FICC Portfolio Monthly

Demystifying the credit risk premium

Bank of America Merrill Lynch

Credit Analysis

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The credit risk premium: implied vs. realised default risk

Efficiently harvesting risk premia across asset classes has been one of the strongest trends in the asset management industry in recent years. However, credit has seen relatively little development versus other major asset classes due to generally higher bid/offer costs and liquidity constraints for cash bonds. A consequence of this is that risk premia strategies in credit potentially have a great deal to offer to investors as they have not as well explored as, say, in equities.

In the last few years, however, the growth of a more liquid (versus bonds) CDS index market with tighter bid/offer costs has enabled rapid development of investable credit factors. In this piece, we look to understand and quantify the Credit Risk Premium (CRP) – in essence the difference between implied vs. realised default risk – that a number of such strategies are looking to harvest.

Why does the credit risk premium exist?

It is human nature to fear the worst. Given this behavioural bias, financial markets often overvalue the price of downside protection given demand from investors needing to hedge against a variety of risks, including default (idiosyncratic), macroeconomic cycle-related (systemic) and liquidity risks.

In our view, the credit risk premium stem from: (i) behavioural biases and the fear of significant unexpected losses ("black swan" events), (ii) macroeconomic/business cycle trends, (iii) fears of liquidity constraints and (iv) demand/supply imbalances such as investors systematically bidding up CDS index protection.

Credit risk has volatility-like characteristics

Conceptually, being long bonds is similar to being short a put on the value of a firm's assets. Thus, being long credit risk is not dissimilar to being short volatility in the equity space. The CDS market reflects the risk of a company breaching its viability threshold unexpectedly. For that reason, it is fair to link credit spreads to equity vol as the realisation of an "extreme" event (like a default) is fairly binary. Credit is not only a fundamentally binary instrument, but also behaves like one. CDS index spreads tend to be more correlated to asset vols than the assets themselves.

Quantifying the credit risk premium in CDS

The CDS market has been used as a tool to hedge default risk. An insurance instrument will naturally demand a higher spread than what the presumed default risk would justify. Based on historical data, we find almost no series where the spread at inception of a CDS index series has not been able to compensate for the credit events suffered in the CDS index market in the subsequent five years.

What's worked in the past? Credit > equity, HY > IG, EU > US

We find that the past 12 years would have been more favourable to the credit risk premium over equities. Risk-adjusted returns would have been higher for long risk via HY CDS vs. respective equity markets. Long risk via European CDS indices would have done better in return and risk-adjusted return terms than their US counterparts since 2007. .

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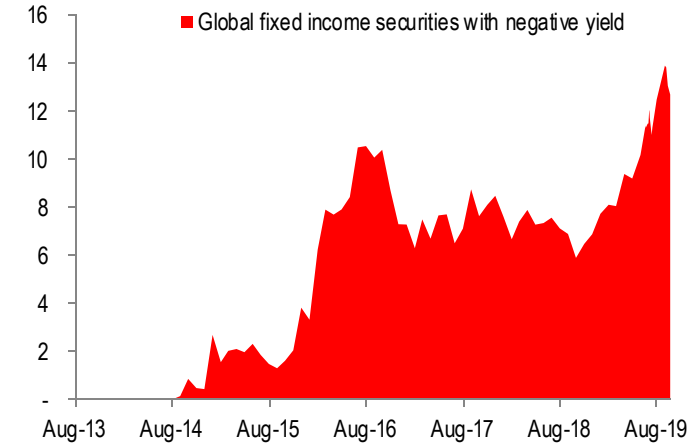
The credit risk premium – demystified

After years of accommodative central bank policies, the fixed income world is starved of yield. Around $13tn of assets are negative yield and, with QE2 just around the corner and yields close to record lows, credit investors are naturally starting to question where spreads go from here. We think that in a world of central bank largesse and more QE, credit investors will come to explore the value of harvesting the very core risk a credit investor is exposed to; the credit default risk premium.

Chart 1: The lack of yield in a single chart

$13 trillion of negative-yielding assets globally



Source: ICE Data Indices, LLC

Chart 2: Can spreads go tighter from here? Employing a credit risk premium lens allows us to see more upside in credit space

Source: ICE Data Indices, LLC, Bloomberg

Our work highlights that credit spreads are still attractive compared to default risks. Historically credit investors have been almost always gotten compensated adequately for default risks. Our work highlights, a healthy positive spread between market traded levels (that reflects the implied default risk) vs. subsequent realised defaults.

The CDS market allows investors the ability to access credit risk in a systematic way. Long risk via the CDS market allows long-only bond investors not only to add a liquidity "hedge" to their portfolios, but also to diversify and improve their performance ratios.

Defining the credit risk premium

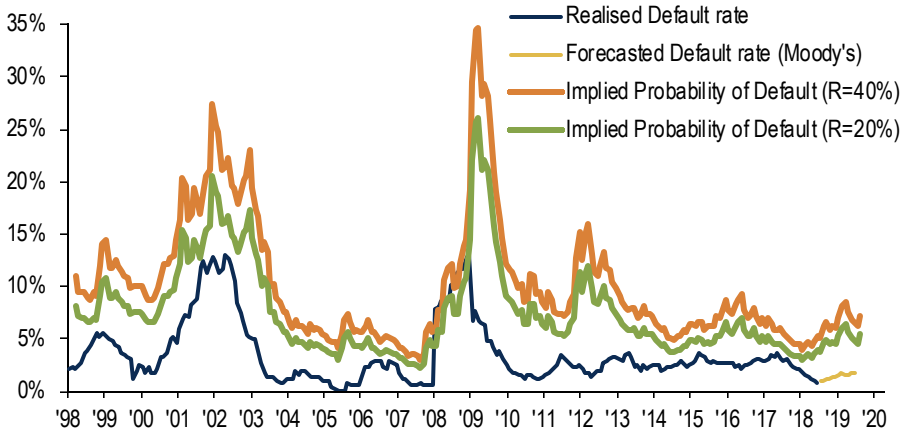
The credit risk premium (CRP) is defined as the excess return of the credit market over risk-free securities. The CRP is the compensation required by investors to hold risky credit securities. This can be via the corporate bond market or the CDS market. The risk premium of a credit instrument should compensate a credit investor for (i) holding/being exposed to default risk and (ii) bearing market volatility risk.

Efficiently harvesting risk premia across asset classes has been one of the strongest trends in the asset management industry in recent years. Credit has seen fewer such strategies develop than other asset classes. Higher bid/offer costs than other asset classes, and the fact that credit-related products tend to trade over-the-counter, have not helped.

However, there has been interest from credit investors to employ systematic strategies to harvest credit risk premia on the back of significant growth of the CDS index market that not only benefits from much tighter bid/offer costs but is also cleared. CDS indices have transformed the way credit investors can trade credit risk due to their superior liquidity, standardisation and counter-cyclical behaviour, in our view.

Chart 3: Implied probability of default is (almost) always higher than subsequent realised defaults

We convert Euro high-yield spreads to implied default probabilities assuming 20% or 40% recovery rates



Source: BofA Merrill Lynch Global Research, Moody's, ICE Data Indices, LLC

In this note we attempt to demystify **the Credit Risk Premium (CRP)**. In effect, the credit risk premium is the difference between credit spreads that reflect implied default risk (the level of compensation market participants require to be exposed to default risk) vs. the subsequently realised defaults. Our work demonstrates that credit investors in global corporate bond and synthetics markets – both high-grade and high-yield – have been well-compensated historically for bearing credit risk.

This is very similar to the notion of an implied over realised vol premium that exists in the volatility market across other asset classes. The need to insure against adverse market moves demands a premium to buy downside protection via the option market (in equities for instance). **Similarly, the need to own insurance in the credit market is keeping implied over realised default spreads in positive territory.**

The credit market is typically overpricing default risk that an investor is ultimately exposed to. We think the credit market – both the physical (corporate bonds) and, more importantly, the synthetics (CDS) market – behaves like a "vol" instrument and so there is value in exploring and comparing it with other vol markets.

Why is there a credit risk premium?

The credit risk premium may stem from: (i) behavioural bias and the fear of significant unexpected losses; (ii) macroeconomic and business cycle trends; (iii) fears of liquidity constraints; and (iv) structural factors that determine the balance between supply and demand.

In this note we shed more light on the primary building blocks of the credit market: the compensation a credit investor requires for being exposed to credit (default) risk. We provide our thoughts on why this premium exists, how it can be explained and what is driving it.

Why the credit risk premium exists

It's human nature to fear the worst-case scenario. Thus markets often overprice downside protection, a manifestation of behavioural biases on the back of painful past episodes of market stress. Investors need to hedge against default risks (idiosyncratic nature), macroeconomic/business cycle risks (systemic nature) and liquidity risks.

More than ever before, we think there is value in understanding the reason that investors need to hedge in the credit space. Traditional credit investors that are long bonds need primarily to hedge against: credit quality deterioration that could ultimately lead to single-name defaults; macro/business cycle deterioration that is reflected by generic widening of credit spreads; and (equally important) "liquidity" shocks in the underlying physical market.

These factors give the CDS market characteristics that we can find in vol markets across other asset classes. Harvesting risk premia in vol markets arise from market participants' needs to hedge downside risks of the underlying market. CDS are designed for exactly that reason. The CDS market is inherently a vol market, we think.

The default risk insurance premium

The first layer of premium in credit can be identified as the difference between the credit spread level that reflects the market "implied" default risk (and thus the level of expected loss) vs. the "realised" default risk. The binary nature of the instrument itself justifies our classification of the CDS market into the volatility "asset class".

A volatility risk premium strategy in equities for instance, harvests the typically positive difference between implied volatility and the subsequently realised volatility. Typically there is a healthy spread between the two for investors to harvest. The vol risk premium results from strong demand for downside protection as investors are less inclined to be exposed to downside risks.

Vol instruments are typically used as hedging tools for risk held in the respective asset class (or for cross-asset hedging purposes) as vol structures benefit from more attractive risk/reward profiles compared to shorting via linear instrument. As an insurance instrument, options and vol are structurally overpricing downside risks. Looking into credit, we need to think about "the vol risk premium" via a different lens. To identify the essence of "vol selling" in credit, we delve into the basics of the nature of the CDS market.

Credit default swaps (CDS) are over-the-counter (OTC) instruments designed to transfer credit risk between two parties by way of bilateral agreements. One party (the protection Buyer) agrees to pay another party (the protection Seller) periodic fixed payments, in exchange for receiving a payment should a third party (the Reference Entity) or its obligations suffer one or more pre-agreed Credit Events.

Investment in bonds can subject investors to either undesired interest rate risk or additional expense in hedging out this risk. These cash market limitations are more accentuated when investors seek to express a bearish view. In this instance, investors' ability to short cash instruments is constrained by their ability to borrow the cash instruments and by the rollover risk inherent in short-term repos.

By contrast, CDS (a contractual agreement among two parties referencing the credit risk of a third entity) provide more flexibility for expressing views on credit risk.

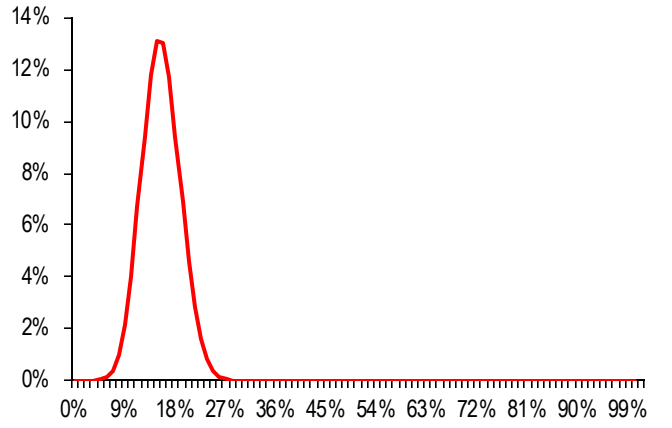
The CDS (credit default swap) market has been developed and used as a tool to hedge the key risk of a credit instrument, **default risk**. As an *insurance instrument*, an investor that buys protection via a CDS contract (either on a single-name format or index format) is looking to protect against adverse market moves (hedge mark-to-market fluctuations) but most importantly to hedge against defaults (or more broadly a credit event).

As credit investors are typically long risk via bonds, they are looking to hedge via the CDS market against an adverse market move (MtM volatility or default risk), having to pay a premium to protect against an asymmetric "tail" risk. This "tail" risk can be conceptualised by laying out the balance of the two potential outcomes for a long CDS protection position:

- the reward of receiving the difference between par value and the recovered amount upon a credit event occurring for the referenced entity with a probability of p; and
- the cost carring a long protection position over the life of the CDS contract for as long as the referenced entity does not suffer a credit event at a probability of $1-p$.

Chart 4: HY defaults - a relatively low probability but not rare event

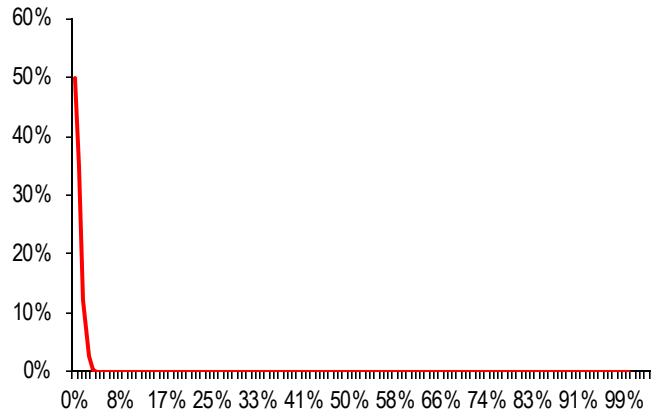
5y default rate density distribution for high-yield (global)



Source: Moody's; Percentage of portfolio defaulting over the following 5 years (x-axis). Probability per default rate (y-axis)

Chart 5: A default in the high-grade space is a very rare and binary event

5y default rate density distribution for high-grade (global)



Source: Moody's; Percentage of portfolio defaulting over the following 5 years (x-axis). Probability per default rate (y-axis)

How often though does a credit investor reap the benefit of owning downside protection, effectively receiving recovery when a credit event occurs? Charts 4 and 5 depict the default probability distributions (for the following five years as per Moody's calculations) for high-yield and high-grade credit portfolios, respectively. Clearly both these charts highlight the **binary** nature of the life of a CDS contract.

The distribution is characterised by a very "fat" tail, i.e. a low probability of an extreme event (credit event/default), and a high probability of no event (issuer remains solvent). The probability of a credit event is extreme and quite remote for a high-quality entity, but less so for a high-yield one. Effectively a credit investor wants to hedge against rare events that have significant adverse PnL effect to their portfolios.

The liquidity risk insurance premium

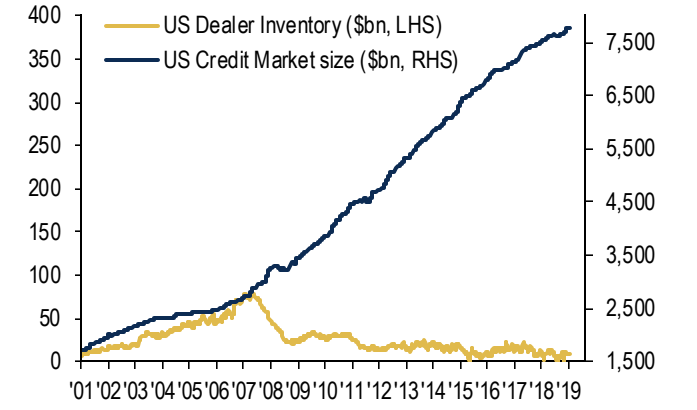
The "buy-side" vs. "sell-side" imbalance in credit is the largest it has ever been (Chart 6). In a world of growing buy-side assets but lower street liquidity, sharp corrections are more common. Dealer inventories of corporate bonds are clearly way down on where they were in '07, but banks also appear to be more nimble in managing their mark-to-market risks and overall exposures on their securities portfolios.

As credit market liquidity is becoming more challenging with market participants seeing fewer bids when they need them, the CDS market has become the vehicle to manage credit risk. Bond trading frequencies have been challenged over the years, but trading

volumes in the CDS market are rising rapidly, both in the index and the options market, as credit investors look to source liquid ways to manage their risk, especially on the downside.

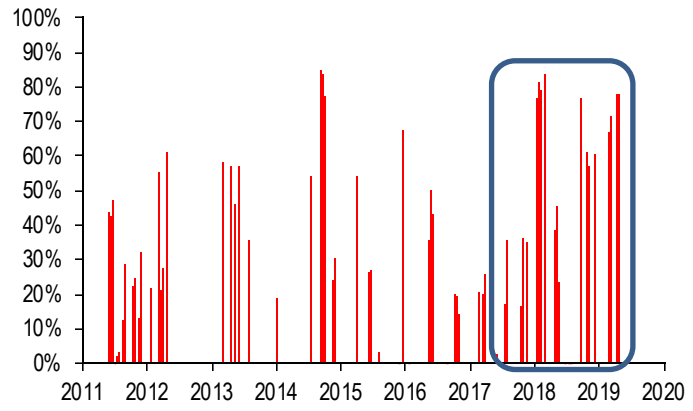
Challenging liquidity and higher market fragility (Chart 7) over the years has pushed more investors to embrace CDS indices and macro instruments as a "liquidity" hedge for their portfolios (more in our annual review of credit market liquidity). The CDS index market benefits from much tighter transaction costs and superior liquidity in terms of size that can be traded.

Chart 6: The "buy-side" vs. "sell-side" imbalance after the GFC



Source: BofA Merrill Lynch Global Research; Bloomberg, The US market size is the sum of the $ IG (C0A0) and HY (H0A0) cash indices face value

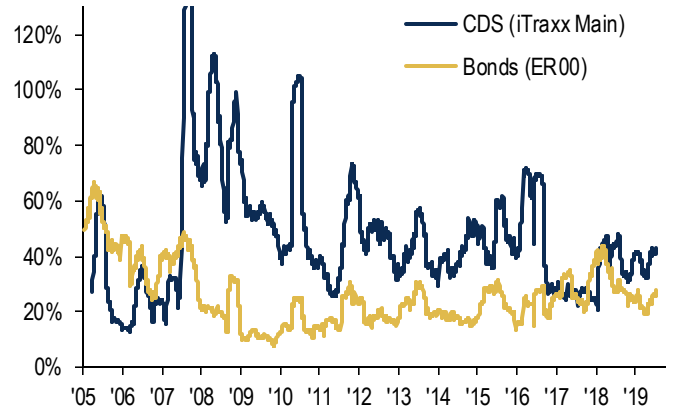
Chart 7: Liquidity shocks are becoming more frequent and sharper



Source: BofA Merrill Lynch Global Research
We measure 5-day moves for the 3m ATM vol vs. moves over the same 5-day period for the put-call skew (120-80% of the Fwd). We then calculate the 50-day rolling correlation between these two time series. We only present correlations when 5-day vol moves are higher than 5 vol points.

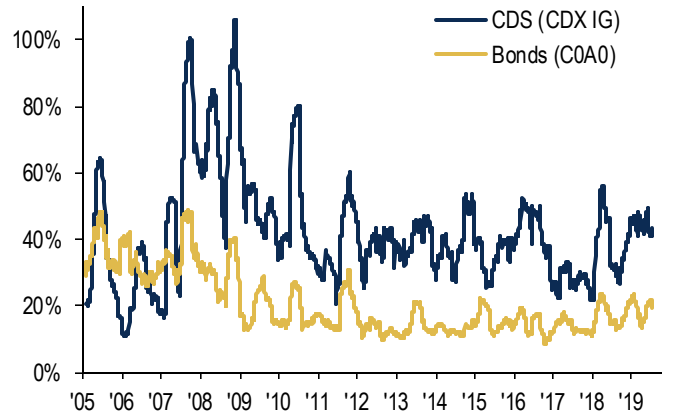
The fact that investors have been keener to use CDS indices to hedge downside risks vs. selling bonds has kept CDS indices much wider than what the subsequently realised defaults would justify. As a result, as Charts 8 and 9 highlight, **CDS indices have been exhibiting higher volatility vs. the bond market**, which has transformed into a more "buy-and-hold" market.

Chart 8: Visualising the credit liquidity premium - CDS tends to be more volatile than bonds (in Europe)
3m realized vol of iTraxx Main 5yr spreads vs. 3m realized vol of the bond market ASW



Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC

Chart 9: Visualising the credit liquidity premium - CDS tends to be more volatile than bonds (in the US)
3m realized vol of CDX IG 5yr spreads vs. 3m realized vol of the bond market ASW



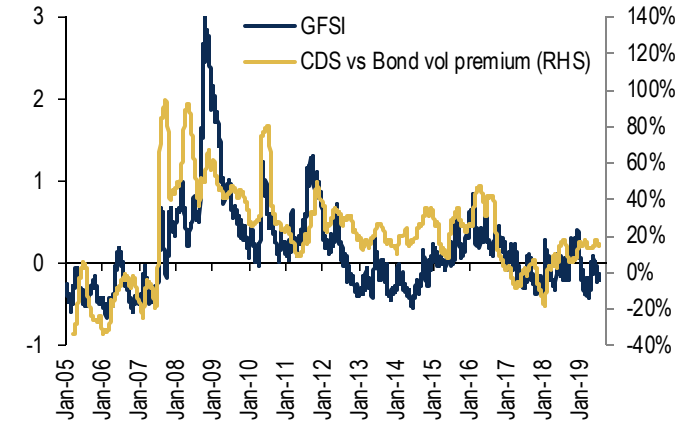
Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC

Rarely have we seen bond markets realising more volatility than the CDS market in recent years. This "liquidity insurance" premium between the two markets has traditionally been very well-correlated to the level of market uncertainty. **The greater**

the market stress, the higher the volatility in the CDS market, compared to the underlying bond market.

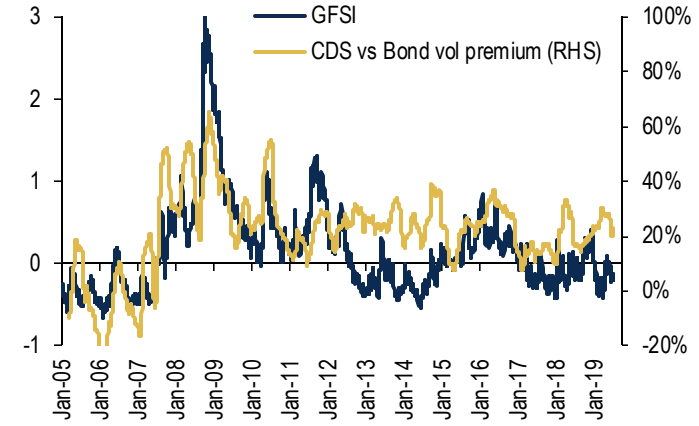
In Charts 10 and 11, we overlay our BofAML GFSI indicator against the difference between the CDS and the bond market realised volatility – our *liquidity insurance premium proxy*. Our work shows that the CDS vs. bond market realised vol premium has identical cycles to the level of stress in the market, as defined/captured by the GFSI. CDS indices have become the instrument of choice to manage risk in credit. This is the case as the bond market is more a "buy-and-hold" market.

Chart 10: The CDS vs. bond "liquidity insurance" premium is highly correlated to market stress. – the higher the market stress, the higher the vol premium of CDS vs. bonds (in Europe)



Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC

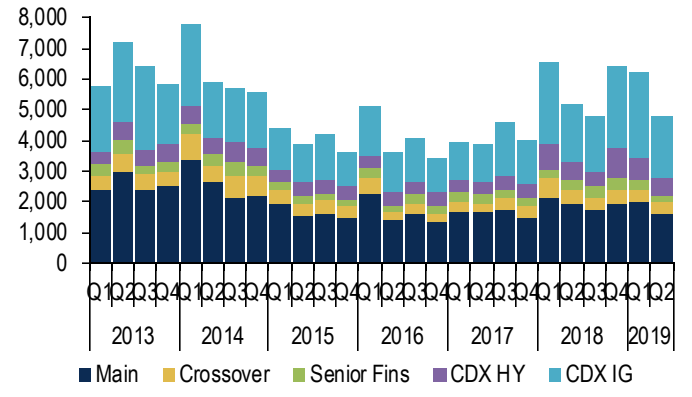
Chart 11: The CDS vs. bond "liquidity insurance" premium is highly correlated to market stress. – the higher the market stress, the higher the vol premium of CDS vs. bonds (in the US)



Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC

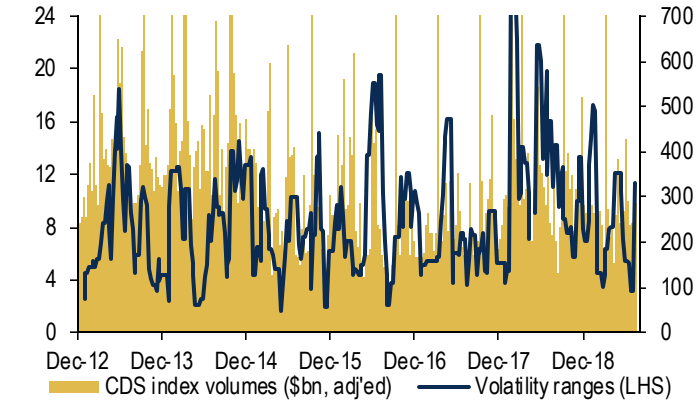
The fact that the bond market has a "self-healing" mechanism is providing support to the corporate bonds space. Primary issuance slows down when markets are stressed, thus improving technicals and the wider spreads move, the stronger the subsequent bounce-back. Investors typically want to hedge rather than sell their bonds in a world of central bank support, a behavioural trend that is effectively "ring-fencing" the bond market.

Chart 12: CDS indices are back - Volumes for CDS indices have increased materially over the past several years amid rising macro risks, central bank interventions and rising geopolitical/political risks



Source: BofA Merrill Lynch Global Research; DTCC; Trading volume notionals in $billions

Chart 13: CDS index trading volumes multiply when there is a significant rise in market volatility, providing a trading "safe haven" for credit investors. Volumes in CDS index market are typically counter-cyclical.



Source: BofA Merrill Lynch Global Research; DTCC
CDS index volumes refer to iTraxx Main, XO and Senior Fins (all series) CDS indices, on a weekly basis. We aggregate based on the respective index spread level vs. that of iTraxx Main; i.e. spread adjusted.

By contrast, CDS index market volumes are linked to the stress level in the market. The higher the volatility, the higher the volumes are in the synthetics

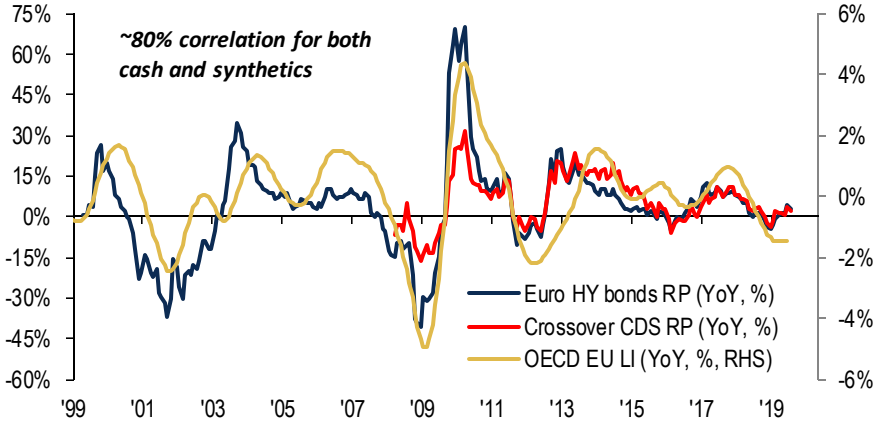
market (Chart 13). Due to its unrestricted size (size of the CDS market is not driven by corporate issuance, but rather by the hedging needs of the two counterparties that are willing to trade credit risk), the CDS market is more prone to behave like a vol instrument (quick spikes on the back of rising stress but slower recoveries due to its nature as a hedging instrument.

The credit risk premium and the macro/business cycle

A combination of macro variables typically explains the vol risk premium (RP) across assets. For example a large proportion of equity market volatility can be explained by a combination of macro variables like the Purchasing Manager Index (PMIs), consumer spending, or the unemployment rate. Additionally, interest rate volatility is closely connected to both real interest rates and inflation expectations.

In credit, our European Credit Macro Indicator is doing something similar: it is a group of macro indicators – that are not market-driven – that best explains patterns and trends in the high-grade and high-yield corporate bond market.

Chart 14: Our work shows that the credit cycle is directly linked to the business cycle. The credit risk premium is following the global business cycle risk in both bonds and CDS



Source: ICE Data Indices, LLC, Bloomberg, Markit

Thus we can say that there is evidence that a blend of macroeconomic indicators and their trends can provide a comprehensive framework to understand the cycle of the credit risk premium. This is applicable across corporate bonds and the CDS market.

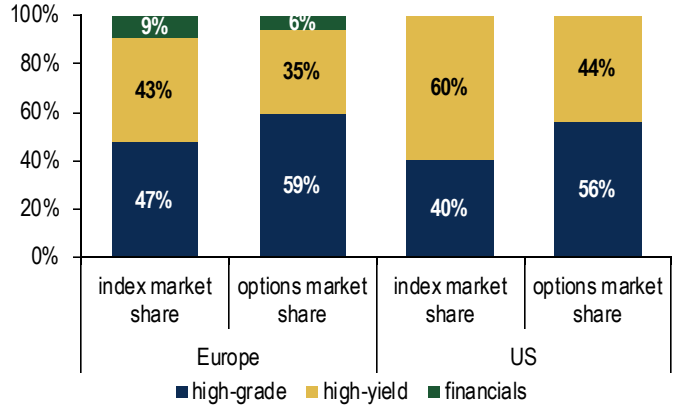
Demand vs. supply dynamics in the CDS market

The existence of the credit risk premium is also a function of supply vs. demand dynamics. For years, the CDS market has been the vehicle to source protection against negative returns from the corporate bond market.

As a result, the buyers of protection have outweighed the sellers. This has been the case especially in indices that have seen lower volumes (in relative terms) traded in the options market. Indices where their market share is higher in the index market vis-à-vis the index options market (like XO and Senior Fins indices) typically house a net long protection positioning from a non-dealers perspective (Chart 16).

By contrast indices (CDX IG and iTraxx Main) that have been traded actively in the options market have seen less pressure to own protection via the linear market (CDS indices) as the CDS options market tends to bear the brunt of the protection buying via payers/payer spreads.

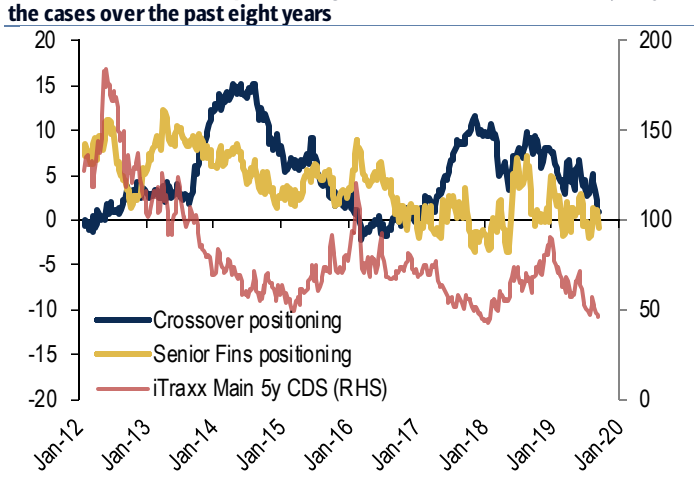
Chart 15: The share of CDS indices and options across the European and US market. Main and CDX IG are more prevalent in the options market.



Source: DTCC and SDR data. We normalise the index positioning based on historical betas. For SDR data we compare the number of trades rather than volumes as a proxy

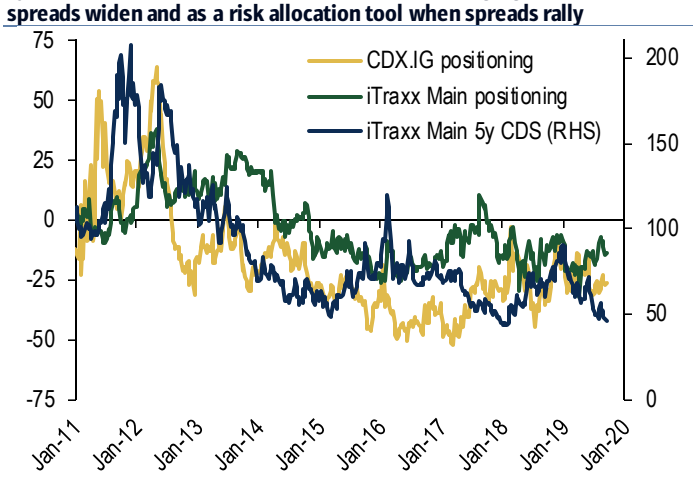
For that reason the positioning trends for these indices are more correlated to the market/risk cycle (Chart 17).

Chart 16: Crossover and Senior Fins have been mainly used as a hedging instrument. Non-dealer positioning has been net short in the majority of the cases over the past eight years



Source: Bloomberg, DTCC, positioning in $bn (LSH axis). A positive figure indicates non-dealers being net long protection via the CDS index

Chart 17: CDX IG and iTraxx Main have been exhibiting a relatively more cyclical behaviour. The se indices are used as a hedging instrument when spreads widen and as a risk allocation tool when spreads rally



Source: Bloomberg, DTCC, positioning in $bn (LSH axis). A positive figure indicates non-dealers being net long protection via the CDS index

Typically **buyers of CDS protection** are real-money accounts (that are restricted using the options market), CVA desks, risk managers, and relative value players (typically hedge funds). On the flipside, **sellers of CDS index protection** are, often "fast-money" and RV accounts but also real-money investors that want to use the instrument as a risk allocation vehicle when markets are bullish or when supply is low and inflows are strong (during the ECB's corporate QE program for instance).

The options index market and its impact on the index market

As discussed above, the options market is a key driver of the technicals in the underlying index market, thus impacting positioning trends in the latter. At this point we should highlight rising popularity in the credit index options market of short vol strategies where investors sell ATM vol (via straddles, i.e. selling same strike payers and receivers) to harvest the credit vol risk premium. In effect, they take the view that the underling instrument (CDS index) will most likely remain range-bound. An alternative implementation that also harvests extra premium attached to the likelihood of wider spreads is via selling OTM payers and delta hedging (partially or via overlaying full delta).

Other accounts are sellers of receivers taking the view that spread rallies will not last long. However, over the years, there have been plenty of occasions where these short vol positions had to be "forced" sellers of CDS protection to delta-hedge or ultimately deliver the underlying index in which they have been exercised (by their counterparty that owns the receivers). Thus, part of the net sellers of CDS index protection (long risk positions) is a "side-effect" of the options market.

Why is credit a vol instrument?

The fundamental view

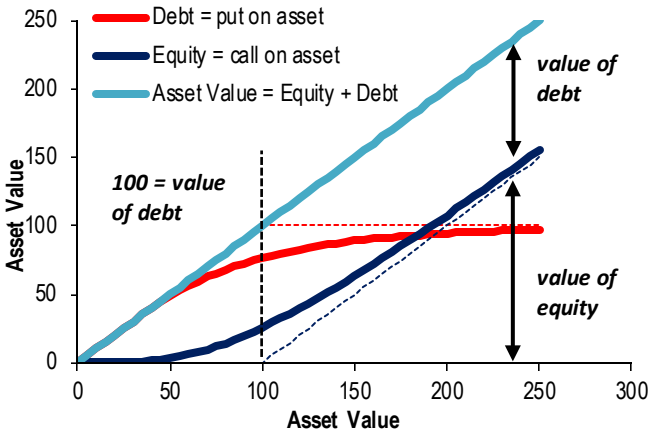
Conceptually being long credit/bonds is similar to being short a put option on the value of a firm's assets. Thus, being long credit risk is very similar to being short vol in the equity space.

In Merton's structural model – the workhorse model for understanding how the risk of default is linked to security prices – volatility is the key input for determining default risk. Default occurs when the asset value drops below the face value of firm's debt. In simple terms, a firm has higher risk of default due to either: (i) little cushioning between the value of its assets and the size of its debt commitments, or (ii) high volatility of its asset value. As the asset value is better captured by stock prices, equity vol is typically used as an input to any Merton model (or any iteration).

By definition, the CDS market reflects exactly the same: the risk of a company breaching that viability threshold "unexpectedly". For that reason, it is fair to link credit spreads – and more specifically – CDS spreads to equity vol as the realisation of an "extreme" event (i.e. default) is fairly binary.

Chart 18: Credit sits higher in the capital structure than equity

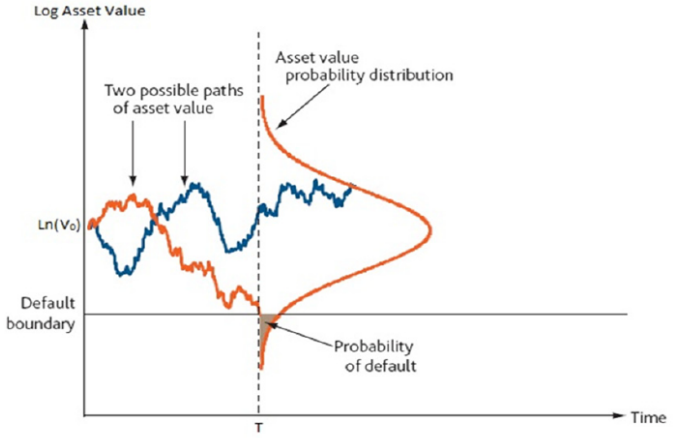
Credit is a put on the asset value of a company struck at face value of the debt and thus exhibits negative convexity to the firm's EV. Equity is the call on the asset value of the firm struck at the value of debt, exhibiting positive convexity.



Source: BofA Merrill Lynch Global Research

Chart 19: The link between asset value and probability of default

Downside risk for a debt holder much more binary than the risk exposure for an equity holder. Credit CDS market is the purest way to price the default risk, thus inherently a binary instrument



Source: Bank of England paper on Modelling credit risk

Looking at the tails

As an insurance instrument, CDS should protect against severe downside credit risks, and thus it should exhibit downside convexity within its hedging capabilities. As in other vol markets the CDS market exhibits positive convexity when fundamentals deteriorate. The positive convexity kicks in at the level where the debt burden outpaces a firm's enterprise value (Chart 18).

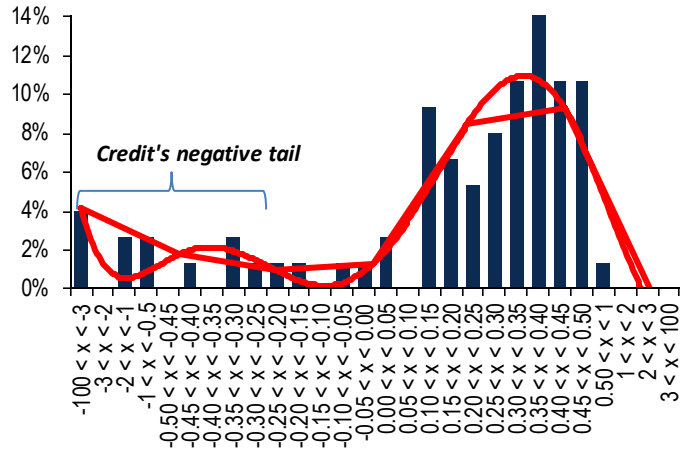
To showcase our view that credit spreads closely resemble vol market characteristics, we pool a large number of credits (across high-grade and high-yield) and calculate the Enterprise Value-over-Total Debt ratio (EV/TD) for each. We use that metric to measure the distance-to-default for a credit. We pool more than 400 non-fins credits from the bond market and more than 170 from the CDS market (there might be some overlap). In chart 21, we present the OAS vs. government bond spread or the 5y CDS level vs. the EV/TD ratio for every credit.

By definition, as the EV/debt ratio declines and approaches 100%, this should mean a further drop in the EV level or an increase of the debt burden will increase the risk of a negative credit outcome (as the EV is below the debt level). Thus, at a level of 100%, the

CDS contract would need to exhibit positive convexity and protect the owner of CDS protection against further deterioration in credit fundamentals. This is exactly what our work highlights: at levels of EV/Debt below 100%, the convexity of CDS protection kicks in and credit spreads move materially wider, realising their binary nature.

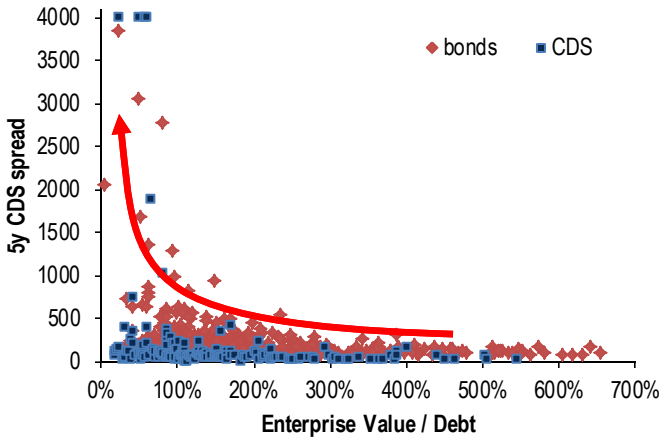
Chart 20: Spread distribution (normalized) for the high-yield CDS market

The vast majority of names trade on the tight end of the distribution. On a handful of names trade at "distress" levels, thus the credit market behaves like a binary instrument



Source: BofA Merrill Lynch Global Research; 5y CDS level for XO names; we normalise by employing a z-score analysis on the 5y CDS level across all the names of the index

Chart 21: The downside protection kicks-in at around the 100% level of our distance-to-default metric



Source: BofA Merrill Lynch Global Research; Note in order to increase the size of the universe under our microscope we use also data from the bond market. Note we cap the chart y-axis at 4000bp (anything trading above this level we set it at 4000bp to normalize the tail for charting purposes.

Using options terminology, we could define the 100% level of EV/debt as the CDS's "option strike". Should the EV/Debt ratio cross the 100% threshold (strike), the hedging "optionality" kicks in as the insurance instrument becomes "in-the-money". For levels of EV/TD ratio above 100%, there is time value for that option to become valuable, but no intrinsic value; thus the spread level convexity is very small (Chart 21 red trend line is relatively flat before the 200% level for instance).

Note that the convexity kicks in at a level of 100% as at that level there is "pin" risk: this is the fine line between default and no default, and thus the instrument justifies its hedging nature against such binary outcomes.

CDS – looks like and trades like a vol instrument

Credit is not only a fundamentally binary instrument, but it also behaves like one. There is performance-related evidence that CDS markets have similar price reaction features to vol markets. Our work shows that CDS indices are more correlated to cross-asset vol markets than the respective underlying markets.

Another way to provide more evidence on why we think the CDS market has "vol market" characteristics is by looking at historical correlations. We take daily levels for all the CDS indices and normalise the trends by employing a z-score methodology. On a daily basis, we calculate the z-score over the past 12 months. We do the same for the vol and the underlying market levels of different assets across a broad range of equity, rates, commodities and currencies.

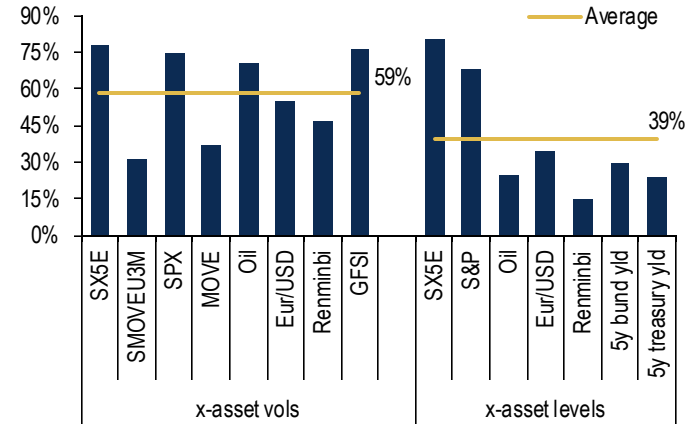
We find that CDS indices are more correlated to cross-asset vols than the respective underlying markets. As chart 22 highlights, Crossover spreads have been more correlated to rates vol than 5y bunds; more correlated to oil (WTI) 3M ATM vol than oil levels; and more correlated to the 3M ATM renminbi and euro/dollar vol than the currencies themselves. We present similar analysis for the three other key CDS indices in Europe and the US (iTraxx Main, CDX IG, CDX HY) in the Appendix.

In chart 23 we present the overall results of this analysis. We present the average correlation of each CDS index to: (i) a broad range of cross-asset vol markets; and (ii)

their underlying markets. We find that all CDS indices, both high-grade and high-yield in Europe and the US exhibit the same "vol" characteristics as they are more correlated to different vol metrics than the underlying markets themselves.

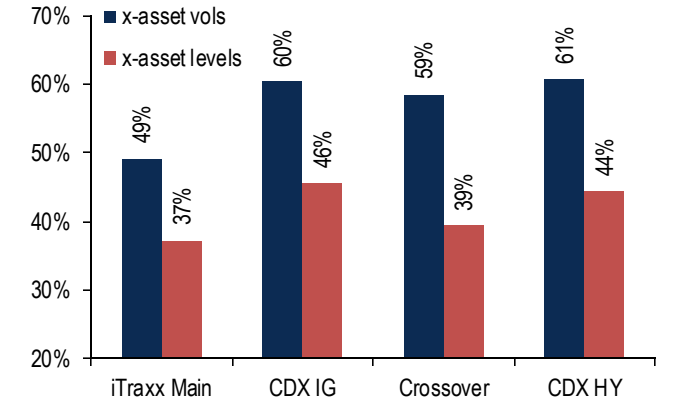
Chart 22: XO spreads are more correlated to asset vols than the assets themselves

Correlation of XO 5y CDS trend (z-score) vs. that of different assets



Source: BofA Merrill Lynch Global Research, Bloomberg; data since mid-2010; 3m vols

Chart 23: All CDS indices across the globe exhibit higher correlation to cross asset vols than the underlying markets themselves



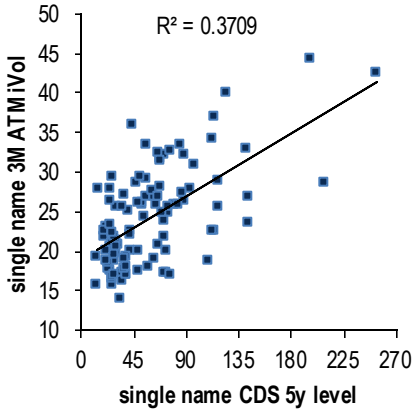
Source: BofA Merrill Lynch Global Research, Bloomberg; Bucketing together the assets of chart 20

High correlations between single-name equity vol and their CDS too

We also find similar behaviour on a single-name level. The charts below illustrate our point that single name risks are captured by both the equity vol and the CDS market in a similar manner.

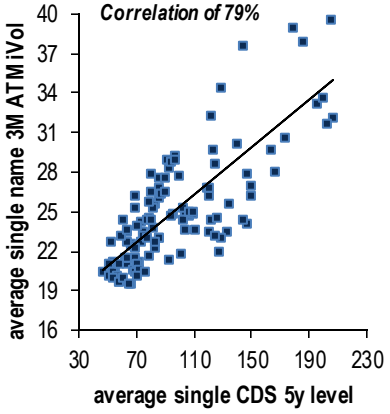
Chart 24: Cross-market correlation across a large pool of single names

Regressing 3m equity implied vol vs. 5y CDS level



Source: BofA Merrill Lynch Global Research, Bloomberg
As of the 5th August available data; Correlation of 61%

Chart 25: The higher the average SN implied vol the wider the average SN 5y CDS level



Source: BofA Merrill Lynch Global Research, Bloomberg
We present the previous chart in a scatterplot format
Correlation of 79%

Chart 26: When credit is under stress CDS behaves more and more like a vol instrument

Equity SN vol vs. CDS correlation on month intervals

Source: BofA Merrill Lynch Global Research, Bloomberg
We pool 103 single names that have consistently data since early 2010 in both equity vol (3m ATM) market and the CDS market. We calculate the correlation between 3m implied vol levels and the 5y CDS on a monthly basis.

Using monthly data we find that single-name equity implied vols are highly correlated to the respective name's 5y CDS level. Chart 24 displays the current state of play, and chart 25 shows the historical relationship between the two markets. We also find that the correlation between single-name implied vol and 5y CDS correlations are increasing in periods of rising stress (Chart 26). This highlights the increasing insurance nature of both markets when stress rises.

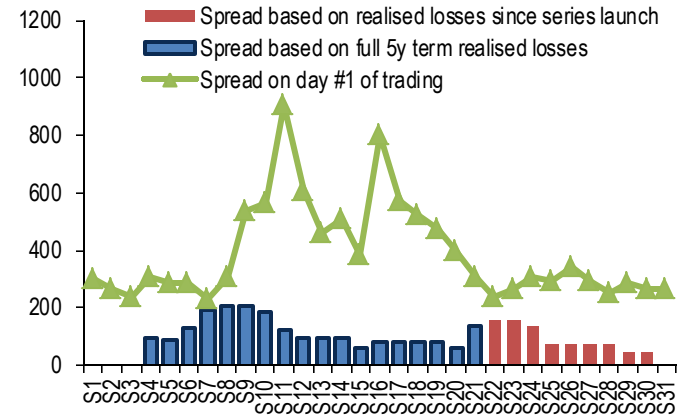
Quantifying the credit risk premium in CDS

As we have discussed so far, the first layer of risk premia we can harvest from credit markets is the difference between implied default risk (as depicted in the CDS market and the corporate bond market) and the (subsequently) realised default risk.

The CDS market has been used as a tool to hedge default risk. An insurance product will naturally demand a higher spread than what the presumed default risk would justify. There is value, in our opinion, in examining if a seller of protection has historically overpaid or underpaid to sell protection for the level of defaults realised over the following five-year timeframe. We look over the historical defaults across the past 31 series of the XO index in Europe (Chart 27) and the past 32 series of CDX HY in the US (Chart 28).

Chart 27: Credit risk premium in Crossover - Implied vs. realized spreads

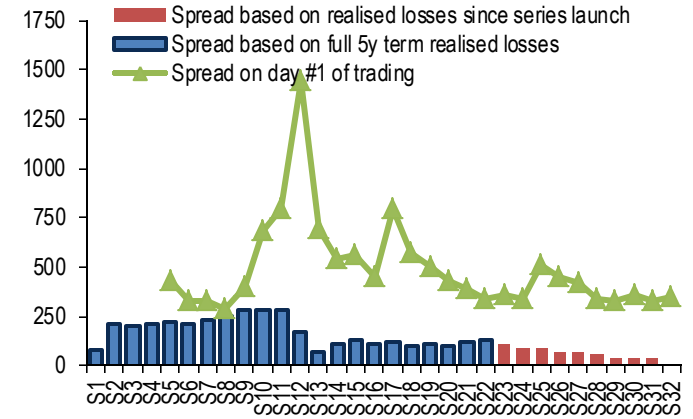
Comparing the starting spread of 5y XO CDS post the roll day for a new series vs. realized losses (adjusting for recovery) over the life of the respective 5y CDS contract



Source: BofA Merrill Lynch Global Research

Chart 28: Credit risk premium in CDX HY - Implied vs. realized spreads

Comparing the starting spread of 5y CDX HY CDS post the roll day for a new series vs. realized losses (adjusting for recovery) over the life of the respective 5y CDS contract

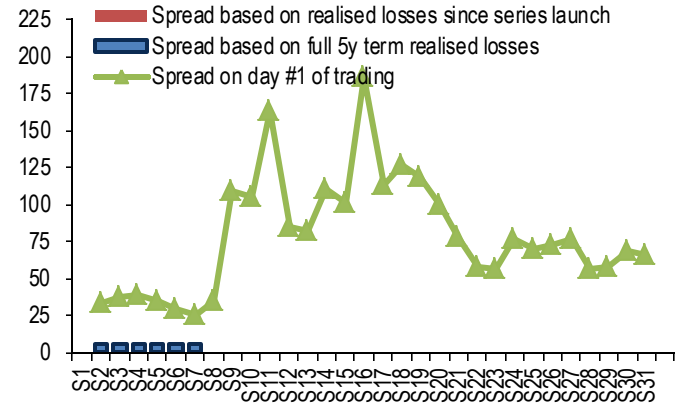


Source: BofA Merrill Lynch Global Research

We find no series where the spread at inception (first day of trading post Roll) has not been able to compensate for the credit events and the subsequently realised losses (adjusting based on auction recoveries) suffered in both HY CDS indices. In simple terms, a seller of XO or CDX HY 5y CDS protection of a new series would have been more than compensated by the spread captured vs. the losses suffered by the occurrence of credit events across the respective portfolios over the following 5 years.

Chart 29: Credit risk premium in Main - Implied vs. realized spreads

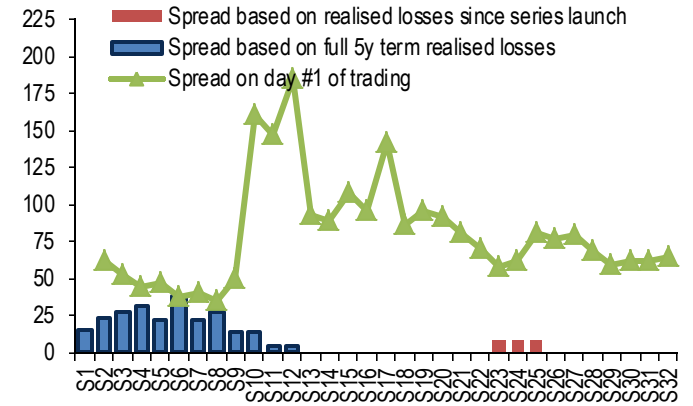
Comparing the starting spread of 5y Main CDS post the roll day for a new series vs. realized losses (adjusting for recovery) over the life of the respective 5y CDS contract



Source: BofA Merrill Lynch Global Research

Chart 30: Credit risk premium in CDX IG - Implied vs. realized spreads

Comparing the starting spread of 5y CDX IG CDS post the roll day for a new series vs. realized losses (adjusting for recovery) over the life of the respective 5y CDS contract



Source: BofA Merrill Lynch Global Research

We run the same analysis for the high-grade CDS indices in Europe (iTraxx Main, chart 29) and the US (CDX IG, Chart 30). Our work shows a sizeable risk premium in IG as – especially in the case of iTraxx Main – there was rarely any credit event.

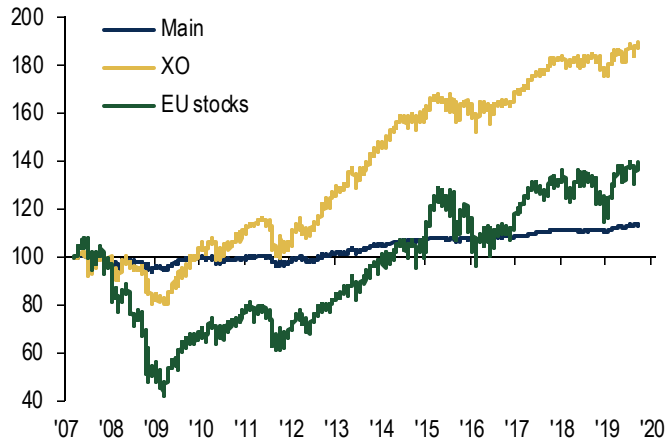
Selling protection on iTraxx Main would also have been a successful strategy over time. MtM risk aside, selling protection on iTraxx Main would have only given away a marginal part of the spread captured at roll day on the back of only one credit event (during a 5y cycle) in the history of the European IG CDS index.

The story is similar for the CDX IG index, though arguably the seller of protection would have realised slightly higher credit event-driven losses. Nonetheless these losses would have been more than offset by the spreads captured.

Long credit via selling CDS – historical performance

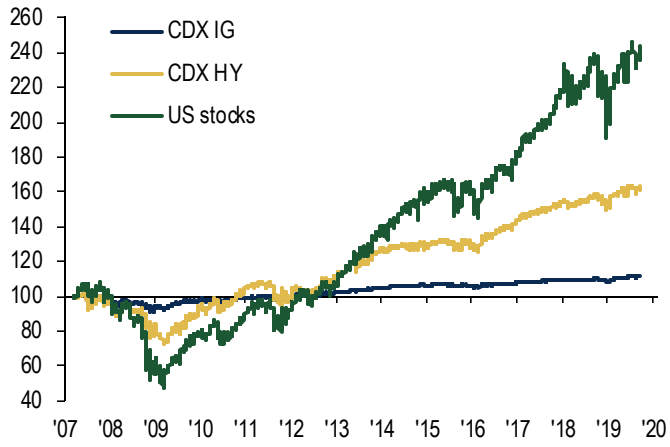
Historically selling protection on CDS indices, both in Europe and the US has been a profitable strategy overall. In our analysis we look at iTraxx Main, Crossover, CDX.IG and CDX HY 5y CDS indices. In the charts below we present the performance of a long risk (short protection) position across the main four CDS indices across Europe and the US.

Chart 31: Long risk via European CDS indices vs. European stocks



Source: Bloomberg, Markit, SXXR for equities

Chart 32: Long risk (selling protection) via US CDS indices vs. US stocks



Source: Bloomberg, Markit, SPXT for equities

In Table 1 we present some key performance metrics (based on Charts 31 and 32) like annualised performance, volatility, information ratios and max drawdowns. We also compare a long (risk) CDS position vs. the equity market in the respective regions to assess the relative performance of these two "neighbouring" asset classes.

Table 1: Historical statistics for the CDS market across Europe and the US. We also compare vs. stocks and government bond markets

	Since Mar'07							
Key stats	**Main**	**XO**	**EU stocks**	**Euro Govt**	**CDX IG**	**CDX HY**	**US stocks**	**US Govt**
Annual return	1.03%	5.41%	4.51%	4.76%	0.87%	4.19%	9.18%	3.89%
Annual volatility	2.51%	7.92%	19.03%	3.80%	2.31%	7.73%	19.30%	4.43%
Information Ratio	**0.41**	**0.68**	**0.24**	**1.25**	**0.38**	**0.54**	**0.48**	**0.88**
Max Drawdown	**-6.7%**	**-21.1%**	**-61.3%**	**-6.9%**	**-9.5%**	**-28.9%**	**-56.6%**	**-7.4%**
Correlations	**Main**	**XO**	**EU stocks**	**Euro Govt**	**CDX IG**	**CDX HY**	**US stocks**	**US Govt**
Main	100%	90%	70%	1%	83%	75%	63%	-41%
XO	90%	100%	74%	-2%	75%	80%	64%	-42%
CDX IG	83%	75%	65%	-6%	100%	85%	72%	-38%
CDX HY	75%	80%	69%	-8%	85%	100%	76%	-37%

Source: ICE Data Indices, LLC, Bloomberg, Markit data. BofA Merrill Lynch Global Research calculations
We use the following indices in that order: ITRXTE5I, ITRXTX5I, SXXR, EG00, CDXTIL15, CDXTHL15, SPXT, G0Q0., less overnight funding
We calculate correlations over 5-day rolling periods.

Below we outline our key takeaways:

- **Beta beats:** We find that the high-yield CDS indices have performed better than their high-grade counterparts. This has been consistent across Europe and the US. Beta not only does better in absolute returns, but also risk-adjusted.

- **Credit > Equities:** We find that the past 12 years have been more favourable to the debt market vs. the equity market. As table 1 highlights, performance ratios have been higher in the high-yield CDS space vs. the respective (geographically) equity markets. Not only that, but drawdowns have been more moderate in the CDS space compared to equities by a wide margin.

- **European CDS indices have done better than their US counterparts over the past years.** This has been the case not only on an absolute performance basis, but also on a risk-adjusted basis. We think this is directly linked to the significantly lower realised default/credit events in the European space, as on average they have been almost identical (in the case of iTraxx Main vs. CDX IG).

- **Government bonds over credit:** We should note that government bond markets have done much better than CDS and equities across the globe. Performance ratios in government bond land have been significantly higher than in corporate risk-linked land across both ends of the capital structure (credit and equities).

- **Diversification benefit:** We also run cross-markets correlations (5-day rolling window). We found that credit CDS indices provide significant diversification benefits to an equity and government bond portfolio. We note that iTraxx Main and Crossover historical returns have been totally uncorrelated to European government bond returns. Correlations between CDS and equities (both in Europe and the US, across IG and HY) have not been that high, at around the 70% mark.

Adding CDS long (risk) to a bond portfolio

We have talked many times about challenging bond market liquidity and the importance of using CDS indices to diversify and add "liquidity" insurance to a long-only portfolio. Our work below highlights exactly this.

We backtest a theoretical credit portfolio that comprises 80% of bond exposure (Euro-denominated bonds in high-grade and high-yield space; we do the same for dollar-denominated bonds) and 20% of the relative CDS exposure (iTraxx Main, Crossover, CDX IG and CDX HY, respectively).

Table 2: Backtested analysis for an 80% (bonds) / 20% (CDS) hypothetical portfolio

Data period starts in March 2007 till August 2019. We calculate correlations over 5-day rolling periods.

	Since Mar'07							
Key stats	EU IG corp	EU HY corp	US IG corp	US HY corp	EU IG + Main	EU HY + XO	US IG + CDX IG	HY + CDX I
Annual return	0.84%	3.78%	0.94%	3.11%	0.87%	4.06%	0.92%	3.27%
Annual volatility	1.59%	6.03%	2.35%	6.48%	1.60%	5.87%	2.12%	6.19%
Information Ratio	0.53	0.63	0.40	0.48	0.54	0.69	0.43	0.53
Max Drawdown	-18.0%	-46.9%	-24.9%	-46.5%	-15.5%	-41.6%	-21.8%	-41.8%
Calmar ratio	0.05	0.08	0.04	0.07	0.06	0.10	0.04	0.08
Correlations	EU IG corp	EU HY corp	Main	XO	US IG corp	US HY corp	CDX IG	CDX HY
Main	58%	62%	100%	90%	57%	63%	83%	75%
XO	58%	66%	90%	100%	55%	68%	75%	80%
CDX IG	46%	57%	83%	75%	58%	67%	100%	85%
CDX HY	49%	60%	75%	80%	55%	72%	85%	100%

Source: ICE Data Indices, LLC, Bloomberg, Markit data. BofA Merrill Lynch Global Research calculations. Note that there are no trading costs/fees included in this backtest.

Euro IG: ER00; Euro HY: HE00; USD IG: C0A0; USD HY: H0A0

This performance is back-tested and does not represent the actual performance of any account or fund. Back-tested performance depicts the theoretical (not actual) performance of a particular strategy over the time period indicated. No representation is being made that any actual portfolio is likely to have achieved returns similar to those shown herein

Below we outline some key highlights of our backtested analysis:

- Historically our backtest suggests that in all scenarios/cases where a CDS long was added as part of a credit bond portfolio, performance metrics improved. The same is the case for max drawdowns as the 80%/20% bond/CDS portfolios tend to experience less severe downturns vs. an outright bond portfolio.
- For the high-yield market in Europe and the US, not only have the information ratios increased, according to our backtest, but both have seen an improvement in the annual return performance and the annualised volatility.
- This would have been the result of a strong diversification effect, as correlations (table 2) between the CDS and the bond market would have been far from perfect (around the 60-70% range).

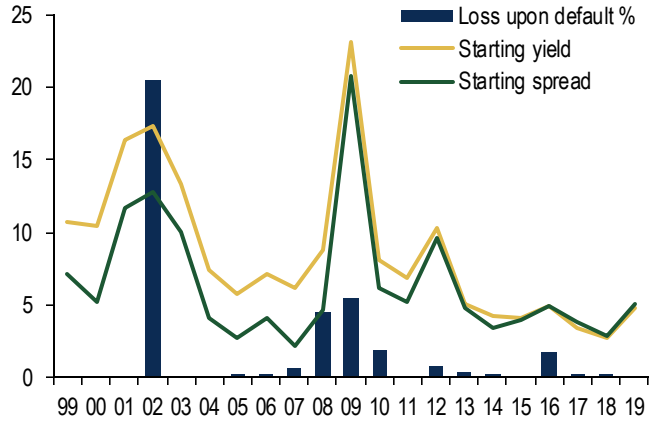
Conclusion: Based on the above we can conclude that our backtest suggests that adding CDS longs into a pure long-only bond portfolio would have allowed credit investors to (i) improve their portfolio liquidity (CDS tends to trade at much tighter bid/offer costs, as our work here has proven), (ii) improve performance ratios and (iii) reduce downside risks when tail risks arise.

Notes: we should highlight that the above backtest does not include transaction costs. However based on our work here, we feel that performance of a credit portfolio that includes a CDS long position would have performed even better, as CDS indices tend to trade at much tighter b/o cost than the corporate bond market.

Quantifying the CRP in bond land

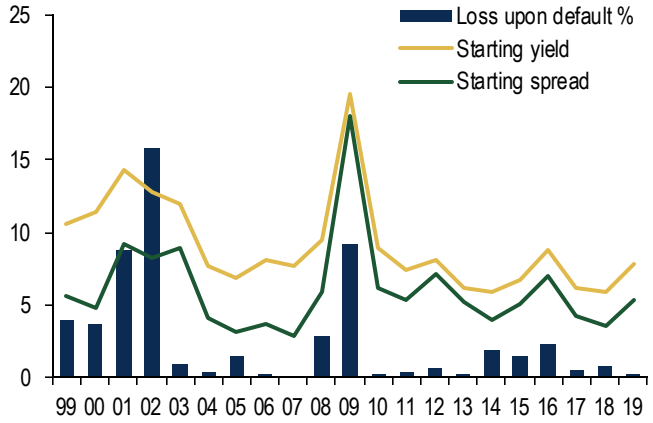
We run similar analysis in the corporate bond market to quantify the difference between realised losses and losses implied by the credit spread level observed in the underlying market. Has a bondholder (high-grade or high-yield market) historically been compensated for defaults within portfolios?

Chart 33: Risk vs. reward being long Euro-denominated HY bonds
Loss upon default vs. starting year yield and OAS spreads for HE00 index



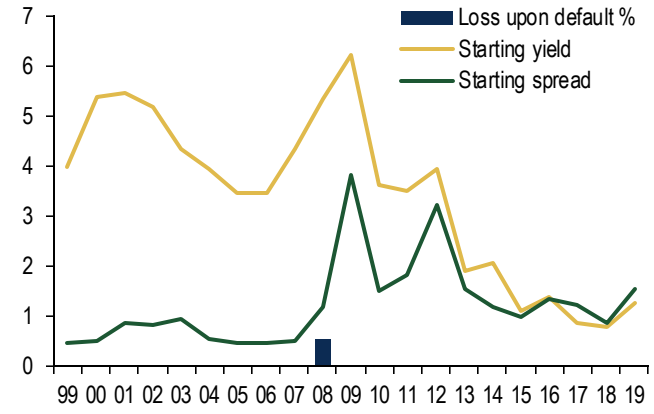
Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC, HE00
Loss upon default is the product of the defaulted notional times (1 - recovery)

Chart 34: Risk vs. reward being long USD-denominated HY bonds
Loss upon default vs. starting year yield and OAS spreads for H0A0 index



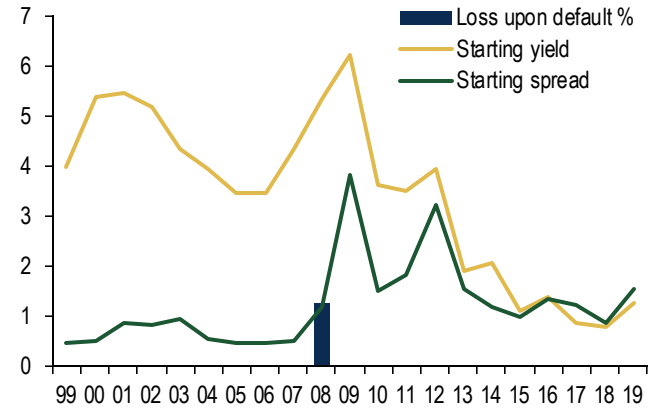
Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC, H0A0
Loss upon default is the product of the defaulted notional times (1 - recovery)

Chart 35: Risk vs. reward being long Euro-denominated IG bonds
Loss upon default vs. starting year yield and OAS spreads for ER00 index



Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC, ER00
Loss upon default is the product of the defaulted notional times (1 - recovery)

Chart 36: Risk vs. reward being long USD-denominated IG bonds
Loss upon default vs. starting year yield and OAS spreads for C0A0 index



Source: BofA Merrill Lynch Global Research, ICE Data Indices, LLC, C0A0
Loss upon default is the product of the defaulted notional times (1 - recovery)

In Charts 33 to 36, we present the gap between realised and implied defaults since the late 90s based on the ICE indices. We examine the credit risk premium between implied and realised default losses across the European and the US high-grade and most importantly high-yield markets. We present the gap between the yield and the spread at the beginning of a year and the subsequent losses realised during that calendar year.

Our key findings are summarised here:

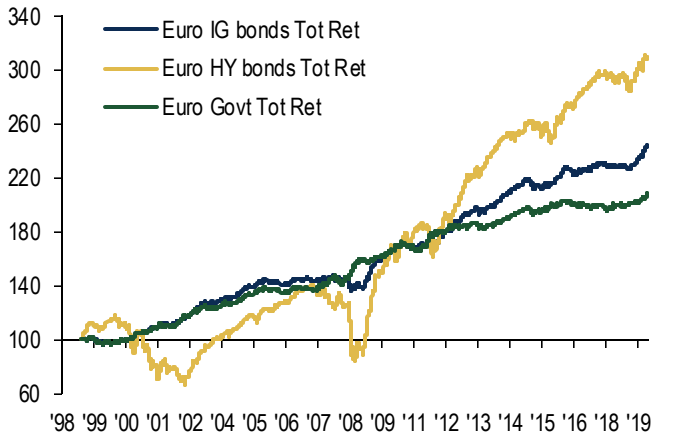
- Based on historically realised default rates in the HE00 and the H0A0 high-yield indices (the euro- and the dollar-denominated indices respectively) and the respective recovery rates, we can see that only during the 2002 period would a high-yield investor (benchmarked) have suffered "hard" (we do not focus on mark-to-market) losses on the back of defaults during that year.

- During the global financial crisis, a total-return (based on yields) and even an excess-return (based on spreads) investor would have more than broken even vs. realised default losses. This was the case in both the euro and the dollar HY corporate bond market. Every year thereafter a high-yield portfolio would have received an even higher spread and larger yield than the losses suffered by credit defaults.
- Replicating the same analysis for the high-grade corporate bond market we found that an investor would have never realised any "hard" loses in the euro-denominated high-grade market (chart 35).
- However, as chart 36 illustrates, during the global financial crisis (GFC) of 2008, a dollar high-grade investor would have failed to recoup losses during the year with the spread locked at the beginning. As the dollar high-grade credit market is more a total-return market than an excess-return market, we could say the yield on offer at the beginning of the year more than compensated for the year's realised losses.

Long credit via owning bonds – historical performance

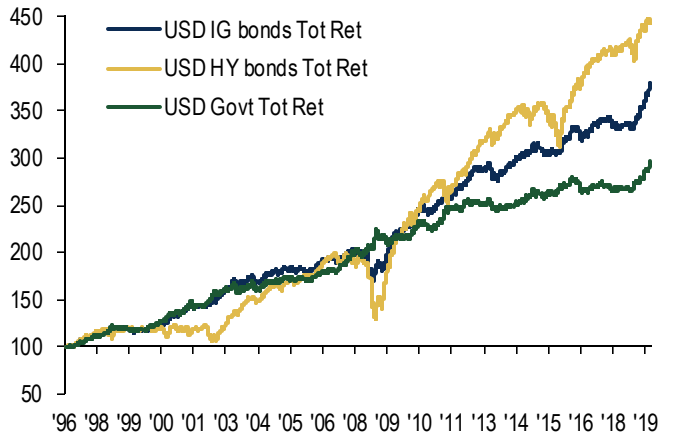
In Charts 37 to 38 we present the historical total returns of the respective credit bond indices. The gap between the credit total return and the government bond return proxies the credit risk premia in the high-grade and the high-yield European and US corporate bond market.

Chart 37: Total return comparison between credit and rates in Europe/€



Source: ICE Data Indices, LLC. Using the ER00, HE00 and EG00 indices

Chart 38: Total return comparison between credit and rates in US/US$



Source: ICE Data Indices, LLC. Using the C0A0, H0A0 and G0Q0 indices

In Tables 1 and 2 we present summary statistics for the realised CRP (credit risk premium) for IG and HY corporate bond markets in Europe and the US. We also compare vs. the equity market and the government bond market in the respective regions.

Finally we provide metrics depending on the phase of the economic cycle. We define the economic cycle based on trends in the OECD Leading Indicators in Europe and the US. Note that the expansion/contraction phases are determined by employing a z-score analysis and the continuation/transition phases based on changes over 12 months of the z-score.

Broadly we find that results are consistent across the European and the US markets.

Table 3: Historical statistics for the European/Euro markets

		------ Excess returns ------		---------- Total Returns ----------			
	Key stats	Euro IG	Euro HY	Euro IG	Euro HY	Euro Govt	Stocks
Daily	Average +ve return	0.05%	0.22%	0.11%	0.18%	0.13%	1.19%
	Average -ve return	-0.06%	-0.28%	-0.12%	-0.26%	-0.13%	-1.75%
	Average return	0.00%	0.01%	0.02%	0.02%	0.01%	0.02%
	Best +ve return	0.69%	3.48%	0.60%	3.43%	0.96%	9.84%
	Worst -ve return	-1.23%	-5.46%	-0.82%	-5.57%	-1.03%	-8.51%
Annualised	Annual return	0.72%	2.38%	4.25%	5.41%	3.49%	4.18%
	Annual volatility	1.39%	6.62%	2.43%	5.93%	2.79%	18.61%
	Information Ratio	**0.52**	**0.36**	**1.75**	**0.91**	**1.25**	**0.22**
	Max Drawdown	**-18.0%**	**-53.7%**	**-7.6%**	**-43.5%**	**-5.7%**	**-63.8%**
	Expansion	2.05%	9.36%	4.46%	11.48%	3.37%	12.36%
	Contraction	-0.87%	-6.42%	4.12%	-2.05%	5.73%	-9.60%
	difference	***2.92%***	***15.79%***	***0.34%***	***13.53%***	***-2.36%***	***21.97%***
	Continuation	0.79%	2.35%	4.39%	5.50%	4.39%	2.24%
	Transition	0.37%	0.79%	4.03%	4.08%	4.74%	1.45%
	difference	***0.42%***	***1.56%***	***0.36%***	***1.41%***	***-0.36%***	***0.79%***

Source: ICE Data Indices, LLC, BofA Merrill Lynch Global Research calculations, for stocks we use the SXXR index; data since Jan-1999

Table 4: Historical statistics for the European/USD markets

		------ Excess returns ------		---------- Total Returns ----------			
	Key stats	USD IG	USD HY	USD IG	USD HY	USD Govt	Stocks
Daily	Average +ve return	0.06%	0.22%	0.21%	0.14%	0.20%	0.76%
	Average -ve return	-0.08%	-0.26%	-0.23%	-0.19%	-0.21%	-0.81%
	Average return	0.00%	0.01%	0.02%	0.03%	0.02%	0.03%
	Best +ve return	1.73%	3.17%	1.97%	2.74%	2.07%	11.57%
	Worst -ve return	-2.37%	-4.98%	-2.31%	-4.84%	-1.96%	-9.03%
Annualised	Annual return	0.63%	2.15%	5.83%	6.58%	4.74%	7.43%
	Annual volatility	2.02%	5.81%	4.73%	4.32%	4.41%	18.41%
	Information Ratio	**0.31**	**0.37**	**1.23**	**1.52**	**1.07**	**0.40**
	Max Drawdown	**-25.0%**	**-46.5%**	**-16.7%**	**-35.0%**	**-7.4%**	**-61.0%**
	Expansion	3.10%	8.26%	6.18%	11.01%	2.85%	12.37%
	Contraction	-2.54%	-5.63%	4.75%	0.59%	6.72%	-4.15%
	difference	***5.64%***	***13.89%***	***1.44%***	***10.42%***	***-3.87%***	***16.52%***
	Continuation	0.94%	3.25%	5.74%	7.43%	4.43%	6.40%
	Transition	-0.35%	-1.55%	6.08%	3.86%	5.85%	0.00%
	difference	***1.29%***	***4.80%***	***-0.34%***	***3.57%***	***-1.42%***	***6.39%***

Source: ICE Data Indices, LLC, BofA Merrill Lynch Global Research calculations, for stocks we use the SPXT Index; data since Jan-1997

Some key takeaways from the summary statistics:

- **Credit returns and the CRP appear to be correlated with the macroeconomic cycle.** Note that the average high-grade and high-yield credit market (excess) return is around -0.87% and -6.42% during recessions, respectively, in Europe. During expansions these figures are 2.05% and 9.36%, respectively. Therefore, expectations about the macro/business cycle are an important determinant of the credit risk premium.

- The CRP tends to be wider during the expansionary phases compared to the contraction phases of the macro cycle. In part, this is because credit spreads tend to tighten "gently" during expansions and there are no abrupt changes to the default cycle. In contrast, contractionary phases typically result in "unexpectedly" high default rates that result in abrupt spread spikes and thus unexpectedly large price drops.

- Also, we find that performance tends to be much better in the continuation phase compared to the transition phases of the business cycle. Again, this is partly related to the fact that transition phases are inherently less stable and thus likely characterized by unexpected changes in investors' perception of default and recessionary risk.

- This is also consistent with what we see in the equity market. The equity risk premium is behaving similarly, with positive annualized returns during expansionary business cycles and losses during recessionary periods. Transition phases are also associated with lower returns compared to returns realised during continuation phases.

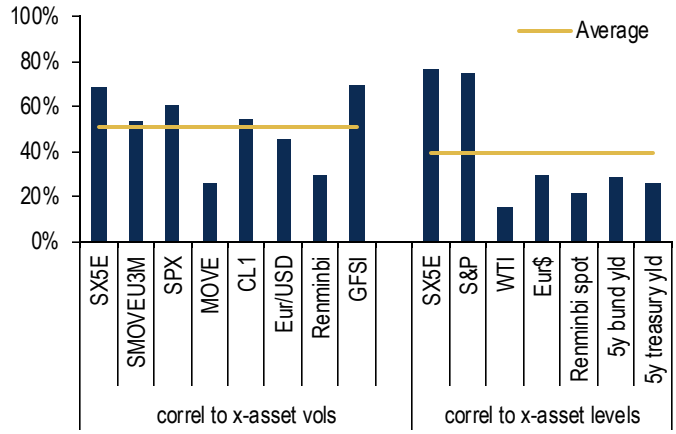
- However there appears to be little correlation between the government bond market returns and the macro cycle. The average Euro government bond market returns are on the positive side irrespective of the business cycle (at 4.4% during expansions and 7.1% during recessions).

Appendix

CDS index correlations vs. x-asset vols and levels

Chart 39: iTraxx Main is more correlated to vol than the underlying mkts

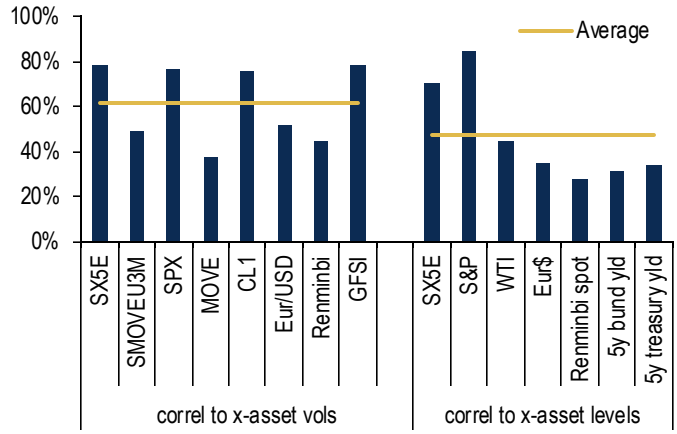
Correlation of iTraxx Main 5y CDS trend (z-score) vs. that of different assets



Source: BofA Merrill Lynch Global Research, Bloomberg

Chart 40: CDX IG is more correlated to vol than the underlying markets

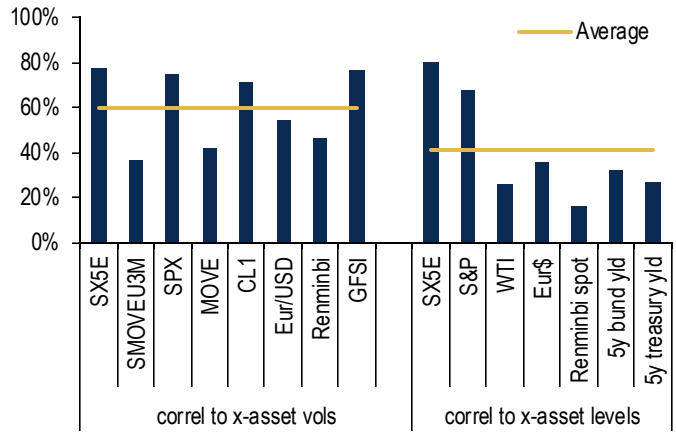
Correlation of CDX IG 5y CDS trend (z-score) vs. that of different assets



Source: BofA Merrill Lynch Global Research, Bloomberg

Chart 41: Crossover is more correlated to vol than the underlying mkts

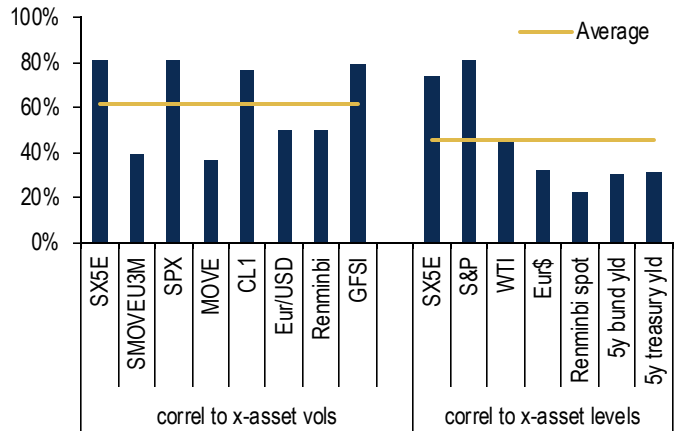
Correlation of XO 5y CDS trend (z-score) vs. that of different assets



Source: BofA Merrill Lynch Global Research, Bloomberg

Chart 42: CDX HY is more correlated to vol than the underlying markets

Correlation of CDX HY 5y CDS trend (z-score) vs. that of different assets



Source: BofA Merrill Lynch Global Research, Bloomberg

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