Corrected Note (first published 25 March 2015) (See page 31 for details)

A Primer on Hedging Credit Portfolios

Choosing and Sizing Credit Hedges

- During periods of market weakness, long-risk investors may choose to sell some of their securities in order to reduce the risk in their portfolios. Alternatively, they can choose to add offsetting trades, or hedges. Credit investors face a wide choice of instruments and techniques that they can use to hedge the market risk or the tail risk in their portfolios.
- We present several macro credit instruments that are commonly used for hedging credit portfolios: CDS indices, iBoxx Total Return Swaps, CDS index options and CDS index tranches. Furthermore, combinations of these instruments, such as CDS index curve trades and bond-CDS basis trades, can be used as hedges in their own right. Finally, we present equity options and equity volatility options as alternative hedges for credit portfolios.
- There are two broad types of risk: market risk and tail risk. The main characteristic of a market risk sell-off is that it is a fairly orderly widening of credit spreads. During a tail risk sell-off, investors are forced to act differently to their usual behaviour because they may be forced to unwind positions or "capitulate" (Table 1).
- In order to compare the relative attractiveness of different hedges, we have developed a hedge effectiveness measure that captures the potential payoff of the hedge divided by the expected cost. We use this ratio to compare different hedges in a unified framework. We currently find that payer spreads and payer ladders offer attractive payoff ratios, but this is something that may change over time.

Table 1: Hedge Types

Hedging Instrument	Market Risk	Tail Risk
CDS Index	Yes	Yes
Payer Option	Depends on the strike	Yes
Payer Spread	Yes	No
Payer Ladder	Yes	No
iBoxx TRS	Yes	Yes
Equity Tranche	Yes	No
Mezzanine Tranche	Yes	Yes
Senior Tranche	No	Yes
3s5s Main DV01 steepener	Yes	No
3s5s Main DV01 flattener	No	Yes
Macro Negative Basis Trade	Yes	No
Macro Positive Basis Trade	No	Yes
E-Stoxx Futures	Yes	Yes
E-Stoxx Puts	Depends on the strike	Yes
E-Stoxx Put Spread	Yes	No
VSTOXX Futures	Yes	Yes
VSTOXX Calls	Depends on the strike	Yes
VSTOXX Call Spreads	Yes	No

Source: J.P. Morgan

European Credit Derivatives & Quantitative

Aida Mehonic [AC]
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Saul Doctor
(44-20) 7134-1539
saul.doctor@jpmorgan.com

Danny White
(44-20) 7134-1812
danny.c.white@jpmorgan.com

Daniel Lamy
(44-20) 7134-0467
daniel.lamy@jpmorgan.com

Matthew Bailey
(44-20) 7134-2384
matthew.a.bailey@jpmorgan.com

J.P. Morgan Securities plc

See page 31 for analyst certification and important disclosures.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

J.P.Morgan

Table of Contents

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Section 1: Market Risk and Tail Risk

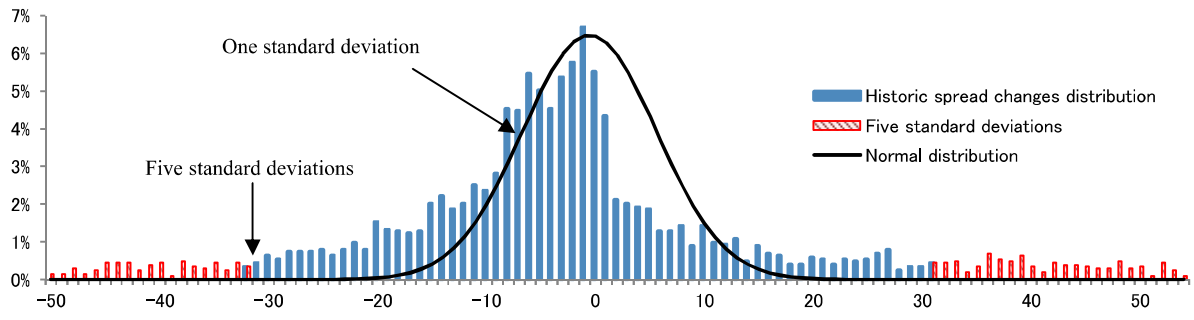
There are many instruments across different asset classes that investors can use to reduce the risk in their portfolios. The suitability of a hedge depends on the type of scenario the investor is most concerned about. We distinguish two broad categories in this handbook: **market risk** and **tail risk**.

The main characteristic of a market risk sell-off is that it is a fairly orderly widening of credit spreads. In contrast, a tail risk sell-off is an event where credit spreads widen quickly to such an extent that many market participants have not had time to sufficiently adjust their risk positions and, as a result, start sustaining losses and financial stress, which, in turn, forces them to close out certain positions. This was the case during the 2008/09 sell-off; many credit investors were forced to sell bonds in order to meet redemptions due to the withdrawal of liquidity and there was widespread capitulation and forced selling in the markets. In this sense, the key difference between market risk and tail risk is in the behaviour of investors and the extent of **capitulation** in the markets under the two scenarios: during a tail risk sell-off, investors are forced to act differently to their usual behaviour and that becomes reflected in "inverted" relationships between credit instruments as will be explained in the note; whereas a market risk sell-off is a more orderly and typically a more gradual process.

Normal Distribution as a Broad Framework for Spread Moves

When investors talk about a market or a tail risk event, they are referring to both the likelihood and the impact of the event. The term "tail" comes from the shape of the probability distribution function of the Normal (Gaussian) distribution (Figure 1). The "belly" of the distribution is the central area of the probability distribution curve on either side of the mean and the "tails" of the distribution are the parts that are far from the mean. Broadly speaking, a small or a moderate market move falls under the category of market risk and is in the "belly" of the distribution. A large and unexpected market move falls under the category of tail risk and it is in the "tail" of the distribution curve.

Figure 1: Distribution of 3-month iTraxx Main 5y Spread Changes
Data since May 2004. log(spread_2/spread_1).



Source: J.P. Morgan

There are important differences between the distribution of daily market moves and the Normal distribution. One of the most important differences is the size of the tails of the distribution. It is clear from Figure 1 that historical daily spread changes are only very approximately distributed as a Normal variable. One of the most

significant differences between the two distributions is that the tails of the distribution of the historical market data are much bigger than those of the Normal distribution. Investors are aware of this difference since they know that events which are more than five or even ten standard deviations away from the mean occur with a much higher frequency than would be suggested by the Normal distribution.

There is no one fixed definition of tail risk or market risk. In this note, we refer to spread moves further than five standard deviations from the mean as tail risk events, and all the other events as market risk events. This would imply that any small or moderate sell-off that would see iTraxx Main widen from the current level of 55bps to 85bps falls broadly into the category of market risk and any widening beyond 85bps would be a tail risk event. These are only approximate statistical designations of market risk and tail risk and depend on the current level as well as on the recent realised volatility.

Market Risk

There are numerous factors that could cause a moderate sell-off in the markets in the near term. The main feature of a market risk sell-off is that spreads widen in an orderly fashion and the spread levels are driven by sentiment and not by forced selling and forced unwinding of positions. The most common worries currently among investors are:

- Falling oil prices
- Deflation/recession in the Eurozone
- Political uncertainty (Greece)
- China growth slowdown
- Volatility from the expected rise in US interest rates
- Liquidity risks
- Geopolitics: Russia/Ukraine, Middle East

Tail Risk

The majority of investors we speak with do not currently seem concerned with a tail-risk type of sell-off. However, newly resurfaced concerns over Greek politics do potentially pose risk of a political contagion to other countries of southern Europe, where we may see more voter support for parties who wish for an EU exit. Some investors may wish to hedge tail risks such as those of a disorderly break-up of the Eurozone and a surge in corporate defaults.

It is not straightforward to define the optimal hedge. Every investor makes their call about the risks that they are most concerned about and they adjust the risks in their portfolios accordingly. It is almost meaningless to talk about the "best hedge" in a general sense. However, for an investor who would like to hedge their portfolio against a particular scenario (e.g. moderate vs large sell-off), it becomes easier to judge what the most effective and the cheapest hedge would be for protecting the portfolio in that scenario. This is where we hope this handbook will be useful to credit investors. In Sections 2 and 3, we present individual instruments and strategies for hedging credit portfolios. In the last section, we rank all the different hedges presented in the note according to their effectiveness in a unified framework, and we hope that such a unified framework will help investors easily choose the optimal hedge for their particular concerns.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Section 2: An Overview of Common Credit Hedges

In this section, we describe the most common instruments that credit investors can use in order to add hedges to their portfolios. Each section describes a separate hedging product, followed by an example of its application to a portfolio.

CDS Indices

Product Overview and Market Structure

A CDS index is a basket of single-name CDS contracts that trades as a single unit. Due to the large number of names in the index, idiosyncratic risks associated with any given single name are small and, hence, the index levels largely represent the overall credit market sentiment. For this reason, CDS indices are useful for expressing views on credit sentiment as a whole and are seen primarily as a credit spread instrument rather than a credit default instrument.

Table 2: Average Daily Volumes in 2014

$bn

Index	Volume
iTraxx Main	39.7
CDX.IG	32.4
iTraxx Xover	10.3
CDX.HY	9.8
iTraxx Sen Fin	5.5
CDX.EM	1.1
iTraxx Sub Fin	0.5
iTraxx Asia ex-Jpn	0.4
iTraxx Japan	0.3
iTraxx Australia	0.3
SovX West Eur	0.2
SovX CEEMEA	0.1

Source: DTCC, J.P. Morgan

The most commonly traded credit indices in Europe are iTraxx Main, which is currently based on 125 underlying High Grade European credits, and iTraxx Crossover, which is based on 75 underlying High Yield/Non-Rated European credits. These two indices are the most liquid credit instruments in Europe (Table 2). The bid-offer spread on iTraxx Main is typically half a basis point. It is the most widely traded European credit product, with average daily volumes of $40bn in 2014. Bid-offer spread on iTraxx Crossover is typically around 2bps, with the average daily volumes of $20bn in 2014.

Hedging Techniques

An investor who wishes to hedge a bond portfolio can choose to buy protection on a CDS index such as iTraxx Main. There are several factors that need to be decided on:

- Which CDS index to use?
- Which maturity?
- In what notional size?

Choice of CDS Index

The choice of the CDS index depends on the underlying bond portfolio. If the majority of the portfolio consists of European High Grade bonds, then iTraxx Main is the CDS index that is likely to have the highest correlation with the portfolio. Investors can also use more than one CDS index in order to better replicate the underlying portfolio. For example, an investor who is benchmarked to iBoxx EUR Corporates will find that their portfolio is best hedged, in our view, by three CDS indices in the following proportions: 70% iTraxx Main, 20% iTraxx Senior Financials and 10% Sub Financials.

Maturity

It is a feature of the CDS market that the 5y maturity is the most liquid one. Apart from the 5y, traded maturities for indices are also 3y, 7y and 10y points. Apart from liquidity considerations and the related bid-offer costs, the investor should also take into account the maturity of their bond portfolio, the shape of the CDS index curve and the length of time during which they plan to hold the hedge.

Example

An investor holds €100m of EUR High-Grade corporate bonds in their portfolio, with the average duration of 4.5 and is worried about possible short-term market turmoil and wishes to hedge 10% of the portfolio notional against a widening in spreads. The investor buys protection on iTraxx Main 5y at the current level of 55bps on the notional of €10m and exits the trade in 3 months. The cost of the hedge is the time value, which is equal to €30k over three months. The DV01 is equal to €5.3k and so the breakeven level is at 61bps.

The time value is calculated from the coupon carry, excess carry and the slide.

Table 3: Trade Details: Long Protection on iTraxx Main

Direction	Index	Maturity	Entry Spread	Notional	DV01	Exit Spread	Exit Upfront (€)	Coupon Carry	Excess Carry	Slide	Time Value
Buy Protection	Main S23	Jun-20	55	10,000,000	5,271	52	-237,053	-25,556	10,814	-15,251	-29,992

Source: J.P. Morgan

Beta versus HG Bond Portfolio

The effectiveness of CDS instruments for hedging bond portfolios depends on how CDS spreads and bond spreads behave in different circumstances. In theory, a CDS contract is designed to have the same default risk as the bond and it should therefore have the same spread as the bond. However, there are a number of factors that cause the two spreads to diverge, broadly falling into these categories:

- **Technical reasons.** Some of these are the existence of the cheapest-to-deliver bond; bonds usually trade away from par, whereas CDS contracts trade as par swaps; treatment of accrued coupon on the bond and the CDS is not equivalent in case of a default; CDS and bond credit event definitions can have differences.
- **Supply and demand.** Due to a variety of factors, investors may prefer bonds over CDS or vice versa. Some of these factors are: investment fund cash balances, availability of bonds in primary and secondary markets, general liquidity conditions, regulation and capital requirements for expressing risk through bonds versus CDS for banks and insurers, etc.

Historically, there have been times when the difference between bond spreads and CDS spreads diverged significantly. CDS spreads traded tighter than bond spreads during the credit crisis of 2008-2009, since investors were forced to sell bonds in order to meet redemptions and there was not a similar technical driver for CDS spreads to widen to the same extent. During this period, the beta between bond spreads and CDS spreads was 1.8. At other times, European CDS spreads traded wider than bond spreads, as in recent years, during which we have seen negative net issuance in EUR HG bonds. This has been acting as a strong technical that kept bond spreads low, while investors have been using CDS indices as a hedge. The spread beta between bonds and CDS during this period was 0.75. In other words, the EUR Bond-CDS basis has been trading at both positive and negative levels over the past ten years (Figure 15).

The long protection in CDS indices trade in the example above therefore is an "overhedge" for 10% of the notional of a EUR High Grade bond portfolio in the current environment, while it is likely to be an "underhedge" in case of a tail risk sell-off such as the one during the credit crisis of 2008-2009, due to the fluctuations in the bond-CDS basis.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

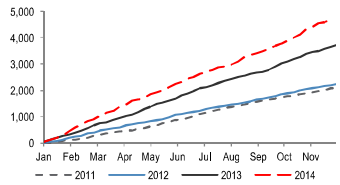
Options

Product Overview and Market Structure

Investors can choose to use options on CDS indices instead of using the CDS index itself. Options on CDS indices work in a similar way to options on interest rate swaps. A call option on a CDS index, or *a receiver option,* gives the option holder the right to receive spread on the CDS index at the strike level and is therefore long risk. A put option on a CDS index, or *a payer option*, gives the option holder the right to pay spread on the CDS index at the strike level and is therefore long protection.

Figure 2: Cumulative Traded Volumes on CDS Index Options

($bn)

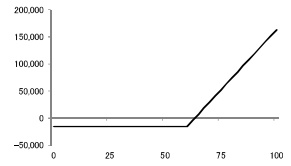


Source: JP Morgan, DTCC

Options on CDS indices are liquid products, with average daily volumes of $16bn over the course of 2014, according to the DTCC data; traded volumes have steadily grown over the past few years (Figure 2). Options are currently quoted on iTraxx Main, iTraxx Crossover and iTraxx Senior Financials indices in Europe, and on CDX.IG and CDX.HY in the US. We believe that there are a dozen dealers currently trading CDS index options in Europe. At-the-money options in iTraxx Main 5y typically trade with a bid-offer of 2 cents, which is equivalent to less than 0.5bps in running terms, considering that the duration of the underlying index is typically between 4.6 and 5. We refer the reader to our note on option trading strategies for further details (*CDS Options Strategies*, D. White).

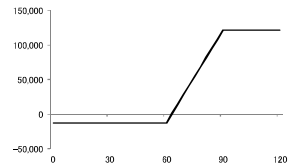
Hedging Techniques

Figure 3: Payer Option Payoff Profile



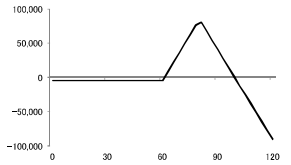
Source: J.P. Morgan

Figure 4: Payer Spread Payoff Profile



Source: J.P. Morgan

Figure 5: Payer Ladder Payoff Profile



Source: J.P. Morgan

Buy a Payer Option

Put options on CDS indices are commonly called payer options or payer swaptions. A buyer of a payer option has the right to pay spread (buy protection) on the underlying CDS index for a pre-specified spread level (*strike*) on the option expiry date. The key feature of this trade is that it is a hedge against wider spreads and it has a limited downside if spreads tighten. The maximum loss the investor can sustain on this trade is the price of the option, should spreads remain tighter than the strike level. For any spread values wider than the strike at expiry, the option payoff grows linearly with the index payoff and protects the investor from the widening in spreads.

Buy a Payer Spread

Payer spreads combine options at two different strikes to express a bearish view with a capped upside. Investors can cheapen the cost of buying a payer option by selling another payer option with a higher strike. The cheaper hedge comes at the cost of a capped upside in a sell-off scenario. Payer spreads are usually an attractive strategy for investors who are worried about a small to moderate sell-off. This is because buyers of payer spreads only pay for protection against a moderate widening in spreads, which is cheaper than buying protection for the full range of spread moves wider provided by the outright payer options.

Buy a Payer Ladder

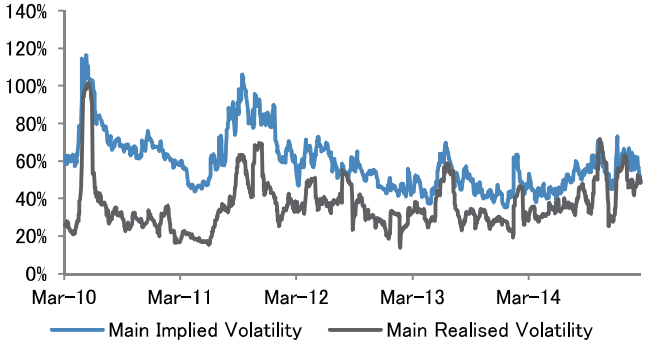
Payer ladders combine options at two different strikes to express a range-bound bearish view. Investors who wish to put on a hedge that will pay out in the case of a limited market sell-off, but are not worried about a large market sell-off, should buy payer ladders. These trades are often structured at zero premium, so that, for every cent that the investor spends on buying a payer option at a lower strike (say 70), they earn a cent from selling a payer option on a larger notional at a higher strike (say 90). The attractiveness of this trade is the low or zero upfront cost. However, the danger is that there could be a large sell-off in the market in which case the payer ladder would not only stop being a hedge, but it would produce additional losses on top of the losses of the underlying bond portfolio.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Implied vs Realised Volatility

Historically, implied volatility has generally been higher than realised volatility (Figure 6). However, this differential has decreased in the last two years. This means that hedging strategies based on options have become cheaper over this period as buyers of options no longer need to pay a high premium for implied volatility, since implied volatility now trades significantly closer to realised volatility.

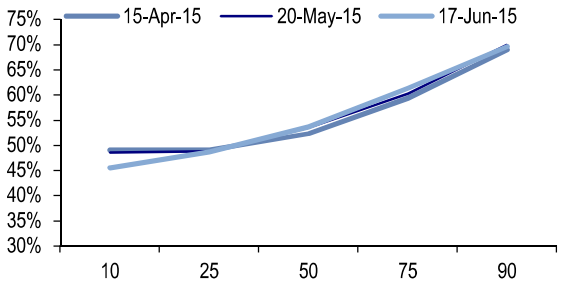
Figure 6: Implied vs Realised Volatility: iTraxx Main 5y 1m Volatility



Source: J.P. Morgan

Figure 7: Option Skew in iTraxx Main

Y-Axis: Implied Volatility X-Axis: Option Strike



Source: J.P. Morgan

Option Skew

Option skew is the difference between implied volatility at different strikes. Higher strike options generally trade with higher implied volatility (Figure 7). The higher the skew, the more expensive it is to hedge the portfolio using out-of-the money payers. At the same time, when the skew is high, payer spreads and payer ladders become more attractive as hedges, since they both involve buying an option at the lower strike and selling an option at a higher strike where implied volatility is high. We summarise the most common option strategies in Table 4.

Table 4: Option Strategies Summary

Strategy	What?	Why?	When?
Payer Option	Long Payer	Protect against full range of widening	Concern about a large sell-off
Payer Spread	Long Payer, Short Payer at Higher Strike	Protect against moderate widening	Concern about moderate sell-off
Payer Ladder	Long Payer, Short Payers at Higher Strike in Higher Notional	Protect ONLY against moderate widening	Concern ONLY about moderate sell-off, would lose money in large sell-off

Source: J.P. Morgan

Example: Payer Spread

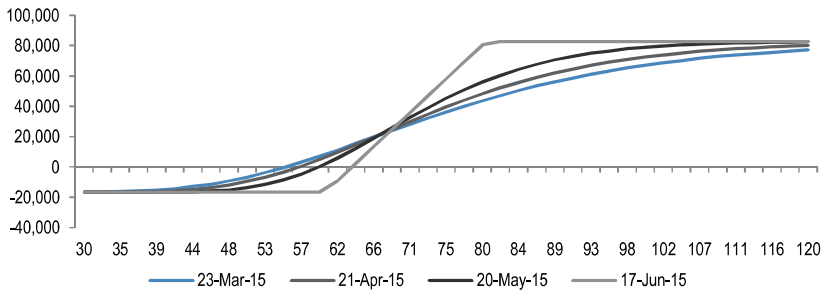
An investor manages €100m in EUR High Grade bonds and wishes to hedge 10% of the portfolio against a small to medium sell-off. iTraxx Main is at 55bp today and the investor is worried about it selling off further to possibly reach 80bps, but does not want to pay for protection beyond 80bps. A 60-80 payer spread would be an attractive way to position for this view through options.

The total cost of this strategy is 16.6 cents as shown in Table 5, and the maximum payoff to cost ratio in this case is 5. The trade returns a profit for iTraxx Main wider than 63bps at expiry. This structure is attractive for an investor who is worried about a road-bump in the near future that would see a limited sell-off in the markets, but does not foresee a large sell-off which would see iTraxx Main widen beyond 80bps.

CDS Index: iTraxx Main S23
Option Strategy: Payer Spread
Strike 1: 60bps
Strike 2: 80bps
Expiry: 17 Jun 2015
Notional: €10,000,000 (10% of the portfolio notional)

Figure 8: Payoff Diagram: 60-80 June-15 Payer Spread

Y-Axis: P&L X-Axis: Spread



Source: J.P. Morgan

Table 5: Trade Details: Payer Spread

Buy/Sell	Option	Index	Expiry	Strike	Notional	Cost (cents)	Cost (€)
Buy	Payer	iTraxx Main 23	17/06/2015	60	10,000,000	25.6	25,586
Sell	Payer	iTraxx Main 23	17/06/2015	80	10,000,000	8.9	-8,945
	Ref at 55bp				Total	16.6	16,641

Source: J.P. Morgan

Example: Payer Ladder

An investor who manages €100m in EUR High Grade bonds wishes to hedge 10% of the portfolio against a small to medium sell-off only and not against a tail risk sell-off. iTraxx Main is at 55bp today and the investor is worried about a possible widening beyond 60bps, but is comfortable with taking on the risk that iTraxx Main widens beyond 80bps. Here is how the investor could add a payer ladder as a range-bound hedge.

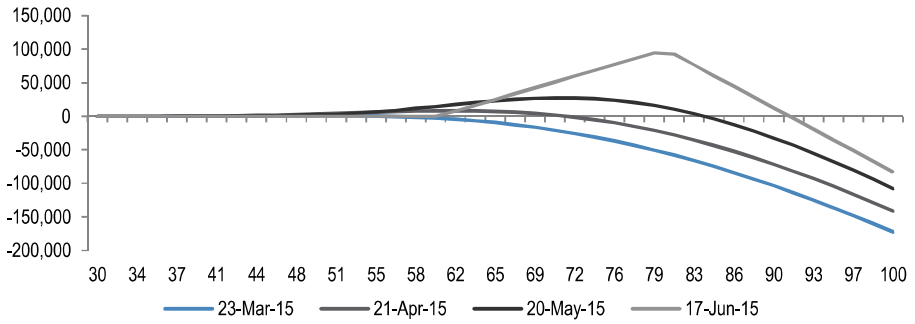
Table 6: Trade Details: Payer Ladder

Buy/Sell	Option	Index	Expiry	Strike	Notional	Cost (cents)	Cost (€)
Buy	Payer	iTraxx Main 23	17/06/2015	60	10,000,000	25.6	25,586
Sell	Payer	iTraxx Main 23	17/06/2015	80	28,600,000	8.9	-25,581
	Ref at 55bp					Total	4

Source: J.P. Morgan

CDS Index: iTraxx Main
Option Strategy: Payer Ladder
Strike 1: 60bps
Notional 1: €100m
Strike 2: 80bps
Notional 2: €286m
Expiry: 17 June 2015

Figure 9: Payoff Diagram – Payer Ladder



Source: J.P. Morgan

This strategy has a zero upfront cost as the price of the payer option at 60bps and the payer option at 80bps exactly offset each other (Table 6). The payoff diagram is shown in Figure 9. The maximum payoff is 94.6k if iTraxx Main trades at 80bps at expiry. The trade returns a profit for iTraxx Main between 60bps and 91bps at expiry.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

iBoxx Total Return Swaps

Product Overview and Market Structure

iBoxx indices are a suite of bond indices owned by Markit that many market participants use as benchmarks for bond portfolio performance. Replicating the performance of the index using the underlying bonds can be expensive and time consuming. The iBoxx TRS is a product that offers investors a way to gain either long- or a short-risk exposure to corporate bond performance.

iBoxx TRS contracts currently trade on six underlying indices:

iBoxx € Corporates

iBoxx € Liquid High Yield

iBoxx £ Corporates

iBoxx $ Liquid IG

iBoxx $ Liquid High Yield

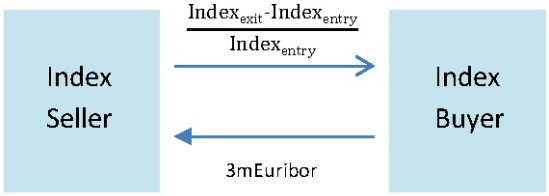
iBoxx $ Leveraged Loans

The TRS differs in three ways from CDS indices. Firstly, it references bonds rather than CDS, secondly, the TRS index return includes a rates as well as a credit component and, finally, the index composition of the CDS and bond indices differ.

iBoxx Total Return Swaps allow investors to gain long or short exposure to the performance of an index of corporate bonds in an unfunded swap format. The swap is traded as an over-the-counter contract between an investor and a dealer. The TRS consists of two legs: the index leg and the floating leg (Figure 10). The index buyer receives the performance of the index, which is equal to the difference between the index level at maturity and the index level on the trade date, divided by the index level on the trade date. The floating leg is typically the 3m Libor rate for the appropriate currency. The index level, or the net asset value (NAV) is published by Markit. For example, for iBoxx € Corporates, the NAV can be found under the Bloomberg ticker QW5A.

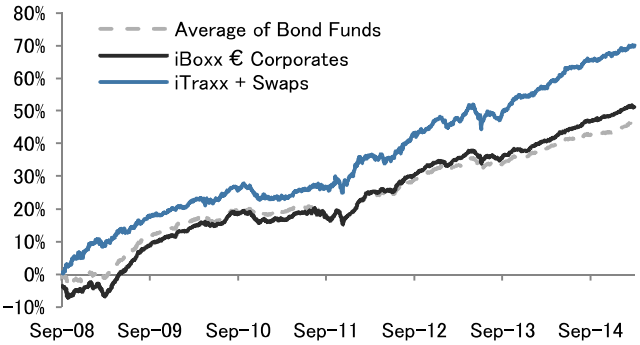
iBoxx TRS contracts started trading in 2011 and the trading documentation became standardised in 2012 (available here from the Markit website). Since then, trading volumes have been steadily increasing. According to internal estimates, TRS volumes more than tripled this year compared to last. We have written about the TRS product in *The iBoxx TRS Handbook, S. Doctor and D. White, November 2013*. Typical traded contract sizes are €25mm-50mm for iBoxx € Corporates and 10mm-20mm for iBoxx € Liquid High Yield. It is our understanding that there are seven dealers currently active in trading these contracts and investors can unwind/novate their swaps with any of them.

Figure 10: Trade Diagram
Final Level is equal to the NAV of the index as published by Markit for the day of TRS contract expiry.



Source: J.P. Morgan

Figure 11: Tracking Error: iBoxx TRS versus iTraxx Main
10 EUR HG Bond Fund returns compared to returns from iBoxx EUR Corps and iTraxx Main + IR Swaps.



Source: J.P. Morgan

If the contract is novated/unwound before expiry, it will be marked at the offer level on the day of the unwind, which will in general be different from NAV. Typical bid-offer costs in running terms are around 3bps for short-dated expiries and 8bp for 1y expiries, assuming the contract is held till expiry. Running costs are calculated by dividing the TRS upfront costs by the duration of the underlying index.

Hedging Strategies

A credit portfolio manager who takes a short risk position in a TRS contract on an iBoxx index will pay the performance of the index at expiry, while receiving Libor. If the iBoxx index sells-off, the index return will be negative and the investor will receive a payout at expiry equal to the underperformance of the index between the entry level and the level at expiry.

iBoxx TRS is exposed to both the spread and the rates components of an index. When used as a hedge for a credit portfolio, it protects the portfolio against **both the spread and the rates moves.** The iBoxx TRS may not perfectly offset the HG portfolio return due to duration/composition mismatches.

The tracking error between an average EUR HG portfolio and the hedge (Figure 11) is lower for iBoxx € Corps than it is for iTraxx Main + Swaps. iBoxx TRS is therefore, in general, a better hedge for credit bond portfolios than iTraxx Main combined with interest rate swaps.

Example

An investor takes a short risk position in iBoxx EUR Corporates on 23 March 2015, with the following details:
Index: iBoxx € Corporates
Direction: Client pays index
Maturity: 20th June 2015
Notional: €10,000,000
Entry Index Level: 216
Floating Leg: 3m Euribor
Suppose that the index closes at 212 on 20 June 2015. The payment due to the investor is $\frac{216-212}{216}$% of the notional, which is 1.85% of the notional. The investor has also had to make quarterly Euribor payments on IMM dates (20 Jun-15) which, assuming that 3mEuribor stays at the current level of 2.2bps, is equal to 0.55cents in total. Therefore, the investor has made 1.84% over this period (we ignore present value discounting for this illustrative calculation).

iBoxx TRS Options

Options are quoted on iBoxx indices in a similar way that options trade on CDS indices. These options are traded on the underlying iBoxx index level, which means that they are options on the total return of bonds, and not only on spreads. Call options give the holder the right to “buy” the iBoxx index at the strike level, while put options give the holder the right to "sell" the iBoxx index at the strike level. More details about TRS options can be found in *The iBoxx TRS Handbook*, *S. Doctor and D. White, November 2013*.

Exchange-Traded Funds (ETFs)

Investors can also use exchange-traded funds, which are cash-based products. They are frequently structured as index funds that are traded and listed like stocks. The performance of ETFs is based on a selected portfolio of bonds, which is used to replicate the benchmark. Their performance is not guaranteed to follow the benchmark due to the imperfect replication.

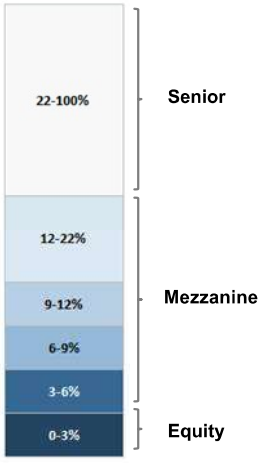
Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Index Tranches

Product Overview and Market Structure

CDS index tranches are standardised derivative contracts that offer exposure to a select range of losses on a CDS index such as iTraxx Main. Tranches are defined by the attachment and detachment points and are divided into equity, mezzanine and senior tranches. Tranches are only exposed to a certain number of losses in the index. For example, the iTraxx Main 3-6% tranche suffers losses only if more than 3% of the index notional is wiped out through defaults, and in this case 3% is the attachment point. If 6% of the index is lost through defaults, the entire tranche notional is wiped out and it is no longer exposed to the underlying index, with 6% being the detachment point. For more details on CDS index tranches, we refer the reader to our earlier note *CDS Index Tranches Strategies, D. White*.

Figure 12: Typical Tranche Capital Structure



Source: J.P. Morgan

Similar to a CDS contract, a tranche is quoted as a spread or an upfront plus a fixed coupon. Currently, traded tranches are based on iTraxx Main Series 9 and 21, iTraxx Crossover S22, CDX.IG S9, S19, S21 and S23 and CDX.HY S19, S21 and S23. The inputs that are required to price a tranche are the average portfolio spread, dispersion, implied correlation and the maturity.

Hedging Strategies

Senior tranches react to the absolute levels of spreads as well as to the implied correlation of default events. As the correlation between credits rises, the spread of the senior tranche increases. A buyer of protection on the senior tranche is therefore taking a long risk position in implied correlation. This trade profits if correlation increases, which generally occurs when the level of systemic risk increases. Therefore, senior tranches are good candidates for systemic tail risk hedges.

Investors concerned only about a few single names in the index should hedge their risk using the **equity tranche**. This is an idiosyncratic risk hedge suitable for investors who are concerned about a few isolated defaults and are not worried about a systemic tail risk sell-off. Buyers of protection on the **mezzanine tranches** are not worried about a few isolated defaults, but are exposed to the market-wide deterioration in credit quality. **Senior tranches** are designed to protect investors who are concerned about a tail risk event such as a large systemic sell-off.

Investors can combine equity, mezzanine and senior tranches in order to tailor the hedge according to their more specific concerns. For example, investors who are concerned about both idiosyncratic defaults and an overall deterioration in credit quality, but do not think that a large systemic sell-off is likely to happen could buy protection on the equity and the mezzanine tranches, effectively constructing a 0-22% tranche. This hedge should perform in all but the most extreme type of tail risk sell-off.

An investor who buys protection on the 12-100% and on the 6-12% tranche is effectively buying protection on the 6-100% tranche. In this way, investors can construct X-100% tranches, where X ranges through all the quoted attachment points. X-100% tranches meet two requirements that investors look for in tail hedges:

- *Cheap*, in absolute value cost compared to buying index protection. This is because buyers of protection on the senior tranches pay for hedging market exposure without paying for default exposure. Therefore, the spread per unit of delta for these tranches is typically less than one.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

- They must hedge *macro risks*, i.e. less dependent on individual single name stories than the index or junior tranches. Table 7 shows spreads for X-100% tranches and the index. By removing the exposure to the first default losses, the cost of X-100% tranches decreases substantially. The cost per unit of index can be proxied by the ratio of the spread of the tranche and its index delta. Even though their delta is lower than one, they generate tighter spreads per unit of delta than the index: e.g. the 22-100% spread is 15bps and its delta is 0.50, which is equivalent to 30bps (= 15/0.50) per unit of delta vs a 50bps spread for the index (which has a delta of 1).

Table 7: Spread per unit of Delta for iTraxx Main S21 Jun-19 Tranches (bps)

	Spread	Δ	Spread per Delta	Multiple of Index
0-3%	715	9.6	75	1.8
3-6%	189	4.4	43	1.0
6-9%	99	2.2	45	1.1
9-12%	47	2.2	21	0.5
12-22%	46	0.5	93	2.2
22-100%	15	0.5	29	0.6

Source: J.P. Morgan

The decision between 6-100% and 22-100% very much depends on the "tail event" the investor has in mind:

- **A systemic tail risk sell-off**: such as the one in 2008/9, with spreads widening across the board (in parallel) and tranche correlations increasing.
- Or an **idiosyncratic tail risk sell-off**: with a group of credits becoming very distressed and/or defaulting but the rest not widening as much, e.g. only some Eurozone countries leave the currency union, but the Eurozone survives. This scenario is a combination of idiosyncratic and systemic risk.

Thicker X-100% tranches have attracted attention because they can outperform the senior tranche in less severe tail events.

In general, the 22-100% short generates higher payoff ratios in "systemic" tail events, involving additive spread widening (i.e. all credits widen the same bp amount) and higher correlations. The senior tranche (22-100%) can be considered as the most extreme tail hedge, given that it is the most senior (and the cheapest). However, it does require a very severe tail event to widen more than the index in delta terms (e.g. it did not underperform the index during the 2011 H2 sell-off). The 6-100% short generates higher payoff ratios when spreads widen proportionately, with the widest names becoming very distressed or defaulting, and when correlations fall (i.e. in "idiosyncratic" tail events).

Investors who are uncertain about which type of tail event we may face should find 9/12-100% tranches more attractive. 9-100% and 12-100% tranches have payoff ratios between those of 6-100% and 22-100%.

Example – Long Protection on the Senior Tranche

An investor who manages €100mm in EUR High Grade bonds wishes to hedge 10% of the portfolio against a tail risk sell-off. iTraxx Main is at 55bp today and the investor is worried about a possible widening to 150bp. A possible hedge would be to buy protection on the senior tranche of iTraxx Main (Table 8). The last time when iTraxx Main traded at 150bps, the 3y senior tranche was at 27bps, compared to the current 15bps. Assuming a similar level of correlation, the investor would be paid 36 cents. This compares to the payout of 4.7% on the index.

Table 8: Trade Details: Long Protection on Senior Tranche

Buy/Sell	Index	Tranche	Maturity	Notional	Carry (bps)
Buy Protection	iTraxx Main 21	22-100%	5y	10,000,000	15

Source: J.P. Morgan

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Section 3: Hedges that Combine Credit Instruments

Curve Trades

Product Overview

Curve trades express a view on the relative value between short-dated and long-dated risk. CDS index curve trades combine two trades on the same index, but at differing maturities and in opposite directions. For example, an investor may buy protection on the 5y iTraxx Main contract and sell protection on the 3y iTraxx Main contract in equal notional, which is equivalent to buying protection on the 3y2y forward on iTraxx Main. This trade will profit if the 5y spread on iTraxx Main increases or the 3y spread decreases or both. In all three cases, the difference between the 3y and the 5y spreads increases, i.e. the 3s5s curve becomes steeper. Hence, the name for this type of trade: a 3s5s curve steepener. Similarly, an investor who sells protection on the 5y contract and buys protection on the 3y contract has put on a 3s5s curve flattener.

Types of curve trades

Equal notional steepener/flattener

DV01-weighted steepener/flattener

A curve trade can be structured so that the two legs have the same notional; in which case, it is economically equivalent to a *forward contract*. These trades are called **Equal Notional Steepeners/Flatteners**. Alternatively, an investor can size the notionals on a curve trade so that the ratio of the notionals on the two legs of the trade is equal to the ratio of their durations. This is the so-called the **DV01-weighted Steepener/Flattener**. In this case, the investor expresses a view only on the steepness on the curve and is immune to the absolute level of spreads, i.e. the parallel shifts to the CDS curve. Traded tenors in iTraxx Main for example are 3y, 5y, 7y and 10y and so any combination of these four contracts could be traded as a steepener/flattener. There is significantly less liquidity in iTraxx Crossover curve trades, but it is possible to get quotes on 5s7s Crossover curves at this point in time.

Hedge behaviour

iTraxx Main curve steepness depends on the absolute level of the 5y spread. Over the past ten years, as iTraxx Main 5y spreads have traded as low as 20bps and as high as 215bps, the relationship between iTraxx Main curves and 5y spreads has not been constant (Figure 13). For example, for spreads wider than 140bps, curves traded at both positive and negative levels. For low spread values, there seems to be a fairly clearly defined relationship between curves and spreads[1]. In particular, in recent years the relationship between curves and spreads has been well-defined and could be fitted to a quadratic equation as shown in Figure 14. For wider spread values, the curve behaviour depends on the drivers of a sell-off. If the sell-off is orderly and there is no forced selling of bonds, curves do not necessarily invert. However, if there is real panic in the markets and investors are worried about the short-term default risk, curves flatten and even start to invert.

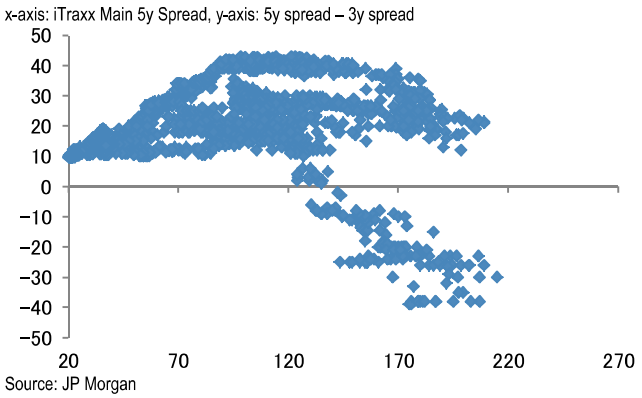
Therefore, investors who wish to hedge a small to moderate widening in the current environment of low spreads should trade 3s5s curve steepeners (Figure 14). These trades should have a positive payoff if spreads widen to 100bps, but are unlikely to be effective for any further widening. Investors who are worried about a large tail risk type of sell-off should put on 3s5s curve flatteners. These positions should have

[1] We have written previously in more detail about how curve steepness is correlated with spread levels (*CD Player*, *CD Player 2015 Outlook*).

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

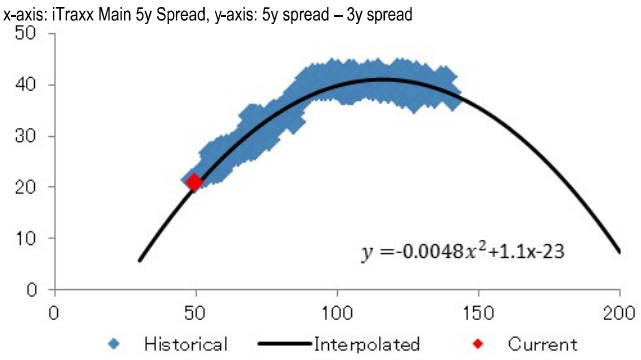
a positive payoff for spreads widening beyond 120bps and especially so if investor concerns about the likelihood of defaults over the short-term horizon rises. But if spreads sell off only moderately (say to 80bps), the 3s5s flatteners would lose money.

Figure 13: iTraxx Main 3s5s versus 5y spread (over the last 10 years)



Source: JP Morgan

Figure 14: iTraxx Main 3s5s versus 5y spread (from mid 2012)



Source: JP Morgan

Hedging Techniques

3s5s steepening likely to occur in case of a small to moderate sell-off

Investors who wish to put on hedges against a small to medium sell-off should consider buying 3s5s DV01-weighted steepeners on iTraxx Main. These trades have a lower cost of carry than buying iTraxx Main 5y protection. On a notional of €10m, the 3-month time value for the steepener is 1k, compared to 25k for buying iTraxx Main 5y protection on the same notional (Table 9). For iTraxx Main 5y widening by 20bps, we expect 3s5s curves to steepen by about 5bps, judging by history. Or in other words, the realised beta between the 3s5s curve and the iTraxx Main 5y spread is 4 ($=\frac{20}{5}$). However, the ratio of the time-value between the outright index trade and the steepener is 25($=\frac{25}{1}$); since the time value ratio is higher than the beta, this DV01-weighted steepener is a cheaper hedge than iTraxx Main 5y for a small to medium sell-off. We realise that this is a non-consensus trade since historically 3s5s flatteners have been considered to be a hedge. This has been the case, however, when spreads traded above 140bps. We believe that in the current regime, 3s5s curves would steepen in a small to medium sell-off. However, it is true that in a tail risk scenario of a major sell-off, 3s5s curves would flatten. So in the current environment, the 3s5s steepeners are a market risk hedge, whereas the 3s5s flatteners are a tail risk hedge.

Example

An investor wishes to hedge 10% of their €100m corporate bond portfolio against a small to medium widening and decides to put on a DV01-weighted steepener, as shown in Table 9. We expect this trade to pay 0.25bp for every 1bp widening of iTraxx Main 5y, while costing 0.04c for every 1c of time value for iTraxx Main 5y. Because the beta is 4, the notional of the steepener should be 40m (=4x10%x100m).

Table 9: Trade Details: DV01-weighted 3s5s iTraxx Main Steepener

Direction	Index	Maturity	Spread	Notional	DV01	3m Carry	3m Slide	3m Time Value
Buy Protection	iTraxx Main S23	Jun-20	55	40,000,000	21,085	-58,975	--60,850	-119,825
Sell Protection	iTraxx Main S23	Jun-18	35	63,682,596	-21,085	59,426	55,961	114,937
	Trade Horizon	23-June-2015					Total	-4,438

Source: J.P. Morgan

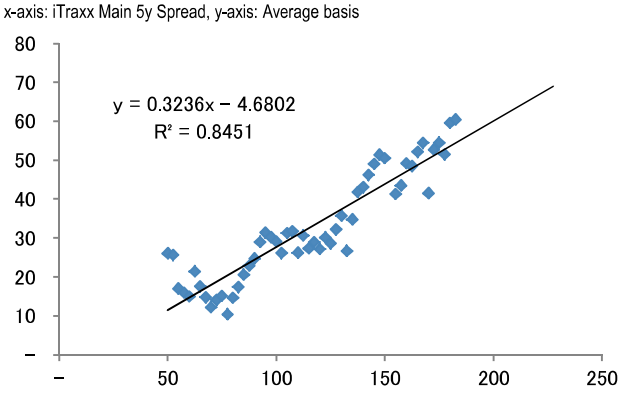
Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Macro Basis Trades as Hedges

Product Overview and Market Structure

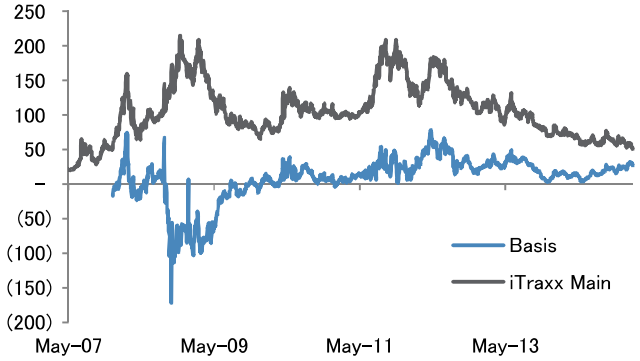
The bond-CDS basis has historically been correlated with the underlying iTraxx Main 5y spread. In a low spread environment, the bond-CDS basis in EUR HG generally trades in a market directional manner, so that as spreads widen, the basis tends to widen as well and vice versa (Figure 14), because CDS has a higher spread beta than bonds. Because of this correlation with spread moves, the basis itself can be traded as a hedge. However, this hedge has a limited effectiveness for very wide spreads. In an environment where spreads are very wide, the basis actually tends to trade in the opposite direction from spreads: as spreads sell-off, the basis can become less positive or even negative as was the case during the crisis of 2008/09 (Figure 13). This effect was caused by the underperformance of bonds, which was brought on by the withdrawal of funding and investors were forced to sell bonds in order to meet redemptions.

Figure 15: Basis versus iTraxx Main 5y Spread since mid-2012



Source: JP Morgan

Figure 16: Average EUR HG Basis



Source: JP Morgan

Investors wishing to hedge their portfolios against moves wider in iTraxx Main can consider positioning for the basis to widen, instead of positioning outright for the underlying spreads to widen, or in other words, they can put on a **Macro Negative Basis Trade**. The advantage of this trade is that in many cases it has a lower cost of carry compared to simply buying protection on iTraxx Main. A Macro Negative Basis Trade is a hedge suitable for situations in which credit spreads are low and they go through a small or a medium sell-off. The trade is likely to have a positive payoff for a moderate widening in credit spreads (up to 120bp in iTraxx Main), but for a more extreme widening, it is likely to make a loss. In this respect, its payoff profile is similar to that of a Payer Ladder or of a 3s5s DV01 curve flattener.

The Macro Negative Basis trade consists in taking a long-risk position in bonds and a short-risk position in CDS. This trade profits if the basis between CDS and bonds becomes more positive. In the current environment of low spreads, this generally happens in a market sell-off.

We think that there are two main reasons why EUR CDS underperforms bonds in a moderate sell-off:

1. ***Investor behaviour:*** In Europe, there is often less liquidity in bonds than in CDS. Given that we have had six consecutive years with negative net issuance in High Grade bonds in Europe, bond investors may be reluctant to sell bonds during

small sell-offs and so they prefer to hedge the market risk by buying protection on CDS indices such as iTraxx Main and Crossover, which pushes their spreads wider. The indices in turn pull the underlying single names wider, thus increasing the bond-CDS basis.

2. ***Low default environment:*** Corporate defaults in Europe are at multiyear lows and investors are often mostly concerned about mark-to-market losses due to the market risk and not by the default risk. Market risk can be hedged by CDS indices without the need to sell the bonds.

On the other hand, investors who wish to hedge a tail risk sell-off should consider a **Macro Positive Basis Trade**. In the tail risk sell-off of 2008/09, bond spreads widened more than CDS spreads as investors were forced to sell bonds to meet redemptions and the basis became negative. In this type of sell-off, we expect a Macro Positive Basis Trade to have a positive payoff and it is therefore a candidate for a tail risk hedge.

Hedging Techniques – Macro Negative Basis Trade

In order to put on a Macro Negative Basis as a hedge, the investor takes a long position in bonds through iBoxx TRS and buys CDS index protection. Technical details about how to implement the two legs of the trade are in Sections on CDS Indices and iBoxx TRS.

Example

An investor who manages €100m in EUR High-Grade bonds wishes to hedge 10% of the portfolio against a small to medium sell-off. iTraxx Main is at 55bp today and the investor is worried about a possible widening to 80bps, but is comfortable with taking on the risk that iTraxx Main widens beyond 100bps. Here is how the investor could add a Macro Negative Basis Trade as a range-bound hedge.

Recent realised beta between the average EUR HG bond-CDS basis and iTraxx Main 5y is 0.3. Based on this, the notional of the basis trade is equal to the notional of the index protection divided by the beta.

Index: iBoxx € Corporates
Direction: Client receives index
Maturity: 20 June 2015
Notional: €33,000,000
Entry Index Level: 216
Floating Leg: 3m Euribor

Table 10: Trade Details: Macro Negative Basis Trade

Direction	Instrument	Maturity	Notional	Level	Time Value (cents)	Cost (EUR)
Buy Index	iBoxx € Corporates TRS	20-Jun-15	33,000,000	Index offer 216 (yield 105bp)	27	89,100
Pay Fixed	5y Interest Rate Swap vs 3m Euribor	20-Jun-20	33,000,000	28bps	6	1,980
Buy Protection	iTraxx Main S23	20-Jun-20	33,000,000	55bps	-25	-82,500
					Total	8,580

Source: J.P. Morgan, BBG

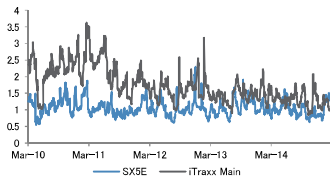
Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Eurostoxx-50 Futures and Options

Credit markets and equity markets often move in line with one another and for this reason credit investors can use instruments from equity markets in order to hedge their portfolios. Equity index futures and options are common tools used for reducing the downside risk in a credit portfolio.

Some of the reasons for using equity derivatives for hedging credit portfolios are: cost, relative value view and a preference for exchange-traded derivatives. For example, the ratio of implied to realised volatility for equity options can be lower than in credit options, implying that equity options are cheaper than credit options at that point in time (Figure 17). Investors may have a view that an upcoming market sell-off will hit the equity market harder than it will hit the credit market and may therefore prefer to put on a hedge through equity derivatives. Additionally, Eurostoxx-50 futures and options are exchange-traded products and certain investors can prefer to use them for this reason.

Figure 17: Ratio of Implied to Realised Volatility: SX5E and iTraxx Main



Source: J.P. Morgan

The Eurostoxx-50 is the benchmark index for large cap Eurozone stock markets. Futures and options on the Eurostoxx-50 are liquid, exchange traded instruments that allow investors to hedge portfolios or alternatively enhance returns by creating alpha strategies based on these instruments.

Eurostoxx-50 and iTraxx Main daily mark-to-market changes typically have a high degree of correlation. We can estimate the expected beta between the two instruments based on the historical correlation. By looking at recent historical moves, investors can determine how much the Eurostoxx-50 moves for every 1bp move in iTraxx Main. One way of estimating this would be to calculate the ratio of standard deviations of the daily changes in the two instruments. This quantity is called the **realised beta**.

Eurostoxx-50 Index Futures

Eurostoxx-50 futures contracts provide the holder with a synthetic long or short position on the index. These contracts are cash settled on the expiry date, with the payoff equal to the difference between the future strike and the index level on the expiry date.

A credit investor who holds €100m in HG bonds would like to use Eurostoxx-50 futures to hedge 10% of the portfolio over a horizon of three months. The investor could enter into a short futures contract expiring in three months in €10m/beta, which is currently equal to €2m, as the recent realised price beta between Eurostoxx-50 and iTraxx Main is 5. The size of one futures contract is equal to €10 multiplied by the index future level, currently at 3630. Therefore, one contract is worth €36k and the investor would short 56 (=€2m/36k) contracts.

Eurostoxx-50 Index Options

Credit investors can use the realised beta between Eurostoxx-50 index and the credit spreads, in order to determine how to size the trade. An alternative way to size the trade would be to use the implied beta, or in other words, to size the hedges so that the upfront cost is the same. As an example of how to use the realised beta to size the trade, suppose that an investor wishes to hedge 10% of the notional of the €100m bond portfolio against spreads widening beyond 60bps, but does not wish to hedge against smaller moves in spreads. They would therefore buy an iTraxx Main Payer option with a strike at 60bps on the notional of €10m. Instead of hedging with iTraxx Main protection, the investor wishes to hedge with Eurostoxx-50. The strike of the Eurostoxx-50 put option will be equal to: $spot - 5\ x\ realised\ beta.$

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Example

An investor manages €100m in EUR High Grade bonds and wishes to hedge 10% of the portfolio against a small to medium sell-off. iTraxx Main is at 55bps today and the investor is worried about it selling off further to possibly reach 80bps, but does not want to pay for protection beyond 80bps. Moreover, the investor wishes to hedge this exposure through Eurostoxx-50 options rather than iTraxx Main options.

The way to express this view would be to buy a Eurostoxx put at a strike corresponding to iTraxx Main at 60bps and sell a Eurostoxx put at a strike corresponding to iTraxx Main at 80bps. To determine the strikes, we calculate the realised beta between iTraxx Main and Eurostoxx-50.

Based on the recent daily changes in iTraxx Main and Eurostoxx-50, the realised beta over the past three months is 25. This means that for every 1bp change in iTraxx Main, we expect Eurostoxx-50 to change by 25 index points. Therefore, the iTraxx Main strike at 60bps, which is a 5bps move in iTraxx Main corresponds to 125 index points away from the spot level of 3650. The first put option should have a strike at 3525, based on the current beta. The second put option corresponds to iTraxx Main at 80bps, which is 25bps away from the spot level. In Eurostoxx-50, this corresponds to 625 index points away from the spot level of 3650. Therefore, the second put option should have a strike at 3025.

The cost of this strategy is shown in Table 11. For every 1bp of widening in iTraxx Main between 60bps and 80bps, the iTraxx Main payer spread on the notional of €10m pays out €5k. The Eurostoxx-50 should move by 25 index points for every 1bp move in iTraxx Main. One Eurostoxx-50 put option pays out €250 for a 25 index points move and, so, 20 contracts pay out €5k. The cost of the 20 put spread contracts is €15.6k, compared to the €16.6k for the Main 60-80 payer spread (Table 5), which currently makes Eurostoxx-50 put spreads an attractive hedge from a cost perspective.

Table 11: Trade Details: Eurostoxx-50 Put Spread

Buy/Sell	Option	Index	Expiry	Strike	No of Contracts	Cost per contract (€)	Cost (€)
Buy	Put	Eurostoxx-50	19/06/2015	3525	20	960	19,200
Sell	Put	Eurostoxx-50	19/06/2015	3025	20	180	3,600
	Eurostoxx-50 at 3650					Total	15,600

Source: J.P. Morgan

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

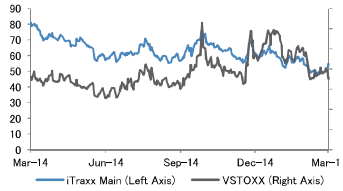
VSTOXX Futures and Options

The VSTOXX index tracks implied volatility on Eurostoxx-50. The spot value of the VSTOXX index is calculated from short-term implied volatility on the Eurostoxx-50 and it is not directly tradable. The format in which VSTOXX trades is through the VSTOXX futures and options. These contracts enable investors to express a view about implied volatility at a future date.

Reasons for using VSTOXX futures and options as a hedge for credit portfolios are broadly similar to those described in the Eurostoxx-50 section, such as the cost, relative value view and liquidity.

Figure 18: ITraxx Main 5y and VSTOXX

Left Axis: bps. Right Axis: Index points.



Source: J.P. Morgan, BBG

VSTOXX Index Futures

VSTOXX futures contracts provide the holder with a long or short position on the VSTOXX index. These contracts are cash settled on the expiry date, and the investor receives the difference between the future strike and the index level on the expiry date.

A credit investor who holds €100m in HG bonds would like to use VSTOXX futures to hedge 10% of the portfolio over a horizon of three months. The investor could enter into a short futures contract expiring in three months on €10m/beta. Recent realised spread beta between iTraxx Main and VSTOXX is 0.85, i.e. for 1bps daily spread change in iTraxx Main, VSTOXX changes by 0.85 index points. In price terms, for 1 cent daily move in iTraxx Main, VSTOXX changes by 0.17 index points. Therefore, in order to hedge €10m of iTraxx Main, the investor would buy €60m VSTOXX futures. The size of one futures contract is equal to €100 multiplied by the index future level, currently at 21.50. Therefore, one contract is worth €2.15k and the investor would short 28k (=60m/2.15k) contracts.

VSTOXX Index Options

Call options on the VSTOXX index have a positive payoff in a market downturn and are a good candidate for hedges

Options on the VSTOXX index trade in a similar fashion to options on the Eurostoxx-50 itself: calls and puts are quoted and their prices depend on the implied volatility of the VSTOXX, which is the implied volatility of the Eurostoxx-50. A VSTOXX call option gives the right to the option buyer to purchase implied volatility at a pre-agreed strike level. If stock markets are volatile at expiry, the VSTOXX call option is likely to be in the money and therefore it behaves like a hedge in a market downturn. For more information on the VSTOXX index, we refer the reader to *Options on Implied Volatility, D. Silvestrini*.

An investor who holds €100m in EUR HG bonds wishes to hedge 10% of the portfolio notional using VSTOXX call options. One way to determine the size of the VSTOXX call option is to determine the implied beta between iTraxx Main payers and VSTOXX calls. This means that if an investor is happy to spend 10 cents on an iTraxx Main Payer option, they would spend the same amount on the VSTOXX call option.

Example – VSTOXX Call Spread

An investor manages €100m in EUR High Grade bonds and wishes to hedge 10% of the portfolio against a small to medium sell-off. iTraxx Main is at 55bps today and the investor is worried about it selling off to possibly reach 80bps, but does not want to pay for protection beyond 80bps. Moreover, the investor wishes to hedge this exposure through VSTOXX options rather than iTraxx Main options. The structure that provides a range-bound hedge is an option spread. The investor could use an iTraxx Main Payer Spread at 60-80 (in delta terms, 58%Δ to 25%Δ). These strikes

correspond to VSTOXX call strikes of 21 and 29, as they are the delta-equivalent options. In this example, we use delta equivalent options in VSTOXX and the implied beta to size the trade. The trade consists in buying a VSTOXX call option at strike 21 and selling a VSTOXX call option at strike 29 (Table 12). The iTraxx Main 60-80 Payer Spread costs 17 cents (Table 5) and therefore the investor would spend 17k in order to hedge 10% of the portfolio using iTraxx Main Payers (Figure 8). For the same cash amount, the investor could buy 82 VSTOXX call spread contracts with a June expiry (Table 12).

For every 1bp of iTraxx Main widening between 60bps and 80bps at expiry, the investor who holds a 60-80 Payer Spread on the notional of €10m would receive $0.01\% \times 5 \times €10m = €5k$, where the duration of iTraxx Main is 5. Assuming that VSTOXX moves with the same realised beta as in recent history, 1bp move in iTraxx Main corresponds to 0.85 index points increase in VSTOXX. The VSTOXX call spread pays €100 per index point widening between 21 and 29, and therefore 82 call option contracts pay out €8.2k per VSTOXX index point, or €7k per 0.85 of an index point (corresponding to 1bps move in iTraxx Main). Therefore, the implied beta is higher than the realised beta and VSTOXX call spreads are an attractive range-bound hedge from the cost perspective.

Table 12: Trade Details: VSTOXX Call Spread

Buy/Sell	Option	Index	Expiry	Strike	Number of contracts	Option Cost	Cost (€)
Buy	Call	VSTOXX	17/06/2015	21	82	2.8	22,960
Sell	Call	VSTOXX	17/06/2015	29	82	0.75	6,150
	Ref VSTOXX at 19				Total	2.05	16,810

Source: J.P. Morgan

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Section 5: How to Compare Hedges?

There is no one unique method for comparing the effectiveness of different portfolio hedges. For a given situation, there are usually several options that would qualify as a suitable hedge. The choice of the hedge depends broadly on the following considerations:

1. Market risk or tail risk hedge
2. Correlation between the underlying portfolio and the hedging instrument
3. The cost of hedging
4. Liquidity of the instrument in a sell-off (to avoid unwind concerns)

Market risk vs Tail risk

Investors can choose to hedge the outright risk of a market downturn, irrespective of the extent of the sell-off. In this case, the investor hedges both the market and the tail risk. However, sometimes investors are only concerned about a short-term weakness in the markets and are not willing to pay for hedging against a large crisis-like downturn. In this case, the investor should put on a market risk hedge, while remaining exposed to the risk of a tail-event. Conversely, some investors may wish to add tail risk hedges to their portfolios, as they weigh the costs and benefits of the hedge against what they perceive as the probability of a large tail risk sell-off.

The hedging instruments presented in the previous section can be divided into these two categories as shown in Table 13.

Table 13: Hedge Types

Hedging Instrument	Market Risk	Tail Risk
CDS Index	yes	yes
Payer Option	depends on the strike	yes
Payer Spread	yes	no
Payer Ladder	yes	no
Equity Tranche	yes	no
Mezzanine Tranche	yes	yes
Senior Tranche	no	yes
3s5s Main DV01 steepener	yes	no
3s5s Main DV01 flattener	no	yes
Macro Negative Basis Trade	yes	no
Macro Positive Basis Trade	no	yes
E-Stoxx Futures	yes	yes
E-Stoxx Puts	depends on the strike	yes
E-Stoxx Put Spread	yes	no
VSTOXX Futures	yes	yes
VSTOXX Calls	depends on the strike	yes
VSTOXX Call Spreads	yes	no

Source: J.P. Morgan

Correlation with the underlying portfolio

The correlation between the portfolio and the hedging instrument is a key consideration for investors. From this standpoint, the higher the correlation of the hedging instrument with the underlying, the more reliable the hedge is.

While it is possible to hedge a bond portfolio with equity options, there is no certainty over the effectiveness of this hedge since the performance of the bond and the stock markets does not necessarily move in line and the two asset classes can become disconnected.

In general, when choosing the appropriate hedge, the investor looks to minimise surprises and hedge with the instrument which has the highest correlation with the underlying portfolio. Other considerations are the cost of the hedge, any relative value views, liquidity constraints, etc.

The cost of Hedging

A portfolio manager needs to make a decision about the best choice of the hedging instrument while having limited information about how much each hedge is likely to cost over their chosen time horizon. Some hedges have a fixed cost that is paid upfront such as options and there is no uncertainty over their costs. Other hedges, such as buying protection on iTraxx Main, are generally not held to maturity and they need to be unwound at market levels at the end of the hedging time horizon. The cost of a hedge which will not be held to maturity cannot be known in advance and can only be estimated based on the expectations about the market moves over the desired time horizon.

Hedge Effectiveness

We have developed a hedge effectiveness measure which captures the potential payoff of the hedge divided by the expected cost. The expected cost is calculated from a model, which uses the options market to calculate the probabilities of different market levels at the end of the hedging time horizon. It also uses the historical relationship between the hedge and the index in order to estimate the expected cost. We use the ratio of the potential payoff and the expected cost to compare different hedges in a unified framework.

To calculate the expected cost of the hedge, we use a lognormal distribution for spreads in a tightening scenario. The volatility of this distribution is equal to the realised volatility over the past three months, currently 45% for iTraxx Main and 39% and Crossover

The Payoff/Cost Measure for Hedges

We have previously published several *CD Player Market Themes* comparing tail hedges across credit. In these *Market Themes,* we developed a framework assessing the payoff of these hedges in a widening scenario relative to their cost in a range-bound or tightening scenario. This framework involved a parameter which we term the payoff/cost measure.

We define the Payoff/Cost Measure as:

(Expected payoff from the hedge if spreads widen)/(Expected cost of the hedge if spreads tighten).

This measure gives an idea of how much profit we can expect to make from this hedge as a proportion of the amount it will cost us if spreads fail to widen, or if they tighten. For example, for a trade with a payoff/cost measure of two, if we expect to lose €1,000,000 if spreads fail to widen then we would expect to make an average of €2,000,000 given that spreads widen to a given level.

We use a three-month trade horizon. In order to use this measure to assess the effectiveness of a hedge in our two scenarios described above, we use the Payoff/Cost Measure with a spread widening to 80bp in iTraxx Main (a small sell-off scenario) and to 100bp (a medium sell-off scenario).

Methodology

We base the calculation of the expected cost of the hedge based on assuming that spread moves follow a log-normal distribution and that the standard deviation of this distribution is equal to the realised volatility in iTraxx Main/Crossover over the past three months.

This probability distribution function allows us to calculate the expected cost of the hedge, conditional on spreads tightening. We regard this quantity as the likely cost of the hedge in case that spreads rally.

On the other hand, we calculate the hedge payoff in case that spreads widen. This is calculated for different sell-off scenarios. For example, in a scenario where iTraxx Main reaches 80bps, the expected payoff of a payer option at strike 70bps will be $(80-70)*5=0.5\%$, assuming that the duration of iTraxx Main 5y is 5.

The ratio of the hedge payoff and the hedge cost is the **hedge effectiveness measure**.

Example – iTraxx Main protection

The expected loss is calculated assuming a lognormal distribution of spreads, and we calibrate the volatility to the realised volatility over the past three months. Then we average the cost of the hedge for all tight spread levels, by respecting the lognormal distribution of probabilities. Table 14 shows an example for iTraxx Main 5y protection.

The expected cost of this hedge is 0.26%, which is calculated by taking a product of the second and the third column in Table 14, for values tighter than 55bps which is the current spread level.

Table 14: Spreads Probability Distribution in 3 Months Implied by the Options Market

Spread	Weighted Probability	Index P&L
1	0.0%	-3.0%
10	0.0%	-2.4%
20	0.0%	-1.9%
30	0.5%	-1.4%
40	13.4%	-0.9%
50	36.4%	-0.4%
60	31.0%	0.1%
70	13.6%	0.7%
80	4.0%	1.1%
90	0.9%	1.6%
100	0.2%	2.1%
110	0.0%	2.0%
120	0.0%	1.1%
130	0.0%	-0.5%
140	0.0%	-2.9%

Source: J.P. Morgan

The hedge payoff is the MtM of the index trade if the spread widens. So the hedge payoff, at 80bps, is equal to 1.1% (approximately $(80-55)bps*5-Time\ Value$), while the hedge payoff at 100bps is equal to 2.1%. Dividing the hedge payoff by the expected cost, we get the hedge effectiveness measure to be 4.4 for the 80bps sell-off and 8.1 for the 100bps sell-off. This ratio indicates how many euros the hedge pays out per every euro spent and it can be used to compare all the different hedging instruments in a single framework.

High-Grade Portfolio

Using the hedge effectiveness method described above, we compare different hedging instruments for HG portfolios in Table 15.

We consider two sell-off scenarios for iTraxx Main 5y: a moderate sell-off to 80bps and a more pronounced sell-off to 100bps.

Table 15: Hedge Effectiveness (Payoff/Expected Cost)

Ref. iTraxx Main S23 5y = 55bp		iTraxx Main at 80bp		iTraxx Main at 100bp	
Hedge	**Expected Cost**	**Hedge Payoff**	**Hedge Effectiveness**	**Hedge Payoff**	**Hedge Effectiveness**
Index					
iTraxx Main 5y Protection	0.26%	1.1%	4.4	2.1%	8.1
Options					
60bp iTraxx Main Jun-15 Payer	0.13%	0.8%	6.0	1.7%	13.3
80bp iTraxx Main Jun-15 Payer	0.04%	-0.1%	-1.5	0.9%	19.8
60-80bp iTraxx Main Jun-15 Payer Spread	0.08%	0.8%	10.1	0.8%	9.9
60-80bp iTraxx Main Jun-15 Payer Ladder	0.00%	1.0%	n/a	-0.8%	n/a
Tranches - Decompression Scenario					
6-100% iTraxx Main S9 10y	0.0%	0.3%	27.7	0.6%	55.4
9-100% iTraxx Main S9 10y	0.0%	0.3%	27.9	0.6%	55.9
22-100% iTraxx Main S9 10y	0.0%	0.2%	28.5	0.4%	55.6
Tranches - Compression Scenario					
6-100% iTraxx Main S9 10y	0.0%	0.5%	25.9	0.8%	47.9
9-100% iTraxx Main S9 10y	0.0%	0.4%	25.8	0.8%	47.2
22-100% iTraxx Main S9 10y	0.0%	0.4%	25.2	0.6%	43.1
Basis					
Negative Basis Trade	0.10%	1.6%	17.1	2.3%	23.4
Curves					
3s5s DV01 Weighted Steepeners	0.08%	0.8%	9.4	1.0%	12.2
Eurostoxx-50					
Jun-15 Future	1.7%	14.6%	8.6	23.0%	13.6
90% Jun-15 Put (strike 3230)	0.3%	4.0%	12.3	13.4%	40.8
90% Jun-15 Put (strike 2870)	0.1%	-0.4%	-3.4	3.4%	30.3

Source: J.P. Morgan.

High-Yield Portfolio

Using the hedge effectiveness method described above, we compare different hedging instruments for HY portfolios in Table 16. Payer spreads and payer ladders have the highest hedge effectiveness levels.

Table 16: Hedge Effectiveness (Payoff/Expected Cost)

Ref. iTraxx Xover 5y = 250bp		iTraxx Xover at 350bp		iTraxx Xover at 400bp	
Hedge	**Expected Cost**	**Hedge Payoff**	**Hedge Effectiveness**	**Hedge Payoff**	**Hedge Effectiveness**
Index					
iTraxx Xover 5y Protection	1.36%	3.2%	2.3	5.1%	3.7
300bp iTraxx Xover Jun-15 Payer	0.40%	1.3%	3.1	3.1%	7.8
400bp iTraxx Xover Jun-15 Payer	0.11%	-0.2%	-1.7	-0.1%	-1.2
300-400bp iTraxx Xover Jun-15 Payer Spread	0.28%	1.4%	5.1	3.3%	11.5
300-400bp iTraxx Xover Jun-15 Payer Ladder	0.17%	1.6%	9.6	3.4%	20.0

Source: J.P. Morgan.

Conclusion

There are two broad types of risk: market risk and tail risk. Some hedging instruments offer protection across the entire spectrum of different possible sell-off scenarios, such as buying CDS index protection. Others allow a more tailored hedge: for example, payer ladders hedge market risk, while remaining very exposed to tail risk.

The most common hedging instruments are presented in this note. On the synthetic side, CDS indices, CDS index options and CDS index tranches are the most commonly used ones. In cash, iBoxx TRS and ETFs are the most commonly used hedges. Combinations of instruments such as trading TRS and CDS indices to express a bond-CDS basis view or combining different CDS index maturities to express a curve view can also be used to hedge portfolio risk. Finally, instruments in other asset classes such as options in Eurostoxx-50 or VSTOXX can also be used to reduce the risk in credit portfolios.

Some instruments allow investors to tailor the hedge according to what they see as the most likely risk on the horizon. Option strategies such as payer spreads and payer ladders are among the most popular market risk hedges. Tranches are another good example of tailored risk hedging: buying equity tranche protection offers a hedge against isolated idiosyncratic events while buying senior tranche protection allows investors to hedge against a highly systemic sell-off.

There is no perfect way to compare different hedges. We have devised a simple effectiveness measure, which is the ratio of the hedge payoff for a given sell-off scenario and the expected cost of the hedge in case spreads tighten. We have used this measure to compare the different hedges presented in this note for two sell-off scenarios, one that would see iTraxx Main reach 80bps and the other that would see iTraxx Main reach 100bps. It is important to bear in mind that the comparison of the hedges is based on a set of assumptions about how the hedging instruments will behave. We have broadly assumed that the hedging instruments will be correlated in the future in a way that reflects recent history. This is only an assumption and therefore any hedge comparison measure should be taken only as an indication. Investors should base their choice of hedges on a number of factors that ultimately depends on their views about likely market moves, with the hedge effectiveness measure providing one such factor.

At the present time, our hedge effectiveness measure indicates that for a sell-off that would see iTraxx Main reach 80bps or 100bps, the most attractive hedges are likely to be iTraxx Main payer spreads and payer ladders, X-100% tranches, Macro Negative Basis trade and Eurostoxx-50 put spreads.

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com

Corrected Note: Minor edits to Table 1 and Table 9 and to text on Page 18

Analyst Certification: The research analyst(s) denoted by an "AC" on the cover of this report certifies (or, where multiple research analysts are primarily responsible for this report, the research analyst denoted by an "AC" on the cover or within the document individually certifies, with respect to each security or issuer that the research analyst covers in this research) that: (1) all of the views expressed in this report accurately reflect his or her personal views about any and all of the subject securities or issuers; and (2) no part of any of the research analyst's compensation was, is, or will be directly or indirectly related to the specific recommendations or views expressed by the research analyst(s) in this report. For all Korea-based research analysts listed on the front cover, they also certify, as per KOFIA requirements, that their analysis was made in good faith and that the views reflect their own opinion, without undue influence or intervention.

Important Disclosures

Company-Specific Disclosures: Important disclosures, including price charts and credit opinion history tables, are available for compendium reports and all J.P. Morgan–covered companies by visiting https://jpmm.com/research/disclosures, calling 1-800-477-0406, or e-mailing research.disclosure.inquiries@jpmorgan.com with your request. J.P. Morgan's Strategy, Technical, and Quantitative Research teams may screen companies not covered by J.P. Morgan. For important disclosures for these companies, please call 1-800-477-0406 or e-mail research.disclosure.inquiries@jpmorgan.com.

Explanation of Credit Research Ratings:
Ratings System: J.P. Morgan uses the following issuer portfolio weightings: Overweight (over the next three months, the recommended risk position is expected to outperform the relevant index, sector, or benchmark), Neutral (over the next three months, the recommended risk position is expected to perform in line with the relevant index, sector, or benchmark), and Underweight (over the next three months, the recommended risk position is expected to underperform the relevant index, sector, or benchmark). J.P. Morgan Emerging Markets Sovereign Research uses Marketweight, which is equivalent to Neutral. NR is Not Rated. In this case, J.P. Morgan has removed the rating for this security because of either a lack of a sufficient fundamental basis or for legal, regulatory or policy reasons. The previous rating no longer should be relied upon. An NR designation is not a recommendation or a rating. NC is Not Covered. An NC designation is not a rating or a recommendation. Analysts can rate the issuer, the individual bonds of the issuer, or both. An issuer recommendation applies to all of the bonds at the same level of the issuer's capital structure, unless we specify a different recommendation for the individual security. When we change the issuer-level rating, we are changing the rating for all of the issues covered, unless otherwise specified. For CDS, we use the following rating system: Long Risk (over the next three months, the credit return on the recommended position is expected to exceed the relevant index, sector or benchmark), Neutral (over the next three months, the credit return on the recommended position is expected to match the relevant index, sector or benchmark), and Short Risk (over the next three months, the credit return on the recommended position is expected to underperform the relevant index, sector or benchmark).

Valuation & Methodology: In J.P. Morgan's credit research, we assign a rating to each issuer (Overweight, Underweight or Neutral) based on our credit view of the issuer and the relative value of its securities, taking into account the ratings assigned to the issuer by credit rating agencies and the market prices for the issuer's securities. Our credit view of an issuer is based upon our opinion as to whether the issuer will be able service its debt obligations when they become due and payable. We assess this by analyzing, among other things, the issuer's credit position using standard credit ratios such as cash flow to debt and fixed charge coverage (including and excluding capital investment). We also analyze the issuer's ability to generate cash flow by reviewing standard operational measures for comparable companies in the sector, such as revenue and earnings growth rates, margins, and the composition of the issuer's balance sheet relative to the operational leverage in its business.

J.P. Morgan Credit Research Ratings Distribution, as of January 1, 2015

	Overweight	Neutral	Underweight
Global Credit Research Universe	25%	57%	17%
IB clients*	71%	64%	58%

Note: The Credit Research Rating Distribution is at the issuer level. Please note that issuers with an NR or an NC designation are not included in the table above.
*Percentage of investment banking clients in each rating category.

Analysts' Compensation: The research analysts responsible for the preparation of this report receive compensation based upon various factors, including the quality and accuracy of research, client feedback, competitive factors, and overall firm revenues.

Other Disclosures

J.P. Morgan ("JPM") is the global brand name for J.P. Morgan Securities LLC ("JPMS") and its affiliates worldwide. J.P. Morgan Cazenove is a marketing name for the U.K. investment banking businesses and EMEA cash equities and equity research businesses of JPMorgan Chase & Co. and its subsidiaries.

Options related research: If the information contained herein regards options related research, such information is available only to persons who have received the proper option risk disclosure documents. For a copy of the Option Clearing Corporation's Characteristics and Risks of Standardized Options, please contact your J.P. Morgan Representative or visit the OCC's website at http://www.optionsclearing.com/publications/risks/riskstoc.pdf

Legal Entities Disclosures
U.S.: JPMS is a member of NYSE, FINRA, SIPC and the NFA. JPMorgan Chase Bank, N.A. is a member of FDIC. **U.K.**: JPMorgan Chase N.A., London Branch, is authorised by the Prudential Regulation Authority and is subject to regulation by the Financial Conduct Authority and to limited regulation by the Prudential Regulation Authority. Details about the extent of our regulation by the Prudential Regulation Authority are available from J.P. Morgan on request. J.P. Morgan Securities plc (JPMS plc) is a member of the London Stock Exchange and is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority. Registered in England & Wales No. 2711006. Registered Office 25 Bank Street, London, E14 5JP. **South Africa**: J.P. Morgan Equities South Africa Proprietary Limited is a member of the Johannesburg Securities Exchange and is regulated by the Financial Services Board. **Hong Kong**: J.P. Morgan Securities (Asia Pacific) Limited (CE number AAJ321) is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission in Hong Kong and/or J.P. Morgan Broking (Hong Kong) Limited (CE number AAB027) is regulated by the Securities and Futures Commission in Hong Kong. **Korea**: J.P. Morgan Securities (Far East) Ltd, Seoul Branch, is regulated by the Korea Financial Supervisory Service. **Australia**: J.P. Morgan Australia Limited (JPMAL) (ABN 52 002 888 011/AFS Licence No: 238188) is regulated by ASIC and J.P. Morgan Securities Australia Limited (JPMSAL) (ABN 61 003 245 234/AFS Licence No: 238066) is regulated by ASIC and is a Market, Clearing and Settlement Participant of ASX Limited and CHI-X. **Taiwan**: J.P.Morgan Securities (Taiwan) Limited is a participant of the Taiwan Stock Exchange (company-type) and regulated by the Taiwan Securities and Futures Bureau. **India:** J.P. Morgan India Private Limited (Corporate Identity Number - U67120MH1992FTC068724), having its registered office at J.P. Morgan Tower, Off. C.S.T. Road, Kalina, Santacruz - East, Mumbai – 400098, is a member of the National Stock Exchange of India Limited (SEBI Registration Number - INB 230675231/INF 230675231/INE 230675231) and Bombay Stock Exchange Limited (SEBI Registration Number - INB 010675237/INF 010675237) and is regulated by Securities and Exchange Board of India. Telephone: 91-22-6157 3000, Facsimile: 91-22-6157 3990 and Website: www.jpmipl.com. For non local research reports, this material is not distributed in India by J.P. Morgan India Private Limited. **Thailand**: This material is issued and distributed in Thailand by JPMorgan Securities (Thailand) Ltd., which is a member of the Stock Exchange of Thailand and is regulated by the Ministry of Finance and the Securities and Exchange Commission and its registered address is 3rd Floor, 20 North Sathorn Road, Silom, Bangrak, Bangkok 10500. **Indonesia**: PT J.P. Morgan Securities Indonesia is a member of the Indonesia Stock Exchange and is regulated by the OJK a.k.a. BAPEPAM LK. **Philippines**: J.P. Morgan Securities Philippines Inc. is a Trading Participant of the Philippine Stock Exchange and a member of the Securities Clearing Corporation of the Philippines and the Securities Investor Protection Fund. It is regulated by the Securities and Exchange Commission. **Brazil**: Banco J.P. Morgan S.A. is regulated by the Comissao de Valores Mobiliarios (CVM) and by the Central Bank of Brazil. **Mexico**: J.P. Morgan Casa de Bolsa, S.A. de C.V., J.P. Morgan Grupo Financiero is a member of the Mexican Stock Exchange and authorized to act as a broker dealer by the National Banking and Securities Exchange Commission. **Singapore**: This material is issued and distributed in Singapore by or through J.P. Morgan Securities Singapore Private Limited (JPMSS) [MCI (P) 199/03/2014 and Co. Reg. No.: 199405335R] which is a member of the Singapore Exchange Securities Trading Limited and is regulated by the Monetary Authority of Singapore (MAS) and/or JPMorgan Chase Bank, N.A., Singapore branch (JPMCB Singapore) which is regulated by the MAS. This material is provided in Singapore only to accredited investors, expert investors and institutional investors, as defined in Section 4A of the Securities and Futures Act, Cap. 289. Recipients of this document are to contact JPMSS or JPMCB Singapore in respect of any matters arising from, or in connection with, the document. **Japan**: JPMorgan Securities Japan Co., Ltd. is regulated by the Financial Services Agency in Japan. **Malaysia**: This material is issued and distributed in Malaysia by JPMorgan Securities (Malaysia) Sdn Bhd (18146-X) which is a Participating Organization of Bursa Malaysia Berhad and a holder of Capital Markets Services License issued by the Securities Commission in Malaysia. **Pakistan**: J. P. Morgan Pakistan Broking (Pvt.) Ltd is a member of the Karachi Stock Exchange and regulated by the Securities and Exchange Commission of Pakistan. **Saudi Arabia**: J.P. Morgan Saudi Arabia Ltd. is authorized by the Capital Market Authority of the Kingdom of Saudi Arabia (CMA) to carry out dealing as an agent, arranging, advising and custody, with respect to securities business under licence number 35-07079 and its registered address is at 8th Floor, Al-Faisaliyah Tower, King Fahad Road, P.O. Box 51907, Riyadh 11553, Kingdom of Saudi Arabia. **Dubai**: JPMorgan Chase Bank, N.A., Dubai Branch is regulated by the Dubai Financial Services Authority (DFSA) and its registered address is Dubai International Financial Centre - Building 3, Level 7, PO Box 506551, Dubai, UAE.

Country and Region Specific Disclosures
U.K. and European Economic Area (EEA): Unless specified to the contrary, issued and approved for distribution in the U.K. and the EEA by JPMS plc. Investment research issued by JPMS plc has been prepared in accordance with JPMS plc's policies for managing conflicts of interest arising as a result of publication and distribution of investment research. Many European regulators require a firm to establish, implement and maintain such a policy. This report has been issued in the U.K. only to persons of a kind described in Article 19 (5), 38, 47 and 49 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (all such persons being referred to as "relevant persons"). This document must not be acted on or relied on by persons who are not relevant persons. Any investment or investment activity to which this document relates is only available to relevant persons and will be engaged in only with relevant persons. In other EEA countries, the report has been issued to persons regarded as professional investors (or equivalent) in their home jurisdiction. **Australia:** This material is issued and distributed by JPMSAL in Australia to "wholesale clients" only. This material does not take into account the specific investment objectives, financial situation or particular needs of the recipient. The recipient of this material must not distribute it to any third party or outside Australia without the prior written consent of JPMSAL. For the purposes of this paragraph the term "wholesale client" has the meaning given in section 761G of the Corporations Act 2001. **Germany:** This material is distributed in Germany by J.P. Morgan Securities plc, Frankfurt Branch and J.P.Morgan Chase Bank, N.A., Frankfurt Branch which are regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht. **Hong Kong:** The 1% ownership disclosure as of the previous month end satisfies the requirements under Paragraph 16.5(a) of the Hong Kong Code of Conduct for Persons Licensed by or Registered with the Securities and Futures Commission. (For research published within the first ten days of the month, the disclosure may be based on the month end data from two months prior.) J.P. Morgan Broking (Hong Kong) Limited is the liquidity provider/market maker for derivative warrants, callable bull bear contracts and stock options listed on the Stock Exchange of Hong Kong Limited. An updated list can be found on HKEx website: http://www.hkex.com.hk. **Japan:** There is a risk that a loss may occur due to a change in the price of the shares in the case of share trading, and that a loss may occur due to the exchange rate in the case of foreign share trading. In the case of share trading, JPMorgan Securities Japan Co., Ltd., will be receiving a brokerage fee and consumption tax (shouhizei) calculated by multiplying the executed price by the commission rate which was individually agreed between JPMorgan Securities Japan Co., Ltd., and the customer in advance. Financial Instruments Firms: JPMorgan Securities Japan Co., Ltd., Kanto Local Finance Bureau (kinsho) No. 82 Participating Association / Japan Securities Dealers Association, The Financial Futures Association of Japan, Type II Financial Instruments Firms Association and Japan Investment Advisers Association. **Korea:** This report may have been edited or contributed to

from time to time by affiliates of J.P. Morgan Securities (Far East) Ltd, Seoul Branch. **Singapore:** JPMSS and/or its affiliates may have a holding in any of the securities discussed in this report; for securities where the holding is 1% or greater, the specific holding is disclosed in the Important Disclosures section above. **Taiwan**: This material is issued and distributed in Taiwan by J.P. Morgan Securities (Taiwan Limited). **India:** For private circulation only, not for sale. **Pakistan:** For private circulation only, not for sale. **New Zealand:** This material is issued and distributed by JPMSAL in New Zealand only to persons whose principal business is the investment of money or who, in the course of and for the purposes of their business, habitually invest money. JPMSAL does not issue or distribute this material to members of "the public" as determined in accordance with section 3 of the Securities Act 1978. The recipient of this material must not distribute it to any third party or outside New Zealand without the prior written consent of JPMSAL. **Canada:** The information contained herein is not, and under no circumstances is to be construed as, a prospectus, an advertisement, a public offering, an offer to sell securities described herein, or solicitation of an offer to buy securities described herein, in Canada or any province or territory thereof. Any offer or sale of the securities described herein in Canada will be made only under an exemption from the requirements to file a prospectus with the relevant Canadian securities regulators and only by a dealer properly registered under applicable securities laws or, alternatively, pursuant to an exemption from the dealer registration requirement in the relevant province or territory of Canada in which such offer or sale is made. The information contained herein is under no circumstances to be construed as investment advice in any province or territory of Canada and is not tailored to the needs of the recipient. To the extent that the information contained herein references securities of an issuer incorporated, formed or created under the laws of Canada or a province or territory of Canada, any trades in such securities must be conducted through a dealer registered in Canada. No securities commission or similar regulatory authority in Canada has reviewed or in any way passed judgment upon these materials, the information contained herein or the merits of the securities described herein, and any representation to the contrary is an offence. **Dubai:** This report has been issued to persons regarded as professional clients as defined under the DFSA rules. **Brazil**: Ombudsman J.P. Morgan: 0800-7700847 / ouvidoria.jp.morgan@jpmorgan.com.

General: Additional information is available upon request. Information has been obtained from sources believed to be reliable but JPMorgan Chase & Co. or its affiliates and/or subsidiaries (collectively J.P. Morgan) do not warrant its completeness or accuracy except with respect to any disclosures relative to JPMS and/or its affiliates and the analyst's involvement with the issuer that is the subject of the research. All pricing is as of the close of market for the securities discussed, unless otherwise stated. Opinions and estimates constitute our judgment as of the date of this material and are subject to change without notice. Past performance is not indicative of future results. This material is not intended as an offer or solicitation for the purchase or sale of any financial instrument. The opinions and recommendations herein do not take into account individual client circumstances, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies to particular clients. The recipient of this report must make its own independent decisions regarding any securities or financial instruments mentioned herein. JPMS distributes in the U.S. research published by non-U.S. affiliates and accepts responsibility for its contents. Periodic updates may be provided on companies/industries based on company specific developments or announcements, market conditions or any other publicly available information. Clients should contact analysts and execute transactions through a J.P. Morgan subsidiary or affiliate in their home jurisdiction unless governing law permits otherwise.

"Other Disclosures" last revised November 29, 2014.

JP Morgan European Credit Research

Global Head of Credit Research
Stephen Dulake
www.jpmorganmarkets.com/stephendulake
25 Bank Street
4th Floor
London E14 5JP

Team Assistant
Sam Smith
(44 20) 7742-5897
sam.smith@jpmchase.com

High Grade and High Yield Research Groups

Head of Credit Strategy & Derivatives Research

Saul Doctor
(44-20) 7134-1539
saul.doctor@jpmorgan.com
www.jpmorganmarkets.com/sauldoctor

Head of European Credit Corporate Research

Arun Kumar
(44-20) 7134-0924
arun.n.kumar@jpmorgan.com
www.jpmorganmarkets.com/arunkumar

Credit Strategy & Derivatives Research

Daniel Lamy
(44-20) 7134-0467
daniel.lamy@jpmorgan.com
www.morganmarkets.com/daniellamy

Danny White
(44-20) 7134-1812
danny.c.white@jpmorgan.com
www.jpmorganmarkets.com/dannywhite

Aida Mehonic
(44-20) 7134-2416
aida.mehonic@jpmorgan.com
www.jpmorganmarkets.com/aidamehonic

Matthew Bailey
(44-20) 7134-2384
matthew.a.bailey@jpmorgan.com
www.jpmorganmarkets.com/matthewbailey

Consumer & Retail

Katie Ruci
(44-20) 7134-1644
alketa.ruci@jpmorgan.com
www.jpmorganmarkets.com/katieruci

Ela Kurtoglu
(44-20) 7134-2337
ela.n.kurtoglu@jpmorgan.com
www.jpmorganmarkets.com/elakurtoglu

Louie Peters
(44-20) 7134-3071
louie.peters@jpmorgan.com
www.jpmorganmarkets.com/louiepeters

Autos & Chemicals

Stephanie Vincent, CFA
(44-20) 7134-1538
stephanie.a.vincent@jpmorgan.com
www.jpmorganmarkets.com/stephanievincent

Denis Piffaretti
(44-20) 7134-2562
denis.piffaretti@jpmorgan.com
www.jpmorganmarkets.com/denispiffaretti

Transport & Healthcare

Danielle Ward, CFA
(44-20) 7742-7344
danielle.x.ward@jpmorgan.com
www.jpmorganmarkets.com/danielleward

General Industrials

Benjamin Defay
(44-20) 7134 5936
ben.defay@jpmorgan.com
www.jpmorganmarkets.com/bendefay

Peter Wessel-Aas
(44-20) 7134 2561
peter.wessel-aas@jpmorgan.com
www.jpmorganmarkets.com/peterwessel-aas

Financials

Roberto Henriques, CFA
(44-20) 7134-1733
Roberto.henriques@jpmorgan.com
www.jpmorganmarkets.com/robertohenriques

Axel Finsterbusch, CFA
(44-20) 7134-4711
axel.j.finsterbusch@jpmorgan.com
www.jpmorganmarkets.com/axelfinsterbusch

Diana Aidarkhanova
(44-20) 7134-0191
diana.aidarkhanova@jpmorgan.com
www.jpmorganmarkets.com/dianaaidarkhanova

TMT – Telecoms/Cable, Media & Technology

Andrew Webb
(44-20) 7134 0121
andrew.x.webb@jpmorgan.com
www.jpmorganmarkets.com/andrewwebb

Constantin T Wolf
(44-20) 7134 5765
constantin.t.wolf@jpmorgan.com
www.jpmorganmarkets.com/constantintwolf

Isabelle De Cointet
(44-20) 7134 2996
isabelle.decointet@jpmorgan.com
www.jpmorganmarkets.com/isabelledecointet

Robert Danilczuk
(44-20) 7134 3043
robert.a.danilczuk@jpmorgan.com
www.jpmorganmarkets.com/robertdanilczuk

Utilities

Daniel Vaun
(44-20) 7134-3060
daniel.vaun@jpmorgan.com
www.jpmorganmarkets.com/danielvaun

Vinay Anicatt
(44-20) 7134-3051
vinay.anicatt@jpmorgan.com

Research Distribution

To amend research distribution, please contact **Sam Smith** our Credit Research Administration, contact details above.
J.P. Morgan research is available at http://www.jpmorganmarkets.com