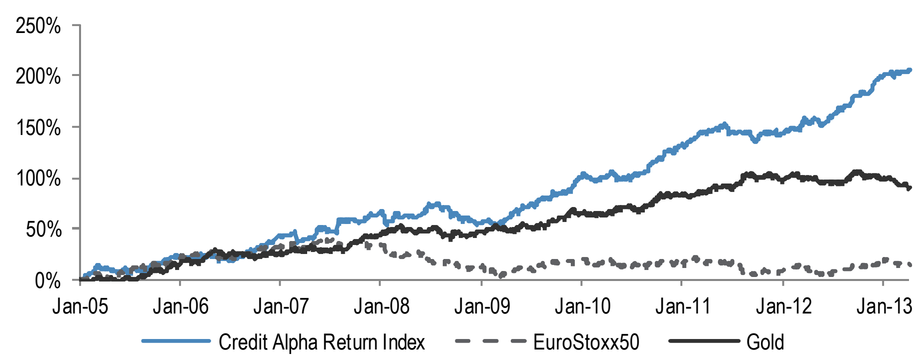
In both the case of high grade and high yield credit, we feel that the correlation between the Credit Alpha Return Index and the index in question is sufficiently low to ensure that an investor is not simply increasing their overall risk levels by using CARI or other credit derivative strategies as a portfolio overlay.

We can also compare the performance of the Credit Alpha Return Index to other asset classes outside of credit. Figure 17 compares the performance of CARI with the volatility-scaled performance of both the EuroStoxx 50 and of a long gold trade; in both cases the notional is scaled to target an annual volatility of 10%.

The Credit Alpha Return Index shows a superior performance to that of both the EuroStoxx 50 index and gold on a volatility-scaled basis. Again, this indicates that for a investor comfortable with a set level of volatility, credit derivatives have offered a superior long risk investment than investments in other asset classes over the past nine years.

Figure 17: Comparison of Credit Alpha Return Index with Volatility-Scaled Performance for EuroStoxx50 and iBoxx € Corporates

P&L (%). Notionals for each index are constantly re-scaled to target an annual P&L volatility of 10%.



Source: J.P. Morgan.

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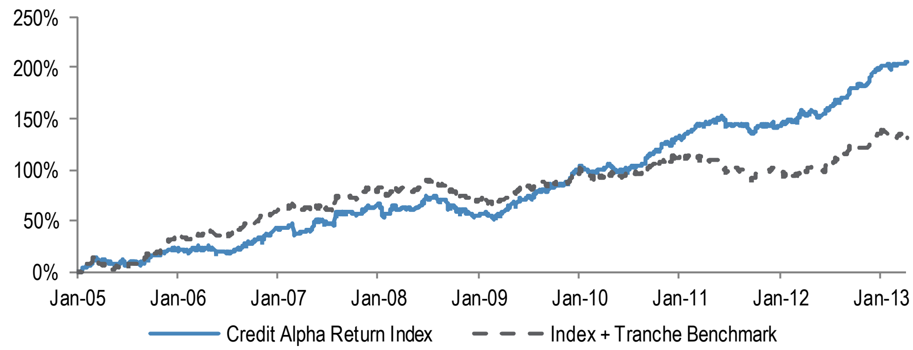
The most profitable part of the *Credit Alpha Return Index* in recent years has been the Option and Curve components.

Over recent years the performance of the Credit Alpha Return Index has primarily been driven by the Curve and Option Benchmarks. This can be seen from Figure 18, which compares the performance of CARI with an index which has had the option and curve components removed; these indices moved largely in line up until January 2011 at which point the strong performance of the Curve and Option Benchmarks began to dominate the overall index.

Figure 18: Comparison of Credit Alpha Return Index with iTraxx Index + Tranche Only Benchmark

P&L (%). Notionals for each index are constantly re-scaled to target an annual P&L volatility of 10%. Lookback period of 1 month.



Source: J.P. Morgan.

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Constructing a Benchmark for Credit Derivatives

Benchmark indices are designed to reflect the average performance of a certain market and to give market participants a point of comparison for the returns of investors in this market. Achieving the performance of a benchmark should not be a difficult task; in fact many passive investors do exactly this with little tracking error (net of access fees) by structuring their portfolios to mimic the composition of the underlying benchmark as closely as possible. We present the returns of our credit derivatives benchmarks as the return that is obtainable from simple strategies on liquid credit derivative products, rather than a historically optimised return which relies on choosing certain strategies over others.

Our benchmarks are designed to track the returns of a variety of credit derivatives strategies which capture some type of risk premia in the credit markets. When combining the returns of these different strategies we must find some way to size each relative to the others and also how to size the return of the overall benchmark.

In the cash bond space, all the bonds that meet the criteria of the benchmark (often based on rating, currency and issue size) will be included and the returns weighted by the outstanding market value of the bond. If an investor was able to purchase all the outstanding bonds in the market that met this criteria, his or her return would match that of the bond benchmark.

We use a *target volatility* method to combine and size our J.P. Morgan iTraxx Alpha Benchmarks.

When trying to apply this methodology to credit derivatives strategies we immediately run into a number of hurdles. Firstly, the concept of "outstanding market value" for a CDS contract does not exist as such; while there is publically available data on the amount of CDS notional outstanding this does not represent the size of the market in the same way that the cash bond market does; for every buyer of CDS protection there will be a seller. Secondly, even if we were to try and create a benchmark for credit derivatives based on outstanding net notionals there is little available data on CDS options, curves and tranches.

Another issue is that cash bond benchmark returns are based on return on investment; if you buy a bond priced at 100 and one year later it is still priced at 100 and you have received one 5% coupon then your return on investment is 5%. The unfunded nature of the CDS market invalidates the "return on investment" concept; the upfront cash payment written into the CDS contract is in most cases small compared to the CDS notional and in some cases the seller of protection will be the party receiving the upfront. Sellers of CDS protection will be required to pay an initial margin to enter the position; this represents the “true" investment required to open a CDS position but is ill-suited to base a benchmark index upon; there is little publically available data on the initial margins required to enter credit derivatives trades.

Instead, we use a **target volatility** scaling to combine and then size our benchmark returns. Our logic here is that the true constraints on the size of a position in the credit derivatives market are the mark-to-market volatility that the investor is willing to accept on the position and the initial margin required to enter the trade. Given that the initial margin will be largely based upon the volatility of the position, we feel that a target volatility scaling method gives a good representation of the return on initial margin.

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The target volatility method works by calculating what the realised P&L volatility of the position would have been over the past month. Once this has been established, the size of the position on this day is scaled such that the P&L volatility over the past month would have been equal to the target volatility. For example, let us assume that on day *i* that our Index Benchmark will consist of 50% iTraxx Main, 30% iTraxx Senior Financials and 20% iTraxx Crossover and that this position would have had a P&L volatility of 5% over the past month for the weightings on this day. If we have a target volatility of 10%, the size of the overall position is doubled such that this position would have had a realised P&L volatility of 10% over the past month.

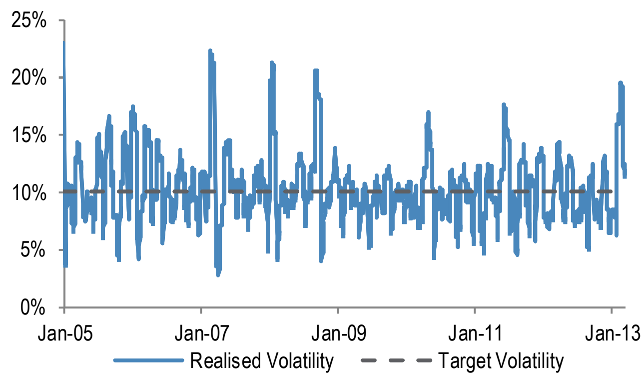
This rebalancing occurs on a regular basis; in the results discussed here and in the previous chapter we assume that the notional of each strategy within the Credit Alpha Return Index and the overall leverage of CARI is rebalanced daily. In Appendix II we discuss both the impact of rebalancing on less frequent intervals and changing the lookback period for volatility calibration.

In reality, the realised volatility on any particular day is unlikely to be exactly equal to that over the last three months and as a result the realised volatility of the target-volatility scaled benchmark can overshoot or undershoot the target level. The difference between the realised volatility of the Credit Alpha Return Index and the target volatility is shown in Figure 19

This concept of target volatility means that the benchmark indices will automatically adjust to suit the prevailing market conditions at the time. When markets are stable and P&L volatility is low, the benchmarks will increase leverage in order to achieve the target volatility. Similarly, when volatility is high the benchmark indices will automatically adjust and will scale down the notional at risk. The leverage of the Credit Alpha Retrun Index throughout time is shown in Figure 20.

Figure 19: Realised P&L Volatility vs. Target P&L Volatility for Credit Alpha Return Index

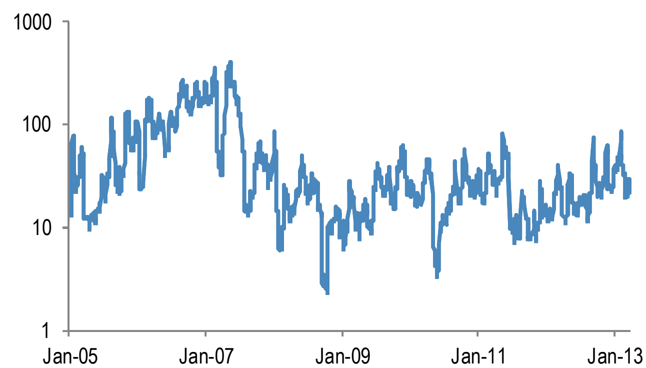
Target volatility of 10%. Sample period of 1 month.



Source: J.P. Morgan.

Figure 20: Leverage of Credit Alpha Return Index

Target volatility of 10%. Logarithmic Scale. Sample period of 1 month.



Source: J.P. Morgan.

We use the target volatility scaling method to size the notionals for the individual index, curve, option and tranche benchmarks as well as the overall Credit Alpha Return Index. The composition and structure of each individual benchmark are discussed in the following pages.

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Index Benchmark

The *Index Benchmark* tracks the return from selling 5y protection on a combination of iTraxx Main, Crossover and Senior Financial indices. The individual weightings of each index in the benchmark are based on the inverse of the 5y spreads as of the close of the previous day, as shown in Equation 1 to Equation 3. For example, if the index spreads are 100bp, 200bp and 400bp for Main, Senior Financials and Crossover respectively then the weightings of each index will be 4/7, 2/7 and 1/7th respectively for the next business day. This weighting means that the amount of carry received from each index is equal.

Equation 1: Main Weighting

$$w_{Main}^{i} = \frac{\frac{1}{S_{Main}^{i-1}}}{\frac{1}{S_{Main}^{i-1}} + \frac{1}{S_{Xover}^{i-1}} + \frac{1}{S_{Fin}^{i-1}}}$$

w^i_j = weighting of index *j* on day i. S^i_j = 5y Spread of index *j* at close of business on day *i.*

Equation 2: Xover Weighting

$$w_{Xover}^{i} = \frac{\frac{1}{S_{Xover}^{i-1}}}{\frac{1}{S_{Main}^{i-1}} + \frac{1}{S_{Xover}^{i-1}} + \frac{1}{S_{Fin}^{i-1}}}$$

w^i_j = weighting of index *j* on day i. S^i_j = 5y Spread of index *j* at close of business on day *i.*

Equation 3: Fin Senior Weighting

$$w_{Fin}^{i} = \frac{\frac{1}{S_{Fin}^{i-1}}}{\frac{1}{S_{Main}^{i-1}} + \frac{1}{S_{Xover}^{i-1}} + \frac{1}{S_{Fin}^{i-1}}}$$

w^i_j = weighting of index *j* on day i. S^i_j = 5y Spread of index *j* at close of business on day *i.*

Using these weightings we can then establish what the realised P&L volatility of the Index Benchmark over the past three months would have been if these weightings had been used. Based on this, we then scale the notional of the benchmark in line with the target volatility. For example, if the new weightings would have produced an annual P&L volatility of 5% over the past three months compared to a target volatility of 10% then the notional of the benchmark would be doubled to meet this target. We further explain how weightings and historical returns produce the required leverage in Appendix I.

The calculation for the daily return of the Index Benchmark is shown in Equation 4

Equation 4: Index Benchmark Daily Return

$$Index\ Benchmark\ Daily\ Return_i = Leverage_i \times \sum_{j=1}^{3} w_{ij} R_{ij}^{Index}$$

w_{ij} = weighting of index *j* on day *i.* R_{ij} = Daily return from selling 5y protection on index *j* on day *i* as % of notional.

The current breakdown of the positions in the Index Benchmark for a portfolio of €100million targeting a volatility of 10% is shown in Table 7.

Table 7: Current Breakdown of Index Benchmark

For a €100mm portfolio targeting an annual P&L volatility of 10%.

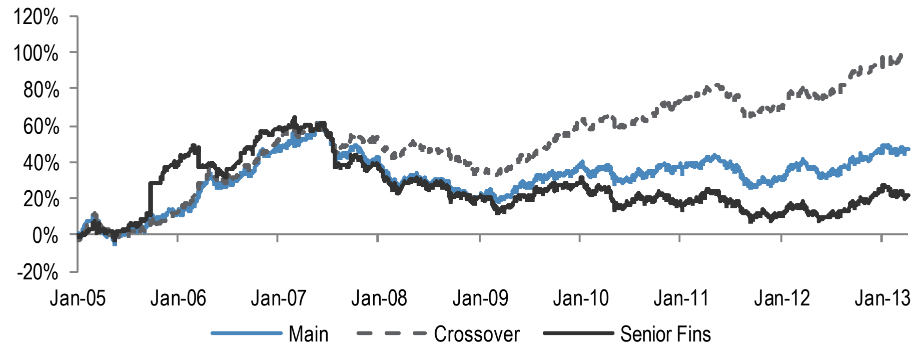
Position	Notional (€)
Sell Main S19 5y Protection	146,685,415
Sell Xover S19 5y Protection	36,861,953
Sell Fin Senior S19 5y Protection	98,984,505

Source: J.P. Morgan. Positions correct as of 5 April 2013

The relative performance on each component of the Index Benchmark can be seen in Figure 21 on a volatility-scaled basis. iTraxx Crossover has been the best performing of the three indices, benefiting from low default rates in Europe. The Senior Financial index has underperformed as a result of the continuing systemic concerns around financial institutions in Europe.

Figure 21: Performance of Index Benchmark Components

P&L (%) from selling 5y protection. Target volatility = 10% with a one month lookback.



Source: J.P. Morgan.

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Curve Benchmark

The *Curve Benchmark* follows the return of duration-weighted steepeners in iTraxx Main, Crossover and Senior Financials. Duration-weighted steepeners are conventionally positive time value trades with negative jump-to-default exposure; the Curves Benchmark reflects the historical profitability of these trades.

In each index, we use duration-weighted steepeners based on the entire tradeable curve. For iTraxx Main and Crossover the 3y point is tradeable and so we use 3s10s duration-weighted steepeners. This can be seen as a combination of a 3s5s and 5s10s duration-weighted steepener (correctly weighted) and gives exposure to the entire curve rather than focusing on a single part of it. For Senior Financials only the 5y and 10y points are tradeable and so we use the P&L from 5s10s duration-weighted steepeners on Senior Financials as an input into the Curve Benchmark. We denote the daily returns of each component of the Curve Benchmark using R_{ij}^{Curve} as follows:

$$R_{ij}^{Curve} \begin{cases} j=1 & \text{Return of Main 3s10s DV01-weighted steepener on day } i \\ j=2 & \text{Return of Xover 3s10s DV01-weighted steepener on day } i \\ j=3 & \text{Return of Fin Sen 5s10s DV01-weighted steepener on day } i \end{cases}$$

These returns are based on our CURSTI indices, which we discuss in *iTraxx Alpha Strategies*, 12th October 2012

Similar to the Index Benchmark, we give a weighting to the steepener in each index based on the 5y spread of that index, as shown in Equation 1 to Equation 3. The overall return of the Curve Benchmark, after volatility scaling, is shown in Equation 5

Equation 5: Curve Benchmark Daily Return

$$Curve\ Benchmark\ Daily\ Return_i = Leverage_i \times \sum_{j=1}^{3} w_{ij} R_{ij}^{Curve}$$

w_{ij} = weighting of index *j* on day *i*. R_{ij} = Daily Return of Duration-Weighted Steepener on index *j* on day *i*.

The current breakdown of the positions in the Curve Benchmark for a portfolio of €100million targeting a volatility of 10% is shown in Table 8.

Table 8: Current Breakdown of Curve Benchmark

For a €100mm portfolio targeting an annual P&L volatility of 10%.

Position	Notional (€)
Main S19 3s10s DV01 Steepener	1,195,728,902
Xover S19 3s10s DV01 Steepener	300,485,927
Fin Senior S19 5s10s DV01 Steepener	806,887,542

Source: J.P. Morgan. Positions correct as of 5 April 2013. Curve notionals are the notional of the shorter tenor.

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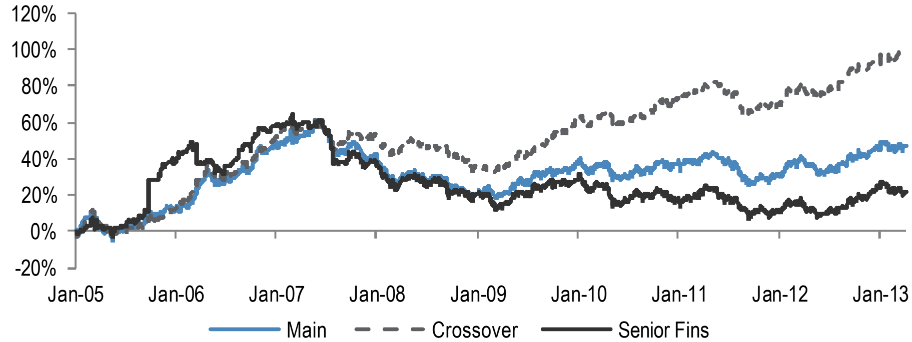
The volatility-scaled performance of the separate components of the Curve Benchmark can be seen in Figure 21. DV01-weighted steepeners on iTraxx Crossover have been the most successful of the three indices.

Figure 22: Performance of Curve Benchmark Components

P&L (%) from DV01-weighted steepeners. Target volatility = 10% with a one month lookback.



Source: J.P. Morgan.

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Option Benchmark

Our *Option Benchmark* tracks the return from selling both short-dated (0-1 month) and longer-dated (3-6 month) volatility on iTraxx Main, Crossover and Senior Financials. We then apply leverage to the benchmark to target a set P&L volatility. By selling both short and longer-dated volatility, the Options Benchmark tracks the return from being both short gamma and short vega. This means that the benchmark can profit from both a fall in implied volatility and any difference between implied and realised volatility.

The daily returns of each component of the Option Benchmark are as follows:

$$R_{ij}^{Option} \begin{cases} j=1 & \text{Return from selling 50\% 0-1 month and 50\% 3-6 month volatility, delta hedged, on iTraxx Main on day } i. \\ j=2 & \text{Return from selling 50\% 0-1 month and 50\% 3-6 month volatility, delta hedged, on iTraxx Xover on day } i. \\ j=3 & \text{Return from selling 50\% 0-1 month and 50\% 3-6 month volatility, delta hedged, on iTraxx Fin Senior on day } i. \end{cases}$$

These returns from selling volatility across indices and tenors are based on our VICI indices, the returns of which are available on *DataQuery* and *JPMorganMarkets*[4].

As with the Index and Curve Benchmarks, the weightings of each index within the Option Benchmark are based on the 5y spreads of each index, as shown in Equation 1 to Equation 3.

The overall return of the Option Benchmark, after volatility scaling, is shown in Equation 6.

Equation 6: Option Benchmark Daily Return

$$Option\ Benchmark\ Daily\ Return_i = Leverage_i \times \sum_{j=1}^{3} w_{ij} R_{ij}^{Option}$$

w_{ij} = weighting of index *j* on day *i*. R_{ij} =Daily return from 50% selling 0-1 month volatility and 50% 3-6 month volatility, delta hedged, on index *j* on day *i*.

The current breakdown of the positions in the Option Benchmark for a portfolio of €100million targeting a volatility of 10% is shown in Table 9.

Table 9: Current Breakdown of Option Benchmark

For a €100mm portfolio targeting an annual P&L volatility of 10%.

Position	Notional (€)
Sell 0-1 Month Main Volatility, Delta hedged daily	474,490,019
Sell 3-6 Month Main Volatility, Delta hedged daily	474,490,019
Sell 0-1 Month Xover Volatility, Delta hedged daily	119,239,046
Sell 3-6 Month Xover Volatility, Delta hedged daily	119,239,046
Sell 0-1 Month Fin Senior Volatility, Delta hedged daily	320,189,706
Sell 3-6 Month Fin Senior Volatility, Delta hedged daily	320,189,706

Source: J.P. Morgan. Positions correct as of 5 April 2013. Option notionals refer the notional of straddles sold.

[4] See *Credit Volatility Indices*, D. White, 30th March 2011 and *iTraxx Alpha Strategies*, 12th October 2012.

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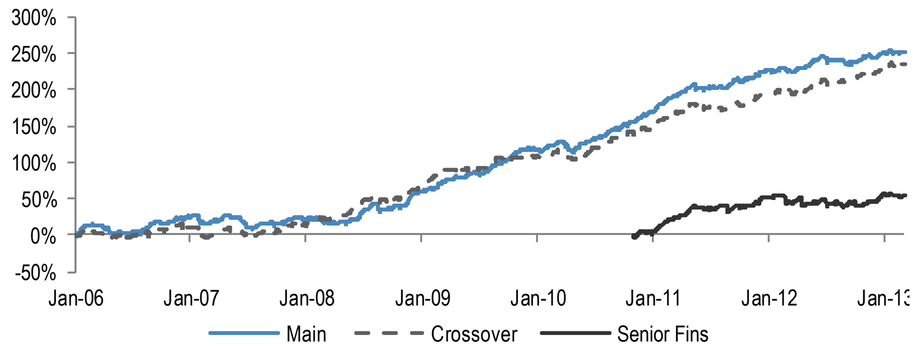
Figure 23 shows the performance of each individual component of the Option Benchmark on a volatility scaled basis. Short volatility strategies on Main and Crossover have behaved very similarly. Options on Senior Financials only became widely liquid in late 2010, meaning that this component was only contributing to the overall Option Benchmark performance from this point onwards.

Figure 23: Performance of Option Benchmark Components

P&L (%) from selling 0-1 month and 3-6 month straddles. Target volatility = 10% with a one month lookback.



Source: J.P. Morgan.

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Tranche Benchmark

The *Tranche Benchmark* tracks the return from selling protection on the most junior part of the capital structure, namely the 0-3% and 3-6% tranches for a range of tenors. The Tranche Benchmark can be seen as tracking the return from leveraged, idiosyncratic default risk. Given that tranches are only traded on iTraxx Main, there is no Crossover or Fin Senior component in this benchmark.

The daily return of the unscaled tranche benchmark is as follows:

$R_i^{Tranche}$	Return on day i from selling 0-6% protection on iTraxx Main in equal weightings split across 3y, 5y, 7y and 10y tenors where valid.

We use equal weightings in order to take equal exposure to short, mid and long-dated tranches.

The underlying index here is the on-the-run index up until iTraxx Series 9, at which point the return continues to be based on S9 due to the higher liquidity of tranches on this series. These returns are based on our TRACI indices, which track the return from selling protection on iTraxx tranches (see *iTraxx Alpha Strategies*, 12th October 2012 for more details).

The daily return of the Tranche Benchmark after volatility scaling is shown in Equation 7.

Equation 7: Tranche Benchmark Daily Return

$$Tranche\ Benchmark\ Daily\ Return_i = Leverage_i \times R_i^{Tranche}$$

R_i = return from selling protection on 0-6% tranche on current iTraxx Main series across valid 3y, 5y, 7y and 10y tenors for day *i*.

The current breakdown of the positions in the Tranche Benchmark for a portfolio of €100million targeting a volatility of 10% is shown in Table 10.

Table 10: Current Breakdown of Tranche Benchmark

For a €100mm portfolio targeting an annual P&L volatility of 10%.

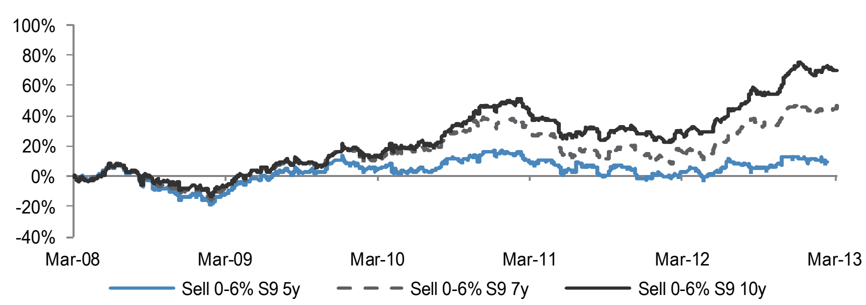
Position	Notional (€)
Sell 0-6% iTraxx Main S9 Jun-15 protection, delta hedged daily	62,264,171
Sell 0-6% iTraxx Main S9 Jun-18 protection, delta hedged daily	62,264,171

Source: J.P. Morgan. Positions correct as of 5 April 2013.

The historical volatility-scaled performance of the individual components of the Tranche Benchmark since the inception of the S9 index is shown in Figure 24Figure 23. The longer-dated tranches have been the biggest contributors to the strong performance of the Tranche Benchmark.

Figure 24: Performance of Tranche Benchmark Components

P&L (%) from selling 0-6% protection, delta-hedged daily. Target volatility = 10% with a one month lookback.



Source: J.P. Morgan.

Credit Alpha Return Index (CARI)

The *Credit Alpha Return Index* incorporates the returns of the individual Index, Curve, Option and Tranche benchmarks into a single benchmark index. After each of the individual benchmarks have been scaled to meet the volatility target, we then combine the scaled returns according to the following weightings:

- 25% Index Benchmark
- 25% Curve Benchmark
- 25% Option Benchmark
- 25% Tranche Benchmark

Given that the volatilities of the individual benchmarks are already scaled to the same target volatility before we combine them we can interpret the above weightings as the amount of CARI P&L volatility we are allocating to each individual area. We expect 25% of the P&L volatility of the Credit Alpha Return Index to be individually attributable to each of the Index, Curve, Option and Tranche Benchmarks.

After combining the individual benchmarks based on the above allocations, the realised volatility of the Credit Alpha Return Index over the past three months is likely to be different to the target volatility of the individual benchmarks as some of the P&L changes of the individual benchmark will cancel out. To compensate for this, we re-scale the size of the Credit Alpha Return Index to meet the target volatility.

The current breakdown of the positions in the Credit Alpha Return Index for a portfolio of €100million targeting a volatility of 10% is shown in Table 11.

Table 11: Current Breakdown of Credit Alpha Return Index

For a €100mm portfolio targeting an annual P&L volatility of 10%.

Position	Notional (€)
Sell Main S19 5y Protection	47,760,063
Sell Xover S19 5y Protection	12,002,074
Sell Fin Senior S19 5y Protection	32,228,877
Main S19 3s10s DV01 Steepener	389,323,558
Xover S19 3s10s DV01 Steepener	97,836,767
Fin Senior S19 5s10s DV01 Steepener	262,718,689
Sell 0-1 Month Main Volatility, Delta hedged daily	154,491,660
Sell 3-6 Month Main Volatility, Delta hedged daily	154,491,660
Sell 0-1 Month Xover Volatility, Delta hedged daily	38,823,658
Sell 3-6 Month Xover Volatility, Delta hedged daily	38,823,658
Sell 0-1 Month Fin Senior Volatility, Delta hedged daily	104,252,223
Sell 3-6 Month Fin Senior Volatility, Delta hedged daily	104,252,223
Sell 0-6% iTraxx Main S9 Jun-15 protection, delta hedged daily	20,272,913
Sell 0-6% iTraxx Main S9 Jun-18 protection, delta hedged daily	20,272,913

Source: J.P. Morgan. Curve notionals are the notional of the shorter tenor. Option notionals refer the notional of straddles sold. Positions correct as of 5 April 2013.

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Appendix I: Benchmark Calculations

The target volatility scaling method requires us to project the volatility for a strategy based on the weightings of the individual components. To project this volatility we calculate what the P&L volatility of the strategy would have been over a recent period using the new weightings.

The calculation of this projected volatility on day k is shown in Equation 8. An explanation of the StDev function is given in Appendix II.

Equation 8: Projected Volatility for day *k*

n = lookback period in days. w_{ij} = weighting of benchmark component j on day i. R_{ij} = return of benchmark component j on day i. *StDev* is the standard deviation of a range of values.

$$Projected\ Volatility_k = StDev_{i=k-n}^{k-1}\left(\sum_{j=1}^{3} w_{ij}R_{ij}\right) \times \sqrt{252}$$

Based on this projected volatility we can then calculate the leverage that must applied to the benchmark on day k to achieve the target volatility. This leverage is given in Equation 9.

Equation 9: Leverage

$$Leverage_k = \frac{Target\ Volatility}{Projected\ Volatility_k}$$

Appendix II: The Impact of Lookback and Rebalancing Frequency on Benchmark Performance

The volatility scaling method used in creating our *J.P. Morgan iTraxx Alpha Benchmarks* relies on rebalancing the size of each benchmark constituent in line with the recent volatility of the strategy. When performing this volatility calibration there are several parameters that must be decided upon. These include:

- The method used to calculate historical volatility; e.g. a standard volatility calculation or one which uses an exponential weighting.
- The lookback period for the volatility calculation.
- How often the notionals of the underlying strategies are rebalanced.

Varying each of these parameters will have an impact upon the performance of the benchmark. In this piece we have not deliberately aimed to use the combination of parameters which give the best performance; we do not believe that this is the aim of a benchmark index. Despite this, it is still useful to be aware of how changing these parameters affects performance, especially for investors looking to enter similar volatility-scaled strategies.

Volatility Calculation Method

When calculating the historical P&L volatility of a strategy there are several different methods available to us. The most commonly used volatility calculation weights each day equally and only looks over a set number of days (the lookback period). The equation for the conventional standard deviation is shown in Equation 10; here the lookback period is denoted by n.

A second way of calculating a historical volatility is to use an exponentially weighted standard deviation. This method gives higher weighting to more recent days and has no limit to the lookback period; all historical data is included, albeit with a limited effect for older data. The equation for the exponentially weighted standard deviation is shown in Equation 11. When using the exponential weighting method we must also define how much weighting will be given to recent data relative to old data; this is done using $n_{1/2}$, which can be interpreted as how many days into the sample we have to look before 50% of the weighting is accounted for. For example, if $n_{1/2} = 20$, then the 20 most recent days make up 50% of the weighting in the volatility calculation, with all the other days in the sample beyond that (from 21 to infinity) making up the other 50%.

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Equation 10: Conventional Standard Deviation

$$StDev(\boldsymbol{x}) = \sqrt{\frac{\sum_{i=1}^{n} x_i^2}{n-1}}$$

Equation 11: Exponentially Weighted Standard Deviation

$$StDev(\boldsymbol{x}) = \sqrt{\sum_{i=1}^{\infty} \omega_i x_i^2}$$

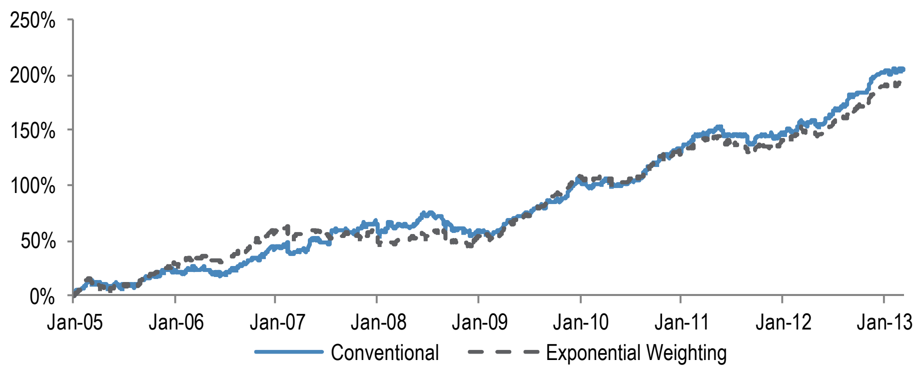
$$\omega_i = \left(e^{\lambda} - 1\right)e^{-\lambda i} \quad where \quad \lambda = \frac{\ln 2}{n_{1/2}}$$

The exponential method has the advantage that priority is always given to more immediate data points and so can better reflect rapid changes in a market environment. Furthermore, large one-day changes can have a large impact when using the standard method, creating a sudden drop in volatility when they exit the lookback period. In the exponential method, these large one day changes are instead given a lower weighting as time passes and so there is no sudden discontinuity at a point in the future. The downside of using the exponential method is that it is more computationally time-consuming than the conventional method and that it is a less-transparent calculation for anyone trying to replicate the results of the benchmark.

Importantly however, there seems to be little overall difference in using one method over the other in historical results. This can be seen in Figure 25; the Credit Alpha Return Index has seen very little deviation over the past eight years using the two different methods. Both of these strategies have an information ratio of 2.16.

Figure 25: Comparison of Conventional and Exponentially Weighted Volatility Calculations for Credit Alpha Return Index.

P&L (%). 1 month lookback period for conventional method, $n_{1/2}$ = 21 days for Exponential Weighting. 10% volatility target.



Source: J.P. Morgan.

As a result of this, we choose to use the conventional method for our generic benchmarks given the greater simplicity of this method. All the results in this piece are based on this conventional method.

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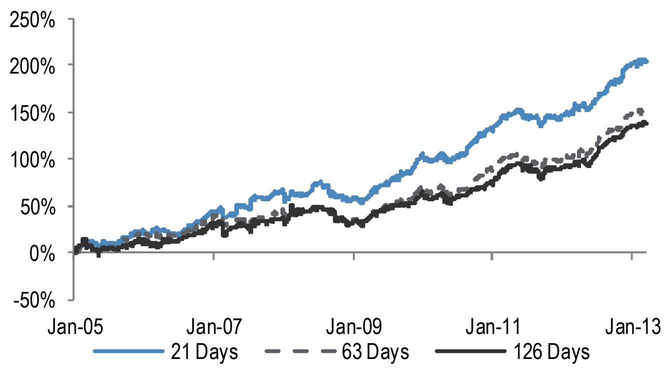
Lookback Period

The sizing of our benchmarks is based upon the historical P&L volatility of the underlying strategies; to calculate this volatility we must decide on a timescale to base it on. This can potentially make a large difference to the behaviour of the benchmarks; if we select a long lookback period then the strategy will be slower to adapt to changes in market conditions but will also be less affected by isolated short-term movements.

Figure 26 shows the performance of the Credit Alpha Return Index for lookback periods of one, three and six months. The strategy based on a one month lookback period has clearly and consistently outperformed the strategies based on longer calibration periods since 2005. The performance of the Index Benchmark is shown in Figure 27 for one and three month lookback periods.

Figure 26: Comparison of Credit Alpha Return Index Performance using different lookback periods

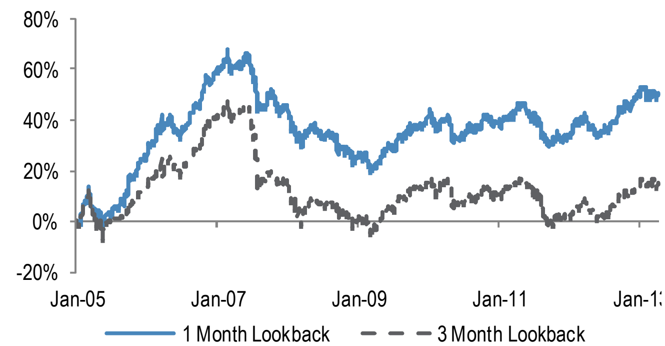
P&L (%). 10% volatility target.



Source: J.P. Morgan.

Figure 27: Comparison of Index Benchmark Performance using different lookback periods

P&L (%). 10% volatility target.



Source: J.P. Morgan.

We believe this outperformance of the one month strategy can be attributed to the correlation between changes in credit spreads and changes in volatility. Typically, increases in market volatility are associated with spread widenings (and similarly flatter curves and higher implied volatilities). This correlation means that the strategies underlying our Credit Alpha Return Index will make a loss as volatility increases. As a result, strategies that can adjust to this increased volatility quickly can reduce the impact of the loss, whereas strategies with a longer lookback period are slower to delever and end up taking a loss on a larger notional. Similarly, strategies that use a shorter lookback period are able to increase leverage and take advantage of calmer markets more quickly.

This effect is especially pronounced in the Index Benchmark, as shown in Figure 27. Prior to 2007 the benchmark based on a one month lookback was able to ramp up leverage more quickly during benign markets and profit from the strong performance of credit but was also able to delever more quickly in mid-2007 and encountered a considerably small initial drawdown than the benchmark using a three month lookback.

In the results discussed in this piece we have used the one month volatility scaling unless specified otherwise.

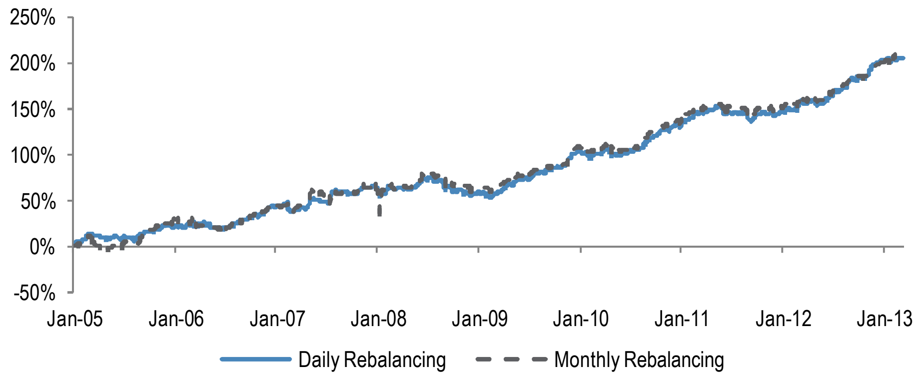
Rebalancing Frequency

When using the recent volatility to calibrate the leverage of a benchmark we must also decide how often to perform this rebalancing. Typically cash bond indices (including the JPM and iBoxx indices) rebalance on a monthly basis and will update the underlying composition and rebalance the percentage contribution of each bond to the overall index at this point. Rebalancing more often than this would be cumbersome for a cash bond index given the need to check that current bonds still meet the index criteria and also to see if new bonds are now eligible for the index.

However, for our benchmark indices the underlying strategies do not change with time and we are under no constraints to only rebalance the percentage contribution of each strategy on a monthly basis. As a result, we choose to rebalance our benchmarks on a daily basis which we feel makes sense given that a number of the underlying strategies are delta-hedged and rebalanced on a daily basis. However, as can be seen from Figure 28 there is very little difference in performance depending on whether daily or monthly rebalancing is used.

Figure 28: Comparison of Credit Alpha Return Index Performance for Daily and Monthly Rebalancing

P&L (%). 1 Month lookback period with 10% volatility target.



Source: J.P. Morgan.

All the results in this piece are based on daily rebalancing.

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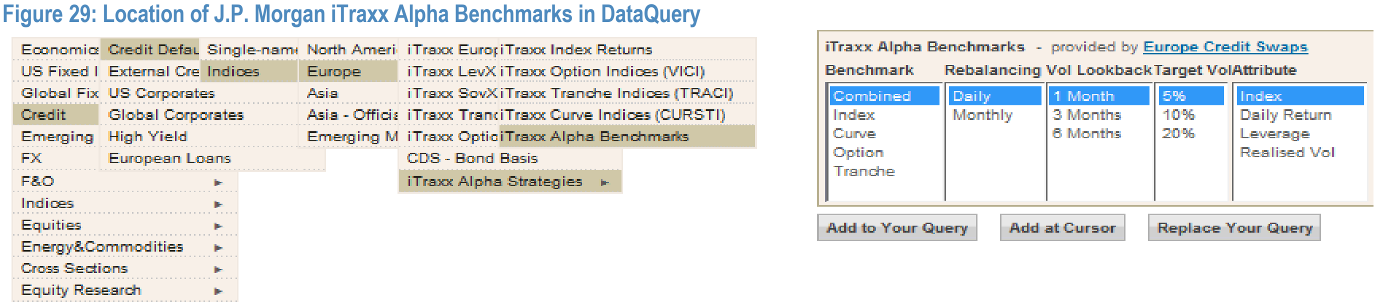
Appendix III: J.P. Morgan iTraxx Alpha Benchmark data in *DataQuery*

Historical performance data of the *J.P. Morgan iTraxx Alpha Benchmarks* is available in *DataQuery* by choosing the following options:

Credit -> Credit Default Swaps -> Indices -> iTraxx Alpha Strategies -> iTraxx Alpha Benchmarks

Clients can access return, volatility and leverage data for each individual benchmark. In addition, it is possible to customise the parameters used to build each benchmark, including the rebalancing frequency, volatility lookback period and target volatility level.

Figure 29: Location of J.P. Morgan iTraxx Alpha Benchmarks in DataQuery



Source: J.P. Morgan.

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