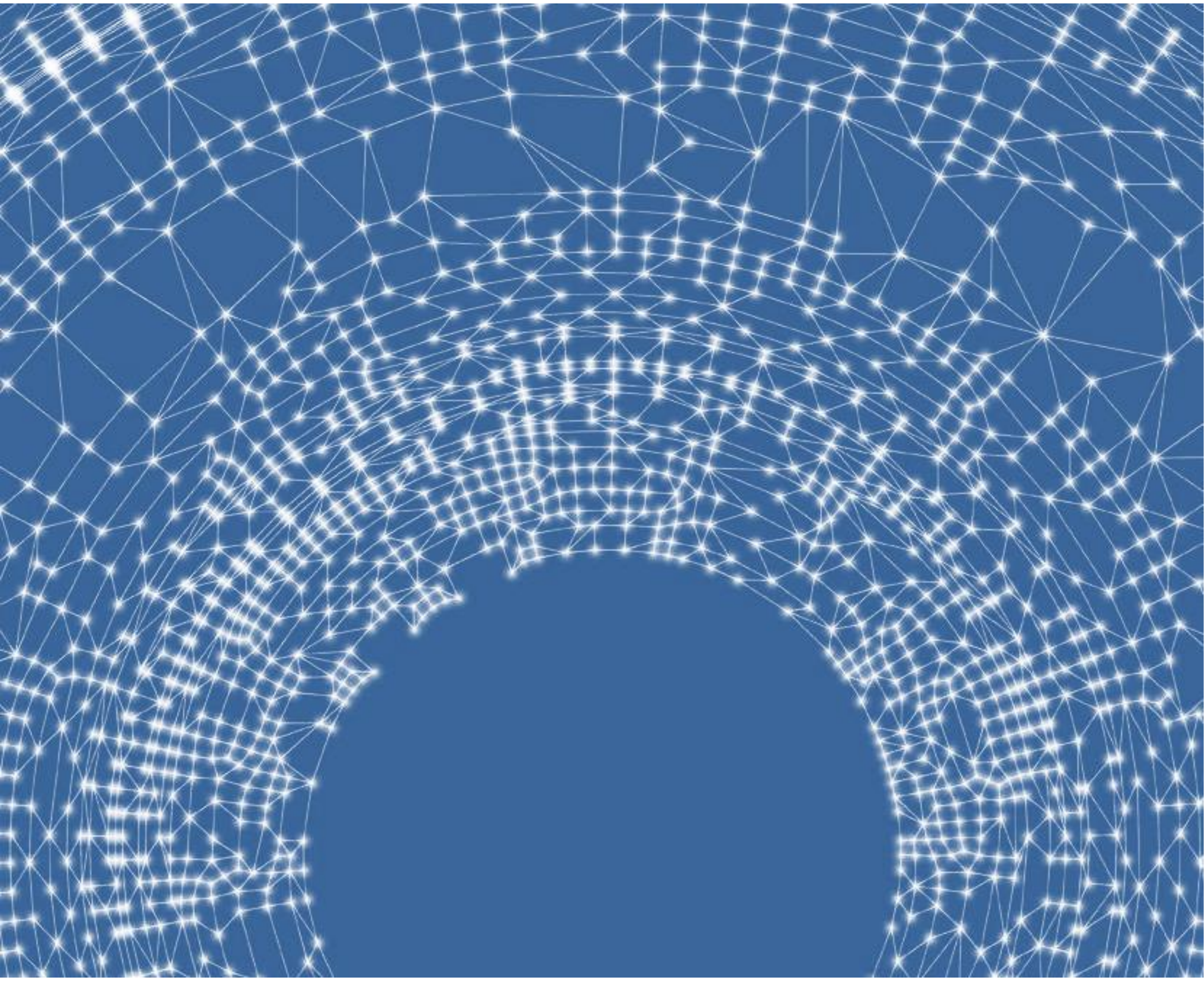
Sovereign Credit Default Swaps and Consensus Credit Estimates

APRIL 2016



Key Highlights

Consensus Probability of Default ("PD") and Loss Given Default ("LGD") data can be used to estimate synthetic CDS prices.

From these, Sovereign CDS Risk Premiums can be estimated by comparing Actual CDS prices with Synthetic CDS prices.

These Sovereign CDS Risk Premiums:

- are a function of credit quality - every broad notch downgrade typically doubles the risk premium
- are volatile and can be tracked over time
- provide realistic indicative pricing for new, illiquid or untraded Sovereign CDS, with possible extension to Corporate CDS
- provide indicative pricing for credit insurance products
- provide a link between market-derived Point-in-Time ("PIT") and model-driven Through-the-Cycle ("TTC") estimates of default risk

Synthetic CDS prices can be used by CDS traders in marking to market to support appropriate capital allocation, especially for contracts which are not currently trading.

Adjusting for the risk premium may help to reduce variability in risk weights when using market implied risk measures.

Introduction

In the first quarter of 2016, Intercontinental Exchange recently reported a spike in cleared Credit Default Swap ("CDS") volumes and prices, with new weekly and daily records being set throughout January 2016. This is a significant change - since its peak at $58trn in 2007, the global CDS market has been steadily shrinking, valued at $13.3trn in June 2015[1]. Of this, $6.8trn relates to single name entities with the balance in traded indices. The majority of CDS have a maturity of 1-5 years, with liquidity typically concentrated in the 5 year maturity[2].

Although a CDS is designed as a hedging instrument against credit default risk, it also provides a barometer of the probability of single obligor default. Recent market volatility has highlighted this risk measure function, and also coincides with a renewed regulator attention on the benchmark role of CDS prices[3].

This note focuses on the $2.2trn Sovereign CDS market. As with Government bond yields, Sovereign CDS prices can be used to estimate Probabilities of Default ("PD") but these are, by definition, ***risk neutral*** (rather than ***real world***)[4]. In addition, CDS prices in particular are subject to distortions: limited numbers of market makers, variable liquidity in their reference bonds, and uncertainty about recovery values. As a result, CDS prices typically contain multiple complex risk premiums[5].

In this paper we use the Credit Benchmark ***real world*** PD data to calculate theoretical Sovereign CDS prices, and compare these with actual observed (USD 5Y) Sovereign CDS prices. The difference provides an estimate of this composite risk premium[6].

This composite risk premium can be used as an input for a calibrated CDS model pricing framework. Such a framework can be used to estimate a risk neutral benchmark Sovereign CDS price where there is no active trade, and can also be used for Sovereign entities that do not currently have any associated CDS in issue[7]. A suitably calibrated version of this framework can also be applied to Corporate CDS.

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[1]BIS and DTCC data.
[2]Markit, Bloomberg, BIS.
[3]Italian regulators have explicitly referred to CDS in their recent bank guarantee scheme: http://www.dt.tesoro.it/en/news/news_gacs.html
[4]Risk neutral PDs imply that the associated asset price contains a premium to compensate risk averse investors. Real world PDs reflect the expected long run frequency of defaults in a large sample of similar obligors.
[5]For the remainder of this paper, these multiple premiums (or *premia* as some academics prefer) will be referred to as a single combined risk *premium*.
[6] The Probabilities of Default are Through-the-Cycle / Hybrid, so this premium should be viewed as being partly driven by changes in short term market related factors which are reflected in CDS prices.
[7]A similar technique can be used for bonds of equivalent duration. The difference between the CDS and comparable bond risk premium will reflect the elements of risk that are unique to CDS.

Synthetic CDS Framework

An estimate of a 5 year synthetic CDS price can be made using the following equation[8]:

Synthetic 5 Year CDS Price
= [1- Recovery Rate] x [- natural log(1-Cumulative 5-year PD)]   {1}

This requires estimates of (a) the recovery rate (b) the cumulative 5-year probability or default.

Credit Benchmark collect Ex Ante Senior Unsecured, Loss Given Default ("LGD").[9] The recovery rate in equation {1} can be approximated by (1- LGD), using LGD values derived from contributor data.

Credit Benchmark collect Ex Ante, 1 year, Through the Cycle / Hybrid estimates of Probability of Default (PD(1)).

A Hazard rate approach applied to these provides a simple approximation to the cumulative 5 year probability of default:

$PD(5) = [1- (1-PD(1))^5]$ {2}

This paper will use the hazard rate approach but it should be noted that this ignores transitions.[10]

Exhibit 1 shows an example of these calculations.

Example:
PD(5) = 50Bps; LGD = 0.6; Recovery = (1-LGD) = 0.4
Synthetic CDS = [1 – 0.4] x [-ln(1-0.005)] = 0.6 x 0.005013 = 30.08Bps
Note that when LGD = 1, the CDS price is almost identical to the input PD. Obviously, if the LGD is zero then the CDS price is also zero, since there is no loss to insure.

Exhibit 1: Synthetic CDS Calculation Example

[8] With constant risk free rates r and hazard rate h the default leg would be (1-Recovery Rate) (h/(h+r)) (1 - exp(- (h+r) 5)). Equation 1 uses approximation exp(x) = 1+x. Thanks to Professor Damiano Brigo for this point.
[9] Variations in discount rates are ignored since these are bank specific and unobservable in the current dataset.
[10] An alternative approach is to use the transition matrix to estimate the probability that an entity which has a PD of X in year 1 will have defaulted by year 5, allowing for the possibility that it may have been upgraded or downgraded in the meantime. This assumes that the Transition Matrix (TM) represents a time homogenous Markov process, but if there is path dependency then the TM approach will also be approximate. See Appendix 1 for an estimate of the scale of this effect.

Framework Implementation

Exhibit 2 shows the distribution of quorate[11] Sovereign LGDs derived from contributions to the Credit Benchmark database in Q4 2015.

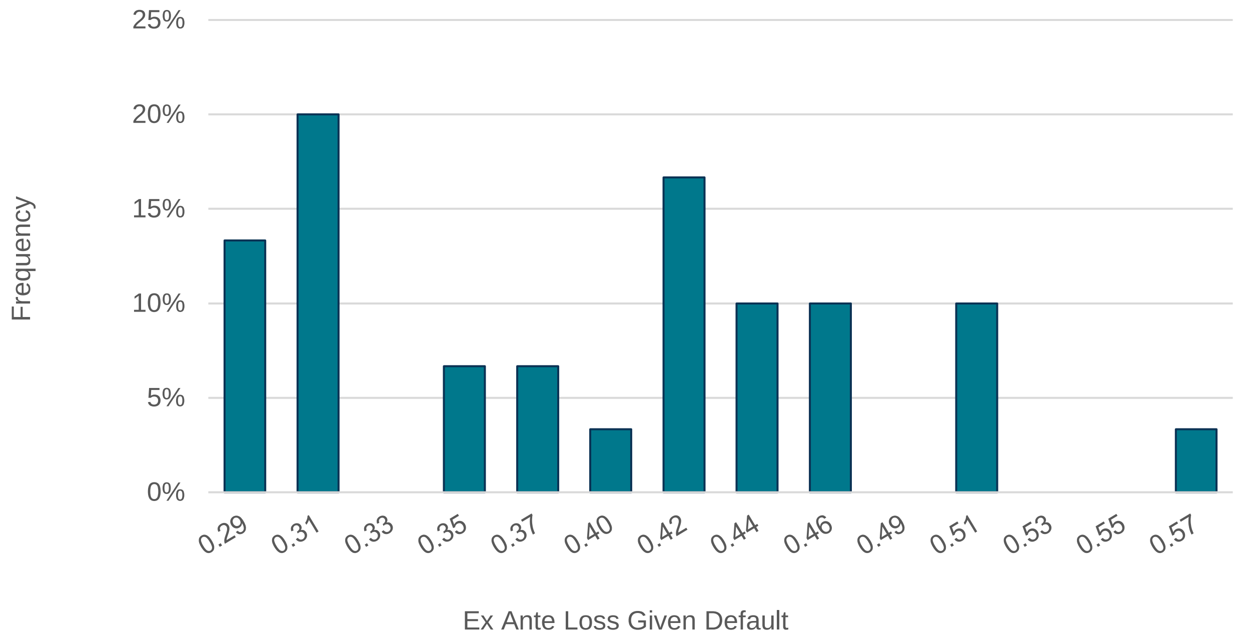


Exhibit 2: Distribution of Quorate Sovereign LGDs

This shows that consensus values for the Ex Ante, Senior Unsecured downturn LGD varies from 0.29 to 0.57 and the simple average across these quorate observations is 0.40.

It is worth noting that the rollout of Advanced-IRB LGD models is still work in progress in many financial institutions, so the quorate coverage in the CB database is less than 100%. For this reason, the analysis shown here is based on the single LGD = 0.40 average value as an input to calculate individual synthetic Sovereign CDS prices. One advantage of this approach is that it isolates the effect of PD differences.

It should be noted that the standard recovery rate assumption in CDS pricing is 0.4, implying an LGD of 0.6. The analysis in this report is focused on the impact of variations in PD for a given LGD assumption, but it is also possible to re-run the analysis under a range of different LGD assumptions.

[11] "Quorate" in this context means that for a single name obligor, there are at least 3 contributors providing PD estimates.

Exhibits 3 and 4 show the relationship, in January 2016, between actual[12] and synthetic Sovereign CDS prices for lower PD and higher PD Sovereigns respectively. The red line on each chart has a slope of 45 degrees. Nearly all of the plotted points lie on or above these lines; i.e. actual CDS prices are higher than the synthetic CDS prices when LGD is assumed to be 0.4.

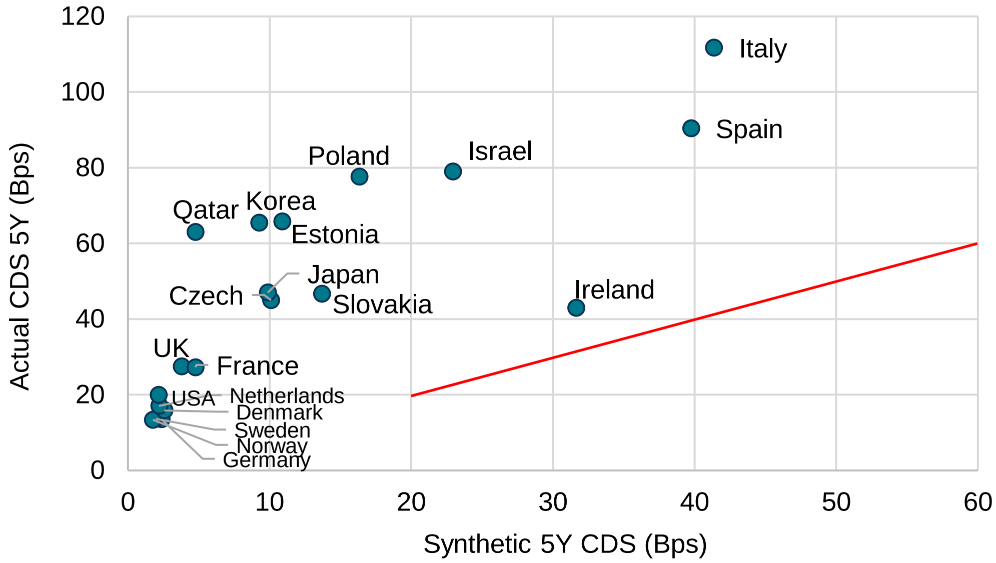


Exhibit 3: Theoretical and Actual CDS < 100 Bps. January 2016

For the lower PD Sovereigns in Exhibit 3, there are three distinct groups. The very low PD countries, such as USA and Germany, show a premium of 15-20 Bps. The middle ranking group, in the upper right quadrant above Japan and Slovakia, shows a higher premium of 40-60 Bps[13]. Italy and Spain are above 90 Bps.

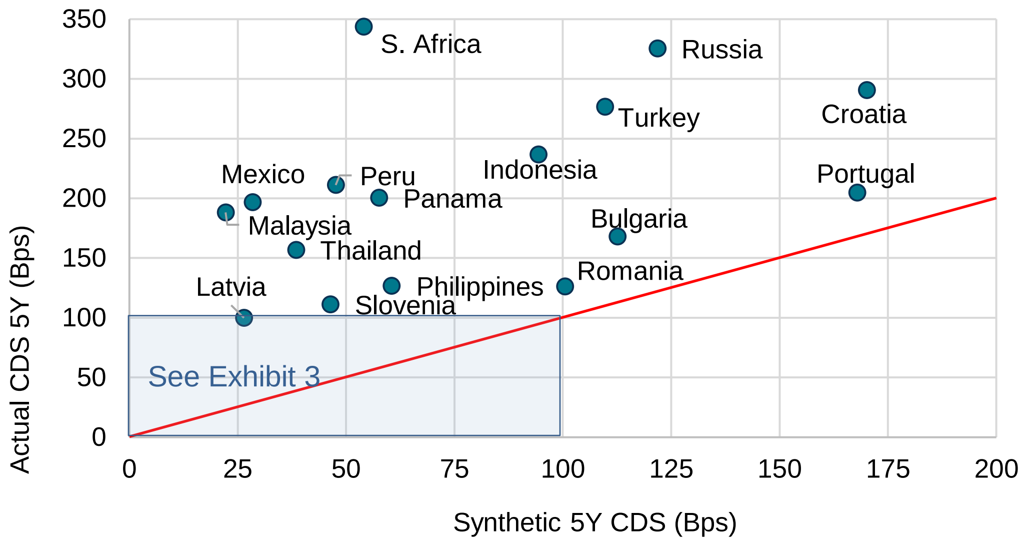


Exhibit 4: Theoretical and Actual CDS ≥ 100 Bps. January 2016

The higher PD countries in Exhibit 4 show premiums of 100-300 Bps. Russia, Croatia, and Turkey show high risk premiums, with South Africa as an outlier.

[12] These Sovereigns have been chosen on the basis that the USD 5Y CDS have recently traded.
[13] Ireland is a noticeable outlier, and lies very close to the 45-degree line.

Individual Sovereign Risk Premiums

Exhibit 5 shows individual Sovereign premiums in January 2016.

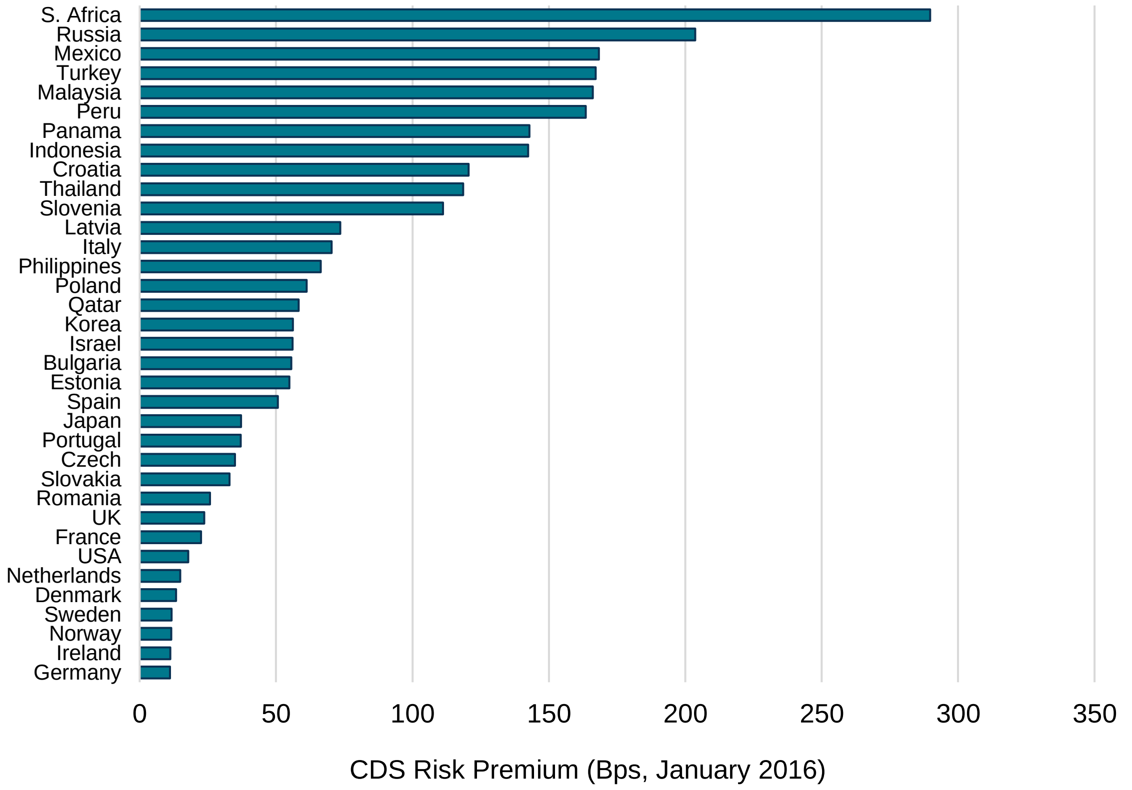


Exhibit 5: Risk Premiums by Sovereign, January 2016

This shows that the risk premium for a single Sovereign can vary from about 10 Bps to nearly 300 Bps, mainly depending on credit quality.

Some of the countries with the highest PD also show relatively low risk premiums. Some of these differences will be due to LGD assumptions; but they will also reflect the many distortions discussed previously that periodically appear in individual CDS markets.

As the industry moves towards IFRS9 implementation in 2018, there is an increased focus on PIT estimates. These are typically calibrated to the market values of traded instruments, with the challenge that many loans do not have a tradable equivalent. The Credit Benchmark dataset has the advantage that it covers all issuers, even if they have no traded instruments in issue. With a suitable loss adjustment framework, the risk premiums shown here could be used to convert TTC into indicative PIT estimates.

To adjust for sampling variation, Exhibit 6 shows these Risk Premiums averaged by groupings of the Credit Benchmark Consensus (CBC) credit categories.

Exhibit 6: CDS Risk Premiums by CBC Groups, January 2016

Exhibit 6 implies that in January 2016, every broad category downgrade results in the risk premium approximately doubling (and closer to tripling for AAA vs. AA). The relationship appears to be stable, in the sense that it is possible to interpolate between categories to give Risk Premiums for AA+, AA-, A+, etc

This provides a compact set of summary risk premiums that can be used to provide indicative prices for new Sovereign CDS; and with suitable calibration this could be extended to Corporate CDS pricing.

For example, a financial institution lends to Obligor ABC. The obligor is unrated by any of the credit rating agencies, but the lender has decided that it is broadly category A. If it was to approach a reinsurer for credit insurance, it would expect to pay a premium of just over 70 Bps over its estimate of the synthetic CDS price.

The next section shows that there is significant variation in this premium over time; so the position, and possibly the shape, of the chart in Exhibit 6 is likely to change from month to month.

It is important to note that a number of Sovereign CDS trade very infrequently. It is not unusual to see quotes on USD 5Y CDS which are one, three or even six months out of date. The risk premiums calculated here, combined with recent PD and LGD estimates, will usually give a fresher estimate of where the CDS should be trading.

Tracking the Sovereign CDS Risk Premium over time

The six charts in Exhibit 7 show the relationship between Actual and Synthetic CDS prices for each month in H2 2015:

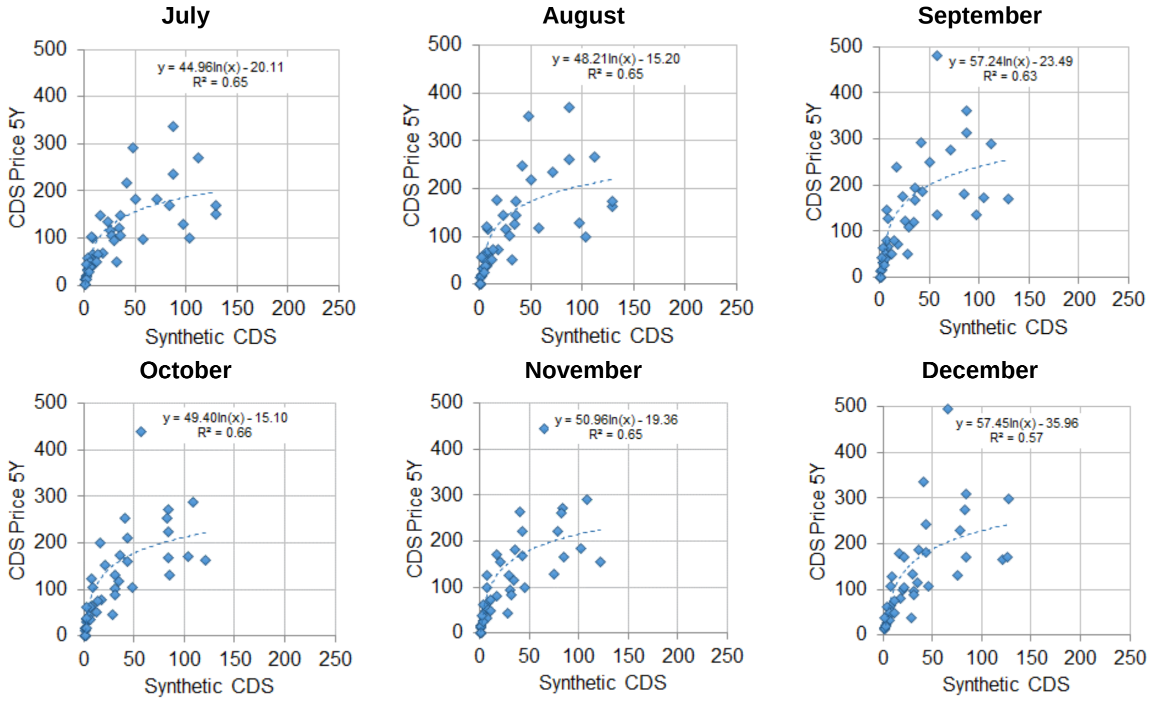


Exhibit 7: Theoretical and Actual CDS Prices, July – Dec 015, LGD = 0.40

All 6 monthly snapshots show similar patterns but the function parameters show considerable variation. The line of best fit[14] is non-linear (semi-logarithmic) and the level of explained variation varies between 57% and 66%.

Testing the assumption that LGD = 0.4 with alternative LGD values (in steps of 0.1 between 0.1 and 1) shows that the optimal LGD values for best fit are in the range of 0.3-0.4[15], although the fit is likely to improve if individual LGDs, specific to each Sovereign, are used.

However, the typical assumption used in CDS pricing is a recovery rate of 0.4, implying an LGD of 0.6. Higher LGD values will bring the plotted points closer to the 45 degree line and reduce the risk premium. So in practice, there is a family of risk premiums associated with different single value LGD assumptions, as well as one which is based on individual LGDs specific to each Sovereign.

[14] Measured by the Coefficient of Determination (R^2)
[15] Although the differences are small in the range 0.2-0.5. For assumed LGD values of more than 0.6, the fit shows significant deterioration.

Extension to full time series

A synthetic equivalent time series index can be constructed by applying equation {1} to each constituent to calculate Synthetic CDS price estimates, based on the Credit Benchmark PD history for each entity and an assumed common LGD.[16] To track the actual CDS, this paper uses the S&P/ISDA International Developed Nation Sovereign CDS OTR Index[17].

Exhibits 8 shows the relationship between these Actual and Synthetic CDS indices over time, with an assumed LGD of 0.4, which shows that actual CDS prices are significantly more volatile than synthetic CDS prices:

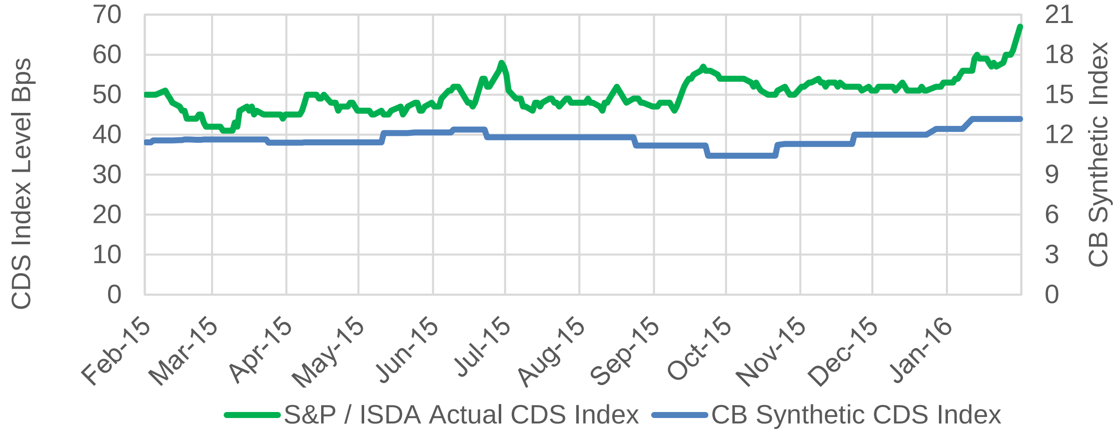


Exhibit 8: Sovereign Index: Actual and Synthetic CDS

Exhibit 9 shows the Risk Premium defined as the difference between the S&P / ISDA CDS index and the associated Synthetic CDS index.

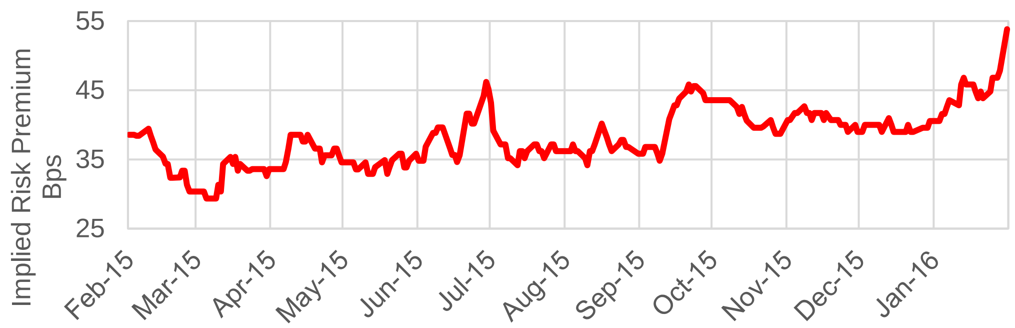


Exhibit 9: Implied CDS Risk Premium

The spread chart in Exhibit 9 shows a clear uptrend, but with the risk premium varying from 30 Bps to 55 Bps, with a low in March 2015; and highs in in July 2015, October 2015 and January 2016. Part of the October spike was driven by a dip in average PD estimates over a 2-month period, whereas the January 2016 spike reflects rising global credit concerns.

It is again worth noting that the level of the risk premium will change with different LGD assumptions. Since LGD estimates are unlikely to change very often, the trend and variation would be very similar.

[16] Alternatively, as noted previously, the Sovereign entity-specific consensus LGD can be used where quorate estimates are available. Coverage is currently less than 100%.

[17] See Appendix 2 for constituents

Detailed Conclusions

- ***Synthetic CDS Prices can be estimated from Consensus PD and Consensus LGD data.***

  With standard closed form pricing formulas and some simplifying assumptions about credit transition probabilities, it is possible to give reasonable approximations to real world equivalent CDS prices.

- ***CDS Risk Premiums can be estimated by comparing Actual CDS prices with Synthetic CDS prices, for equivalent maturities.***

  This Risk Premium is a composite of a number of different sources of risk – liquidity, counterparty, hedging and market.

- ***CDS Risk Premiums are time varying and can be tracked.***

  Although the daily changes in CDS premiums are the main driver of this variation, changes in the real world price can occur independently of CDS price changes. The risk premium time series is a function of the difference between the two and in this paper the combined time series shows more obvious trends than either of the two constituent series.

- ***CDS Risk Premiums are broadly a function of credit quality; every broad notch downgrade typically doubles the risk premium.***

  Lower credit quality implies a smaller pool of investors and typically lower liquidity, and higher price volatility, in reference bonds. The resulting reduced scope for effective hedging and increased price volatility is likely to lead to fewer market makers in that CDS. Higher price volatility will also lead directly to higher risk premiums. This also means that, at any given date, the typical risk premium can be estimated provided the broad credit category of the obligor is known.

- ***CDS Risk Premiums can provide indicative pricing for new or untraded Sovereign or Corporate CDS.***

  There are many CDS issues, including those for Sovereign obligors, which do not regularly trade. The framework described here can be used to provide indicative pricing based on a combination of PD, LGD and CDS Risk Premium. The PD is used to identify the CBC category and the associated risk premium, as well as estimating the hazard rate. The LGD provides an estimate of the recovery rate. The CDS pricing formula combined with the risk premium, gives an indicative CDS price. With suitable re-calibration, this could be extended to Corporate CDS.

- ***CDS Risk Premiums may be of use in translation between market-derived PIT and fundamental TTC estimates of default risks.***

  Market derived PIT estimates will typically contain a risk premium element. The framework described here allows that element to be explicitly identified and quantified. This potentially provides one element of a consistency check between market derived (i.e. risk neutral) PIT estimates and real world TTC estimates.

Appendix 1: Estimation of Multi-Period Probabilities of Default

The simple Hazard rate approach for the i^{th} obligor in credit category j uses equation {2} for the 5 year cumulative probability:

$PD(5)[i] = [1- (1-PD(1)[i])^5]$ {2}

The simplest of many transition matrix approaches uses the following equation for the 5 year matrix:

$T(5) = T(1)^5$ {3}

Where T(1) is a k x k one year transition matrix and k is the number of credit categories, including default. So the k^{th} column represents default.

So after 5 years, the cumulative default probability for obligors in credit category j is given by element [j,k] of T(5).

If one year probabilities of default are the same for each approach, then PD(5)[i] = T(1)[j,k]

The difference |d| between T(5)[j,k] and PD(5)[i] is a non-trivial function of the structure of T(1):

- If T(1) is diagonal, then |d| = 0.
- If T(1) is upper triangular, so that default is an absorbing state, then |d| is non-zero but typically less than if T(1) has non zero elements in the lower triangle.
- If T(1) has non zero elements in the upper and lower triangles, then |d| can be positive or negative and is typically proportionately larger for the higher quality (lower PD) names.
- As k increases, the absolute value of |d| is usually lower for a given value of T(1)[j,k].

For practical applications, it is worth verifying that the two methods give results that are within an acceptable degree of tolerance for the specific intended purpose.

Appendix 2: Synthetic CDS Index Constituents

The Synthetic CDS index is based on the S&P/ISDA International Developed Nation Sovereign CDS Index Weighted Average Spread (SPCDMR50) and the 5Y single name US Government CDS price (CT786896 Curncy in Bloomberg).

Sovereign	S&P Rating	Source
USA	AA+	Bloomberg / CMA
Japan	AA-	S&P / ISDA
Italy	BBB+	
France	AA+	
Germany	AAA	
Belgium	AA	
Austria	AA+	
Spain	A	
United Kingdom	AAA	
Netherlands	AAA	
Australia	AAA	
Portugal	BB	
Ireland	BBB+	
Denmark	AAA	
Sweden	AAA	
Finland	AAA	
Switzerland	AAA	
Norway	AAA	

Source: S&P Dow Jones Indices LLC.

The launch date of the S&P/ISDA International Developed Nation Sovereign CDS OTR Index was October 25, 2010.

All information presented prior to the index launch date is back-tested. Back-tested performance is not actual performance, but is hypothetical. The back-test calculations are based on the same methodology that was in effect when the index was officially launched. Past performance is not a guarantee of future results. Please see the Performance Disclosure at http://www.spindices.com/regulatory-affairs-disclaimers/ for more information regarding the inherent limitations associated with back-tested performance.

Appendix 3: Stability of Risk Premiums by Sovereign

Exhibit A.3.1 shows the relationship between Risk Premiums in a comparison between January 2016 and December 2015.

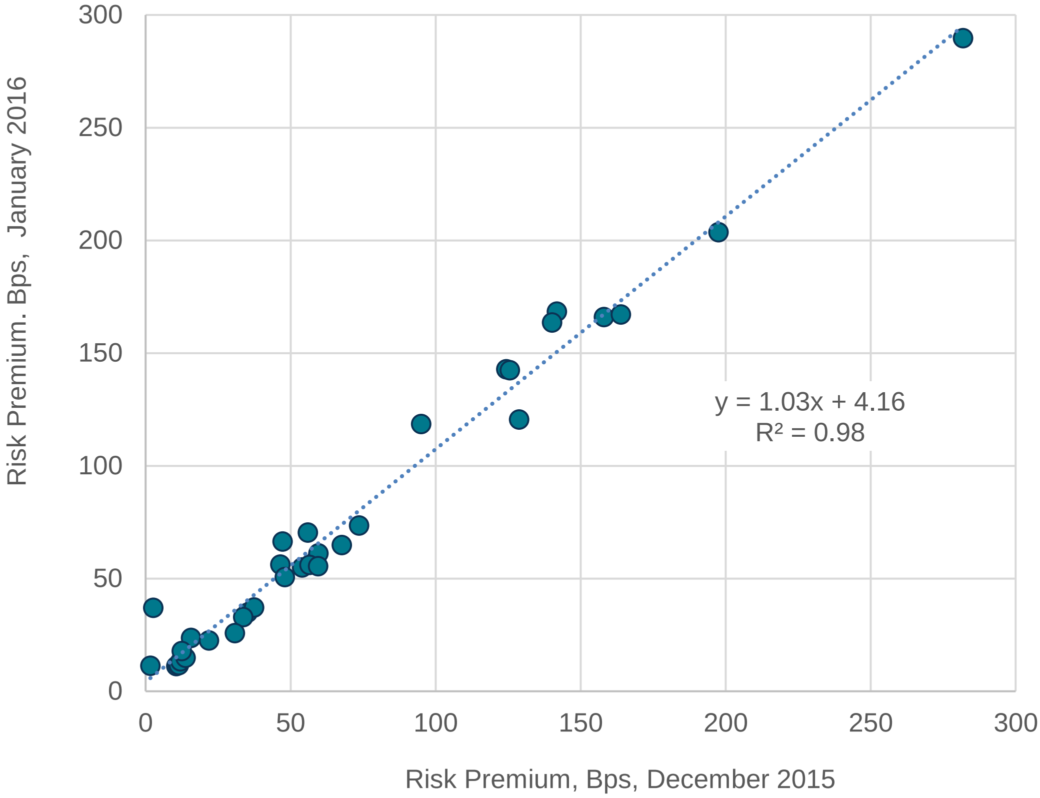


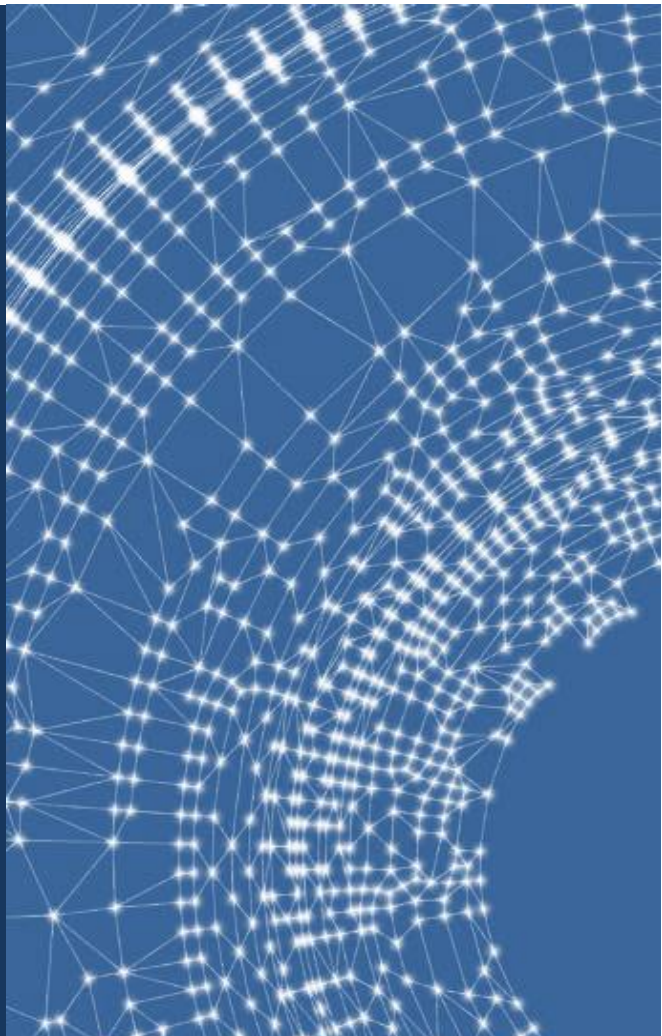
Exhibit A 3.1: Risk Premium Comparison, Dec 2015- Jan 2016

This shows that the risk premiums in December explain 98% of the variation in Risk Premiums in January, and the slope coefficient of 1.03 and the positive intercept of 4.16 show that the overall risk premium increased in January compared with December.

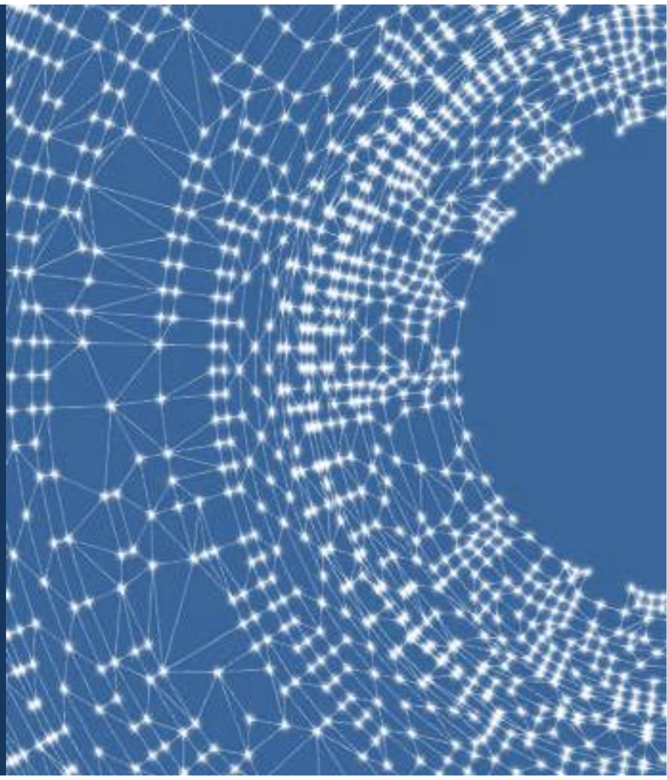
As this paper has already shown, differences in *individual* Sovereign risk premiums are mainly driven by differences in individual Sovereign credit quality. The overall level of the risk premium will be driven by macro factors including liquidity, capital requirements, the market shares of different market makers, funding costs and market volatility.

Summary Conclusions

- **Synthetic CDS Prices can be estimated from Consensus PD and Consensus LGD data.**
- **CDS Risk Premiums can be estimated by comparing Actual CDS prices with Synthetic CDS prices, for equivalent maturities.**
- **CDS Risk Premiums are time varying and can be tracked.**
- **CDS Risk Premiums are broadly a function of credit quality; every broad notch downgrade typically doubles the risk premium.**
- **CDS Risk Premiums can provide indicative pricing for new or untraded Sovereign CDS and by extension to Corporate CDS.**
- **CDS Risk Premiums may be of use in translation between market-derived PIT and fundamental TTC estimates of default risks.**



About Credit Benchmark



Credit Benchmark is an entirely new source of data in credit risk. We pool PD and LGD estimates from IRB banks, allowing them to unlock the value of internal ratings efforts and view their own estimates in the context of a robust and incentive-aligned industry consensus. The resultant data supports banks' credit risk management activities at portfolio and individual entity level, as well as informing model validation and calibration. The Credit Benchmark model offers full coverage of the entities that matter to banks, extending beyond Sovereigns, banks and corporates into funds, Emerging markets and SMEs.

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