Bank Regulation, Credit Ratings, and Systematic Risk

by

Giuliano Iannotta*

and

George Pennacchi**

*Department of Finance, Universitá Bocconi
**Department of Finance, University of Illinois

Bank of Finland, CEPR, JFI, and SUERF Future of Risk Management Conference, Helsinki Sept 22-23, 2011

The Rationale for Bank Regulation

- Banks fund longer-term, illiquid loans with demand deposits. Their fragility may justify a government lender of last resort and deposit insurance.

- However, government "safety nets" create incentives for banks to take excessive risks. This moral hazard needs to be restrained by bank regulation.

- But Basel Accord risk-based capital standards and (FDIC) deposit insurance premia may encourage a moral hazard whereby banks take excessive ***systematic*** risks.[1]

[1] See Kupiec (2004) and Pennacchi (2006).

Credit Ratings – Based Regulation

- Basel II and III set risk-based capital charges based on either internal credit ratings (Internal Ratings-Based Approach) or external ratings (Standardized Approach).

- Risk-weights for the Standardized Approach:

- **Claims on corporates**

Credit Assessment	AAA to AA-	A+ to A-	BBB+ to BB-	Below BB-	unrated
Risk Weight	20%	50%	100%	150%	100%

- Moreover, deposit insurance premia are often risk-insensitive, or based on credit ratings or estimates of expected losses from the bank's failure.

Credit Ratings, Regulation, and Moral Hazard

- Suppose that the:
  1. credit ***rating*** of a bond or loan reflects its ***physical*** (actual) ***expected default losses***.
  2. credit ***spread*** of a bond or loan reflects its ***risk-neutral expected default losses*** (systematic risk).

- Then if capital standards and/or deposit insurance premia are based on credit ratings, banks will maximize shareholder value by choosing loans and bonds with the highest systematic risk.

Outline of Rest of Talk

- Theory explaining why credit-rating based regulations lead banks to take excessive systematic risk.
- Empirical evidence that credit ratings do not account for the systematic risk impounded in a bond's credit spread.
- Implications and conclusions.

Model Summary

- Assumptions
  1. At date 0, insured depositors contribute € D_0 and shareholders contribute € K_0 to a bank that invests these funds in bonds and loans worth $A_0 = D_0 + K_0$.
  2. Each bond or loan is the debt of a firm whose capital structure satisfies Merton (1974).
  3. Default-free deposits are paid the competitive rate, r.
  4. The CAPM holds.
  5. A government regulator sets the bank's risk-based capital standards and/or deposit insurance premium.

Government Subsidy and Shareholder Value

- Let G_0 and E_0 be the values of the claims on the bank's assets by the government and the shareholders. Then

$$A_0 = D_0 + K_0 = D_0 + G_0 + E_0$$

which implies

$$E_0 - K_0 = -G_0$$

so that any government subsidy, $-G_0$, benefits the bank's shareholders.

No Subsidy Capital Standards

- Merton (1977) shows that $G_0 = 0$ if the insurance premium equals the value of a put option written on the bank's assets, $A_0 = D_0 + K_0$, with a maturity, T, equal to the term of the insurance:

$$\text{Premium} = \text{Put}[D_0 + K_0]$$

- This is equivalent to requiring capital, K_0, so that the premium equals the bank's ***risk-neutral*** expected losses. (Put is valued as if the expected asset return equals r.)

Capital Standards in Practice

- Setting capital standards based on a VaR calibration or based on credit ratings that reflect physical expected default losses implies:

$$\text{Premium} = \text{Put}[(D_0 + K_0)e^{(\mu - r)T}]$$

where μ is the actual expected asset return.

- When $\mu > r$,

$$\text{Put}[(D_0 + K_0)e^{(\mu - r)T}] < \text{Put}[D_0 + K_0]$$

and capital standards and/or the premium are lower than fair, so that $G_0 < 0$ and $E_0 - K_0 > 0$.

A Bank's Choice of Systematic Risk

- A bank's excess expected return on its asset portfolio of bonds and loans equals

$$\mu - r = \beta \times \varphi_M$$

where β is the CAPM "beta" of the loan and bond portfolio and φ_M is the excess expected market return.

- Notably, by selecting bonds and loans with the highest beta for any given credit rating, the bank reduces $\text{Put}[(D_0 + K_0)e^{(\mu - r)T}]$, reduces G_0, and maximizes its shareholder value through the subsidy it receives, E_0-K_0.

Debt Beta and Credit Spreads

- Extending Merton (1974), Galai and Masulis (1976) show that the beta of a firm's debt equals

$$\beta_D = N(-d_1)\frac{A}{D}\beta_A = \frac{E}{D}\frac{N(-d_1)}{N(d_1)}\beta_E$$

where A, D, E are the market values and β_A, β_D, β_E are the betas of the firm's assets, debt, and equity, resp., $d_1 = \left[\ln(A/B) + \left(r + \frac{1}{2}\sigma^2\right)\tau\right] / \left(\sigma\sqrt{\tau}\right)$, B and τ are the debt's promised payment and maturity, and σ is asset volatility.

- Given expected default losses, a loan or bond with a higher debt beta has a higher credit spread.

Banks' Portfolio Choice and Credit Spreads

- How might a bank choose high systematic risk bonds and loans that increase its shareholder value?
- Suppose (Basel) capital charges are based on credit ratings that reflect expected default losses.
- Then simply choosing bonds and loans with the highest credit spreads for a given credit rating selects those with the highest systematic risk.
- A naïve bank might believe it is exploiting a market inefficiency when it is really a regulatory arbitrage.

Bond Spreads and Ratings: Empirical Evidence

- We examine a sample of 3,924 bonds issued by 620 listed North American, European, and Japanese firms during 1999 to 2010.

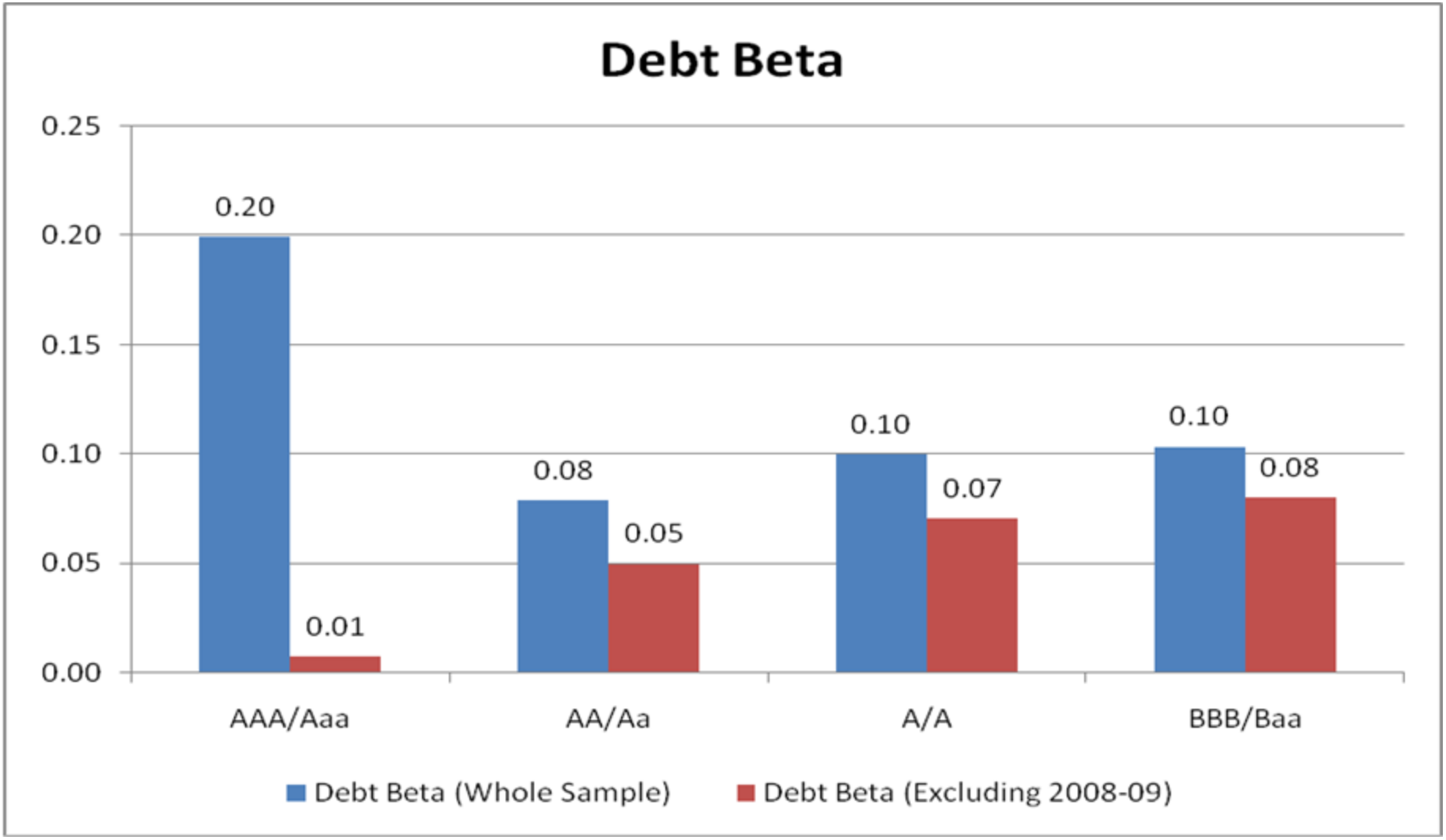
- Data from DCM Analytics gives each bond issue's credit rating and credit spread at the time of issue.

- Following Galai and Masulis (1976), we also calculate each issuer's debt beta, residual volatility, and total volatility from its equity returns and capital structure.

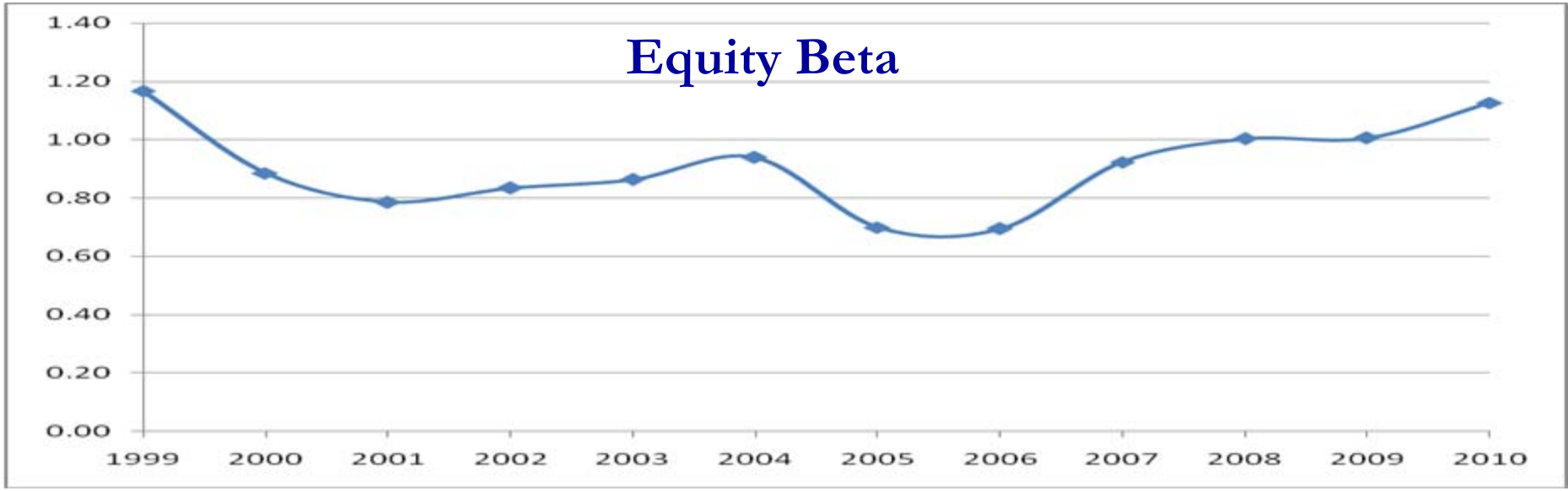
Summary Statistics: Mean Values by Rating

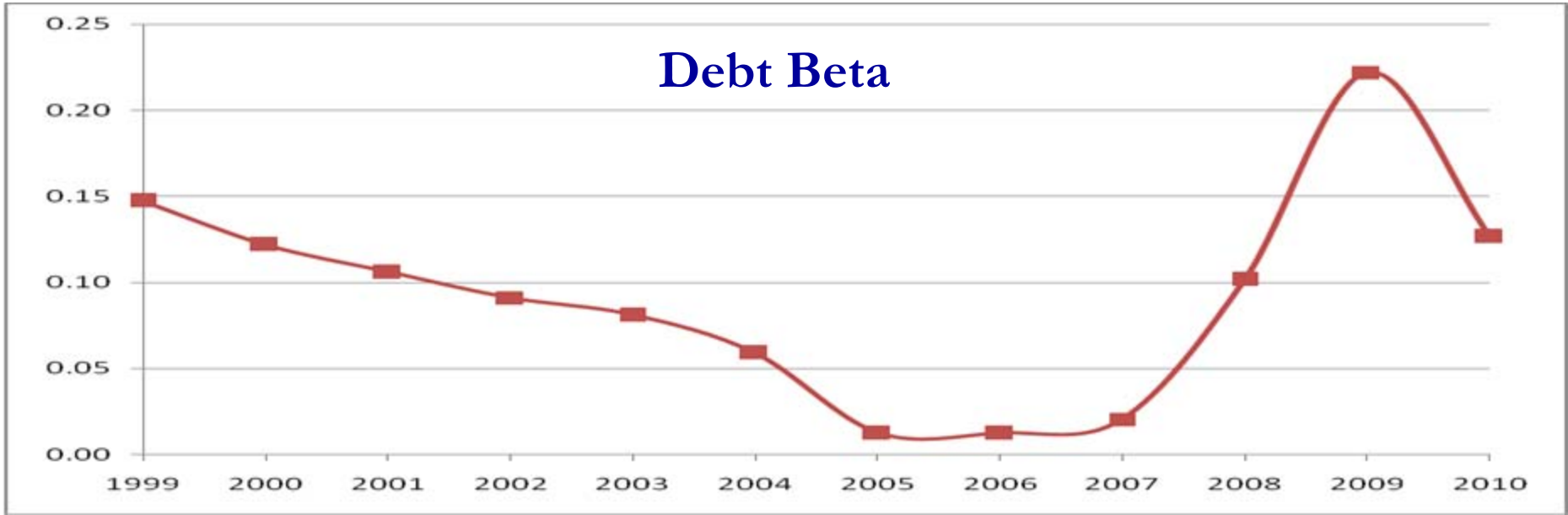
Rating	Obs.	Spread	Maturity (years)	Issuer's Debt		
				Beta	Res. Vol	Tot. Vol.
AAA/Aaa	132	80.696	4.816	0.20	1.03	1.35
AA/Aa	1,156	88.196	7.805	0.08	0.34	0.43
A/A	1,587	114.824	8.440	0.10	0.44	0.56
BBB/Baa	1,049	149.052	8.010	0.10	0.54	0.64
Total	3,924	114.982	8.016	0.10	0.46	0.57

Debt Betas: Pre-Crisis and Crisis Periods



Average Issuer Equity Betas and Debt Betas





Credit Spreads for Low vs High Beta Issuers

All Issues (3,924 Bonds)								
Maturity	Debt Beta below median (0.038)				Debt Beta above median (0.038)			
	AA	A	BBB	Total	AA	A	BBB	Total
≤ 10 years	65.68	77.47	119.45	84.19	114.11***	144.87***	165.86***	143.04***
> 10 years	73.55	108.80	167.84	110.49	128.36***	162.52***	202.070*	162.59***
Total	66.87	82.68	126.19	88.25	115.40***	146.53***	168.41***	144.72***
Excluding 2008-10 (2,599 Bonds)								
Maturity	Debt Beta below median (0.020)				Debt Beta above median (0.020)			
	AA	A	BBB	Total	AA	A	BBB	Total
≤ 10 years	51.22	64.86	85.06	64.98	67.84***	90.48***	88.44	85.05***
> 10 years	74.18	100.17	131.21	96.94	106.71***	124.740**	156.027*	129.90***
Total	55.01	70.91	91.24	70.11	72.68***	94.26***	94.34	89.75***

***, **, * denotes a statistically significant difference at the 1, 5, and 10 % levels.

A Bond Picking Exercise

- Consider the effects of a bank simply choosing high credit spread bonds for each Basel credit rating class.
- Suppose for each year, currency (EUR, USD, JPY), maturity (≤10Y, >10Y), and Basel credit rating class (AA, A, BBB), a bank invests in those newly issued bonds with above median credit spreads.
- The following table shows that, on average, the bank's bonds would have a debt beta 18% above average.

Average Increase in Beta from Picking Bonds with Above Median Credit Spreads

Maturity	EUR	USD	JPY	Total
≤ 10 years	0.190***	0.183***	0.129***	0.169***
> 10 years	0.341***	0.219***	0.108	0.201***
Total	0.212***	0.196***	0.123***	0.178***

For each year, currency, maturity, and credit rating category (AA, A, BBB), we compute the ratio of the average beta of high-spread bonds to the average beta of all the bonds within the same category. This table reports the mean log ratios. ***, **, * indicate statistical significance (1%, 5%, 10%, respectively) of the t-test for the equality of the mean log ratios to zero.

Regression Analysis of Credit Spreads

- To more formally examine the relationship between credit spreads, ratings, and risk, we run the regression:

$$Spread_{i,t} = f\left(Rating, Debt\ Beta, \ln\left(Debt\ Res.Vol.\right), Controls\right) + \varepsilon_{i,t}$$

- The following table shows that, controlling for credit ratings, spreads increase with the beta of the issuer's debt but not its residual volatility (idiosyncratic risk).

Determinants of Credit Spreads

	(1)	(2)	(3)	(4)	(5)
	Whole Sample			Excluding 08-10	Whole
AA+/Aa1	73.641***	82.059***	82.158***	3.797	75.990***
AA/Aa2	83.889***	92.379***	92.150***	5.477	81.549***
AA-/Aa3	109.311***	111.737***	111.650***	17.742*	98.391***
A+/A1	117.662***	119.570***	119.276***	21.217**	107.155***
A/A2	133.765***	134.584***	134.284***	31.379***	121.631***
A-/A3	152.259***	154.257***	153.903***	42.027***	139.632***
BBB+/Baa1	182.061***	182.894***	182.433***	57.829***	166.114***
BBB/Baa2	199.850***	196.790***	196.316***	62.452***	178.798***
BBB-/Baa3	211.318***	208.639***	208.109***	76.344***	188.046***
Debt Beta		108.781***	105.424***	67.799***	41.618**
ln (Debt Residual Volatility)			0.432	0.803	2.555
Crisis (2008-10)					93.842***
Debt Beta × Crisis					228.267***
Obs.	3,924	3,924	3,924	2,599	3,924
Adj. R^2	0.610	0.623	0.623	0.642	0.601

Determinants of Credit Spreads with Bid-Ask

	(1)	(2)	(3)	(4)	(5)
	Whole Sample			Excluding 08-10	Whole
AA+/Aa1	87.790**	100.594**	100.418**	-4.890	92.318**
AA/Aa2	99.555***	113.670***	114.855***	3.097	104.580***
AA-/Aa3	119.208***	129.359***	130.239***	13.445*	117.376***
A+/A1	119.658***	128.089***	129.438***	16.726**	119.009***
A/A2	137.262***	143.876***	145.402***	24.437***	135.210***
A-/A3	146.725***	153.758***	155.407***	37.334***	142.834***
BBB+/Baa1	169.333***	174.518***	176.557***	55.574***	162.262***
BBB/Baa2	190.508***	191.277***	193.208***	57.731***	179.135***
BBB-/Baa3	206.119***	207.675***	209.928***	88.358***	192.440***
Debt Beta		131.123***	139.492***	75.937***	65.137***
ln (Debt Residual Volatility)			-1.185	-0.063	0.819
Crisis (2008-10)					106.996***
Debt Beta × Crisis					299.626***
Avg Bid-Ask Spread	103.655***	89.896***	90.439***	61.144***	112.314***
Obs.	2,395	2,395	2,395	1,732	2,395
Adj. R2	0.641	0.659	0.659	0.662	0.637

Credit Ratings and Systematic Risk

- The previous results show credit spreads increase with systematic risk (debt beta) after accounting for ratings.
- Do credit spreads reflect any systematic risk? We run OLS and probit regressions:

$$Rating_{i,t} = f\left(Debt\ Beta, \ln\left(Debt\ Res.Vol.\right), Controls\right) + \varepsilon_{i,t}$$

- The results in the following table indicate that credit ratings reflect residual or total debt volatility.
- Ratings reflect some systematic risk (debt beta) when excluding 2008-2010 (c.f., Hilscher and Wilson (2010)).

Credit Ratings and Risk Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS						Ordered Probit	
	Whole Sample			Excluding 2008-10				
Debt Beta	1.875***	0.917	0.883	2.947***	1.682***	1.627***	1.259***	1.219***
	(0.006)	(0.202)	(0.218)	(0.000)	(0.002)	(0.003)	(0.000)	(0.000)
ln (Debt Res. Vol.)		0.123***			0.155***		0.109***	
		(0.000)			(0.000)		(0.000)	
ln (Debt Total Vol.)			0.121***			0.153***		0.108***
			(0.000)			(0.000)		(0.000)
Obs.	3,924	3,924	3,924	2,599	2,599	2,599	2,599	2,599
Adj. R^2	0.474	0.482	0.481	0.523	0.537	0.537	0.186	0.186

Reported are coefficients of OLS regressions (Columns 1-6) and ordered probit (Columns 7-8) with robust standard errors clustered both at the year and issuer level. The dependent variable is *Avg_Rating*, i.e. the average of Moody's and S&P's issue ratings converted into numerical scale (AAA/Aaa = 1, AA-/Aa1 = 2, …, BBB-/Bbb3 = 10). Coefficient for control variables are not reported for ease of exposition. ***, **, * indicate significance at 1%, 5%, 10% level, respectively.

Credit Ratings: Moody's vs S&P

- Previously, our *Rating* measure was the average of Moody's and S&P whenever ratings were split.
- The results are very similar if *Rating* is only that of Moody's or only that of S&P: their ratings appear not to differ with regard to systematic risk.
- However, a probit regression with the dependent variable = 1 if ratings are split shows that split ratings are less likely for issuers with higher debt beta.
- An explanation may be that raters are more likely to agree when an issuer's default depends on systematic factors.

Determinants of Split Ratings

	(1)	(2)	(3)	(4)
	Whole Sample		Excluding 2008-10	
	Split			
Debt Beta	-1.033***	-1.004***	-1.554**	-1.531*
	(0.003)	(0.004)	(0.048)	(0.053)
ln (Debt Residual Volatility)	-0.015		-0.013	
	(0.426)		(0.666)	
ln (Debt Total Volatility)		-0.019		-0.015
		(0.304)		(0.606)
Obs.	2,439	2,439	1,336	1,336
Adj. R^2	0.230	0.231	0.234	0.234

Reported are coefficients of probit regressions with robust standard errors clustered both at the year and issuer level. The dependent variable is *Split*, that is equal to 1 if Moody's and S&P's ratings for the same issue are different, zero otherwise. Coefficient for control variables are not reported for ease of exposition. ***, **, * indicate significance at 1%, 5%, 10% level, respectively.

Implications for Structured Finance

- Coval, Jurek, and Stafford (2009) show that highly-rated tranches of MBS, ABS, and CDOs had extreme systematic risk because assets' idiosyncratic risk was diversified away.

- Collin-Dufresne, Goldstein, and Yang (2010) find that these highly-rated tranches had high credit spreads commensurate with their high systematic risk.

- Our theory of rating-based capital regulation can explain banks' attraction for holding these highly-rated tranches.

Conclusions

- Capital standards and/or deposit insurance based on credit ratings or expected default losses create moral hazard for banks to take excessive systematic risk.
- Basel II credit rating–based capital charges encouraged banks to hold highly-rated structured tranches.
- The result of banks' excessive systematic risk was a systemic financial crisis.
- Risk-based capital standards and deposit insurance need reform to make them reflect risk-neutral expected default losses, as do market credit spreads.