CREDIT SUISSE

Quantitative Credit Strategist
CUSP on Sovereigns

Quantitative Credit Strategy

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Adding some light in a low visibility market

CUSP®, our cutting edge credit model, can now be applied to sovereigns, with some interesting results.

The sovereign CDS market receives a lot of attention and affects markets beyond credit, leading to many participants looking at CDS for the first time. The technical details related to sovereign CDS can be dauntingly involved, even for old hands. The result is a market whose links between fundamentals, technicals and valuations are not as well understood as they perhaps might be. The recent volatility is evidence of this high degree of uncertainty.

Motivated by the low visibility in the sovereign CDS market and CUSP's success in the corporate credit space, we have built a CUSP sovereign model to give investors a tool to shed some light on this market. CUSP is our single name, forward–looking, mark-to-market risk model that has a proven track record in giving timely signals in terms of navigating the corporate credit space.

- We explain the necessary assumptions we have made in order to extend the CUSP model to the sovereign CDS market.
- We demonstrate how to interpret the results and when to react on buy and sell signals.
- Performance speaks clearly: We validate the above mentioned signals by back-testing them on the constituents of the iTraxx[1] SovX[2] Series 2 index.
- Despite all the noise, our model suggests that, at current levels, the Western European sovereign CDS market is in line with other markets (e.g., equities), with no strong buy or sell signals at present. We expect this to change in the future and will provide you with future updates.

[1] iTraxx is a trademark of International Index Company Limited.
[2] SovX is a trademark of the International Index Co Ltd

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CUSP methodology

CUSP®, Credit Suisse's forward-looking model for credit spread risk, uses market implied equity volatility information within a proprietary framework to derive measures of single-name spread risk. The measures we use here to signal which names to go short, and which to go long, are the implied roll down (IRD) and the CUSP interpretation of the Sharpe ratio, which involves another CUSP measure, the spread widening risk (SWR). Broadly speaking, the IRD is the predicted change in CDS spread expected by CUSP over a certain horizon, and the SWR is the spread change following a reduction in equity price of one standard deviation[3].

CUSP on corporate credit

As highlighted in several publications (see, for example, *CUSP: Picking Credits The good, the bad and the ugly*[4] and its follow-up, *CUSP: Picking Credits: Consistent navigation in these volatile times*[5]), we believe CUSP has a proven track-record as a powerful tool to select longs and shorts in the corporate credit space.

Sovereign CDS market: Low visibility

Since it is not the main purpose of this publication to explain the details of sovereign CDS, we refer the reader to our latest, very comprehensive publication on this topic: *Sovereign CDS Primer: Devilish details*[6]. The point we do want to highlight, however, is the higher mark-to-market risk and illiquidity premium for sovereign CDS in comparison to corporate CDS. If we decompose CDS spreads into the following components:

1. Expected loss[7], i.e., expected default frequency and expected recovery
2. Uncertainty, i.e., deviations from the expected loss
3. Liquidity risk
4. Mark-to-Market risk

we can at least make some observations about the relative importance of them for the sovereign and corporate CDS market.

First, using ratings as an estimate for expected losses (Moody's and S&P rate companies and sovereigns based on their expected default frequency and expected loss, respectively), we infer that the first component should be higher for corporates than for sovereigns on an absolute basis (based on the fact that Western European sovereigns in general have higher ratings than their corporates).

Second, given the scarcity of data points, especially for sovereign defaults, it is hard to assess the second component for both asset classes. However, the fact that there are even fewer observations on sovereign losses than for corporates shows that the former is more uncertain purely from a statistical point of view.

Third, due to the lower liquidity in the sovereign CDS market – as illustrated here by the lower gross notional traded in sovereigns compared to non-financial corporates (see Exhibits 1 and 2) – investors are likely to demand a higher risk premium.

Finally, that recently the realised volatility of the iTraxx Main and Financial Senior has been lower than that of the SovX hints that the mark-to-market risk for sovereigns may have been higher, which could explain recent underperformance versus the other two indices. This leads us to the main motivation for this publication: We believe that mark-to-

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[3] For further information regarding implied roll down, spread widening risk and the CUSP model in general, the reader is referred to the publication entitled *CUSP 2007, Overview of our Structural Model*, 28 February 2007.

[4] *CUSP: Picking Credits; The good, the bad and the ugly*, 09-Oct-2008

[5] *CUSP: Picking Credits*, 09-Oct-2008

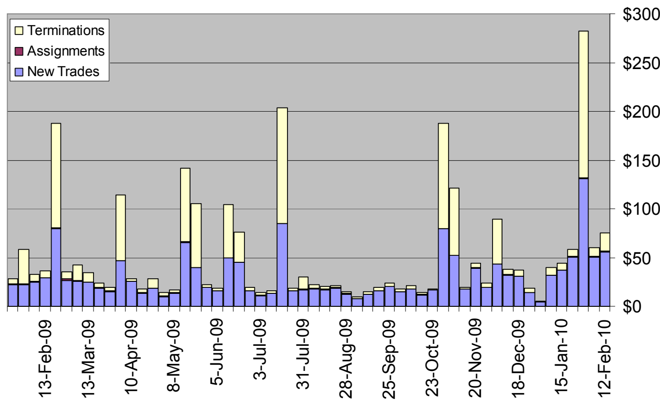
[6] *Sovereign CDS Primer: Devilish details*, 11-Feb-2010

[7] As measured by the real world probability measure, i.e., not the risk neutral pricing measure

market risk plays a major role in evaluating CDS as an asset class (e.g., for generating relative value trade ideas), especially and most importantly in the sovereign CDS space. We believe a tool like CUSP, which assesses mark-to-market risk in a systematic and forward-looking way, can therefore support an investor in making decisions in this highly volatile market.

Exhibit 1: Activity in gross notionals, sovereigns

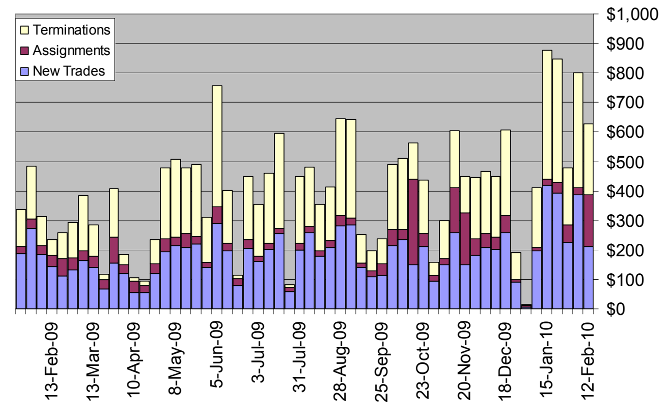
Notionals in $bn



Source: Credit Suisse, DTCC

Exhibit 2: Activity in gross notionals, corporates w/o financials

Notionals in $bn



Source: Credit Suisse, DTCC

CUSP on sovereigns

Assumptions

One of the strengths of the CUSP model is that it is not calibrated to historical time series. Instead, only the latest market observations (and therefore market expectations) are used to estimate its parameters, which makes it forward- rather than backward-looking.

Below we summarise CUSP's input parameters and how we approximate these for sovereigns.

1. CDS curve (level and slope): No need to approximate, sovereign CDS trade at different maturities.
2. Leverage: We approximate the leverage by the debt to GDP ratio of the sovereign. The answer to what comprises debt is ambiguous. Public debt and total debt (public debt plus corporate and household debt) are both valid candidates. We test both versions and highlight the results in the back-testing section.
3. Equity option-implied volatility: In general, this is approximated using the option-implied volatility of the main equity index of the respective sovereign, the DAX being the example for Germany. There are five members of the SovX whose main equity index does not have an implied option volatility (we assume that this is due to the fact that some of the constituents of that equity index lack an option-implied volatility). For these sovereigns we just use the realized volatility of the respective index (see Exhibit 3 for a summary).

Exhibit 3: Sovereigns, equity indices and volatilities

Sovereign	Equity Index	Volatility
Republic of Austria	ATX Index	Option implied
Hellenic Republic	ASE Index	Realised
Italian Republic	IT30 Index	Realised
Portuguese Republic	PSI20 Index	Realised
Republic of Ireland	ISEQ Index	Realised
Kingdom of Spain	IBEX Index	Realised
Federal Republic of Germany	DAX Index	Option implied
French Republic	CAC Index	Option implied
Kingdom of Belgium	BEL20 Index	Option implied
Kingdom of Denmark	KFX Index	Option implied
Kingdom of Norway	OBX Index	Option implied
Kingdom of Sweden	OMX Index	Option implied
Kingdom of the Netherlands	AEX Index	Option implied
Republic of Finland	HEX25 Index	Option implied
United Kingdom Gilt	UKX Index	Option implied

Source: Credit Suisse

Deriving sell and buy signals

In this section we explain how to interpret the outputs of CUSP, focusing mainly on IRD, and demonstrate how we derive trading signals based on it.

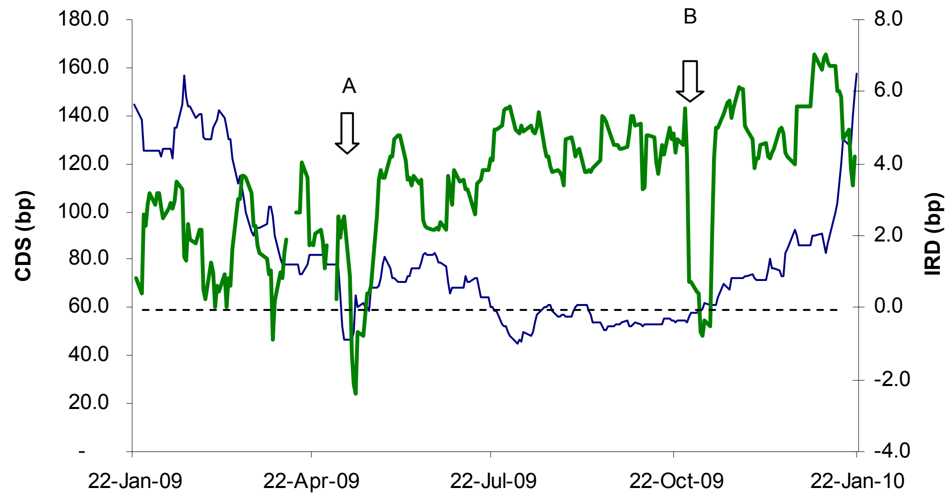
The IRD measures the expected[8] roll down for a certain maturity and horizon. The standard roll down we focus on is the 5-year maturity and on a 3-month horizon (i.e., the roll down one expects to make by selling 5y CDS protection, holding the position for 3 months and then liquidating the position, annualized). A negative or decreasing IRD

[8] Expected under the risk neutral measure that is implied by the CUSP model

intuitively is a negative signal for the credit and therefore a short in terms of risk (and vice versa for longs). We illustrate this for the CDS of Portugal in Exhibit 4. The arrows with the letters A and B indicate when the IRD sharply decreased and then turned negative. On 14 May 2009 (Arrow A), IRD had fallen to -2.4bp and the 5-year CDS was at 65bp. Subsequently, the CDS widened to 81bp on 29 May 2009. Similarly, on 4 November 2009 (Arrow B), the IRD had fallen to -0.7bp and the 5-year CDS was at 59bp. Thereafter, the CDS widened to 92bp on 21 December 2009.

Exhibit 4: Portugal CDS and IRD

5y CDS (blue line) on the RHS, and IRD (bold green line) on the LHS



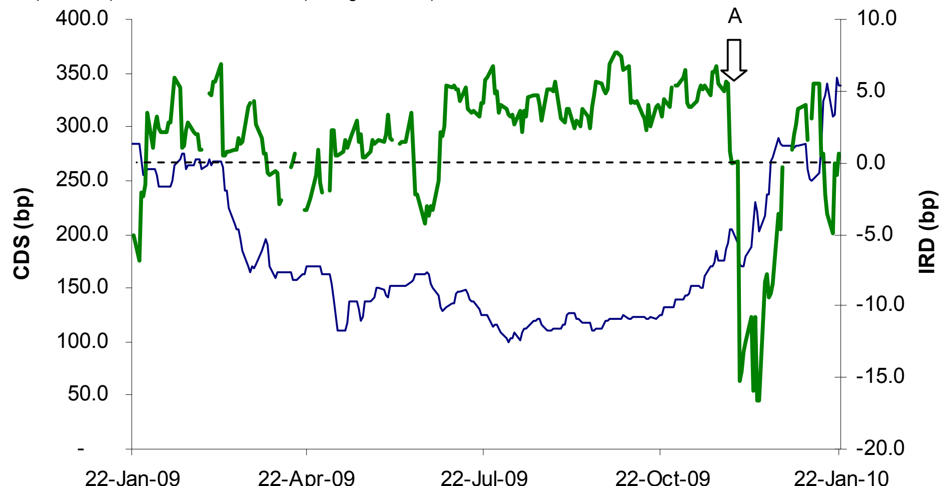
Source: Credit Suisse

Similar observations can be made for the CDS of Greece (see Exhibit 5). On 1 December 2009, a short credit signal was triggered by a sharp fall in IRD to -15.3bp. At the time, 5-year CDS traded at 172bp. Following this short credit signal, the CDS widened to 230bp on 9 December, 290bp on 21 December and 346bp on 20 January 2010.

As we have seen repeatedly for corporates, sharp declines in IRD, like those shown here for Portugal and Greece, have tended to be very strong sell signals. If acted on quickly, there can be enough warning to avoid the worst losses.

Exhibit 5: Greece CDS and IRD

5y CDS (blue line) on the RHS, and IRD (bold green line) on the LHS



Source: Credit Suisse

Back-testing

The previous section suggests going short credit when the IRD is negative and/or its Z-score is negative. For this back-testing exercise we trigger a short if the IRD Z-score exceeds a negative threshold.

When triggering longs we look at the following Sharpe ratio type[9] measure:

(Carry + Implied roll down)/ Spread widening risk

Since a positive or increasing Sharpe ratio is positive for the credit, the model triggers a long position if the Z-score is sufficiently positive.

We now define three trading strategies based on entry and exit thresholds for IRD and the Sharpe ratio Z-scores.

1. Conservative: High absolute IRD and Sharpe ratio Z-score thresholds which limit the number of trades being executed. Trades will be closed if the signal that triggered them becomes less strong (e.g., from -3bp to -1bp).
2. Less Conservative: The same high entry thresholds, but the trade exit thresholds are reduced to zero, i.e., a trading signal needs to revert to neutral before the strategy closes the trade (this is less conservative since a trade would have already been closed in the Conservative strategy if the Z-score had fallen without reverting to zero).
3. Aggressive: Trade entries are triggered for lower thresholds and the trade exit thresholds are the same as in the Less Conservative strategy.

Finally, we measure a trade's P/L in bp, and close trades if the profit or loss is greater than 10bp. We additionally close trades at the latest after 60 trading days. Exhibit 6 summarises the three strategies.

Exhibit 6: Conservative, Less Conservative and Aggressive strategies

	Conservative	Less Conservative	Aggressive
IRD Z-score entry threshold	-3	-3	-2.5
IRD Z-score exit threshold	-1	0	0
Sharpe Ratio Z-score entry threshold	-3.6	-3.6	-3.0
Sharpe Ratio Z-score exit threshold	-1.2	0	0
Max P/L (bp)	10	10	10
Min P/L (bp)	-10	-10	-10
Max number of trading days	60	60	60

Source: Credit Suisse

Back-testing results

1. Aggregated over all 15 members of the iTraxx SovX Series 2, all three trading strategies had a positive cumulative P/L for the period 23 January 2009 – 22 January 2010. Aggregate and individual country P/Ls are illustrated in Exhibit 7.

- As expected, the more aggressive a strategy is, the higher its cumulative P/L, but also the higher its volatility.

[9] The Sharpe ratio is a measure of the excess return per unit of risk in an investment asset or a trading strategy

Exhibit 7: Back-testing results

P/L red if less than -2bp and green if greater than 2bp

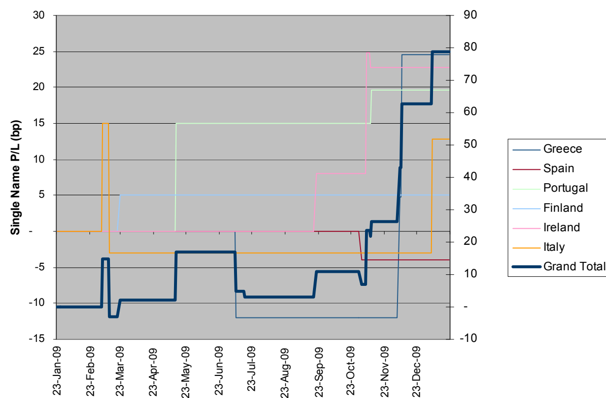
Country/Strategy	Number of trades: conserv.	less cons.	aggressive	P/L of trades in (bp): conserv.	less cons.	aggressive
Germany	-	-	2	-	-	-13
France	-	-	-	-	-	-
Greece	3	3	7	25	25	-2
Italy	4	4	7	13	12	24
Belgium	1	1	1	-0	13	13
Denmark	-	-	1	-	-	-1
Norway	2	2	4	-2	-2	-2
Spain	1	1	1	-4	-15	-15
Sweden	-	-	2	-	-	-25
Netherlands	-	-	-	-	-	-
Portugal	2	2	4	20	20	33
Austria	-	-	1	-	-	35
Finland	1	1	1	5	16	16
Ireland	3	3	4	23	32	70
UK	-	-	1	-	-	14
Grand Total	**17**	**17**	**36**	**79**	**100**	**147**

Source: Credit Suisse

2. Investigating how the P/L for these strategies has evolved over time (see Exhibits 8 and 9), we see that the steepest P/L gains and most of the trade signals have been observed since early November 2009. This is in line with the elevated interest in sovereign CDS during this time, and suggests that the model works best in more volatile markets.

Exhibit 8: Conservative Strategy P/L

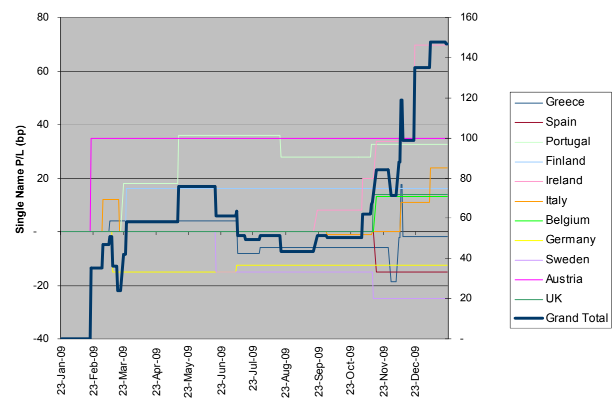
Single name P/L (thin coloured lines) LHS, total P/L (bold dark blue line) RHS



Source: Credit Suisse

Exhibit 9: Aggressive Strategy P/L

Single name P/L (thin coloured lines) LHS, total P/L (bold dark blue line) RHS



Source: Credit Suisse

Total debt instead of public debt

So far we have been using public debt as a percent of GDP as a proxy for a sovereign's leverage. In a credit crisis such as that experienced over the last two years, there are political forces at work that have the tendency to nationalize important companies (e.g., national champions, as well as not only systematically important financial institutions but also big national employers). This makes us believe that the total national debt including corporate and household debt could be a more relevant debt measure, and we test this hypothesis by conducting the same back-testing analysis under this new leverage measure (total debt as a percent of GDP).

- Again, aggregated over all 15 members of the iTraxx SovX Series 2, all three trading strategies had a positive cumulative P/L for the period 23 January 2009 – 22 January 2010. Aggregate and individual country P/Ls are illustrated in Exhibit 10.
- This time, the Less Conservative strategy was the most profitable, followed by the Conservative and the Aggressive strategies.
- For each strategy there are more trades being triggered now, which more than proportionally increases the cumulative P/L of the Conservative and Less Conservative strategies (74% P/L increase each). However, the Aggressive strategy looks less favourable than in the previous set-up, with a decrease in cumulative P/L of 23%.
- Looking a bit more deeply into the reasons for the underperformance of the Aggressive strategy, we find that several countries had either lower profits (four countries) or higher losses (Spain). Finland, Germany and the UK, however, had higher P/Ls than previously. These indicate the higher overall volatility of the Aggressive strategy in comparison to the other two strategies.
- We also find that three specific trades particularly contributed to these losses. All of them were longs and all of them were very close to the Sharpe ratio Z-score threshold of 3bp, i.e., they were only just triggered. This brings up the question of what the ideal threshold for triggering these trades should be. Further work could be done to address this and other optimisations (maximum and minimum P/L, number of trading days, etc). However, for the purposes of this publication, since the aim is solely to illustrate the effectiveness of the model, using reasonable, but constant, thresholds suffices.
- Again, we see that the steepest P/L gains and most of the trade signals have been observed since early November 2009 (see Exhibits 11 and 12).

Exhibit 10: Back-testing results for total debt

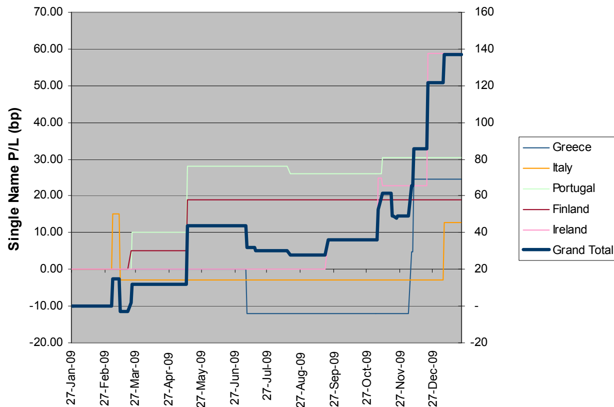
P/L red if less than -2bp and green if greater than 2bp

	Number of trades			P/L of trades in (bp)		
Country/Strategy	conserv.	less cons.	aggressive	conserv.	less cons.	aggressive
Germany	-	-	1	-	-	12
France	-	-	-	-	-	-
Greece	3	3	7	25	25	-2
Italy	3	4	6	13	12	24
Belgium	1	1	2	-0	1	-2
Denmark	-	-	-	-	-	-
Norway	2	2	3	-2	-2	-4
Spain	1	1	3	-1	-1	-34
Sweden	-	-	1	-	-	-10
Netherlands	1	1	2	1	1	0
Portugal	4	4	4	31	27	27
Austria	-	-	1	-	-	12
Finland	2	2	2	19	30	30
Ireland	4	4	6	59	68	33
UK	2	1	2	-6	14	27
Grand Total	**23**	**23**	**40**	**137**	**174**	**113**

Source: Credit Suisse

Exhibit 11: Conservative Strategy P/L (total debt)

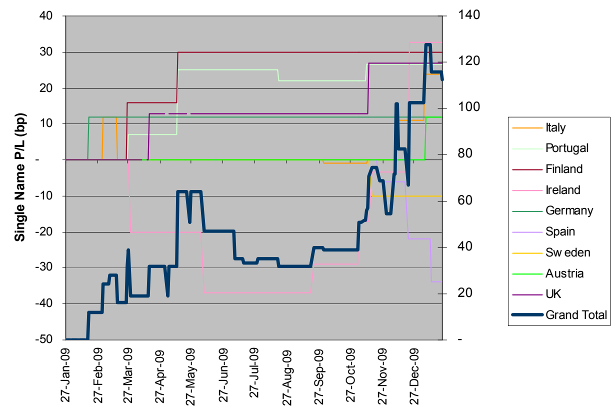
Single name P/L (thin coloured lines) LHS, total P/L (bold dark blue line) RHS



Source: Credit Suisse

Exhibit 12: Aggressive Strategy P/L (total debt)

Single name P/L (thin coloured lines) LHS, total P/L (bold dark blue line) RHS



Source: Credit Suisse

Conclusion

The back-testing under the total debt measure outperforms the one under the public debt except for the Aggressive strategy, based on:

- Cumulative P/L: See Exhibit 13 for a comparison of all three strategies drilled down to country level
- Average P/L per trade, and
- Risk-return, as measured by the average P/L per unit of standard deviation (see Exhibit 14).

We also favour the Less Conservative strategy based on the fact that it has the:

- Best risk-return profile of all strategies under all scenarios (64%), and
- Highest average P/L per trade under both debt measures.

We finish with the P/L histogram of the Less Conservative strategy (total debt) in Exhibit 15, which illustrates its P/L distribution and high proportion of profitable trades. The few negative bars on the right essentially are the cost for the big upside chance on the right.

Exhibit 13: P/L comparison of the back-testing results

P/L red if less than -2bp and green if greater than 2bp. Difference = Total debt – public debt numbers

	Public debt			Total debt			Difference		
Country/Strategy	conserv.	less cons.	aggressive	conserv.	less cons.	aggressive	conserv.	less cons.	aggressive
Germany	-	-	-13	-	-	12	-	-	25
France	-	-	-	-	-	-	-	-	-
Greece	25	25	-2	25	25	-2	-	-	-
Italy	13	12	24	13	12	24	-	-	-
Belgium	-0	13	13	-0	1	-2	-0	-12	-15
Denmark	-	-	-1	-	-	-	-	-	1
Norway	-2	-2	-2	-2	-2	-4	-	-	-2
Spain	-4	-15	-15	-1	-1	-34	3	14	-19
Sweden	-	-	-25	-	-	-10	-	-	15
Netherlands	-	-	-	1	1	0	1	1	0
Portugal	20	20	33	31	27	27	11	7	-6
Austria	-	-	35	-	-	12	-	-	-23
Finland	5	16	16	19	30	30	14	14	14
Ireland	23	32	70	59	68	33	36	36	-37
UK	-	-	14	-6	14	27	-6	14	13
Grand Total	**79**	**100**	**147**	**137**	**174**	**113**	**58**	**74**	**-34**

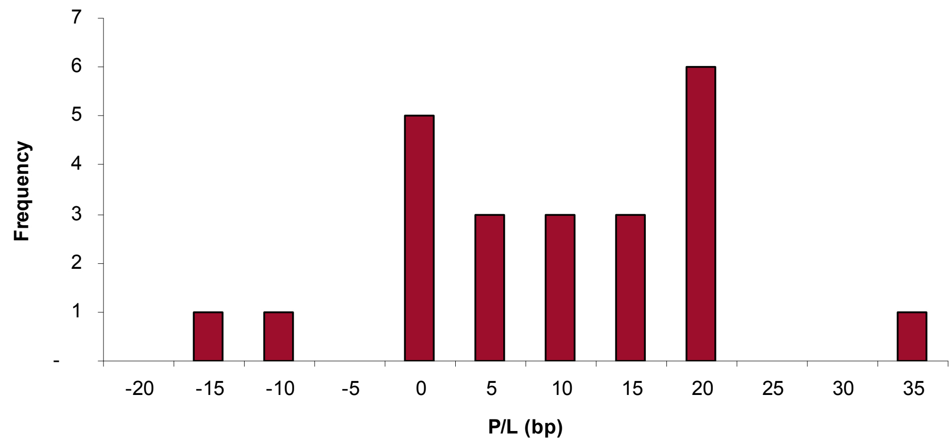
Source: Credit Suisse

Exhibit 14: Comparing strategies

	Public Debt			Total Debt		
	conserv.	less cons.	aggressive	conserv.	less cons.	aggressive
Average P/L (bp)	4.92	5.87	4.32	5.99	7.55	2.95
Standard deviation (bp)	11.17	12.06	13.93	12.30	11.79	12.82
Average/St deviation	44%	49%	31%	49%	64%	23%

Source: Credit Suisse

Exhibit 15: P/L histogram of the Less Conservative strategy (total debt)



Source: Credit Suisse

Current signals

At current levels, the model suggests the Western European sovereign CDS market is in line with other markets (e.g., equities), with no strong buy or sell signals at present. The lowest IRD Z-score in the universe of 15 SovX members is for Spain at -1.5bp, which is not strong enough – based on our back-testing experience – to trigger a long CDS (short credit risk) signal. Germany has the highest Sharpe ratio Z-score at 2.3, which also is not strong enough to create a short CDS (long credit risk) signal. This is what we expected since the different strategies triggered up to four trades a month in the back-testing environment. We will keep you posted regarding future signals.

Exhibit 16: Latest signals

IRD Z-score red if less than -3 bp

Sovereign	5y CDS	10y CDS	Total Debt [%of GDP]	Equity	Equity Vol	SWR	IRD	SWR Z-score	IRD Z-score	Sharpe	Sharpe Z-score
United Kingdom Gilt	90.1	92.0	280.0%	5,325	18.86%	7.5	4.4	-0.9	0.9	3.60	1.5
Republic of Finland	35.0	39.9	162.9%	2,062	21.45%	3.3	1.8	0.5	0.4	3.17	1.1
Kingdom of the Netherlands	42.9	47.9	254.4%	324	22.57%	4.5	2.1	-0.2	1.1	2.85	1.4
Kingdom of Sweden	46.3	49.3	218.0%	947	22.42%	7.0	2.8	-1.2	1.3	2.04	0.0
Kingdom of Norway	19.0	23.0	257.4%	320	33.94%	4.0	0.2	-0.1	0.3	1.25	0.6
Kingdom of Denmark	39.9	45.9	296.2%	359	18.74%	4.0	2.6	-0.9	1.2	3.17	1.8
Kingdom of Belgium	68.7	71.7	214.3%	2,518	18.56%	6.1	3.6	-0.2	0.8	3.41	1.2
French Republic	60.8	62.8	191.7%	3,748	21.23%	4.1	2.1	0.4	1.2	4.25	1.8
Federal Republic of Germany	44.9	47.9	195.4%	5,680	21.27%	3.9	2.1	0.1	1.1	3.42	2.3
Kingdom of Spain	131.9	130.9	246.1%	10,574	29.25%	15.5	1.1	0.9	-1.5	2.19	-0.2
Republic of Ireland	150.7	149.8	284.9%	2,969	18.04%	8.7	4.1	-0.7	-0.1	4.83	0.2
Portuguese Republic	175.1	165.2	290.9%	7,653	14.45%	10.0	4.8	0.0	0.2	4.84	0.1
Italian Republic	127.9	127.9	203.0%	2,327	14.66%	6.8	4.0	-0.6	-0.4	5.31	0.3
Hellenic Republic	358.6	319.8	210.1%	1,882	46.55%	62.4	-12.7	1.5	-1.1	1.23	-0.7
Republic of Austria	82.1	83.1	195.7%	2,562	20.71%	9.0	4.2	-0.4	0.7	2.74	0.3

Source: Credit Suisse, Bloomberg, Datastream

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Sell: Indicates a recommended sell on our expectation that the issue will deliver a return lower than the risk-free rate.

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Outperform: Indicates an above-average total return performer within its sector. Bonds in this category have stable or improving credit profiles and are undervalued, or they may be weaker credits that, we believe, are cheap relative to the sector and are expected to outperform on a total-return basis. These bonds may possess price risk in a volatile environment.
Market Perform: Indicates a bond that is expected to return average performance in its sector.
Underperform: Indicates a below-average total-return performer within its sector. Bonds in this category have weak or worsening credit trends, or they may be stable credits that, we believe, are overvalued or rich relative to the sector.
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