FINM3405 Derivatives and risk management

Tutorial Sheet 9: Credit default swaps (CDS)

October 9, 2024

Question 1. Present the basic, intuitive no-arbitrage argument showing that the breakeven CDS spread k on a reference entity's reference asset should be approximately equal to the risk premium $y - r$ of the yield y on the reference asset over the risk-free rate r. What is meant by the CDS spread **basis** and what are some factors that influence it over time? From the textbook:

Credit Default Swaps and Bond Yields

A CDS can be used to hedge a position in a corporate bond. Suppose that an investor buys a 5-year corporate bond yielding 7% per year for its face value and at the same time enters into a 5-year CDS to buy protection against the issuer of the bond defaulting. Suppose that the CDS spread is 200 basis points, or 2%, per annum. The effect of the CDS is to convert the corporate bond to a risk-free bond (at least approximately). If the bond issuer does not default, the investor earns 5% per year when the CDS spread is netted against the corporate bond yield. If the bond does default, the investor earns 5% up to the time of the default. Under the terms of the CDS, the investor is then able to exchange the bond for its face value. This face value can be invested at the risk-free rate for the remainder of the 5 years.

This shows that the spread of the yield on an n-year bond issued by a company over the risk-free rate should approximately equal the company's n-year CDS spread. If it is markedly more than this, an investor can earn more than the risk-free rate by buying the corporate bond and buying protection. If it is markedly less than this, an investor can borrow at less than the risk-free rate by shorting the bond and selling CDS protection.

The *CDS–bond basis* is defined as

$$\text{CDS–bond basis} = \text{CDS spread} - \text{Bond yield spread}$$

The bond yield spread has traditionally been calculated as the excess of the bond yield over the relevant LIBOR/swap rate.

The arbitrage argument given above suggests that the CDS–bond basis should be close to zero. In fact it tends to be positive during some periods (e.g., pre-2007) and negative during other periods (e.g., the 2007–2009 financial crisis). The sign of the CDS–bond basis since the financial crisis has depended on the reference entity and has been sometimes positive and sometimes negative.

Question 2. Calculate the breakeven CDS spread k and premium paid, and the initial upfront cashflow if the CDS spread is set to $k = 1\%$, for a 2 year CDS with semiannual premiums, notional principal of $F = \$500$m, recovery rate of $R = 60\%$, and the following yield curve and default probabilities:

time	survival probability	default probability	risk-free rate
t1	0.9753	0.0247	2.5%
t2	0.9512	0.0241	2.7%
t3	0.9277	0.0235	2.9%
t4	0.9048	0.0229	3.1%

See spreadsheet and below screengrabs. I get a CDS spread of $k = 2.0252\%$.

Hazard rate:	5%	Notional:	$500,000,000.00							
Period	Time	Survival probability	Default probability	Risk-free rate	Recovery rate	Payout upon default	E[payout]	PV(E[payout])	F x d x survival prob	PV(F x d x survival prob)
1	t1	97.5310%	2.4690%	2.5%	60%	$200,000,000.00	$4,938,017.59	$4,876,676.55	$243,827,478.01	$240,798,604.43
2	t2	95.1229%	2.4080%	2.7%	60%	$200,000,000.00	$4,816,097.51	$4,687,802.65	$237,807,356.13	$231,472,463.40
3	t3	92.7743%	2.3486%	2.9%	60%	$200,000,000.00	$4,697,187.63	$4,497,240.35	$231,935,871.58	$222,062,953.91
4	t4	90.4837%	2.2906%	3.1%	60%	$200,000,000.00	$4,581,213.66	$4,305,804.32	$226,209,354.51	$212,610,301.14
							PV(E[payouts]):	**$18,367,523.87**	**Denominator:**	**$906,944,322.88**
									CDS spread:	**2.0252%**

When the CDS spread is fixed at $k = 1\%$, the protection buyer must pay the protection seller an upfront cashflow of $9,298,080.65.

Hazard rate:	5%	Notional:	$500,000,000.00								
Period	Time	Survival probability	Default probability	Risk-free rate	Recovery rate	Payout upon default	E[payout]	PV(E[payout])	Premium at k=1%	E[premium]	PV(E[premium])
1	t1	97.5310%	2.4690%	2.5%	60%	$200,000,000.00	$4,938,017.59	$4,876,676.55	$2,500,000.00	$2,438,274.78	$2,407,986.04
2	t2	95.1229%	2.4080%	2.7%	60%	$200,000,000.00	$4,816,097.51	$4,687,802.65	$2,500,000.00	$2,378,073.56	$2,314,724.63
3	t3	92.7743%	2.3486%	2.9%	60%	$200,000,000.00	$4,697,187.63	$4,497,240.35	$2,500,000.00	$2,319,358.72	$2,220,629.54
4	t4	90.4837%	2.2906%	3.1%	60%	$200,000,000.00	$4,581,213.66	$4,305,804.32	$2,500,000.00	$2,262,093.55	$2,126,103.01
							PV(E[payouts]):	**$18,367,523.87**		**PV(E[premiums])**	**$9,069,443.23**
										Upfront cashflow	**$9,298,080.65**

Question 3. Suppose that the CDS in the above question is written on a sovereign nation's debt, and towards the end of the 1^{st} 6 months there is a war and the government's remaining default probabilities spike to the following:

time	survival probability	default probability	risk-free rate
t2	0.7788	0.1037	2.7%
t3	0.6873	0.0915	2.9%
t4	0.6065	0.0808	3.1%

Calculate the new CDS value based on a fixed CDS spread of $k = 1\%$, the profit if you initially bought CDS protection in the above example and closed out the position, and the new breakeven CDS spread k. If the government won the war towards the end of the 1^{st} year and its default probabilities dropped to the following, what is the breakeven CDS spread at the end of the 1^{st} year?

time	survival probability	default probability	risk-free rate
t3	0.9851	0.0049	2.9%
t4	0.9802	0.0049	3.1%

What would be your profit or loss here if you didn't close out your position at the end of the 1st 6 months? If you held the CDS to maturity, what is the total amount of premium you'd end up paying over the whole 2 years? I'll do the first part of the question, since the second part should be clear and you can do it yourself. Upon default probabilities spiking, I calculate the new upfront cashflow that the protection buyer would need to pay the protection seller to be $48,620,728.48. This equates to a profit of $39,322,647.84 on the CDS trade.

Hazard rate:	25%	Notional:	$500,000,000.00								
Period	Time	Survival probability	Default probability	Risk-free rate	Recovery rate	Payout upon default	E[payout]	PV(E[payout])	Premium at k=1%	E[premium]	PV(E[premium])
2	t2	77.8801%	10.3696%	2.7%	60%	$200,000,000.00	$20,739,243.39	$20,461,144.99	$2,500,000.00	$1,947,001.96	$1,920,894.06
3	t3	68.7289%	9.1512%	2.9%	60%	$200,000,000.00	$18,302,300.86	$17,779,156.39	$2,500,000.00	$1,718,223.20	$1,669,110.30
4	t4	60.6531%	8.0759%	3.1%	60%	$200,000,000.00	$16,151,723.82	$15,417,863.15	$2,500,000.00	$1,516,326.65	$1,447,431.68
							PV(E[payouts]):	**$53,658,164.52**		**PV(E[premiums])**	**$5,037,436.04**
										Upfront cashflow	**$48,620,728.48**

Question 4. Consider a recovery rate of $R = 60\%$ and the following 4 years of semiannual default and survival probabilities, and risk-free rate yield curve:

time	survival probability	default probability	risk-free rate
t1	0.9900	0.0100	3.39%
t2	0.9802	0.0099	3.63%
t3	0.9704	0.0098	3.78%
t4	0.9608	0.0097	3.86%
t5	0.9512	0.0096	3.92%
t6	0.9418	0.0095	3.95%
t7	0.9324	0.0094	3.97%
t8	0.9231	0.0093	3.98%

Calculate the breakeven CDS spread curve for CDS maturing on each date. A CDS spread curve is no different to any yield curve in that it gives some kind of interest rate or yield for contracts maturing on different dates. Here the yield of interest is the breakeven CDS spread. So we just need to keep a running calculation of breakeven CDS spreads.

Hazard rate:	2%	Notional:	$1.00										
Period	Time	Survival probability	Default probability	Risk-free rate	Recovery rate	Payout upon default	E[payout]	PV(E[payout])	PV(E[payouts])	F x d x survival prob	PV(F x d x survival prob)	Denominator	CDS spread
1	t1	99.0050%	0.9950%	3.3935%	60.0%	$0.40	$0.003980	$0.003913		$0.495025	$0.486697		
2	t2	98.0199%	0.9851%	3.6321%	60.0%	$0.40	$0.003940	$0.003800	$0.007713	$0.490099	$0.472618	$0.959314	**0.8040%**
3	t3	97.0446%	0.9753%	3.7769%	60.0%	$0.40	$0.003901	$0.003686	$0.011399	$0.485223	$0.458498	$1.417812	**0.8040%**
4	t4	96.0789%	0.9656%	3.8647%	60.0%	$0.40	$0.003862	$0.003575	$0.014975	$0.480395	$0.444662	$1.862474	**0.8040%**
5	t5	95.1229%	0.9560%	3.9179%	60.0%	$0.40	$0.003824	$0.003467	$0.018442	$0.475615	$0.431238	$2.293712	**0.8040%**
6	t6	94.1765%	0.9465%	3.9502%	60.0%	$0.40	$0.003786	$0.003363	$0.021805	$0.470882	$0.418259	$2.711971	**0.8040%**
7	t7	93.2394%	0.9371%	3.9698%	60.0%	$0.40	$0.003748	$0.003262	$0.025067	$0.466197	$0.405721	$3.117692	**0.8040%**
8	t8	92.3116%	0.9277%	3.9817%	60.0%	$0.40	$0.003711	$0.003165	$0.028231	$0.461558	$0.393602	$3.511294	**0.8040%**

In hindsight I should have thought of an example in which the CDS spreads were different for different maturities. But the student can ask the question: What would cause this? One answer is different recovery rates and hazard rates over time.

Question 5. What is the role of the International Swaps and Derivatives Association (ISDA)? What is the ISDA CDS Standard Model? You can read about their role on the website.

> Since 1985, the International Swaps and Derivatives Association has worked to make the global derivatives markets safer and more efficient.
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> ISDA's pioneering work in developing the ISDA Master Agreement and a wide range of related documentation materials, and in ensuring the enforceability of their netting and collateral provisions, has helped to significantly reduce credit and legal risk. The Association has been a leader in promoting sound risk management practices and processes, and engages constructively with policymakers and legislators around the world to advance the understanding and treatment of derivatives as a risk management tool.
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> ISDA has over 1000 member institutions from 76 countries. These members comprise a broad range of derivatives market participants, including corporations, investment managers, government and supranational entities, insurance companies, energy and commodities firms, and international and regional banks. In addition to market participants, members also include key components of the derivatives market infrastructure, such as exchanges, intermediaries, clearing houses and repositories, as well as law firms, accounting firms and other service providers.
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> ISDA's work in three key areas – reducing counterparty credit risk, increasing transparency, and improving the industry's operational infrastructure – show the strong commitment of the Association toward its primary goals; to build robust, stable financial markets and a strong financial regulatory framework.

Question 6. Ignoring the realised profits, whose legendary CDS trade do you think was more impressive and sophisticated: Bill Ackman's COVID19 trade or Michael Burry's GFC trade?

I'll leave this as a general debate topic. My view is Michael Burry's trade was light years more sophisticated and complex since it involved negotiating and originating new, novel CDS directly with banks that were written over mortgage backed securities, and it was a bet against the whole US housing market, residential mortgage sector and overall economy.