Is Default Risk Negatively Related to Stock Returns?

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Default Risk and Returns: Theory

Theory suggests positive risk-premium for bearing default-risk:

- Distressed firms fail together and their risk cannot be diversified away.
- Standard implementation of a model like CAPM might fail to capture this risk-premium if default risk is correlated with decline in unmeasured components of wealth such as human capital (Fama and French (1996)) or debt securities (Shockley and Ferguson (2003)).
- If corporate failures are correlated with deteriorating investment opportunities (Merton (1973)).

Default Risk and Returns: Evidence

- Negative relation documented between realized returns and proxies for default risk in the post-1980 period.
- Campbell, Hilscher and Szilagyi (2007) and Dichev (1998). Contributions by Lemmon and Griffin (2002) and Avramov, Chordia, Jostova and Philipov (2007), and others.
- The economic magnitude of under-performance is large – in the range of 10-20% alpha per year in Campbell, Hilscher and Szilagyi (2007).

What Does the Evidence Mean?

- Investors of high default-risk stocks did not demand positive risk-premium, rather they paid for bearing this risk - inefficient markets?
- Investors not fully appreciating/knowing default risk?
- Presence of some other hidden frictions or limits to arbitrage?
- Just a bad draw for distress-risk investors in the post-1980 period?

Our Argument

- The key issue, from the asset pricing perspective, is whether the relation between default-risk and *expected stock return* is positive or not.
- Did investors sufficiently discount the future cash-flows of distressed firms to reflect their desired risk-premium or not?
- Or, to begin with did they expect to earn negative risk-premium on these stocks as suggested by the evidence from realized returns.
- If the answer is latter, then we need to focus more on investor-preferences and/or market frictions to understand this evidence.
- If not, then we need to focus more on why was the realized returns not consistent with the expectations in the post-1980 period?

Expected vs. Realized Returns

- Issues with realized return as a poor proxy for expected return has been noted for a long time (Elton (1999)).
- Realized return can be expressed as the sum of (a) expected returns, (b) information surprises, and (c) some random noise.
- The hope is that information surprises will cancel out in large samples. If not, then realized return can be a very poor proxy of expected returns.
- Grouping of stocks in portfolios might not always solve this problem in small samples - if information surprises affect all stocks in the group in similar ways.

Issues with Realized Returns

- Merton (1980): Shows that estimating expected return in small samples is a challenging task.
- Lundblad (2007): Shows that it is possible to find negative risk-return tradeoff even though the true risk-return tradeoff is positive. Especially true when the volatility of the underlying data generating process is high.
- Given these observations, one solution is to focus our attention on expectations directly. Second solution is to look for the evidence from out-of-sample and/or longer sample periods.
- Pastor, Sinha, and Swaminathan (2007): Advocate the use of implied cost of capital (ICC) using analysts estimates and provide some theoretical underpinnings for this measure.

High Default Risk Portfolio

- By construction, the average stock in high default risk portfolio is more likely to default and lose almost 100% in value.
- The positive return for the portfolio, therefore, must come from a few big winners. Intuitively this is a highly volatile strategy, which is empirically confirmed in the data.
- In annual re-balancing, the large positive returns must come from some of the high performers within a year of portfolio formation itself - further exacerbates the volatility of the portfolio.
- Information surprises might affect all marginal firms of the economy in similar ways.
- In nutshell, the use of realized return is even more problematic for high-default risk portfolios as compared to market level regressions.

Our Analysis

- We extend data back to 1950s to understand the out-of sample validity of default-risk anomaly using realized returns.
  - no reliable evidence of under-performance in pre-1980 period.
- We use *implied cost of capital* estimated from analysts forecasts as a proxy for expected return to test the risk-return trade-off.
  - we find a significant and positive relation between default-risk and expected returns. Investors did discount future earnings at a much higher rate.
- In the post-1980 period, much of the under-performance in realized returns is concentrated in the decade of 1980. No under-performance if we exclude this decade.

Hazard Models

Shumway (2001), Chava and Jarrow (2004), Campbell et. al. (2007)

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{Pr(t \leq T < t + \Delta t \mid T > t)}{\Delta t}$$

$$L(\beta) = \prod_{i=1}^{N} L(\beta \,|\, T_i, N_i, X_i),$$

- Maximum likelihood estimates of default-likelihood using actual bankruptcy data.
- Conditional of survival, estimates the probability of default in the next period as a function of firm-level covariates.
- Requires data on corporate defaults to estimate the model. Taken from Chava and Jarrow (2004) and updated to 2005 - same dataset used by Campbell et al. (2007).

Hazard Model: Estimation

	$hazard - model$	
	Estimate	t-value
$NetIncome/TA$	-0.1217	(-1.27)
TL/TA	3.3667	(28.26)
σ	3.7166	(11.75)
$ExcessReturn$	-0.8395	(-9.19)
$RelativeSize$	-0.2286	(-12.50)
$Intercept$	-9.9958	(-47.05)

- $\frac{\text{net income}}{\text{total assets}}$, $\frac{\text{total liabilities}}{\text{total assets}}$, idiosyncratic volatility of firm's stock returns over the past 12 months (σ), excess return over market in the past 12 months, log of firm's size divided by aggregate market capitalization ($relativesize$).

Back
Close

Distance to Default

- Based on Merton (1974)

$$\frac{dV}{V} = \mu dt + \sigma_V dW$$

- Value equity as a call option on firm-value as follows:

$$E = V\mathcal{N}(d_1) - e^{-rT}F\mathcal{N}(d_2)$$

$$d_1 = \frac{log(V/F) + (r + \sigma_V^2/2)T}{\sigma_V\sqrt{T}}$$

$$d_2 = d_1 - \sigma_V\sqrt{T}$$

- Using Ito's lemma, we get a second equation linking firm-value volatility to equity volatility:

$$\sigma_E = \frac{V}{E}\mathcal{N}(d_1)\sigma_V$$

Distance to Default

- We compute the distance to default as:

$$DD \equiv \frac{log(V/F) + (\mu - \sigma_V^2/2)T}{\sigma_V \sqrt{T}}$$

- Bharath and Shumway (2007) suggest a naive alternative to distance to default, DD_{naive}, which works equally well in out-of-sample predictability of default:

$$DD_{\text{naive}} \equiv \frac{log((E+F)/F) + (r_{it-1} - \text{Naive}\sigma_V^2/2)T}{\text{Naive}\sigma_V \sqrt{T}}$$

where

$$\text{Naive}\sigma_V = \frac{E}{E+F}\sigma_E + \frac{F}{E+F}(0.05 + 0.25 * \sigma_E)$$

and r_{it-1} is the firms stock return over the previous year

Default-risk and Realized Returns: A long-run perspective

- Using distance-to-default measure, we extend the sample period back to 1953 and explore the relation between default-risk and realized returns in long-run.
- We sort stocks into different distress groups based on the distress risk measures as of the July 1 of every year.
- We hold a stock in the assigned portfolio till the next re-balancing period or de-listing date, whichever is earlier.
- We regress value-weighted returns on four-factors to compute the regression alphas.

Default Risk and Realized Returns

	Top 5%				Top 10%			
	post-1980		pre-1980		post-1980		pre-1980	
	Estimate	t-val	Estimate	t-val	Estimate	t-val	Estimate	t-val
Four-Factor Model								
intercept	-0.9776	(-3.44)	-0.2785	(-1.59)	-0.7170	(-2.98)	-0.1421	(-1.08)
mktrf	1.4534	(19.95)	1.1569	(28.26)	1.3805	(22.44)	1.1699	(37.84)
smb	0.7905	(6.91)	1.1196	(16.27)	0.6801	(7.56)	1.0129	(18.85)
hml	0.7686	(5.97)	0.6263	(7.95)	0.6855	(6.20)	0.5652	(10.07)
umd	-0.3275	(-3.80)	-0.2353	(-4.33)	-0.2799	(-3.87)	-0.2328	(-5.75)
R^2	0.659		0.831			0.715		0.886
N	306		342			306		353

- High default-risk stocks have high market, SMB and HML beta. They behave like recent losers.
- While under-performance is large in post-1980 period, it's statistically zero before that.

Default Risk and Realized Returns: Entire Period

Four-Factor Model

	Top 5%		Top 10%	
	Estimate	t-val	Estimate	t-val
intercept	-0.5429	(-3.25)	-0.3691	(-2.75)
mktrf	1.3089	(30.06)	1.2811	(36.77)
smb	0.8946	(11.87)	0.8004	(14.85)
hml	0.6818	(8.80)	0.6296	(9.88)
umd	-0.3130	(-5.41)	-0.2807	(-5.80)
R^2	0.734		0.796	
N	648		659	

Market Model

	Top 5%		Top 10%	
	Estimate	t-val	Estimate	t-val
intercept	-0.3751	(-1.90)	-0.2146	(-1.28)
mktrf	1.3348	(22.50)	1.2974	(25.09)
R^2	0.560		0.628	
N	648		659	

Back
Close

Default Risk and Realized Returns: on IBES Sample

Top 5% Portfolio

	3-Factor		4-Factor	
	Estimate	t-val	Estimate	t-val
intercept	-1.0033	(-3.44)	-0.6345	(-2.25)
mktrf	1.5099	(20.34)	1.4427	(20.30)
smb	0.4895	(5.17)	0.5437	(6.05)
hml	0.7719	(6.83)	0.7115	(6.63)
umd			-0.3862	(-6.05)
R^2	0.606		0.647	
N	306		306	

Default Risk and Realized Returns: Fama MacBeth Regressions

Dependent Variable: Next year's buy and hold return

	post-1980		pre-1980		IBES-only	
	Estimate	t-val	Estimate	t-val	Estimate	t-val
DLP	-15.93	(-4.83)	-2.77	(-0.80)	-9.05	(-2.42)
Controls	Y		Y		Y	
N	26		30		26	

- DLP is the yearly percentile ranking based on expected default frequency (DD measure of default).
- Coefficients represent change in percentage annual return as we move from the safest to riskiest stock.

Expected Returns

- The internal rate of return (*implied cost of capital* (ICC)) that equates the discounted value of expected future cash-flows to shareholders to current stock price.

- A growing literature uses similar measures for expected return. (Pastor et al. (2007), Lee, Ng, and Swaminathan (2007), Brav, Lehavy and Michaely (2005), Fama and French (2002), Claus and Thomas (2001), and Kaplan and Rubak (1995) among others).

Implied Cost of Capital

- Compute ICC as $r_{i,t}$ in the following equation:

$$P_{i,t} = \sum_{k=1}^{k=\infty} \frac{E_t(FCFE_{i,t+k})}{(1+r_{i,t})^k} \tag{1}$$

- Pastor et al. (2007) show that if dividend growth and conditional expected returns both follow AR(1) processes, then ICC is perfectly correlated with conditional expected return.

- Advantages: A forward looking measure; Doesn't explicitly rely on any asset pricing model; Doesn't need long samples.

- Disadvantages: Requires information on expected dividends and growth forecasts; Important to perform several sensitivity analyses.

Computing Expected Returns:Steps

- Obtain consensus EPS forecasts for FY1 and FY2 from the IBES data as of June, 30 of every year; cash-flow to equity-holders computed as EPS estimate times payout ratio (one minus plowback rate).

- EPS forecasts beyond year 3 and up to the terminal date (year 15) estimated using analysts growth rate. After year 3, growth rate mean-reverted to GDP-growth rate in the steady state.

- Plowback rate in the first year taken from the most recent historical data.

- Future plowback rates mean-reverted to a long-term steady state using sustainable growth rate formula, i.e., in the long-run the product of return on equity and plowback rate equals the growth rate ($g = r_e * b$)

Expected Risk-Premium

Measures of Expected Return

variable	mean	25^{th} percentile	50^{th} percentile	75^{th} percentile	std.dev.
r_e^{base}	4.66	1.91	4.11	6.56	5.22
r_e^{10year}	3.61	1.13	3.23	5.55	4.52
r_e^{loweps}	4.03	1.18	3.52	6.02	5.39
$r_e^{higheps}$	5.32	2.53	4.73	7.24	5.21
$r_e^{expplow}$	4.87	1.98	4.21	6.72	5.55

- All number are expressed in excess of one-year risk-free rate.
- r_e^{base}: base case estimate with 15 year forecasting horizon, linear increase in payout ratios and consensus analysts forecasts.
- Other measures are estimated by changing these assumptions one at a time.

Expected Risk-Premium Across Default-Risk Portfolios

- Sort stocks into groups based on default-likelihood.
- Table presents mean expected risk-premium (over prevailing risk-free rate) across these groups.

	EDF	*Hazard*
0-20 percentile	3.24	3.55
21-80 percentile	4.44	4.31
81-100 percentile	6.15	5.80
top 10 percentile	6.59	6.23
top 5 percentile	6.77	6.40

Fama-McBeth Regression

- DLP: Percentile ranking based on default probability.
- Controls include firm-characteristics: size, market-to-book ratio, return volatility, and leverage.

Panel A: Hazard Model

	Model 1		Model 2		Model 3	
	Estimate	*t*-val	Estimate	*t*-val	Estimate	*t*-val
DLP	0.0157	(7.12)	0.0162	(4.11)	0.0131	(4.74)
logta	-0.6121	(-8.03)	-0.6091	(-7.96)	-0.4804	(-5.04)
mtb	-0.3941	(-3.14)	-0.3852	(-3.26)	-0.4852	(-3.29)
booklev			-0.1080	(-0.18)	-0.2919	(-0.59)
retstd					0.1126	(2.34)
intercept	7.9057	(11.96)	7.9131	(10.99)	6.4110	(4.89)

Fama-McBeth Regression

Panel B: Distance to Default

	Model 1		Model 2		Model 3	
	Estimate	t-val	Estimate	t-val	Estimate	t-val
DLP	0.0265	(6.46)	0.0325	(5.01)	0.0315	(6.22)
logta	-0.6289	(-11.77)	-0.5876	(-12.43)	-0.5478	(-7.29)
mtb	-0.3095	(-2.99)	-0.3018	(-3.11)	-0.3518	(-3.11)
booklev			-1.7490	(-2.12)	-1.9271	(-3.00)
retstd					0.0497	(1.07)
intercept	7.4587	(11.36)	7.3605	(11.14)	6.9684	(5.59)

Robustness: (Tables 5 & 6)

- Our estimates could be biased if some of the modeling assumptions and/or inputs to the model systematically produce higher cash-flows for high default risk stocks as compared to low default-risk stocks.
- Model assumptions: Results are robust to changing the forecasting horizon, plowback rates and dividend growth rates.
- Bankruptcy risk and future cash-flows: We explicitly incorporate bankruptcy risk in the estimation of future cash-flows using a Bernoulli distribution calibrated to estimated default probability.
- Analysts bias: Bias is a concern if analysts are systematically biased in favor of high default-risk stocks.

Robustness: Analyst Bias

- Bias a concern if forecast of future earnings too high (as compared to market's expectation) for high-default risk stocks.
- Generally much of investment banking business (and perhaps the bias) likely to be concentrated in low default-risk firms.
- We perform a robustness that biases against finding our results due to analyst bias.
- We take EPS estimate as: $EPS_{mixture} = LOWEPS_i + [(1-d_i)*(HIGHEPS_i - LOWEPS_i)]$, where d_i is the default likelihood percentile (one for riskiest firm).
- Assigns most pessimistic (optimistics) forecasts to highest (lowest) default-risk firm. We compute ICC using this measure of cash-flows.

Robustness: Stale forecasts

- We ensure forecasts are not more than three months old.
- If adverse events happen between forecast date and the estimation date, then we'll have a mismatch in earnings and prices.
- It will bias results in favor of higher ICC for high default-risk stocks, if this situation is more likely to happen for such stocks.
- We control for past-month's (past two/three month's) stock return in the regressions to account for this.

Different Measures of Expected Returns

Panel A

	r_e^{base}		r_e^{10year}		r_e^{loweps}		$r_e^{mixture}$		$r_e^{expplow}$	
	Estimate	t-val	Estimate	t-val	Estimate	t-val	Estimate	t-val	Estimate	t-val
compositeDLP	0.0364	(6.64)	0.0381	(6.88)	0.0308	(5.51)	0.0182	(3.05)	0.0394	(6.71)
logta	-0.4817	(-4.43)	-0.3388	(-3.14)	-0.7581	(-9.75)	-0.5041	(-4.57)	-0.5102	(-4.46)
mtb	-0.4125	(-2.84)	-0.5629	(-3.58)	-0.4249	(-2.59)	-0.5057	(-2.98)	-0.4283	(-2.79)
booklev	-2.9735	(-4.86)	-3.0522	(-5.05)	-2.0515	(-3.64)	-2.4350	(-3.27)	-3.0473	(-4.86)
retstd	0.0738	(1.38)	0.0318	(0.68)	0.0135	(0.30)	0.0775	(1.37)	0.0904	(1.56)
intercept	6.3273	(4.27)	5.1465	(3.76)	8.1225	(6.31)	7.2325	(5.10)	6.4233	(4.14)

Panel B

	r_e^{base}		r_e^{10year}		r_e^{loweps}		$r_e^{mixture}$		$r_e^{expplow}$	
	Estimate	t-val	Estimate	t-val	Estimate	t-val	Estimate	t-val	Estimate	t-val
compositeDLP	0.0327	(7.19)	0.0344	(7.53)	0.0281	(5.49)	0.0155	(2.93)	0.0355	(7.24)
logta	-0.4765	(-4.01)	-0.3399	(-2.93)	-0.7499	(-8.61)	-0.5205	(-4.62)	-0.5049	(-4.05)
mtb	-0.4746	(-2.81)	-0.6305	(-3.39)	-0.4892	(-2.54)	-0.5154	(-3.05)	-0.4950	(-2.79)
booklev	-2.9102	(-3.85)	-2.9219	(-4.12)	-2.0150	(-2.79)	-2.1778	(-2.85)	-2.9890	(-3.87)
retstd	0.0810	(1.50)	0.0377	(0.83)	0.0177	(0.40)	0.0782	(1.44)	0.0965	(1.65)
pastret	-4.5583	(-7.99)	-4.8225	(-8.72)	-3.8331	(-6.19)	-3.4621	(-5.87)	-4.9171	(-8.14)
intercept	6.4969	(4.28)	5.3675	(3.87)	8.2703	(6.29)	7.4256	(5.22)	6.6265	(4.18)

Robustness:Simulated bankruptcy-time

- Explicitly incorporate bankruptcy in the estimates of future cash-flows.

- Simulate a time of bankruptcy by using a Bernoulli distribution calibrated to estimated default probability at the time. Set cash-flows to zero beyond the simulated bankruptcy time.

	Model 1		Model 2		Model 3	
	Estimate	t-val	Estimate	t-val	Estimate	t-val
compositeDLP	0.0240	(4.67)	0.0235	(4.90)	0.0213	(4.31)
logta	-0.4882	(-4.15)	-0.4610	(-3.69)	-0.5069	(-4.25)
mtb	-0.5035	(-3.41)	-0.4664	(-3.38)	-0.5148	(-3.48)
booklev	-4.3582	(-6.81)	-4.4666	(-6.96)	-4.0709	(-6.22)
retstd	0.0312	(0.54)	0.0255	(0.46)	0.0309	(0.55)
invprice			2.1510	(1.50)		
pastret					-4.1786	(-7.22)
intercept	7.5633	(4.58)	7.3148	(4.24)	7.7938	(4.71)

Discussion

- Overall our evidence shows that investors expected positive risk-premium from stocks with high default-risk, but were negatively surprised in the post-1980 period.
- What might explain this? Can they remain negatively surprised for such a long period?
- We revisit the post-1980 under-performance and show that the under-performance is really concentrated in one out of six decades. In the decade of 1980.
- Under-performance of 1980s coincides well with the increased frequency of defaults in mid-1980s post-Bankruptcy Reform Act of 1978.

Figure 1: **Decade-by-decade 4-factor Regression Alpha**

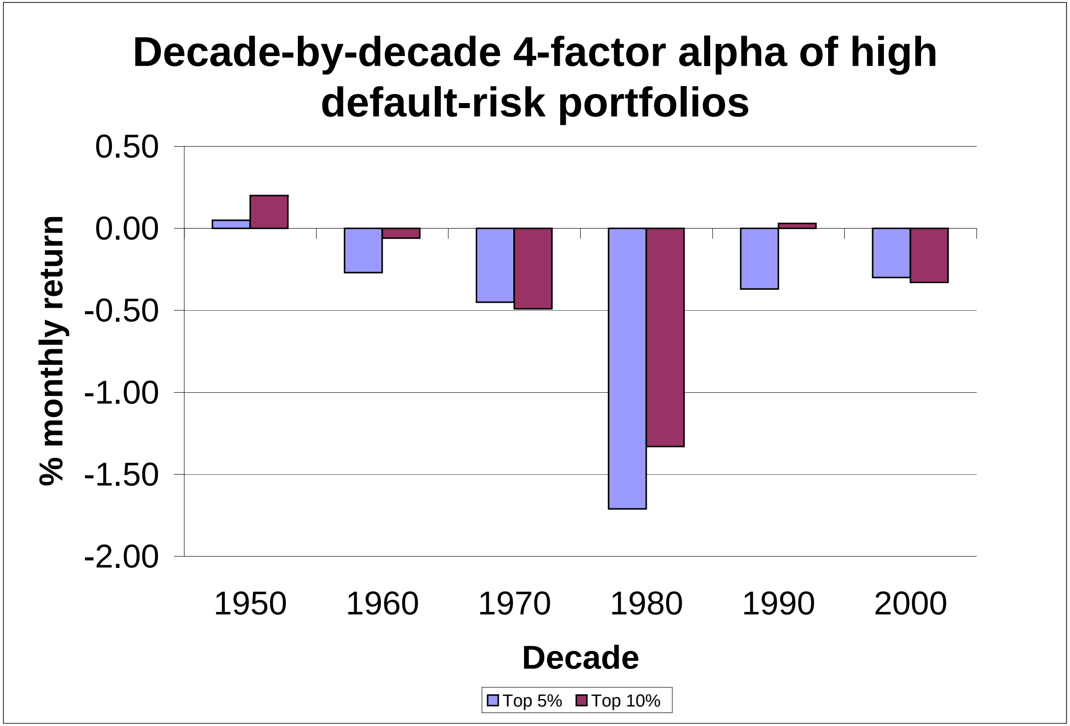

Figure 2: **Bankruptcy frequency (Campbell et al. (2007))**

Table I

Number of Bankruptcies and Failures Per Year

This table lists the total number of active firms, bankruptcies, and failures for every year of our sample period. The number of active firms is computed by averaging over the numbers of active firms across all months of the year.

Year	Active Firms	Bankruptcies	(%)	Failures	(%)
1963	1281	0	0.00	0	0.00
1964	1357	2	0.15	2	0.15
1965	1436	2	0.14	2	0.14
1966	1513	1	0.07	1	0.07
1967	1598	0	0.00	0	0.00
1968	1723	0	0.00	0	0.00
1969	1885	0	0.00	0	0.00
1970	2067	5	0.24	5	0.24
1971	2199	4	0.18	4	0.18
1972	2650	8	0.30	8	0.30
1973	3964	6	0.15	6	0.15
1974	4002	18	0.45	18	0.45
1975	4038	5	0.12	5	0.12
1976	4101	14	0.34	14	0.34
1977	4157	12	0.29	12	0.29
1978	4183	14	0.33	15	0.36
1979	4222	14	0.33	14	0.33
1980	4342	26	0.60	26	0.60
1981	4743	23	0.48	23	0.48
1982	4995	29	0.58	29	0.58
1983	5380	50	0.93	50	0.93
1984	5801	73	1.26	74	1.28
1985	5912	76	1.29	77	1.30
1986	6208	95	1.53	95	1.53
1987	6615	54	0.82	54	0.82
1988	6686	84	1.26	85	1.27
1989	6603	74	1.12	78	1.18
1990	6515	80	1.23	82	1.26
1991	6571	70	1.07	73	1.11
1992	6914	45	0.65	50	0.72
1993	7469	36	0.48	39	0.52
1994	8067	30	0.37	33	0.41
1995	8374	43	0.51	45	0.54
1996	8782	32	0.36	34	0.39
1997	9544	44	0.46	61	0.64
1998	9844	49	0.50	150	1.52
1999	9675	.	.	209	2.16
2000	9426	.	.	167	1.77
2001	8817	.	.	324	3.67
2002	8242	.	.	221	2.68
2003	7833	.	.	167	2.13

Discussion

- Avramov, Chordia, Jostova, and Philipov (2006) document that under-performance of rated firms is concentrated around periods of rating downgrades.
- Significant rating downgrades a possible information event that might make realized return a poor proxy.
- Avramov et al. (2006) also show that on average earnings surprises have been negative and much larger for poorly rated firms as compared to the forecasts.

Robustness

- COMPUSTAT sample-selection bias.
- CRSP-only model.
- IBES-only model.
- Other models of default likelihood.

Default Risk and Realized Return: 5-year Holding Period

Four-Factor Model

	Post-1980		Full Period	
	Estimate	t-val	Estimate	t-val
intercept	-0.1773	(-0.87)	-0.1013	(-0.79)
mktrf	1.4063	(26.83)	1.3282	(41.55)
smb	0.4508	(6.76)	0.6206	(13.97)
hml	0.5555	(6.26)	0.5387	(9.79)
umd	0.0596	(1.23)	0.0044	(0.13)
R^2	0.776		0.828	
N	306		582	

Market Model

	Post-1980		Full-period	
	Estimate	t-val	Estimate	t-val
intercept	0.2906	(1.44)	0.2954	(2.05)
mktrf	1.2603	(20.80)	1.3219	(29.45)
R^2	0.714		0.730	
N	306		582	

Conclusion

- Consistent with the asset pricing theory, there is a positive relation between ex-ante expected return and default-risk.
- In the post-1980 period, especially in the decade of 1980, investors were negatively surprised by low realized returns on high default-risk stocks.
- In the long-run, where realized returns is more likely to average out to expected return, the default-risk anomaly weakens considerably.
- Long-horizon investors of high default-risk stocks do not earn low returns.