The Components of Corporate Credit Spreads:

Default, Recovery, Tax, Jumps, Liquidity, and Market Factors

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ABSTRACT

This paper analyzes the components of corporate credit spreads. The analysis is based on a structural model that can offer a framework to understand the decomposition. The paper contends that default risk may correctly represent only a small portion of corporate credit spreads. This idea stems both from empirical evidence and from the following theoretical assumptions underlying contingent claim models of default: that markets for corporate stocks and bonds are (i) perfect, (ii) complete, and (iii) trading takes place continuously. Thus, in these models there are no transaction or bankruptcy costs, no tax effects, no liquidity effects, no jump effects reflecting market incompleteness, and no market risk factors effecting the pricing of corporate stocks or bonds. The paper starts with the use of a modified version of the Black-Scholes-Merton diffusion based option approach. We estimate corporate default spreads as simply a component of corporate credit spreads using data from November 1991 to December 1998, which includes the Asian Crisis in the Fall, 1998. First we measure the difference between the observed corporate credit spreads and option based estimates of default spreads. We define this difference as the ***residual spread***. We use the term residual to characterize it as that portion of the credit spread not explained by default risk. We show that for AAA (BBB) firms only a small percentage, 5% (22%), of the credit spread can be attributed to default risk. This result from a structural model is confirmed by the empirical result in Elton and Gruber, et al, (2000) based on Moodys and S&P transition matrices and default vectors. Next we show that recovery risk also cannot explain this residual spread. We note that the pure diffusion assumption may lead to underestimates of the default risk. In order to include jumps to default, we next estimate what combined jump-diffusion parameters would be necessary to force default spread to be equal to the observed credit spread. In each rating class on average firms would be required to experience annual *jumps* that decrease firm value by 20% and increase stock volatility by more than 100% *over their observed volatility* in order to eliminate the residual spread. We consider this required increase in stock volatility to be unrealistic as the sole explanation of the residual spread. So next we consider whether the unexplained component can be partly attributable to tax, liquidity, and market risk factors. We note (as Elton and Gruber (2000) note) that tax effects cannot explain this residual spread. Next we investigate what relation liquidity and market factors may have on this residual spread. We find the following empirical results: i) increases in liquidity as measured by changes in each firm's trading volume significantly reduces the residual spread, but does not alter the default spread; ii) increases in stock market volatility significantly reduces the residual spread by increasing the default spread relative to the credit spread, and iii) increases in stock market returns significantly increases the residual spread by reducing the default spread relative to the credit spread. We also find (as Longstaff and Schwartz (1985)) that the risk free interest rate and the term premium changes are relatively insignificant. This paper concludes that credit risk and credit spreads are not primarily attributable to default and recovery risk, but are mainly due to tax, liquidity, and market risk factors.

Appendix

Table 1

Credit and Default Spreads

Reported in basis points are the averages of the medians, quartiles, and standard deviations for each rating category with and without the Fall 1998 Asian/LTC crisis. "Firms" indicates the average number of firms per month during this period.

Panel A: With Asian/LTC Crisis

Nov 1991 – Dec 1998

Rating	Default Spread					Credit Spread	
	Med	1Q	3Q	Std	Firms	Med	Std
AAA	1.6	0.0	7.7	3.1	18	35.5	13.3
AA	2.9	0.4	15.0	8.2	71	47.6	10.3
A	11.4	2.7	43.0	19.8	193	70.0	14.5
BBB	26.1	6.6	81.4	52.3	188	117.1	25.4

Panel B: Without Asian/LTC Crisis

Nov 1991 – June 1998

Rating	Default Spread				Credit Spread	
	Med	1Q	3Q	Std	Med	Std
AAA	1.1	0.0	5.7	2.1	33.2	9.8
AA	1.1	0.1	8.9	2.3	45.7	7.3
A	7.1	1.2	30.1	4.1	67.1	9.1
BBB	14.4	3.2	50.8	8.6	114.5	23.0

Table 2

Residual Spreads

Reported in basis points are the averages of the medians, quartiles, and standard deviations of the residual spreads for each investment grade rating category with and without including the Asian/LTC Crisis of the Fall of 1998.

Panel A: With Asian/LTC Crisis

Nov 1991 – Dec 1998					
Rating	Med	1Q	3Q	Std	% Med
AAA	33.89	35.49	27.79	14.18	0.95
AA	44.70	47.15	32.56	9.51	0.94
A	58.57	67.28	26.95	19.27	0.84
BBB	91.01	110.59	35.75	34.79	0.78

Panel B: Without Asian/LTC Crisis

Nov 1991 – June 1998					
Rating	Med	1Q	3Q	Std	% Med
AAA	32.10	33.21	27.52	14.20	0.97
AA	44.58	45.59	36.78	9.26	0.98
A	59.99	65.90	37.03	17.67	0.89
BBB	100.13	111.29	63.33	25.39	0.87

Table 3

Summary of Spreads

For Diffusion Models

Nov 1991 – Dec 1998

	Default		Credit		Residual		
Rating	**Med**	**Std**	**Med**	**Std**	**Med**	**Std**	**Residual % CS**
AAA	1.6	3.1	35.5	13.3	33.9	14.18	**95.4%**
AA	2.9	8.2	47.6	10.3	44.7	9.51	**94.0%**
A	11.4	19.8	70.0	14.5	58.6	19.27	**83.7%**
BBB	26.1	52.3	117.1	25.4	91.0	34.79	**77.7%**

- Spreads are in basis points. Default spread is calculated with the Merton model with accrued dividends and interest payments and a 45% loss associated with default. The model is calibrated such that the equity price and volatility are matched exactly. The default spread is the average over time of the cross-sectional medians for firms in each rating class. Credit spread data is from CMS for matched duration. Residual spread is the difference.

Table 4

Credit, Default, and Residual Spread Correlations

Panel A: Credit and Default Spread Correlation

Default→	With Asian/LTC Crisis ↓					Without Asian/LTC Crisis ↓			
Credit ↓	AAA	AA	A	BBB		AAA	AA	A	BBB
AAA	0.632	0.487	0.540	0.199	AAA	0.267	0.037	-.042	-.291
AA	0.613	0.682	0.725	0.396	AA	0.042	-.040	-.077	0.335
A	0.591	0.680	0.756	0.490	A	-.317	0.057	-.136	0.183
BBB	0.644	0.678	0.769	0.493	BBB	-.263	0.111	0.096	0.129

Panel B: Credit Spread Correlation

	AAA	AA	A	BBB		AAA	AA	A	BBB
AAA	1.000	0.762	0.760	0.274	AAA	1.000	0.591	0.495	-0.089
AA	0.762	1.000	0.905	0.577	AA	0.591	1.000	0.815	0.429
A	0.760	0.905	1.000	0.712	A	0.495	0.815	1.000	0.640
BBB	0.274	0.577	0.712	1.000	BBB	-0.089	0.429	0.640	1.000

Panel C: Default Spreads Correlation

	AAA	AA	A	BBB		AAA	AA	A	BBB
AAA	1.000	0.727	0.745	0.774	AAA	1.000	0.661	0.282	0.315
AA	0.727	1.000	0.970	0.933	AA	0.661	1.000	0.523	0.614
A	0.745	0.970	1.000	0.977	A	0.282	0.523	1.000	0.870
BBB	0.774	0.933	0.977	1.000	BBB	0.315	0.614	0.870	1.000

Table 5

Effects of Fractional Recovery Rates

And Taxes On Default Spreads

Nov 1991 – Dec 1998

Panel A: Fractional Recovery Rates (FRR)

Rating	100%	80%	60%	40%	20%	0%
AAA	0	2	4	5	7	8
AA	1	3	5	7	9	11
A	6	14	20	27	33	39
BBB	17	29	40	50	61	72

Panel B: Variable Tax Rate with FRR= 80%

Rating	0%	2%	4%	6%	8%	10%
AAA	2	6	10	14	18	22
AA	3	9	14	20	26	31
A	14	18	24	31	38	45
BBB	29	33	39	46	52	59

- Spreads are in basis points. Default spread is calculated with the Merton model with accrued dividends and interest payments and a variable recovery associated with default. The model is calibrated such that the equity price and volatility are matched exactly. The default spread is the average over time of the cross-sectional medians for firms in each rating class. Credit spread data is from CMS for matched duration. Residual spread is the difference.

Table 6

Jump-Diffusion Models

Necessary Jump Parameters and Volatility

CS>DS	Rating	AAA	AA	A	BBB
S/V		.80	.75	.64	.55
V Vol Implied		.191	.170	.160	.157
S Vol Observed No Jumps		.238	.226	.246	.278
CS=DS	Freq/Year	Amplitude			
Additive	1	19%	20%	18%	22%
Additive	2	14%	14%	13%	15%
V Vol Implied Jumps		.330	.337	.352	.425

- **Assess the impact on default spreads of a jump-diffusion model instead of a pure diffusion model for the firm value. Default spreads are estimated with a jump-diffusion process for the firm value following Merton (1976, 1979). Jumps are assumed distributed lognormal with zero mean. The observed stock volatility is reported.**
- **Base case is the Merton model with no jumps and the default spread is much less than the credit spread.**
- **Next the base case parameters are used and a jump process is added (Additive). Jump magnitude is increased until the default spreads are equal to the credit spreads. The frequency of the jumps is annual. Table shows the necessary total firm volatility which is about the same for the necessary jump scenarios.**

Table 7

Residual Spread

Regression Analysis of Components

$$\Delta RS = a + b_1 \Delta \log(Vol) + b_2 r_f + b_3 \Delta Prem_t + b_4 r_{Stk,t} + b_5 \Delta r^2_{Stk,t} + e_t$$

Rating	a	Log(Vol)	r_f	PREM	r_{Stk}	r^2_{Stk}	R^2
AAA	0.003	0.006	-0.071	-0.025	0.082	0.129	0.017
t-stat	0.487	0.149	**-1.888**	-0.769	0.262	0.488	
AA	-0.007	-0.122	-0.056	-0.051	0.582	-0.236	0.025
t-stat	-0.985	**-1.964**	-1.069	-1.323	1.376	-0.597	
A	-0.017	-0.245	-0.019	-0.080	1.330	-0.772	0.096
t-stat	-1.763	**-2.179**	-0.331	**-1.775**	**2.266**	**-1.559**	
BBB	-0.041	-0.513	0.064	-0.088	2.264	-1.670	0.070
t-stat	-1.915	**-1.821**	0.572	-0.770	**2.326**	**-2.044**	

- **Regressions of changes in the residual spread on changes in a measure of trading volume, the level of risk free rate, changes in the slope of term premium, US equity market return, and volatility as changes in the squared US equity market return, and the adjusted R^2 are reported. The adjusted R^2 is much higher (45-60%) when explaining the level on the residual spread.**