SEPTEMBER 21, 1998

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The Anatomy of the High Yield Bond Market

After Two Decades Of Activity—Implications For Europe*

Until the last few years, the high yield bond market was essentially a solely U.S. capital market phenomena. That this non-investment grade, fixed income asset class has grown so impressively in the U.S. and now is possibly on the verge of an explosion of new issuance in Europe is primarily based on a simple summary performance statistic -- an average annual net return to investors of about 250 basis points per year above the risk-free rate for the past two decades. But, just as the U.S. high yield market rebounded from its debacles in the late 1980's and the Mexican Eurobond market from its peso crisis in early 1995, the long-term key factor in Europe will be the fundamental health of firms issuing bonds. Despite short-term gyrations and flights to quality, there is still no substitute for careful and objective analysis of the underlying firms and securities that comprise the market.

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Summary Market Performance of High Yield Bonds

Until the last few years, the high yield bond market was essentially a solely U.S. capital market phenomena. That this non-investment grade, fixed income asset class has grown so impressively in the U.S. and now is possibly on the verge of an explosion of new issuance in Europe is primarily based on a simple summary performance statistic — **an average annual net return to investors of about 250 basis points per year above the risk-free rate for the past two decades.** Figure 1 shows that over the period 1978-1997, U.S. high yield bonds promised, on average, a yield spread of 436 basis points (4.36%) more than 10-year U.S. Treasuries and, in fact, returned a compound average return of 2.47% per year (2.26% arithmetic average). The absolute average annual return was 12.36% over this 20-year period.[1]

Appendices A and B illustrate the absolute and relative return performance of high yield bonds for various annual starting and ending points over the 20-year period 1978-1997. Note that in almost all cases the absolute compound annual average return is in double-digits, mostly in the 10-12% per year range. The relative returns vary more widely. Ever since the early 1990's, compound annual average return spreads have been significantly positive and as of the end of 1997, range between 0.99% and 7.22% per year, depending upon the starting date. As noted above, the rate for the entire period is 2.47%.

[1] In the first seven months of 1998, high yield bonds returned 5.99% to investors, compared to 16.46% on the S&P 500 Stock Index. Although far outdistanced by the stock market in the last three and a half years (1995-1998), high yield bonds have had a respectable aggregate growth of 57% and an average annual (1995-1997) return of 14.60%. Similar stock market return growth rates in Europe have been achieved in what many now perceive as a fully priced, perhaps overpriced, equity market. The precipitous fall in most financial markets in August 1998 caused both the high yield and S&P markets to register slightly negative returns for the first eight months of 1998.

Figure 1 . Annual Returns, Yields And Spreads On Ten-Year Treasury (Treas) And High Yield (HY) Bonds (1978 - 1997)

	RETURN(%)			PROMISED YIELD(%) *		
YEAR	HY	TREAS	SPREAD	HY	TREAS	SPREAD
1997	12.83	11.16	1.67	8.86	5.75	3.11
1996	11.06	0.04	11.02	9.41	6.44	2.97
1995	19.91	23.58	(3.67)	9.70	5.58	4.12
1994	(1.17)	(8.29)	7.13	11.27	7.83	3.44
1993	17.18	12.08	5.11	9.61	5.80	3.81
1992	18.16	6.50	11.66	11.28	6.69	4.59
1991	34.58	17.18	17.40	13.11	6.70	6.41
1990	(4.36)	6.88	(11.24)	17.58	8.83	8.75
1989	1.62	15.99	(14.37)	15.41	7.93	7.48
1988	13.47	9.20	4.27	13.95	9.00	4.95
1987	4.67	(2.67)	7.34	12.66	8.75	3.91
1986	16.09	24.08	(7.99)	14.45	9.55	4.90
1985	22.51	31.54	(9.03)	15.40	11.65	3.75
1984	8.50	14.82	(6.32)	14.97	11.87	3.10
1983	21.80	2.23	19.57	15.74	10.70	5.04
1982	32.45	42.08	(9.63)	17.84	13.86	3.98
1981	7.56	0.48	7.08	15.97	12.08	3.89
1980	(1.00)	(2.96)	1.96	13.46	10.23	3.23
1979	3.69	(0.86)	4.55	12.07	9.13	2.94
1978	7.57	(1.11)	8.68	10.92	8.11	2.81
ARITHMETIC ANNUAL AVERAGE:						
1978-1997	12.36	10.10	2.26	13.18	8.82	4.36
COMPOUND ANNUAL AVERAGE:						
1978-1997	11.88	9.41	2.47			

* End of year yields. Source: Altman & Waldman, 1998.

The return statistics are based on a total return method that is impacted by a multitude of factors, e.g., interest rate changes, business and credit cycles and, probably most importantly, defaults, (and recoveries after default). Indeed, if one subtracts the average annual loss to investors from defaults of 2.18% (Figure 2 — last column) from the promised average yield spread

(4.36%), the result is very close to the annual average return spread. While it is probably an oversimplification to look only at promised yields and expected default losses, the fact of the matter is that investors in a diversified portfolio of high yield bonds, those rated below BBB- (Standard & Poor's, Fitch IBCA and Duff & Phelps) or Baa3 (Moody's), did not really need to consider other factors. To complete the risk picture, however, three other factors do need to be considered, e.g., interest rate, liquidity and currency risk (for foreign investors), but over the long run these other factors do not seem to add much to the story.

Risk and Returns

From Figure 1, we can also observe the impact of interest rate risk on bond performance in a clear and fundamental way. Due to their higher coupon rates, high yield bonds have shorter expected durations than comparable maturity U.S. Treasuries, and this means their price changes, due to actual interest rate changes, will probably be less dramatic. And they are! Note that Treasuries had consistently

lower returns in the late 1970's and early 1980's as interest rates climbed precipitously. The reverse can be observed in the following years 1982-1986 (except for 1983) as interest rates dropped. Hence, during relatively benign credit periods, major shifts in interest rates will drive the market. Of course, in dramatic default periods, credit issues may dominate, e.g., 1989 and 1990 and, ironically, in 1991 when both **returns and defaults** were at record high levels in the same year.[2] In addition, short-term flight-to-quality periods, (e.g., October 1987 and August 1998), will negatively impact returns on high yield bonds.

Figure 2. Default Rates And Losses (A) (1978 - 1997)

YEAR	PAR VALUE OUTSTANDING (a) ($ MMs)	PAR VALUE OF DEFAULT ($ MMs)	DEFAULT RATE (%)	WEIGHTED PRICE AFTER DEFAULT	WEIGHTED COUPON (%)	DEFAULT LOSS (%)
1997	$335,400	$4,200	1.25%	$54.2	11.87%	0.65%
1996	$271,000	$3,336	1.23%	$51.9	8.92%	0.65%
1995	$240,000	$4,551	1.90%	$40.6	11.83%	1.24%
1994	$235,000	$3,418	1.45%	$39.4	10.25%	0.96%
1993	$206,907	$2,287	1.11%	$56.6	12.98%	0.56%
1992	$163,000	$5,545	3.40%	$50.1	12.32%	1.91%
1991	$183,600	$18,862	10.27%	$36.0	11.59%	7.16%
1990	$181,000	$18,354	10.14%	$23.4	12.94%	8.42%
1989	$189,258	$8,110	4.29%	$38.3	13.40%	2.93%
1988	$148,187	$3,944	2.66%	$43.6	11.91%	1.66%
1987	$129,557	$7,486	5.78%	$75.9	12.07%	1.74%
1986	$90,243	$3,156	3.50%	$34.5	10.61%	2.48%
1985	$58,088	$992	1.71%	$45.9	13.69%	1.04%
1984	$40,939	$344	0.84%	$48.6	12.23%	0.48%
1983	$27,492	$301	1.09%	$55.7	10.11%	0.54%
1982	$18,109	$577	3.19%	$38.6	9.61%	2.11%
1981	$17,115	$27	0.16%	$12.	15.75%	0.15%
1980	$14,935	$224	1.50%	$21.1	8.43%	1.25%
1979	$10,356	$20	0.19%	$31.	10.63%	0.14%
1978	$8,946	$119	1.33%	$60.	8.38%	0.59%
ARITHMETIC AVERAGE 1978-1997:			2.85%	$42.9	11.48%	1.83%
WEIGHTED AVERAGE 1978-1997:			3.34%			2.18%

Note: (a) Excludes defaulted issues. Source: Altman & Waldman, 1998.

Liquidity risk is very difficult to quantify but is certainly present amongst the high yield bond sector compared to government bonds. This is particularly true when the investor institutional group is dominated by open-end mutual funds who may need to sell all at once when prospects become very uncertain and/or redemptions are high. This possibility was evident in recent years but the advent of securitized instruments that pool large numbers of high yield bonds into less-vulnerable-to-liquidity assets has mitigated that situation somewhat. And, as the trading and new issue environment amongst the larger investment and commercial banks have become more competitive

[2] This was caused by the gross over-reaction of the market in 1990 when prices of almost all high yield "junk" bonds suffered due to the over-discounting that took place.

since the demise of Drexel Burnham in 1990, spreads and fees have diminished as well.

The final risk component, currency fluctuations, has involved the non-U.S. investor only and is now becoming relevant for the U.S. and other non-European investors in the Euro-denominated high yield debt market. To the extent that the Euro will be a stable, major currency going forward from 1999, this risk will not be a major factor for European investors.

Returns and Volatility

Investors care not only about their realized absolute and relative asset returns, but also about how volatile those returns have been and can be in the future. One of the standard measures of investor risk is the ratio of realized return spreads vs. the associated standard deviation of return - - the so-called "Sharpe Ratio." Among the major asset classes, high yield bonds performed best by this measure over the past dozen years (Figure 3) and second best to the relatively new market for syndicated leveraged loans (the high yield bond counterpart in the bank loan market) over the period 1992-1997.

Figure 3. Returns, Standard Deviations, and Sharpe Ratios Selected Asset Categories, 1985 - 1997

	Three-Month Treasury Bill	Ten-Year Treasuries	Mortgage-Backed	High Grade Corporate	High Yield Bonds	S&P 500 Stock
Mean Monthly Return (%)	0.50	0.83	0.83	0.89	1.02	1.48
Standard Deviation	0.15	1.32	2.25	1.55	1.50	4.21
Sharpe Ratio1	N/A	0.25	0.15	0.25	0.34	0.23

1 Total return minus Return on 91-Day Treasury Bill/standard Deviation of total Return

Source: Standard & Poor's, Salomon Smith Barney Inc.

One important caveat that must be made when citing the Sharpe Ratio, or any other measure that uses a mean-variance approach, is the assumption of a symmetric return distribution with known properties surrounding the various moments of distribution. For high yield bonds, just like all credit assets, we know that the long-term distribution of returns is not normal since the investor has limited upside potential and can only achieve the promised return, or slightly higher if the issue is called at a premium or the credit quality level migrates upward. And, the early redemption of an issue for those investors who trade high yield securities, as opposed to the buy and hold investor, further limits the upside potential. But, the possible loss is great in case of default that is accompanied by a low or negligible default recovery. In fact, default recoveries average about 40% of face value (see Figure 2 and our discussion on defaults at a later point). In summary, high yield bonds have performed extremely well over the past two decades, although this class of assets' superiority, on a risk-adjusted basis, is probably overstated due to the bias discussed above.

Within the non-investment grade sector, the expected positive relationship between risk and return manifests, with Double-B's having the lowest return (slightly over 12%) followed by single-B's and the highest absolute returns for triple-C's. These are long-term relationships and do not manifest every year. Sharpe ratios, however, indicate the reverse, with double-B bonds the leader by far and single-B and triple-B

(the lowest of the investment grade classes) tied for second place, and triple-C's trailing.

Correlation of Returns with Other Asset Classes

Investors who participate in a number of asset groups will be concerned with how each classes' returns correlate with all others - - actual or potential. High yield bonds tend to have average correlations, i.e., in the .40 to .55 range, with most other major asset classes (Figure 4).

Figure 4. Correlation of Monthly Returns Selected Asset Categories, 1985 - 1997

	High Yield	Mortgage-Backed	10-Year Treasuries	3-Month Treasuries	S&P Stocks	NASDAQ Stocks	High Grade Corporate
High Yield	1.000						
Mortgage-Backed	0.460	1.000					
Ten-Year Treasuries	0.426	0.889	1.000				
Three-Month Treasuries	-0.004	0.350	0.301	1.000			
S&P 500 Stocks	0.526	0.318	0.361	0.040	1.000		
NASDAQ Stocks	0.551	0.187	0.213	-0.048	0.863	1.000	
High Grade Corporate	0.550	0.911	0.953	0.275	0.413	0.275	1.000

Sources: National Association of Securities Dealers, Standard & Poor's, Salomon Smith Barney Inc.

The long-run performance of high yield bonds has provided superior returns and reasonable diversification attributes - - especially with their relatively medium correlations with low default risk bonds and only slightly higher correlations with common stocks. The latter might surprise casual observers since high yield bonds have a reputation of being quasi-equities. Indeed, this is true, but only for the most risky of the high yield sectors — low single-B's and triple-C's.

Traditional Measures of Default Rates and Losses

Accurate measurement of default risk is, of course, critical to the task of determining the required risk premiums on bonds of different credit quality and evaluating the returns on those securities. The traditional method that I have followed to measure annual default rates is based on comparing the dollar amount of all issues defaulting in a given year divided by the dollar value of all bonds outstanding as of some point during the year. For any given category of bonds, the annual default rates are then aggregated over some longer time horizon to provide an estimate of the average yearly rate of default.

Historical Default Rates

Appendix C shows the average annual default rate, calculated using the method described above, for below investment-grade debt for the period 1971-1998 (first half). Weighted average default rates for various periods are shown below (Figure 5). Note that the weighted average default rate was 3.31% over the entire 28-year period (1971-1997) and the arithmetic (unweighted) average annual rate is 2.61%. The last six years' (1992-1997) weighted average annual rate is 1.61%. The median rate for the entire sample period is 1.50% per year.

The standard deviation of our annual default rate series was about 3.0%, which translates into about a 2.5% probability of observing an annual default rate above 9.3% - - two standard deviations above the mean. Indeed, we have observed that the default rate was above 9.3% on two occasions out of the 29 years in our time series. Those two outlier years were 1990 and 1991, when the combination of highly leveraged corporate restructurings of the late 1980's, that were financed with excessive levels of debt, and a business recession with a poorly performing stock market caused this massive increase in defaults. And, as noted earlier, the second of these years (1991) was accompanied by phenomenal returns for high yield investors due to the market over-estimation of future default rates in 1991 and beyond.

Figure 5. Average Annual Default Rates for Various Periods (1971 - 1997)

	1971 - 1997	1978 - 1997	1992 - 1997
Weighted Average	3.311%	3.343%	1.607%
Default Rate(1)	(3.048%)	3.160%)	(0.484%)
Arithmetic Average	2.613%	2.850%	1.723%
Default Rate(2)	(2.554%)	(2.660%)	(0.753%)
Median Default Rate	1.500%	1.605%	1.353%

(1)Weighted by the amount of High Yield Debt Outstanding in each year.

(2)Unweighted; Each Year has Equal Weight.

Standard Deviation in Parentheses.

Source: Appendix C.

An alternative, traditional measure of annual default rates is provided by **Moody's** trailing 12-month average rate, as indicated in **Appendix D**. This non-weighted rate for the same period averaged 3.20% per year, based on principal amount outstanding and 3.36% per year, based on percent of issuers outstanding. Hence, the results from both Moody's and our default rate methods are quite similar.

An even more relevant default statistic for most high yield bond investors is the proportion of the portfolio that is lost due to defaults. The use of default rates alone to measure losses assumes that the value of defaulting bonds is zero when the position is liquidated — usually assumed to be just after default. In reality, however, defaulted bonds sell at substantial prices just after default and even higher prices, for most seniorities, upon the resolution of the restructuring process (usually upon emergence from the Chapter 11 bankruptcy reorganization). Figure 6 indicates that, for a sample of 777 defaulting bonds from 1978-1997, the average recovery rate, based on the price of the bonds just after default, was $40.55 on an equivalent face value of $100.00. Note that the recovery rate varies according to the bonds' seniority with senior secured bonds the highest at about 59 cents on the dollar, down to subordinated issues of 32 cents and discounted bonds of 21 cents. In Altman and Kishore (1996), we also have observed recovery rates by industrial sector. These recovery figures can be interpreted as the market's best guess about the eventual recovery, discounted back to the default date. A study by Altman and Eberhart (1994) concluded that the market probably has underestimated recoveries on senior secured and senior unsecured issues and has overestimated recoveries on the more junior seniorities, i.e., higher seniorities perform best in the restructuring period.

Figure 6. Weighted Average Recovery Rates On Defaulted Debt By Seniority Per $100 Face Amount (1978 - 1997)

Default Year	Senior Secured		Senior Unsecured		Senior Subordinated		Subordinated		Discount and Zero Coupon		All Seniorities	
	No.	$	No.	$	No.	$	No.	$	No.	$	No.	$
1997	4	$74.90	12	$70.94	6	$31.89	1	$60.00	2	$19.00	25	$53.89
1996	4	$59.08	4	$50.11	9	$48.99	4	$44.23	3	$11.99	24	$51.91
1995	5	$44.64	9	$50.50	17	$39.01	1	$20.00	1	$17.50	33	$41.77
1994	5	$48.66	8	$51.14	5	$19.81	3	$37.04	1	$5.00	22	$39.44
1993	2	$55.75	7	$33.38	10	$51.50	9	$28.38	4	$31.75	32	$38.83
1992	15	$59.85	8	$35.61	17	$58.20	22	$49.13	5	$19.82	67	$50.03
1991	4	$44.12	69	$55.84	37	$31.91	38	$24.30	9	$27.89	157	$40.67
1990	12	$32.18	31	$29.02	38	$25.01	24	$18.83	11	$15.63	116	$24.66
1989	9	$82.69	16	$53.70	21	$19.60	30	$23.95	-	-	76	$35.97
1988	13	$67.96	19	$41.99	10	$30.70	20	$35.27	-	-	62	$43.45
1987	4	$90.68	17	$72.02	6	$56.24	4	$35.25	-	-	31	$66.63
1986	8	$48.32	11	$37.72	7	$35.20	30	$33.39	-	-	56	$36.60
1985	2	$74.25	3	$34.81	7	$36.18	15	$41.45	-	-	27	$41.78
1984	4	$53.42	1	$50.50	2	$65.88	7	$44.68	-	-	14	$50.62
1983	1	$71.00	3	$67.72	-	-	4	$41.79	-	-	8	$55.17
1982	-	-	16	$39.31	-	-	4	$32.91	-	-	20	$38.03
1981	1	$72.00	-	-	-	-	-	-	-	-	1	$72.00
1980	-	-	2	$26.71	-	-	2	$16.63	-	-	4	$21.67
1979	-	-	-	-	-	-	1	$31.00	-	-	1	$31.00
1978	-	-	1	$60.00	-	-	-	-	-	-	1	$60.00
Total/Average	93	$58.67	237	$48.87	192	$34.99	219	$31.71	36	$20.71	777	$40.55
Median		$54.59		$46.05		$31.30		$33.15		$0.00	-	$41.77
Std.Dev.		$23.00		$26.62		$24.97		$22.53		$17.64	-	$25.89

Source: Altman & Waldman, 1998.

If one adds in the lost semi-annual coupon at the time of default, the average annual default loss for the 20-year period 1978-1997 was 2.18% (weighted by the amount of high yield debt outstanding) and 1.83% per year on an unweighted basis (Figure 2). The actual annual calculation for 1997 defaults is illustrated in Figure 7.

Figure 7. 1997 DEFAULT LOSS RATE

BACKGROUND DATA	
AVERAGE DEFAULT RATE 1997	1.252%
AVERAGE PRICE AT DEFAULT (a)	54.246%
AVERAGE LOSS OF PRINCIPAL	45.754%
AVERAGE COUPON PAYMENT	11.867%
DEFAULT LOSS COMPUTATION	
DEFAULT RATE	1.252%
X LOSS OF PRINCIPAL	45.754%
DEFAULT LOSS OF PRINCIPAL	0.573%
DEFAULT RATE	1.252%
X LOSS OF 1/2 COUPON	5.933%
DEFAULT LOSS OF COUPON	0.074%
DEFAULT LOSS OF PRINCIPAL AND COUPON	0.647%

(a) If default date price is not available, end-of-month price is used. Source: Altman & Waldman, 1998.

Finally, it is important to mention that bondholders lose not only from defaults, but also in cases of financial distress that do not result in a legal default but rather in distressed exchange arrangements. Our default statistics include distressed exchanges, whereby creditors accept cash and/or securities of lower value and lower interest rates than originally promised. Of late, these distressed exchange, out-of-court arrangements are being replaced, in many cases, by so-called “prepackaged Chapter 11 bankruptcies” where the exchange takes place under the less stringent voting requirements of the U.S. Bankruptcy Code.

Promised Yield vs. Expected Default Losses: A Breakeven Analysis

We have shown that, over the last two decades, the promised yield spread on U.S. high yield bonds has averaged almost two and a half (2 1/2%) percent per annum more than the annual loss incurred from defaults. In order to better understand this relationship, the following formula and discussion illustrates a required yield on bonds in order to breakeven vs. default-risk-free Government bonds. One can then observe the actual current promised yields compared to the breakeven yield to assess the relative attractiveness of the market at any point in time.

$$BEY_t = \frac{R_f + \left[D_f (1 - R_{ec}) + D_f \left(\frac{HYC}{2}\right) \right]}{(1 - D_f)}$$

where:

BEY_t = Breakeven Yield in Period t.

R_f = Yield on Default Risk Free U.S. Treasury Bonds.

D_f = Expected (or Average Annual) Default Rate

R_{ec} = Expected (or Average Annual) Default Recovery Rate

HYC = High Yield Coupon Rate on Defaulted Bonds.

If the following conditions and investor expectations exist,

Risk Free Rate (R_f)	= 6.0%
Expected Annual Default Rate (D_f)	= 3.0%
Expected Recovery Rate on Defaults (R_{ec})	= 40.0%
Coupon Rate on Defaulting High Yield Bonds (HYC)	= 12.0%

then the resulting promised yield to maturity that would result in a breakeven situation (BEY) is 8.23%. Note that the promised yield is earned only on the proportion of the market that does not default — hence the denominator in our formula subtracts the default rate from one (1.0). If the current yield on a diversified portfolio of bonds is greater than the breakeven yield, then a positive return spread can be expected. The greater the difference between the promised yield and the breakeven rate, the higher one can expect the return to be. This analysis assumes no change in interest rates over the relevant horizon. As of September 1, 1998, the promised yield to maturity on high yield debt was 11.02% and the 10-year risk free rate was 5.04% (an enormous spread of almost six percent). Assuming the historic average default (3.3%) and recovery (40.0%) rates as reasonable expectations, the breakeven yield calculates at 7.47% and the differential between the promised and breakeven yield equaled 3.55%. This implies a strong positive indication for subsequent high yield returns.

In Altman and Bencivenga (1995), we examined the statistical relationship between the current minus the breakeven rates and the subsequent six and twelve-month

realized returns on high yield bonds, as well as BBB, BB, and B rated bonds, and the results were positive and significant. The formula can also be used to "back-out" the implied default rate that the market consensus is expecting by solving for the default rate that results in the current yield equaling the breakeven rate. As of September 1, 1998, that rate was . An alternative way to look at the differential between the breakeven yield spread and current yield spread is the yield premium that investors require for liquidity risk and also the fact that they could be wrong about their expectations of default and recovery rates. The latter considerations known as the unexpected loss, is a common and relevant consideration in bank lending models

Defaults On High Yield Bonds Rise in First-Half Of 1998 — Still Below Average

The long anticipated rise in default rates and losses in the high yield corporate bond market appears to have started in the first-half of 1998. Defaults and distressed exchanges in the straight (non-convertible), non-investment grade U.S. bond market were $3.7 billion in the first six months of 1998 compared to $2.4 billion in the first six months of 1997 and $4.2 billion for the entire 1997. The number of defaulting issues and issuers also rose to 26 and 19 respectively, compared to 12 and 8 respectively in the first six months of 1997, almost equaling the totals of 29 and 21 for all of last year. In addition, the amount of Eurobond issue defaults (not included in our default rate calculation), swelled dramatically, with the Asian market (e.g., Indonesia, Korea) contributing the vast majority of non-U.S. defaulting issues. Moody's default rates do include international defaults that are rated by that agency. Incidentally, it is extremely difficult to estimate expected default losses in emerging markets due to the lack of historical data, lack of ratings, and particularly highly uncertain restructuring and bankruptcy processes.

Our traditional default rate calculation, measured by the face value of defaults divided into the population of high yield bonds as of the start of 1998, was 0.99% (Figures **Error! Reference source not found.**) compared to 0.83% for the first six months of 1997 and 1.25% for the entire past year. The increase in the first-half default rate occurred despite a significant increase in the base population to $379 billion.

Simple extrapolation of the first half default rate experience would yield a default rate of about 2% for all of 1998. Despite this considerable increase from last year, and from the average for the last five years as well, the rate of default of high yield bonds will still be far below the 1971-1997 long-term weighted average of 3.3%. Not surprisingly, default losses also increased significantly in 1998, as the default rate climbed and the recovery rate dipped considerably. The weighted (by face value) average recovery rate, as measured by the price just after default (or the distressed exchange basis), fell from last year's 54.2% to the 1998 first half level of 38.9%. The resulting default loss, which includes the loss of a semi-annual coupon payment was 0.65% (65 basis points). This loss was approximately equal to the loss for the entire year 1997. If we extrapolate the loss from defaults for the entire year 1998, the result (1.3%) is still below the historical average of 2.2%.

We have often observed an inverse relationship between the change in default rates and the change in recovery rates. More careful analysis of this phenomenon is in the works.

New Issue Bias

We are certainly aware that a booming new issue high yield bond market will bias downward our traditional annual default rate calculation since the denominator is the face value outstanding of the market at the start of the calculation period. In 1997, almost $120 billion of publicly registered and 144a high yield bonds were issued and the base population increased by over $44 billion (net of redemption and rating changes) to $379 billion (the population has increased to over $475 at the end of the first half of 1998). Thus, our 1997 and 1998 default rate and loss calculations will be downward biased since these new issues, with rare exception, do not default within the first year. This short-term bias motivated us, in part, to create the mortality rate approach (see below) which is sensitive to the aging effect.

The Mortality/Aging Approach

Although the traditional method for assessing default rates and losses has considerable relevance for measuring bond performance, it also has potential biases. Because of such biases, the most recent default history — while immensely useful to portfolio managers and other investment officers in projecting near-term expected losses and setting aside adequate reserves to cover such losses — may turn out to have been an unreliable basis for assessing longer-term losses.

Why is that so? First of all, as with all historical studies, it could be suggested that the near-term future is not likely to repeat the average or near-term past. Both the numerator (that is, the amount of annual defaults) and the denominator (the amount of bonds outstanding) in the default rate ratio will surely change in the future. And, if the amount of high yield bonds outstanding fails to increase as it has in the past (or even falls, as it did in 1992 and 1993), while the amount of defaults continues to grow, then default rates and investor losses will rise above the historical levels reported using the traditional approach.

We have also argued, however, that the opposite could take place. That is, as new issues rise from depressed levels and as defaults arising from past excesses are purged from the market, default rates in certain years, e.g., 1990 and 1991, measured traditionally, are likely to be overestimates of the future rates owing to this same bias.

A related criticism of the traditional method for calculating default rates is its failure to consider the possibility that the likelihood of default actually changes with the age of the bond. In putting all junk bonds outstanding at a given point in time in the same basket, the average annual method effectively assumes that the probability of default for a newly-issued bond of a certain rating is identical with that of a bond of that same rating that has been outstanding for, say, five years. But if it is true that the probability of default rises with age — especially in the case of junk bonds where the better firms often call-in the bonds after 3-5 years — then default rates on newly-issued bonds should rise after a few years.

Briefly stated, the basic contention is this: because of the rapid growth of the junk bond market during the 1980s, and again in the mid to late 1990s, use of the traditional methods for measuring defaults could blind investors to the reality that effective default rates could rise well above current reported levels.

While the aging argument has some intuitive appeal, the more important reason for the considerable rise in default rates in 1990 and 1991 was the debt excesses of 1987-1989 caused by the incredibly high premiums paid for corporate restructures, e.g., LBOs. Combined with declining asset sales and values and the lack of refinancing alternatives, the highly leveraged, e.g., debt to equity ratios of 6:1 and above, corporate restructurings disappeared after 1989 and defaulting LBOs became increasingly more common. While LBOs have reappeared in the mid-to-late 1990's, the proportion of equity in the restructured firms' capital structure has been considerably higher — about 30% — leading to more prudent leverage and a better chance that the high debt amounts will be successfully refinanced, if necessary, or paid down.

A final point on this aging effect question reminds us that when a firm issues new bonds, the significant inflow of cash is usually sufficient to make several coupon payments, regardless of the operating performance of the company. It is only after 2-3 years of dismal performance can we expect defaults to occur with any regularity for a particular rating class of bonds. Of course, if the cash is used entirely to refinance an existing debt outstanding, then excess cash for future interest payments would not be available.

Mortality Rates and Losses

The joint queries on a bond's aging effect and the search for default rates on specific rating classes, e.g., BB, B, etc., lead us to develop the mortality approach for default rate measurement. Simply put, mortality rates on corporate bonds is an actuarially-based technique that adjusts for changes over time in the size of the original sample of newly-issued bonds, of a given bond rating, due to defaults, calls and scheduled redemptions. For example, if there are $10 billion of single-B bonds issued in 1996 and $200 million default in 1997, the marginal one-year rate is 2.0%; and if $300 million of the same 1996 cohort defaults in 1998, the second year mortality rate is higher 3.06%, based on the $300 million defaulting on a remaining base of $9.8 billion. The cumulative two-year rate, based on the formula (below) would be $5.00%. The specific calculation for marginal mortality rates (MMR) and cumulative mortality rates (CMR) are:

$$MMR_t = \frac{Dollar\,(or\ Issuer\ Number)\,of\ Bonds\,Defaulting\,in\,Period\,t}{Dollar\,(or\ Issuer\ Number)\,of\ Bonds\,at\,Start\,of\ Period\,t}$$

and

$$CMR_t = 1 - [\Pi\, SR_t]$$

where:

SR_t = Survival rate in Period t = 1 - MMR_t.

It should be made explicitly clear that we are measuring the marginal and cumulative mortality rates for bonds with specific original ratings over the relevant time periods after issuance. As such, we can assess the aging effect. While this method is consistent with actuarial theory, it is different from the cohort (Moody's) and static pool (S&P) approaches utilized by the rating agencies for estimating bond defaults.[3]

Our total defaulted population that had a rating upon issuance and a price at default now numbers over 650. Using the mortality methodology, we update results each year. Mortality rates and losses from 1971-1997 are reported in **Figures** Error! Reference source not found. **and** Error! Reference source not found.. One can observe a number of important statistics from these tables. First, default rates can be assessed for all rating classes, not just the high yield bond groups. As expected, the rates for investment grade bonds are quite low, although not zero. Indeed, even AAA bonds are observed to default and when Texaco's AA bonds defaulted in 1987, the AA rate actually jumped above the A rate.[4]

Note that the five- and ten-year rates for our high yield bond groups, as shown below in Figure 8, seem to be high, but when you factor in their high promised yields, the result is consistent with our earlier discussion of returns net of defaults. For example, the five-year single-B cumulative mortality rate is 21.95%, or about 4.0% per year. This rate is quite similar to the 3.3% annual default rate for all high yield bonds measured using the traditional approach. The corresponding cumulative mortality loss rate is 16.1%, or about 3.0% per year. If one considers an average annual yield

[3] These approaches measure the proportion of issuers that default from different bond rating classes as of some initial date, regardless of the age of the bond. For example, all Ba bond issuers as of January 1, 1996 are observed as to their default frequency in subsequent periods. See Moody's (1998) and S&P (1998) for details and results. The three approaches for measuring corporate bond defaults, as well as rating migration patterns, are discussed and contrasted in Altman, Caouette and Narayanan (1998).

[4] Due to Texaco's high recovery rate, however, the mortality loss rate for AA bonds in Appendix E is lower than the single-A rate -- as it should be.

spread of about 5.0% per year on single-B bonds, the attractiveness of these low-rated issues becomes clearer.

Figure 8.

	Cumulative Default Rates			Cumulative Default Losses		
Rating	One-Year	Five-Year	Ten-Year	One-Year	Five-Year	Ten-Year
BBB	0.03%	1.64%	2.80%	0.02%	0.53%	1.62%
BB	0.37%	8.32%	16.37%	0.24%	5.61%	10.33%
B	1.47%	21.95%	33.01%	0.85%	16.07%	23.74%

Source: Figures **Error! Reference source not found.** and **Error! Reference source not found.** and Altman and Waldman (annually).

In summary, the mortality rate and loss results provide the analyst with a conceptually correct method for assessing the expected default probability of a given new corporate bond issue and these

probabilities are linked with the aging of the bond. **We believe that mortality rates on U.S. bonds can be used in markets outside the U.S. (e.g., Europe) for assessing default rates where the market is too new to provide its own statistics.**

With respect to the aging effect, one can observe that the marginal (yearly) rates for high yield, non-investment grade bonds does have a pronounced increasing default rate from original issuance up to the third year, after which the marginal rates tend to level off. For example, the BB marginal rates are 0.37%, 0.72% and 2.94% for years 1-3 and single-B's are 1.47%, 3.76% and 6.89% respectively. These increasing marginal rates are consistent with the theories put forth earlier.

Cumulative default data from our mortality rate calculations, as well as similar statistics from the rating agencies, are increasingly being used by market analysts and the agencies themselves in evaluating individual and securitized portfolio pools of high yield debt. And, in a recent study (Altman & Waldman, 1998), the mortality methodology was applied to syndicated leveraged bank loans with results that were similar to bonds for the 1991-1996 period.

Growth in Market Size

The last two years (1996-1997) have seen unprecedented growth in new issuance and size of the U.S. high yield bond market. New bonds, which include public registered and 144a issues with

registration rights, totalled $66 billion and $119 billion in 1996, 1997 (Figure 9) and the 1998 amount was running far ahead of 1997 totals until the flight to quality reaction to global stock market and Russian economy problems in late August. We estimate that the size of the U.S. domestic market was about $380 billion at the end of 1997 and is now (September 1998) over $500 billion. Note the dramatic increase in 144a issues as firms find it more convenient to tap the capital markets on a timely basis and then follow soon after with the registration materials. In essence, publicly registered and 144a's with registration rights are identical in their risk-return and credit quality characteristics.

Figure 9. New Issue Volume - High Yield Bonds 1977-1997

	Publi		144		Total	
Year	Number of Issues	Principal Amount ($ Millions)	Number of Issues	Principal Amount ($ Millions)	Number of Issues	Principal Amount ($ Millions)
1977	61	$1,040.2			61	$1,040.2
1978	82	1,578.5			82	1,578.5
1979	56	1,399.8			56	1,399.8
1980	45	1,429.3			45	1,429.3
1981	34	1,536.3			34	1,536.3
1982	52	2,691.5			52	2,691.5
1983	95	7,765.2			95	7,765.2
1984	131	15,238.9			131	15,238.9
1985	175	15,684.8			175	15,684.8
1986	226	33,261.8			226	33,261.8
1987	190	30,522.2			190	30,522.2
1988	160	31,095.2			160	31,095.2
1989	130	28,753.2			130	28,753.2
1990	10	1,397.0			10	1,397.0
1991	48	9,967.0			48	9,967.0
1992	245	39,755.2	29	$3,810.8	274	45,566.0
1993	341	57,163.7	95	15,096.8	436	72,260.5
1994	191	34,598.8	81	7,733.5	272	42,332.3
1995	152	30,139.1	94	14,242.0	246	44,381.1
1996	142	30,739.4	217	35,172.9	359	65,912.3
1997	103	19,822.0	576	98,885.0	679	118,707.0
Total	2,669	395,579.	11,092	174,941.0	3,761	570.520.1

Note: Includes non-convertible, corporate debt rated below investment grade by Moody's or Standard & Poor's. Excludes mortgage- and asset-backed issues, as well as non-144a private placements. Source: Securities Data Company

Some Trends in U.S. High Yield Debt Issuance

The following appear to be recent trends that will help to shape the future risk and return profile of high yield bonds in the U.S.:

- Dramatic increase in 144a issues making it easier and quicker for new issues to be brought to and sold in the market.
- Senior priority debt in the 1990's becoming the dominant seniority with 60-70% of new issuance either senior secured or senior unsecured. This probably means higher than average recovery rates after default, but recoveries are still driven mainly by economic prospects.
- A slight increase in the proportion of high yield bonds issued at very low quality, i.e., B- or below. In 1997, over 25% of new issuance came to market at these low ratings. This is an additional factor indicating an increase in default rates, probably commencing in 1998.
- Large increase in securitizations (CBOs) providing much greater liquidity for high yield investors and permitting additional groups of non-traditional investors

to participate in the market. In addition, we observe some special purpose vehicles formed with both bonds and leveraged loans in the collateral pool.

High Yield Activity in Europe: The Time Has Come

The high yield, non-investment grade bond market in Europe began quietly in 1995. In 1997, about $6 billion of new issues came to market, mostly denominated in U.S. dollars (**Figure 10**), and the growth in 1998 has continued to be impressive. The first Euro denominated bond issue came to market in March 1998.[5] This market will probably grow considerably with the large number of corporations in Europe and elsewhere lacking the size and earnings predictability to obtain investment grade ratings. The benefits of long-term, fixed rate debt, denominated in the new and probably stable Euro, is an enticing market for these firms.

Among the reasons why European companies can be expected to tap this new source of capital are that it provides (1) a means to restructure firms that are overloaded with less flexible, more constraining bank loans by substituting fixed interest capital market bonds; (2) a long-term source of capital for investment — asset growth; and (3) a growing number of firms' independence from the central bank regulated financial institutions or to free-up borrowing capacity in the future from these same institutions. Indeed, Gilson and Warner (1998) argued that flexibility benefits have been the principal driver of high yield bond issues by public companies in the United States for the last two decades.

Combined with the demonstrated attractive promised yield and realized return spreads, discussed earlier, and a growing comfort level for investors in this new market, these supply and demand factors bode well for dynamic market growth in high yield, fixed-rate, Euro-denominated bonds.

The demand side of the equation needs to be convinced of the attractive risk-return trade-off.

In addition, a clearer and possibly integrated set of bankruptcy laws and creditor priorities in Europe would help in cross-border investments. Demand coming from the United States and other non-European countries will help to fuel this new market. Finally, it would appear that the European Union could help to reduce the likelihood of any individual nation's establishing, or continuing, impediments to the corporate bond market's growth. For example, nations will likely be less reliant on their local institutions and individuals financing the country's public debt and therefore less inclined to discourage alternative investment vehicles for those investors.

[5] Cellular Communications International, a U.S. based holding company with ventures in several European companies, issued a 235 million eurobond and it was speculated (**High Yield Report**, March 16, 1998) that the Euro will become as popular as sterling or deutschemarks in the high yield market.

Near Term Opportunities and Risks

Europe had been mired in a prolonged recession in the early and mid-1990's and now seems poised to enjoy a sharp economic recovery. Inflation is historically extremely low and interest rates and unemployment are dropping. The merging of 11 countries' currencies will lead to trade and exchange efficiencies and make cross border investments a painless and less costly transaction. The combination of corporate profit and cash flow growth of over 20% in 1997 and increasing restructuring opportunities, including the substitution of less stringent capital market bonds for bank debt, bode well for the high yield market's growth.

On the negative side, is the very recent wholesale flight to quality as conditions in Russia became chaotic and the Asian crisis continues to sap the optimism of investors worldwide. Europe, despite its economic strengths, cannot avoid these parallel problems. And, if the Asian crisis tips the scales toward a slow down in the United States, Europe's economic growth will be negatively impacted and its markets, including high yield bonds, will suffer and its growth muted.

Since high yield debt and equity markets typically suffer when markets become more credit quality conscious, the near term outlook is consequently uncertain.

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Appendix A. Compound Average Annual Returns Of High Yield Bonds (%)'1978-1996

BASE PERIOD (JAN 1)	TERMINAL PERIOD (DECEMBER 31)																			
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1978	7.5	5.6	3.3	4.3	9.4	11.4	11.0	12.4	12.8	11.9	12.1	11.1	9.90	11.5	11.9	12.2	11.4	11.8	11.8	11.8
1979		3.6	1.3	3.3	9.9	12.2	11.6	13.1	13.4	12.4	12.5	11.5	10.1	11.8	12.2	12.5	11.6	12.1	12.0	12.1
1980			(1.0)	3.1	12.1	14.4	13.2	14.7	14.9	13.6	13.5	12.3	10.7	12.5	12.9	13.2	12.2	12.6	12.5	12.6
1981				7.5	19.3	20.1	17.1	18.1	17.8	15.8	15.5	13.9	11.9	13.8	14.1	14.4	13.2	13.6	13.5	13.4
1982					32.4	27.0	20.5	21.0	20.0	17.3	16.7	14.7	12.4	14.4	14.8	15.0	13.6	14.1	13.9	13.8
1983						21.8	14.9	17.4	17.0	14.4	14.3	12.4	10.1	12.6	11.9	13.5	12.2	12.8	12.6	12.6
1984							8.5	15.2	15.5	12.7	12.8	10.9	8.6	11.5	10.9	12.7	11.4	12.0	12.0	12.0
1985								22.5	19.2	14.1	14.0	11.4	8.6	11.9	12.7	13.2	11.7	12.4	12.3	12.3
1986									16.0	10.2	11.3	8.8	6.0	10.3	11.4	12.1	10.5	11.4	11.4	11.5
1987										4.6	8.9	6.4	3.6	9.2	10.6	11.5	9.8	10.9	10.9	11.1
1988											13.4	7.3	3.3	10.3	11.8	12.7	10.6	11.7	11.6	11.8
1989												1.6	(1.4)	9.3	11.5	12.6	10.1	11.5	11.4	11.6
1990													(4.3)	13.4	15.0	15.5	11.9	13.2	12.9	12.9
1991														34.5	26.1	23.0	16.4	17.1	16.1	15.6
1992															18.1	17.6	11.0	13.1	12.7	12.7
1993																17.1	7.6	11.5	11.4	11.7
1994																	(1.1)	8.8	9.5	10.3
1995																		19.9	15.4	14.5
1996																			11.0	11.9
1997																				12.8

Source: Merrill Lynch High Yield Master Index; Edward I. Altman, New York University Salomon Center

Appendix B. Compound Annual Return Spreads Between 'High Yield And Lt Government Bonds (%)1978-1996

BASE PERIOD (JAN 1)	TERMINAL PERIOD (DECEMBER 31)																			
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1978	8.6	6.6	5.0	5.5	3.1	5.8	4.1	2.7	1.5	2.2	2.4	0.9	(0.0)	1.0	1.7	1.9	2.3	2.0	2.5	2.4
1979		4.5	3.2	4.4	1.7	5.2	3.3	1.7	0.6	1.4	1.7	0.2	(0.8)	0.4	1.2	1.4	1.8	1.5	2.1	2.1
1980			1.9	4.4	0.6	5.3	3.0	1.2	(0.0)	1.0	1.3	(0.2)	(1.3)	0.0	0.9	1.2	1.6	1.3	1.9	1.9
1981				7.0	(0.1)	6.7	3.3	1.0	(0.4)	0.8	1.2	(0.5)	(1.7)	(0.1)	0.8	1.1	1.6	1.3	1.9	1.9
1982					(9.6)	6.4	1.9	(0.6)	(2.1)	(0.3)	0.3	(1.6)	(2.8)	(0.9)	0.2	0.6	1.2	0.8	1.6	1.6
1983						19.5	6.6	1.8	(0.5)	1.2	1.7	(0.6)	(2.1)	(0.1)	(0.2)	1.3	1.9	1.5	2.2	2.2
1984							(6.3)	(7.6)	(7.7)	(3.4)	(1.8)	(4.0)	(5.1)	(2.6)	(2.3)	(0.4)	0.3	0.0	0.9	0.9
1985								(9.0)	(8.5)	(2.5)	(0.7)	(3.6)	(5.0)	(2.1)	(0.3)	0.2	1.0	0.6	1.5	1.5
1986									(7.9)	0.3	1.6	(2.4)	(4.3)	(1.1)	0.6	1.2	1.9	1.4	2.3	2.3
1987										7.3	5.8	(0.7)	(3.4)	0.1	2.0	2.4	3.1	2.4	3.3	3.1
1988											4.2	(5.1)	(7.3)	(1.8)	0.8	1.5	2.4	1.7	2.8	2.7
1989													(12.7	(3.8)	(0.0)	0.9	2.1	1.4	2.6	2.5
1990													(11.2	1.5	4.9	4.9	5.4	4.0	5.1	4.7
1991														17.4	14.3	11.2	10.0	7.5	8.1	7.2
1992															11.6	8.4	7.9	5.3	6.5	5.7
1993																5.1	6.2	3.2	5.2	4.5
1994																	7.1	2.4	5.3	4.4
1995																		(3.6)	4.2	3.3
1996																			11.0	6.4
1997																				1.6

Source: Merrill Lynch High Yield Master Index; Edward I. Altman, New York University Salomon Center and Altman & Waldman, 1998.

Appendix C. Historical Default Rates - Straight Bonds Only Excluding Defaulted Issues from Par Value Outstanding 1972 - Q2 1998 ($ Millions)

Year	Par Value Outstanding	Par Value Defaults	Default Rates
Q1-Q21998	$379,000	$3,739	0.987%
1997	335,400	4,200	1.252%
1996	271,000	3,336	1.231%
1995	240,000	4,551	1.896%
1994	235,000	3,418	1.454%
1993	206,907	2,287	1.105%
1992	163,000	5,545	3.402%
1991	183,600	18,862	10.273%
1990	181,000	18,354	10.140%
1989	189,258	8,110	4.285%
1988	148,187	3,944	2.662%
1987	129,557	7,486	5.778%
1986	90,243	3,156	3.497%
1985	58,088	992	1.708%
1984	40,939	344	0.840%
1983	27,492	301	1.095%
1982	18,109	577	3.186%
1981	17,115	27	0.158%
1980	14,935	224	1.500%
1979	10,356	20	0.193%
1978	8,946	119	1.330%
1977	8,157	381	4.671%
1976	7,735	30	0.388%
1975	7,471	204	2.731%
1974	10,894	123	1.129%
1973	7,824	49	0.626%
1972	6,928	193	2.786%
1971	6,602	82	1.242%

Average Annual Default Rates for various periods are given in Figure 5.

Source: Altman and Waldman (July 1998).

Appendix D. Moody's Default Rate Calucualtion (1971-1997)

Year	Percentage of Principal Amount Outstanding	Percentage of Issuers
1971	1.83%	1.64%
1972	3.97%	3.73%
1973	2.63%	2.26%
1974	3.01%	1.40%
1975	3.40%	2.27%
1976	1.44%	1.37%
1977	5.21%	2.33%
1978	2.15%	1.84%
1979	0.31%	0.42%
1980	1.98%	1.53%
1981	0.78%	0.67%
1982	5.55%	4.27%
1983	1.75%	4.04%
1984	1.79%	4.08%
1985	2.42%	4.38%
1986	1.64%	6.46%
1987	1.22%	4.01%
1988	3.22%	3.57%
1989	6.97%	6.60%
1990	10.96%	8.83%
1991	9.77%	9.65%
1992	3.90%	3.94%
1993	1.31%	3.06%
1994	1.04%	1.67%
1995	3.59%	3.17%
1996	1.61%	1.61%
1997	2.84%	1.81%
Arithmetic Average	**3.20%**	**3.36%**

Source: Moody's Investor Service 1998

Appendix E. MORTALITY RATES BY ORIGINAL RATING - ALL RATED CORPORATE BONDS*(1971 - 1997)

Years After Issuance

		1	2	3	4	5	6	7	8	9	10
AAA	Yearly	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative	0.00%	0.00%	0.00%	0.00%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%
AA	Yearly	0.00%	0.00%	0.43%	0.24%	0.00%	0.00%	0.01%	0.00%	0.04%	0.03%
	Cumulative	0.00%	0.00%	0.43%	0.67%	0.67%	0.67%	0.67%	0.67%	0.71%	0.74%
A	Yearly	0.00%	0.00%	0.04%	0.12%	0.06%	0.13%	0.06%	0.15%	0.10%	0.00%
	Cumulative	0.00%	0.00%	0.04%	0.15%	0.22%	0.34%	0.40%	0.54%	0.64%	0.64%
BBB	Yearly	0.03%	0.29%	0.36%	0.67%	0.31%	0.45%	0.19%	0.09%	0.08%	0.37%
	Cumulative	0.03%	0.31%	0.67%	1.34%	1.64%	2.09%	2.27%	2.36%	2.43%	2.80%
BB	Yearly	0.37%	0.72%	2.94%	1.94%	2.63%	1.09%	2.65%	0.26%	1.69%	3.39%
	Cumulative	0.37%	1.08%	3.99%	5.85%	8.32%	9.32%	11.72%	11.95%	13.44%	16.37%
B	Yearly	1.47%	3.76%	6.89%	6.05%	5.89%	5.95%	4.12%	1.88%	1.72%	1.30%
	Cumulative	1.47%	5.18%	11.72%	17.06%	21.95%	26.59%	29.62%	30.94%	32.13%	33.01%
CCC	Yearly	2.28%	13.56%	13.25%	9.19%	2.96%	9.69%	1.00%	5.50%	0.00%	3.71%
	Cumulative	2.28%	15.53%	26.72%	33.46%	35.42%	41.68%	42.27%	45.44%	45.44%	47.46%

*Rated by S & P at Issuance

Based on 647 issues Source: Altman & Waldman, 1998.

Appendix F. Mortality Losses By Original Rating - All Rated Corporate Bonds*(1971 - 1997) Years After Issuance

		1	2	3	4	5	6	7	8	9	10
AAA	Yearly	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
AA	Yearly	0.00%	0.00%	0.09%	0.09%	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%
	Cumulative	0.00%	0.00%	0.09%	0.17%	0.17%	0.17%	0.18%	0.18%	0.20%	0.22%
A	Yearly	0.00%	0.00%	0.02%	0.07%	0.05%	0.09%	0.02%	0.08%	0.05%	0.00%
	Cumulative	0.00%	0.00%	0.02%	0.10%	0.14%	0.24%	0.26%	0.34%	0.40%	0.40%
BBB	Yearly	0.02%	0.17%	0.19%	0.35%	0.10%	0.26%	0.17%	0.06%	0.05%	0.26%
	Cumulative	0.02%	0.19%	0.39%	0.74%	0.83%	1.09%	1.26%	1.31%	1.36%	1.62%
BB	Yearly	0.24%	0.45%	2.23%	1.47%	1.34%	0.84%	1.40%	0.16%	0.94%	1.75%
	Cumulative	0.24%	0.69%	2.90%	4.33%	5.61%	6.41%	7.72%	7.86%	8.73%	10.33%
B	Yearly	0.85%	2.48%	5.36%	4.17%	4.29%	3.77%	2.55%	1.39%	0.91%	0.84%
	Cumulative	0.85%	3.31%	8.49%	12.31%	16.07%	19.24%	21.30%	22.39%	23.10%	23.74%
CCC	Yearly	1.15%	11.06%	9.76%	5.54%	1.85%	6.67%	0.90%	4.36%	0.00%	3.09%
	Cumulative	1.15%	12.08%	20.66%	25.05%	26.44%	31.34%	31.96%	34.93%	34.93%	36.94%

*Rated by S & P at Issuance

Based on 647 issues Source: Altman & Waldman, 1998.

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Author(s) Name: **No(s):**

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