European Credit Research
21 September 2007

Carry-to-Risk for Credit Indices

Applying our Credit Carry-to-Risk Framework to Tradable Credit Indices

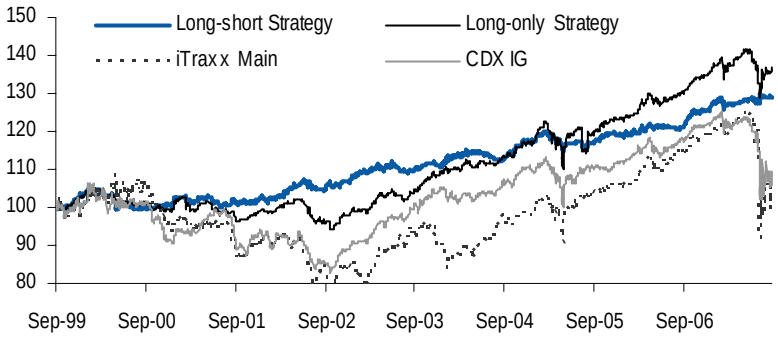
- **Credit Carry-to-Risk is a relative value framework for comparing credits**. It aims to highlight value across different credits by identifying those that provide the highest Carry (income return) for the Risk taken (volatility of return).

- **This note looks at applying the Credit Carry-to-Risk framework to the tradable iTraxx and CDX indices**. It follows on from two notes we wrote last year (*Carry-to-Risk in Credit* and *Relative Value in Tranches*), in which we described the framework as applied to single name CDS and Tranches respectively.

- **We find that when Credit Carry-to-Risk is applied to indices, it provides good returns and information ratios.** Figure 1 shows a return index formed using the Carry-to-Risk framework. Over the past eight years, the index has outperformed all other long risk indices and also has a higher information ratio.

- **Carry-to-Risk can also be used to form a long-short portfolio.** By choosing both high and low Carry-to-Risk indices, we can form a market neutral position. We find that such a portfolio provides a higher information ratio in volatile markets than a straight long-only strategy.

Figure 1: Return Index from Long Risk Indices



Source: JPMorgan

European Credit Derivatives Strategy

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Information Ratios

Index	Information Ratio
Long-Short Strategy (w cap)	0.94
Long-Short Strategy (w/o cap)	0.59
Long –Only Strategy	0.78
iTraxx Main	0.05
iTraxx HiVol	0.52
iTraxx Xover	0.88
CDX IG	0.13
CDX HiVol	-0.15
CDX Xover	0.47
CDX HY	0.47

Source: JPMorgan

See page 18 for analyst certification and important disclosures, including investment banking relationships.

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1. Introducing the Credit Carry-to-Risk Framework

Credit Carry-to-Risk is a relative value framework that aims to highlight value between credits. Rather than telling us the value of an asset outright, it is a tool for comparison and aims to show whether one credit is more or less valuable than another. Carry-to-Risk is therefore a useful measure for investors who have a choice of assets to invest in, as it highlights the most attractive investment.

From a fundamental perspective, Credit is a carry asset and Carry-to-Risk aims to maximise this Carry. Carry exists among a number of different assets and describes the income earned from holding the asset. In credit, carry is the spread accrued over a given time period and primarily compensates investors for capital loss due to default and mark-to-market volatility. Theoretically, the gain from carry should be offset by the loss from default and MtM. However, history suggests that the carry earned in Credit overcompensates investors for the loss.

Carry-to-Risk aims to maximise the carry and minimise the default and MtM volatility. We use Carry-to-Risk as an indicator rather than just Carry, since our aim is to achieve the highest return for the least amount of risk taken. Given a choice of two credits, both with the same spread or carry, Carry-to-Risk tells us to invest in the credit with the lower volatility of returns. By extension, if we increase our notional exposure to the lower volatility credit, we could earn a higher carry for the same volatility taken.

Expected Return is the P&L from a long risk CDS position, which benefits from **Carry** (accrual of initial spread).

Risk is the **Volatility** of our actual return around our expected return.

We therefore look for a measure that incorporates our expected return along with the risk of achieving this return. This measure is Carry-to-Risk.

Equation 1: Carry-to-Risk incorporates Return and Risk

$$\text{Carry} - \text{to} - \text{Risk} = \frac{\text{Expected Return}}{Risk}$$

Source: JPMorgan

A fuller discussion of the Carry-to-Risk Framework as applied to credit can be found in "*Carry-to-Risk in Credit,* S. Doctor, November 2006". Additionally, JPMorgan's "*Investment Strategies*" series has a number of research notes that look at Carry-to-Risk in other asset classes.

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2. Applying the Framework to Credit Indices

Defining our Universe of Indices

The Carry-to-Risk framework can be applied to tradable credit indices and tells us which index offers the most attractive position to maximise Carry-to-Risk. With seven different traded indices across Europe and the US, credit investors have a choice of indices to invest in. Each index provides exposure to a different market and will therefore have a different risk and return profile. Nevertheless, they all provide broad credit market exposure, which is what we are aiming to optimise.

The indices we look at are:

1. **iTraxx Main** – European Investment Grade index comprising 125 single name CDS.
2. **iTraxx HiVol** – Sub-index of iTraxx Main comprising the 30 highest spread single names in the iTraxx Main index.
3. **iTraxx Crossover** – European High Yield index comprising 50 single name CDS rated below BBB- (stable outlook).
4. **CDX IG** – US Investment Grade index comprising 125 single name CDS.
5. **CDX HiVol** - Sub-index of CDX IG comprising the 30 highest spread single names in the CDX IG index.
6. **CDX Crossover** – US Crossover index comprising 35 single name CDS with either a split rating (BBB by at least one rating agency and BB by another) or BB rating by one or two of S&P, Moody's or Fitch.
7. **CDX High Yield** – US High Yield index comprising 100 single name CDS rated below BBB- (stable outlook).

In Section 3 we look at how investing in these indices based on a Carry-to-Risk strategy has performed historically. First however, we explain how to calculate Carry-to-Risk for indices and look at which indices currently look most attractive.

Calculating Credit Carry-to-Risk

Our framework for calculating Carry-to-Risk in Credit looks at the ratio of carry (spread) to risk (return volatility) (Equation 2). The carry for each index is taken from the market traded CDS spread for that particular index. The risk is calculated as the standard deviation of returns, where the return is defined as the Change in Spread × Risky Annuity.

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Equation 2: Carry-to-Risk incorporates Return and Risk

$$\text{Carry - to - Risk} = \frac{\text{Carry}}{\text{Risk}}$$

where

$$\text{Carry} = \text{Annual CDS Spread}$$

$$\text{Risk} = \text{Standard deviation of daily returns over X days}$$

$$= \text{Standard deviation}\left[(S_t - S_{t-1}) \times A_t\right]$$

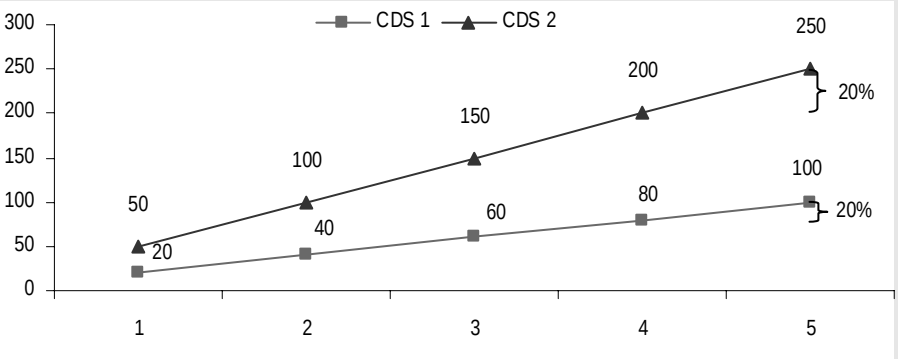
Source: JPMorgan

Unlike the methodology we defined for single name CDS, we calculate carry as annual spread rather than as annual spread plus slide. In the note "*Carry-to-Risk in Credit*, S. Doctor, November 2006", we defined carry for single name CDS as annual spread plus the slide down the maturity curve over a period of time. When calculating carry for the indices however, we simplify our calculation by assuming a linear curve, which means that slide is a fixed proportion of the initial spread. This allows us to calculate a longer history of data since full index CDS curves have not been available over the full cycle.

Assuming a linear curve is equivalent to saying that slide is a fixed percent of the annual spread. A 5y CDS contract for example will slide by 20% of the initial spread during the first year, irrespective of what the spread is (Figure 2). If each index slides by 20% of the annual spread over the period, we would increase the carry measure for each index by 80% (20% × 4), assuming equal risky annuities of 4. Since we would therefore just be scaling the Carry for each index by 1.8 times, we can simply ignore this when *comparing* across indices. This is because Carry-to-Risk looks at the *relative ranking* of each index rather than the outright level.

Figure 2: Assuming a Linear Curve means all CDS slide by a Fixed Percent

x-axis tenor (years); y-axis CDS spread (bp)



Source: JPMorgan

We also assume that default risk is encompassed in our market risk. In calculating Carry-to-Risk for single name CDS, we also included default risk which we included as a negative return on our measure of Carry. Since the indices are diversified pools of CDS, we believe that the effect of defaults in the indices will be encompassed in our mark-to-market loss and will therefore form part of our measure of market risk – the denominator in Equation 2.

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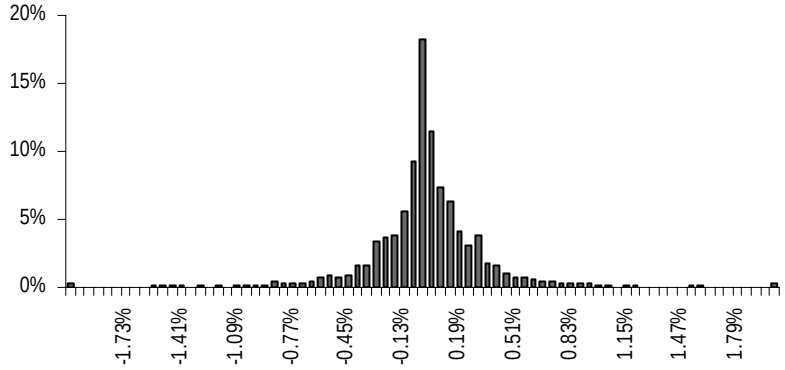
A risk to using Carry-to-Risk for indices is if historical volatility of indices does not capture your view of defaults in the immediate holding period (typically around 3 months). However, returns for indices are much less skewed than for single name credits due to the inbuilt diversification and rolling mechanisms. In Figure 3 we plot a histogram of the daily returns of the iTraxx Crossover index versus the frequency of these returns. The *normal-like* distribution and few outliers makes us comfortable with incorporation default risk in mark-to-market risk.

With a pool of 50 credits in the iTraxx Crossover index, a default in one name is equivalent to a daily loss of 1.6% for the index (assuming a 20% recovery rate). This however assumes a jump to default scenario and it is more likely that the spread on the name will widen out gradually before default. In such a case it is more akin to spread volatility.

Figure 3: Distribution of Returns for iTraxx Crossover
x-axis: Daily Return (%); y-axis: frequency of observation



Source: JPMorgan

Current Opportunities

CDX HY currently offers the highest Carry-to-Risk ratio while iTraxx Main has the lowest. Table 1 shows the current ratios for the credit indices we analyse. Based on the current spread and volatility of the indices, we can see that CDX HY has the highest ratio, 0.33, while iTraxx Main has the lowest ratio, 0.16. This means that CDX HY offers the best value for a high carry, low volatility long risk position while iTraxx Main is the best place to position for a short risk position.

We note however that this analysis was performed prior to the indices roll on 20 September 2007. These ratios may change based on the spreads of the new indices.

Table 1: Current Carry-to-Risk Ratios

Index	Carry (Spread bp)	Risk (Volatility bp)	Carry-to-Risk Ratio
iTraxx Main	47	294	0.16
iTraxx HiVol	60	355	0.17
iTraxx Xover	330	1179	0.28
CDX IG	67	319	0.21
CDX HiVol	175	629	0.28
CDX Xover	245	969	0.25
CDX HY	388	1163	0.33

Source: JPMorgan

Having seen which indices we can position in, as well as how Carry-to-Risk is used for credit indices, Section 3 will discuss how the strategy has performed historically, while Section 4 looks at applying the framework to a Long-Short strategy.

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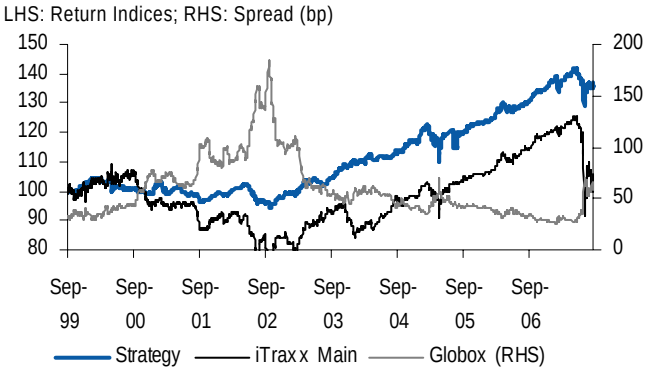
3. Index Carry-to-Risk Performance

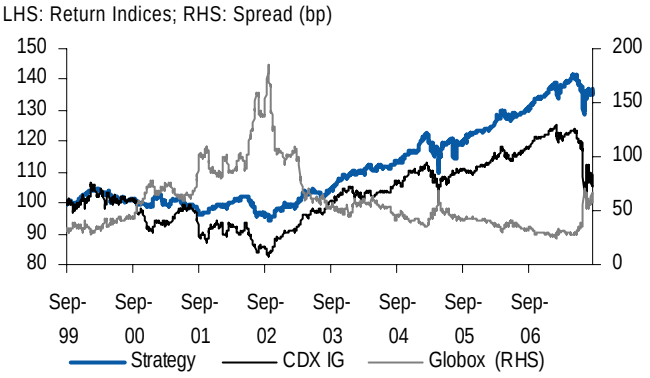
Over the past eight years, a strategy which systematically invests in the index with the highest Carry-to-Risk ratio has consistently outperformed. In order to test whether the framework has worked historically, we can construct a portfolio that takes exposure to the highest Carry-to-Risk index. The portfolio is rebalanced every three months and, at each rebalance, takes exposure to the highest ratio index, which it holds for the following three months. Figure 4 and Figure 5 show the return index of such a portfolio compared with return indices for iTraxx Main in Europe and CDX IG in the US respectively. Additionally, we show the credit market environment by plotting the spread of the Globox index – a spread index that is equally weighted between iTraxx Main and CDX IG. (Table 2 summarises these returns.)

Figure 4: Return Indices for iTraxx Main (Europe) versus Long Risk Strategies



Source: JPMorgan

Figure 5: Return Indices for CDX IG (US) versus Long Risk Strategies



Source: JPMorgan

These return indices start at 100 and increase on a daily basis by Change in Upfront of the index CDS contract plus Accrued Coupon. (This is similar to looking at the [Change in Spread × Risky Annuity] + Accrued Spread.) In order to ensure that the returns from the different indices are comparable, we scale each one so that they all have the same expected annual return. For example, if the spread of iTraxx Main is ten times that of iTraxx Crossover, we would take ten times more exposure to iTraxx Main than we have in iTraxx Crossover.

We analyse the performance of each index back to September 1999 in order to look through a full credit cycle. See Appendix I for how we construct CDS index spreads for periods prior to the existence of iTraxx and CDX.

Analysing the Results

The strategy has historically provided a high information ratio. Figure 4 and Figure 5 show that the strategy has outperformed both the iTraxx Main and CDX IG. However, we need to ensure that we are not taking on too high a level of risk to achieve this outperformance. As we noted earlier, we compare each index by scaling our exposure by the expected annual return of the index. Table 2 shows the annualised return for each index as well as the annualised standard deviation of these returns. With an information ratio of 0.78, our strategy has outperformed a long risk position in all the other indices except the iTraxx Crossover index.

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We believe that the information ratio of 0.78 is impressive, since the strategy can only invest in the seven indices. Since most of the other indices show information ratios below 0.5, with CDX HiVol showing a negative ratio, we cannot expect it to provide information ratios far above these.

Table 2: Returns and Information Ratios over the past eight years

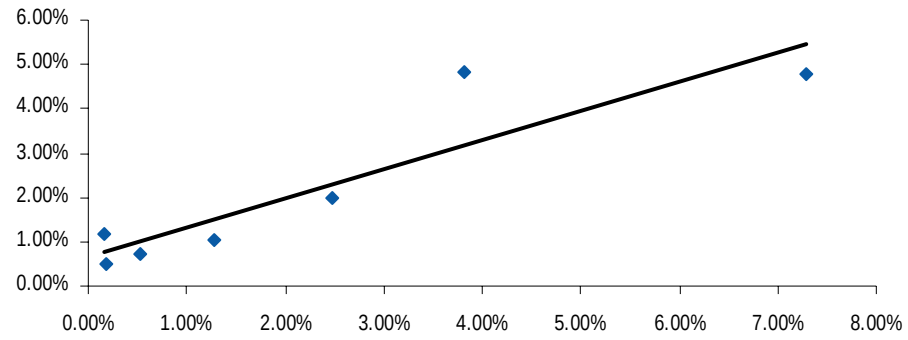
Index	Annual Return	Annual Standard Deviation	Information Ratio
Strategy	4.8%	6.1%	0.78
iTraxx Main	0.7%	12.9%	0.05
iTraxx HiVol	4.7%	9.0%	0.52
iTraxx Xover	5.7%	6.5%	0.88
CDX IG	1.1%	9.1%	0.13
CDX HiVol	-1.1%	7.6%	-0.15
CDX Xover	3.2%	6.8%	0.47
CDX HY	3.1%	6.5%	0.47

Source: JPMorgan

We believe the strategy works due to two reasons:

1. **Carry-to-Risk aims to maximise the return for the risk taken, i.e. the information ratio**. Since we measure the performance of the strategy by the information ratio, it seems reasonable that a strategy which aims to maximise the return for the risk taken should perform well. Carry-to-Risk can be thought of as a forward-looking information ratio. Therefore, choosing our investment based on this maximisation should provide us with a high information ratio. Ultimately what we are saying here is that historical volatility has tended to be a good guide for future volatility.
2. **Since the bulk of credit returns over the eight-year period have come from carry, Carry-to-Risk, which aims to maximise carry, has outperformed**. We can deconstruct the returns from a CDS index investment into what we receive from carry, with the rest coming from spread changes. In Figure 6 we compare the annual return from an investment in each of the seven indices with the annual carry over the period. The upward slope to the curve indicates that there is indeed a positive correlation – higher carry equates to higher returns. This should not be a surprise. As discussed, credit is a carry asset class, so a framework that highlights attractive carry opportunities should perform.

Figure 6: Correlation between Returns and Carry for CDS Indices
x-axis: Average Annual Return, y-axis: Average Annual Carry



Source: JPMorgan

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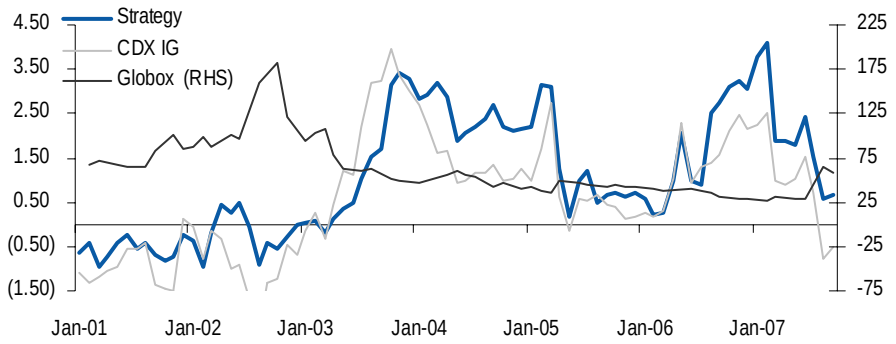
Index Carry-to-Risk in Different Periods

The strategy also performs well in different market conditions. While the strategy has provided good returns and information ratios over the full eight-year period, investors may want to use it for a shorter-term investment. We find that while the rolling 1-year information ratio varies between -1.5 and 4.5, it has tended to be positive and higher than many of the other indices. Figure 7 shows this against the CDX IG index. We have also plotted the Globox index spread to see the market environment. Since the strategy is a long-only strategy, it has negative return and therefore a negative information ratio during periods of market widening e.g. 2001-2003.

Figure 7: Rolling 1-year Information Ratio (over the prior Seven years)
LHS: Information Ratio, RHS: Spreads (bp)



Source: JPMorgan

Consistency of Strategy

Finally, we look at whether the strategy consistently chooses the same index. As this is an algorithmic strategy, we prefer a strategy that uses the algorithm to select different indices and not just one index consistently. Table 3 shows the rank of each index for the time periods used, where 1 represents the best Carry-to-Risk index and 7 the worst. We have highlighted the times each index is chosen as either 1 or 7. As we can see, there is a good variety of ranking and all indices are at different times either highly or lowly ranked.

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Table 3: Consistency of Strategy Choice

Reabalance	iTraxx Main	iTraxx HiVol	iTraxx Xover	CDX IG	CDX HiVol	CDX Xover	CDX HY
21-Jun-07	4	7	5	2	6	3	1
21-Mar-07	1	2	3	5	6	4	7
21-Dec-06	7	6	5	4	3	2	1
21-Sep-06	5	6	4	2	3	7	1
21-Jun-06	7	6	2	4	5	3	1
21-Mar-06	2	3	1	4	6	7	5
21-Dec-05	1	4	5	2	6	7	3
21-Sep-05	4	2	3	5	6	7	1
21-Jun-05	5	7	3	6	4	1	2
22-Mar-05	1	3	5	2	4	7	6
21-Dec-04	3	1	6	5	4	7	2
21-Sep-04	4	7	6	2	1	3	5
22-Jun-04	4	7	5	3	1	2	6
23-Mar-04	5	4	7	3	2	1	6
23-Dec-03	4	6	2	5	3	1	7
23-Sep-03	6	5	1	4	2	3	7
23-Jun-03	7	3	5	6	1	2	4
21-Mar-03	7	6	4	2	1	3	5
23-Dec-02	7	4	5	2	1	3	6
23-Sep-02	7	6	1	2	3	4	5
21-Jun-02	5	4	2	6	7	1	3
21-Mar-02	7	6	1	5	3	2	4
21-Dec-01	7	5	1	4	2	6	3
21-Sep-01	7	6	1	5	3	4	2
21-Jun-01	7	5	2	6	4	3	1
21-Mar-01	7	4	1	5	3	6	2
21-Dec-00	7	5	4	6	2	1	3
21-Sep-00	7	6	4	5	2	1	3
21-Jun-00	7	5	1	6	4	3	2
21-Mar-00	7	5	1	6	4	3	2
21-Dec-99	7	4	1	6	4	3	2
21-Sep-99	7	4	3	6	4	1	2

Source: JPMorgan

Historically the strategy has tended to choose indices towards the lower end of the credit rating spectrum, as these provide high carry for risk.

Recent Performance

Over the six months, the strategy has shown good results, beating all other index investments. Table 4 shows that, unlike the long-only index returns, which were all negative, the strategy provided a slightly positive return.

Table 4: Returns and Information Ratios over the last six months

Daily	Return	Volatility	Info Ratio
Strategy	0.6%	11.4%	0.05
iTraxx Main	-30.9%	36.0%	-0.86
iTraxx HiVol	-4.7%	23.6%	-0.20
iTraxx Xover	-13.1%	16.0%	-0.82
CDX IG	-27.2%	23.5%	-1.16
CDX HiVol	-32.7%	18.9%	-1.73
CDX Xover	-18.2%	16.7%	-1.09
CDX HY	-7.0%	11.7%	-0.59

Source: JPMorgan

Having seen the performance of the long-only strategy, we now look at combining the best Carry-to-Risk index with the worst in order to create a long-short strategy, which should also help reduce the market directionality of a long-only strategy.

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4. Constructing a Long-Short Strategy

Carry-to-Risk can be used to construct a market neutral, long-short portfolio. Portfolio construction in this case is similar to that of a long-only strategy, however, rather than just taking a long position in the *best* Carry-to-Risk index, we also take an offsetting position in the *worst* Carry-to-Risk index. In doing so, we aim for a market neutral strategy that should perform independently of the direction of market moves.

We find that the best long-short strategy is achieved by targeting an annual return based on the net spread of our long-short pairing, but only if we incorporate a volatility cap which ensures the position does not become too leveraged. Without this cap, the leverage on the pairing can become very large, which can cause large losses in time of market dislocation. In what follows, we first present the option of targeting a return or a volatility and then discuss incorporating the volatility cap.

Target Return or Target Volatility?

In order to take an offsetting position in each index, we adjust our notional investment in each by its relative volatility. This will give us a positive net carry for the long-short pair as well as a historical volatility of the pair, which is dependent on their correlation to each other.

We now have two choices: either we can target a return for the strategy based on the net spread from the long-short pair, or we can target a volatility for the long-short pair. We find that targeting a return provides worse results, as an investor can end up taking very large leverage in two indices. This happens when Carry-to-Risk ratios are close together, meaning that the net spread is very low. During periods of market stress, this large leverage can negatively impact returns. Targeting a volatility on the other hand, provides good results as an investor never lets the leverage become too high, as this is capped by the volatility of the strategy.

With a long-short strategy our information ratio over the eight-year period becomes 0.59, down from 0.78 - this is not surprising given that over this period we have had three years of spread widening, but five years of spread tightening. Additionally, a long-short strategy pays away carry in the short position that the long-only strategy earns.

However, as we see in Figure 8, the long-short strategy performs much better than a long-only strategy when the market is selling off; note the period 2000-2002. Additionally, if we consider the rolling information ratio of the strategy, while it has more recently been lower than the long-only strategy, during spread widening periods, it is significantly higher (Figure 9).

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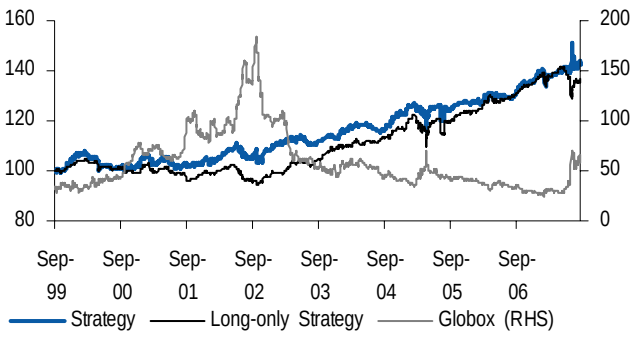
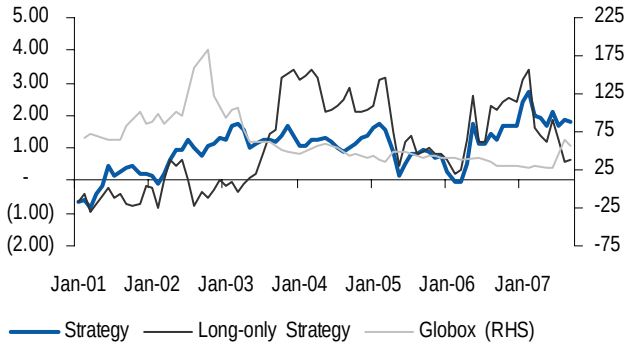
Figure 8: Return Indices for Long-Short Strategy vs Long-only
LHS: Return Indices; RHS: Spread (bp)



Source: JPMorgan

Figure 9: Rolling 1-Year Information Ratio of Long-Short Strategy
LHS: Information Ratio; RHS: Spread (bp)

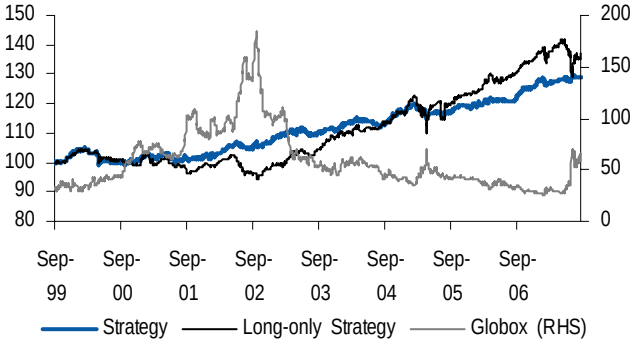


Source: JPMorgan

Incorporating a Volatility Cap

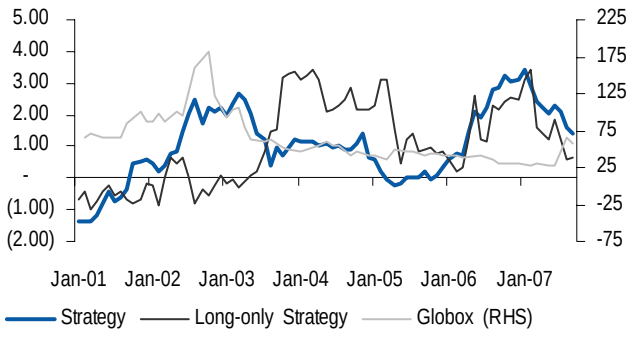
We find that better results come from targeting a return, but using a volatility cap that ensures that the volatility of the long-short and therefore the leverage is not too high. By targeting a return and also using a volatility cap, we find we can increase our information ratio to 0.94. This strategy has performed well both in recent times as well as during the market sell-off period (Figure 10). See Appendix 2 for more details.

Figure 10: Return Indices for Long-Short Strategy with Volatility Cap
LHS: Return Indices; RHS: Spread (bp)



Source: JPMorgan

Figure 11: Rolling information ratio of Long-Short Strategy with Volatility Cap
LHS: Information Ratio; RHS: Spread (bp)



Source: JPMorgan

Table 5: Returns and Information Ratios of the Long-Short Strategy (Sep 1999 - Sep 2007)

Index	Annual Return	Annual Standard Deviation	Information Ratio
Long-Short Strategy (w cap)	3.8%	4.0%	0.94
Long-Short Strategy (w/o cap))	5.5%	9.3%	0.59
Long –Only Strategy	4.8%	6.1%	0.78
iTraxx Main	0.7%	12.9%	0.05
iTraxx HiVol	4.7%	9.0%	0.52
iTraxx Xover	5.7%	6.5%	0.88
CDX IG	1.1%	9.1%	0.13
CDX HiVol	-1.1%	7.6%	-0.15
CDX Xover	3.2%	6.8%	0.47
CDX HY	3.1%	6.5%	0.47

Source: JPMorgan

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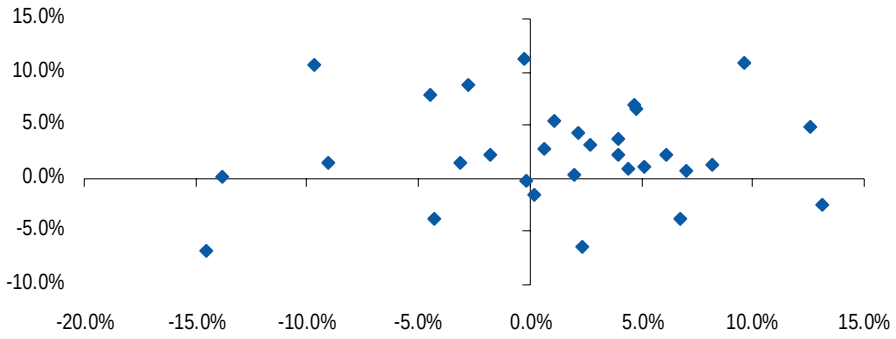
Correlation to Market Moves

Another benefit of the long-short strategy is that it has a low correlation with the market. This means that it should perform irrespective of whether the market is widening or tightening. In Figure 11 we showed that the rolling information ratio was positive in both positive and negative market conditions. This is further evident in Figure 12, which plots the three-monthly returns of the long-short strategy versus iTraxx Main returns. The majority of points are above the x-axis, indicating that the long-short strategy performs either when iTraxx Main is widening or tightening, i.e. in positive or negative market conditions.

Figure 12: Correlation of the Long-Short Strategy to iTraxx Main (Sep 1999 – Sep 2007)
Three-Monthly Returns (%) x-axis iTraxx Main, y-axis Long-Short Strategy



Source: JPMorgan

Table 6 extends this analysis and looks at the correlation of the Long-Short strategy against all the indices. Again we see very little correlation with any other market index, while the indices themselves often exhibit high correlation with each other.

Table 6: Correlation Matrix across Indices

Return Correlation	Strategy	iTraxx Main	iTraxx HiVol	iTraxx Xover	CDX IG	CDX HiVol	CDX Xover	CDX HY
Strategy	100%	1%	2%	20%	6%	6%	10%	2%
iTraxx Main		100%	59%	47%	53%	34%	42%	38%
iTraxx HiVol			100%	58%	69%	54%	47%	41%
iTraxx Xover				100%	61%	55%	52%	41%
CDX IG					100%	87%	57%	48%
CDX HiVol						100%	52%	54%
CDX Xover							100%	55%
CDX HY								100%

Source: JPMorgan

Recent Performance

Over the past two years, the strategy has shown good results, beating all other index investments. In Table 4 we showed that the long-only strategy has achieved an information ratio of 1.24 over the past two years. Over the same period, the long-short strategy with a volatility cap has achieved an information ratio of 1.56.

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5. Concluding Remarks

Credit is a carry asset class and as such, it is not surprising that a strategy which maximises carry performs well. The long-only Carry-to-Risk strategy fulfils this requirement. However, during periods of market stress, long-only strategies struggle to perform, since they need to remain long risk in an environment of widening spreads.

Adding a short position based on Carry-to-Risk allows us to find an attractive short, but with a low cost (carry). This is evident in Table 7 and Table 8 where we look at the information ratios of the different strategies during the market sell-off between September 2000 and September 2002, as well as the recent period June 2007 to September 2007. We see that all long-only strategies provided negative returns, whereas our long-short strategy had a positive return and a positive information ratio. Given the current market environment, this seems like the most attractive position to hold.

We add a cap to our strategies to ensure that we do not take on too much leverage. The information ratios in Table 7 and Table 8 are presented on strategies that apply a volatility cap to ensure the leverage does not become too large. An un-capped strategy can underperform during periods of market stress, particularly if these have been preceded by periods of low market volatility. In a low volatility/low spread regime, we would take on more leverage to achieve the targeted return. If the market turns volatile, these uncapped positions can experience large losses.

Table 7: Returns and Information Ratios (Sep 2000 – Sep 2002)

Index	Annual Return	Annual Standard Deviation	Information Ratio
Long-short	2.3%	4.1%	0.56
Long-only	-1.6%	3.4%	-0.48
iTraxx Main	-8.1%	5.0%	-1.61
iTraxx HiVol	-5.5%	4.9%	-1.13
iTraxx Xover	-0.7%	3.2%	-0.23
CDX IG	-6.6%	4.9%	-1.35
CDX HiVol	-5.7%	4.3%	-1.33
CDX Xover	-3.0%	3.9%	-0.78
CDX HY	-4.9%	4.0%	-1.22

Source: JPMorgan

Table 8: Returns and Information Ratios Strategy (Jun 2007- Sep 2007)

Index	Annual Return	Annual Standard Deviation	Information Ratio
Long-short	0.7%	5.9%	0.12
Long-only	-19.5%	5.9%	-3.29
iTraxx Main	-31.1%	7.7%	-4.04
iTraxx HiVol	-24.1%	7.4%	-3.26
iTraxx Xover	-26.4%	7.0%	-3.77
CDX IG	-27.2%	7.4%	-3.67
CDX HiVol	-30.1%	7.1%	-4.23
CDX Xover	-26.7%	6.9%	-3.84
CDX HY	-21.6%	6.7%	-3.23

Source: JPMorgan

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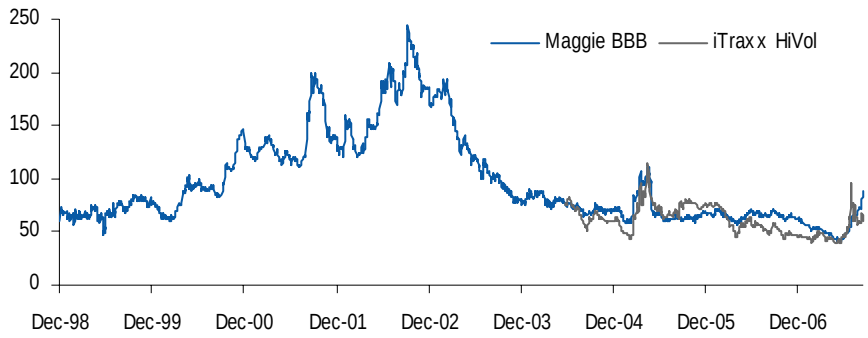
Appendix I: Forming CDS index Histories

We use cash bond indices to provide historical spreads of the iTraxx indices before they existed. Since iTraxx Europe launched on June 22 2004, we do not have historical data for the traded index prior to this date. Our analysis would be of limited use if we only used the past three years of data, as this was until recently a period of sustained spread tightening. We therefore extend this data by using TRAC-X Series 1 and 2 prior to this date and JECI Series 1 and 2 prior to that. This however still only takes us back to 2002 and would not provide enough data for a full credit cycle. We therefore use cash bond indices, in particular the MAGGIE Credit index for spreads prior to this.

This problem is even more acute for indices such as CDX Crossover, which was only launched in September 2005 following the downgrade of Ford and GM. We therefore have no other choice but to use cash bond indices for periods prior to this. Figure 13 gives us confidence that using cash indices is a good proxy for the CDS indices. Here we show the performance of iTraxx HiVol versus JPMorgan's MAGGIE BBB Credit index. Since June 2004 these two indices have moved broadly in line. We therefore believe that their performance prior to this would also have been similar.

Figure 13: Comparing iTraxx HiVol to MAGGIE BBB Credit



Source: JPMorgan

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Appendix II: Sensitivities

Much of the analysis we have done relies on using historical data at specific points in time. An obvious question is whether the analysis is stable and accurate. For example, we measure volatility as the standard deviation of daily P&L over a 60-day period. However, had we used 30 or 130-day periods, would we get very different results?

In this appendix we detail the sensitivity analysis we have performed on the **long-short strategy** and show that while the information ratios we calculate do vary, they are consistently high.

Data Frequency

The analysis we have done assumes that we measure volatility as the standard deviation of *daily* P&L. Alternatively we may wish to use *weekly* or even *fortnightly* P&L. In Table 9 we show the information ratio of the strategy under different data frequencies. We can see that all frequencies provide high information ratios.

We choose daily for our analysis as this captures all information available from our spread data.

Table 9: Effect of Data Frequency on the Information Ratio

business days

Frequency	Return	Volatility	Info Ratio
1 Day	3.8%	4.0%	0.94
3 Days	4.4%	4.4%	1.01
5 Days	3.6%	4.5%	0.78
10 Days	4.0%	4.8%	0.84

Source: JPMorgan

Look-back Period

What happens if we change the look-back period for our volatility? For example if we use the previous 30 days rather than 60 days. Table 10 shows that while adjusting our look-back period does have some impact, the information ratio consistently remains high.

Another methodology for changing the look-back is to use exponentially weighted moving averages (EWMA) rather than just a simple moving average (SMA), as we have done here. SMA weights each value in the look-back period with an equal weighting, while EWMA gives higher weighting to more recent data, which is similar to having a shorter look-back period. We have not found EWMA to change the results we find for SMA presented in Table 10.

Table 10: Effect of Varying the Look-back Periods

Weeks

Look-back	Return	Volatility	Info Ratio
30 Days	4.6%	4.0%	1.15
60 Days	3.8%	4.0%	0.94
130 Days	3.3%	4.3%	0.76
260 Days	3.8%	4.1%	0.91

Source: JPMorgan

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Rebalance Period

The analysis we have done has looked at quarterly rebalancing, with a 60 day look-back, which gives us the information ratio of 0.94. We look at changing the rebalance period and the effect this has on the information ratio. Table 11 shows the information ratio for Annual, Semi-Annual and Quarterly rebalancing periods with different look-back periods along the columns. The table shows that we could have equally taken semi-annual rebalancing with 130-day look-back if we wanted to match the index roll dates.

Table 11: Changing the Rebalance Period

	30 Days	60 Days	130 Days	260 Days
Annual	0.90	1.09	0.74	0.77
Semi-Annual	0.79	0.72	0.92	0.98
Quarterly	1.15	0.94	0.76	0.91

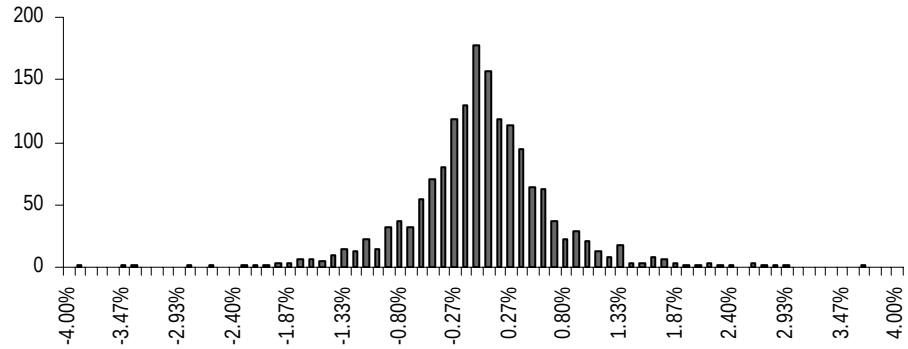
Source: JPMorgan

Consistency of Returns

In order to see whether the returns of our strategy are achieved in a stable fashion, we can look at a histogram of the daily returns. This is shown in Figure 14, where we plot the daily return of the strategy against the frequency it is observed. This data has a mean of 0.04% and a standard deviation of 0.67%. (This is simply the annual data in Table 9 on a daily basis: mean = 9.9%/260 days and standard deviation = 10.8/sqrt[260]).

The chart shows a *normal-like* distribution of return with no significant outliers. This gives us comfort in the stability of our results.

Figure 14: Consistency of Returns
x-axis: Daily Return (%); y-axis: frequency of observation



Source: JPMorgan

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Volatility Cap

Our results show that incorporating a volatility cap in our strategies gives us better results. This volatility cap is used to limit the leverage on our strategy and each time it is breached, we de-leverage the notional of the trade. We find that as we increase the volatility cap, i.e. the maximum volatility we allow without de-leveraging the strategy, our information ratio declines (Table 12). The table shows the level of volatility we allow as a proportion of the target return. For example, if we target a 4% annual return, and 4% volatility, we achieve an information ratio of 0.91. However, if we allow a volatility of 4 times this, i.e. 16%, our annual return increases, but so does the volatility. This lowers the strategy information ratio to 0.71.

We find that the optimum volatility cap has been 1.41 times the target return, so for a target of 4% we use a volatility cap of 5.6%. Additionally, Table 12 shows us that if we target a return of X, we should use a cap of $X \times \text{sqrt}(2)$. E.g. if we target a return of 8%, we should set our volatility cap at 11.3% (= 8% × 1.41).

Table 12: Volatility as a Proportion of the Target Return

Proportion	(Proportion)^2	Annual Return	Annual Standard Deviation	Information Ratio
0.71	0.5	1.75%	2.05%	0.86
1.00	1	2.64%	2.90%	0.91
1.41	2	3.77%	4.02%	0.94
2.00	4	4.96%	5.39%	0.92
2.83	8	5.41%	6.95%	0.78
4.00	16	5.96%	8.43%	0.71
6.00	36	6.73%	10.32%	0.65

Source: JPMorgan

Increasing the number of long-short pairs

The results we show have looked at being long the highest Carry-to-Risk index and short the lowest Carry-to-Risk index. Alternatively, we may choose to be long the top two or three indices and short the bottom indices. We find however that increasing the number of long-short pairs does not improve our results and actually lowers the information ratios.

We believe this is because the strategy tends to pick the best pairing. By increasing the number of indices chosen, the strategy not only picks the best pairing, but also the second and third best pairing. Since the notional of the trade needs to be split between these lower returning pairs, the return of the strategy is dampened.

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