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The Cross-Section of Credit Risk Premia and Equity Returns

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Questions that we ask in the paper

General question

Is credit risk priced in equity returns ?

More precisely

Is there a link between credit risk premia embedded in the term structure of CDS spreads and the cross-section of stock returns ?

Ultimate question

Does the CDS market provide information relevant for asset pricing in equity markets beyond information in traditional factors ?

Why do we ask these questions ?

- Mixed evidence whether credit risk is priced in stock returns
  - relation between real-world PD and stock returns is
    - negative: e.g. Dichev (1998), Campbell et al. (2008)
    - positive: e.g. Vassalou and Xing (2004), Chava and Purnanandam (2010)
  - for risk-neutral PDs: e.g. Anginer and Yildizhan (2010)

- CDS spreads should allow for near-to-ideal measuring of credit risk
  - e.g. Blanco et al. (2005), Longstaff et al. (2005), Ericsson et al. (2007)

- Few studies on link between CDS spreads and equity returns
  - e.g. Blanco et al. (2005), Acharya and Johnson (2007), Ni and Pan (2010)
  - Han and Zhou (2011): slope of CDS term structure and equity returns

Paper in a nutshell

Using a structural framework as theoretical motivation, we show that...

- the equity markets comove with CDS markets;
- the term structure of CDS spreads contains information about risk premia;
- strong link between equity and CDS markets driven by expected risk premia embedded in the term structure of CDS spreads;

  $\Rightarrow$ firms with higher expected risk premia for CDS changes earn higher equity excess return
- the default risk information in CDS spreads is not the same as in traditional factors.

Motivation using the Merton (1974) model (1/3)

- Asset dynamics follow

$$dV_t = \mu V_t dt + \sigma V_t dW_t^{\mathbb{P}}$$

- Real-world probability of default

$$PD_t^{\mathbb{P}} = \Phi\Bigg(\underbrace{- \frac{\log(V_t/D) + (\mu - \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}}}_{\equiv DD} \Bigg)$$

- Risk-neutral probability of default

$$PD_t^{\mathbb{Q}} = \Phi\left(- \frac{\log(V_t/D) + (r - \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} \right)$$

- Link between real-world and risk-neutral probabilities of default

$$PD_t^{\mathbb{Q}} = \Phi\left(\Phi^{-1}(PD_t^{\mathbb{P}}) + \frac{\mu - r}{\sigma}\sqrt{T}\right)$$

Motivation using the Merton (1974) model (2/3)

- Link between real-world and risk-neutral probabilities of default

$$PD_t^{\mathbb{Q}} = \Phi\left(\Phi^{-1}(PD_t^{\mathbb{P}}) + \frac{\mu - r}{\sigma}\sqrt{T}\right)$$

- Market price of risk

$$\begin{aligned}\lambda &\equiv \frac{\mu - r}{\sigma} \\ &= \left(\Phi^{-1}(PD^{\mathbb{Q}}) - \Phi^{-1}(PD^{\mathbb{P}})\right)\frac{1}{\sqrt{T}}\end{aligned}$$

  - λ depends on the difference between $PD^{\mathbb{Q}}$ and $PD^{\mathbb{P}}$ rather than their level.
  - We refer to the r.h.s. as credit risk premium.

- Asset excess returns are directly related to credit risk premia.

Motivation using the Merton (1974) model (3/3)

- We consider the relation between claims on assets: equity and credit protection.
- Equity is a European call on assets with strike D and maturity T. Using Ito's lemma

$$\lambda_E \equiv \frac{\mu_E - r}{\sigma_E} = \lambda$$

- A European put (P_t) on assets with strike D and maturity T offers credit protection.
- We consider a CDS contract with CDS spread determined as continuous insurance fee

$$S_t = \frac{r}{1 - e^{-rT}} P_t$$

- Expected CDS excess return, volatility, and Sharpe ratio

$$\mu_S^{\mathbb{P}} - \mu_S^{\mathbb{Q}} = -(\mu - r)\frac{V}{P}\Phi(-d_1)$$

$$\sigma_S = |-\sigma\frac{V}{P}\Phi(-d_1)|$$

$$\lambda_S \equiv \frac{\mu_S^{\mathbb{P}} - \mu_S^{\mathbb{Q}}}{\sigma_S} = -\lambda$$

Risk premia in the CDS term structure

- Are forward CDS spreads unbiased predictors of future CDS spreads?

$$
\begin{aligned}
F_t^{\tau \times T} &= \mathbb{E}_t^{\mathbb{Q}} \left[S_{t+\tau}^T \right] \\
&= \mathbb{E}_t^{\mathbb{P}} \left[S_{t+\tau}^T \right] + RP_{t+\tau}^T \\
RP_{t+\tau}^T &= \mathbb{E}_t^{\mathbb{Q}} \left[S_{t+\tau}^T \right] - \mathbb{E}_t^{\mathbb{P}} \left[S_{t+\tau}^T \right]
\end{aligned}
$$

- Change in CDS spread: $\Delta S_{t+\tau}^T \equiv S_{t+\tau}^T - S_t^T$
- CDS forward premium: $F_t^{\tau \times T} - S_t^T = \mathbb{E}_t^{\mathbb{Q}} \left[S_{t+\tau}^T \right] - S_t^T$
- CDS excess return: $RX_{t+\tau}^T \equiv \Delta S_{t+\tau}^T - (F_t^{\tau \times T} - S_t^T)$
- The expected risk premium is thus $RP_{t+\tau}^T = -\mathbb{E}_t^{\mathbb{P}} \left[RX_{t+\tau}^T \right]$

Estimating expected CDS excess returns

- We use approaches established in the bond market literature
  - Excess returns resulting from EH deviations reflect risk premia.
  - "Classic" literature: Fama and Bliss (1987), Campbell and Shiller (1991)
  - More recently, Cochrane and Piazzesi (2005) use the whole term structure and extract a single factor
- Model à la Cochrane and Piazzesi (2005), on a company-by-company basis

$$RX_{t+1}^{T} = d^{T}\left(\gamma_0 + \gamma_1 S_t^1 + \gamma_2 F_t^{1\times 1} + \gamma_3 F_t^{3\times 1} + \gamma_4 F_t^{5\times 1} + \gamma_5 F_t^{7\times 1}\right) + \varepsilon_{t+1}^{T}$$

  - Estimate γ:

$$\begin{aligned}\overline{RX}_{t+1} &= \gamma_0 + \gamma_1 S_t^1 + \gamma_2 F_t^{1\times 1} + \gamma_3 F_t^{3\times 1} + \gamma_4 F_t^{5\times 1} + \gamma_5 F_t^{7\times 1} + \overline{\varepsilon}_{t+1} \\ &= \boldsymbol{\gamma}'\mathbf{F}_t + \overline{\varepsilon}_{t+1}.\end{aligned}$$

  - Expected risk premium: $ERP_{t+1} = -\boldsymbol{\gamma}'\mathbf{F}_t$
  - Expected CDS Sharpe ratio: ERP_{t+1}/σ
  - We use various estimates for σ and our findings are qualitatively identical. The results we report are based on a rolling 30-day estimate.

Data

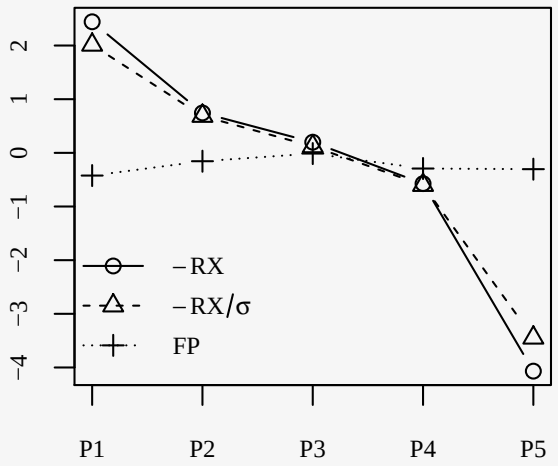
- All data are daily from January 2, 2001 to April 26, 2010.
  - CDS spreads for USD denominated contracts of US based obligors from Markit with maturities of 1, 3, 5, 7, and 10 years.
  - Equity data from CRSP
  - Firm characteristics and ratings from Compustat
  - Fama-French Factors from Kenneth French's online library.
- After extensive data quality checks we are left with 805,184 joint observations of CDS, equity, firm, and rating data for a total of 624 firms.
- Our core results are based on
  - monthly sampling frequency
  - and equally- and value-weighted equity returns.

CDS descriptives and predictability

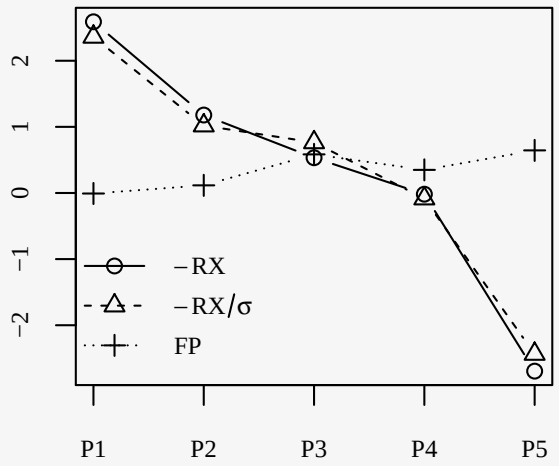
- Shape of term structure of CDS spreads looks different prior and during crisis.
- Average CDS excess returns negative before crisis and positive during crisis.
- Standard unbiasedness / excess return regressions suggest the presence of time-varying risk premia which are predictable to some extent (R^2 approx. 0.07)
- Single-factor model, on average, explains approx 25–33% of the variation of CDS excess returns in the two sub-samples and around 25% in the full sample.

Comovement of CDS and equity markets

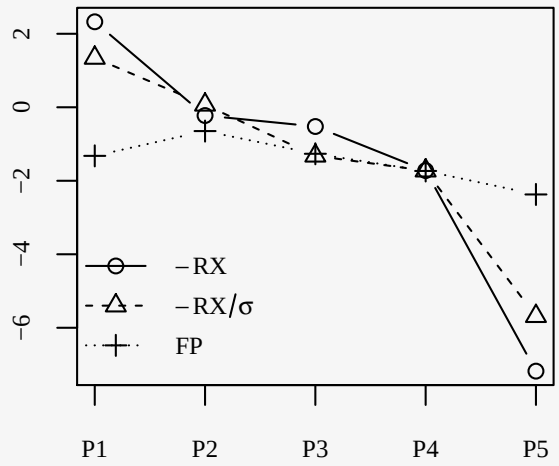
Full Sample (01/2001-04/2010)



Prior to Crisis (01/2001-06/2007)



During Crisis (07/2007-04/2010)



- P1: portfolio of stocks with low $RX_{t+1}^T \equiv \Delta S_{t+1}^T - (F_t^{1\times T} - S_t^T)$
- P5: portfolio of stocks with high $RX_{t+1}^T \equiv \Delta S_{t+1}^T - (F_t^{1\times T} - S_t^T)$

Portfolios sorted by CDS excess returns

- Full sample (01/2001 - 04/2010) portfolio returns (value-weighted)

	P1	P2	P3	P4	P5	P1–P5	Summary
Sort Variable: $-RX_{t+\tau}$							
mean	44.12	7.73	1.12	-5.43	-53.01		P1: low RX ... P5: high RX
Portfolio Returns							
mean	1.87	0.64	-0.01	-1.22	-4.14	6.01	lower
	(2.44)	(1.16)	(-0.02)	(-1.8)	(-2.69)	(5.12)	CDS excess returns $\leftrightarrow$
sd	6.23	4.89	4.07	5.52	9.66	6.83	higher equity excess returns,
SR	1.04	0.46	-0.01	-0.76	-1.48	3.05	significant
Portfolio Characteristics							
DD	7.27	9.26	10.17	9.95	7.95		inversely U-shaped
S5	272.21	98.2	69.35	85.5	213.19		U-shaped
MV	10.24	21.28	27.73	28.01	17.72		inversely U-shaped
BM	0.78	0.59	0.56	0.58	0.75		U-shaped

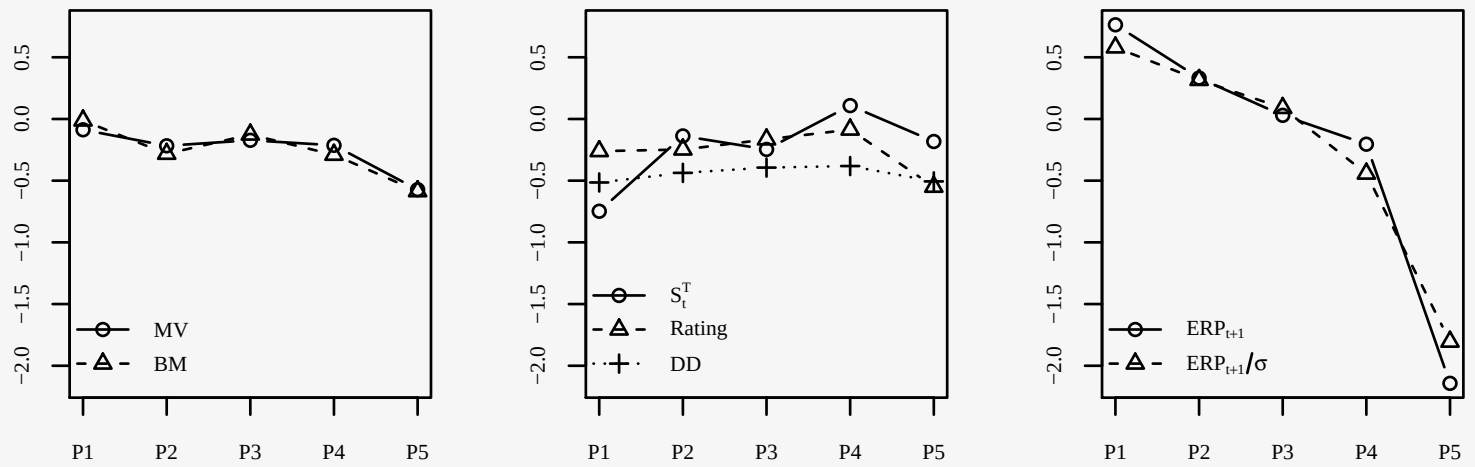
Portfolios sorted by CDS forward premia

- Full sample (01/2001 - 04/2010) portfolio returns (value-weighted)

	P1	P2	P3	P4	P5	P1–P5	Summary
Sort Variable: $F_t^{\tau \times T} - S_t^T$							
mean	1.66	-0.55	-0.87	-1.33	-3.38		P1: high FP ... P5: low FP
Portfolio Returns							
mean	-0.55	-0.47	-0.4	-0.55	-0.43	-0.13	not significant
	(-0.64)	(-0.9)	(-0.69)	(-0.78)	(-0.49)	(-0.27)	
sd	6.86	4.72	4.6	5.84	6.83	5.31	
SR	-0.28	-0.35	-0.3	-0.33	-0.22	-0.08	
Portfolio Characteristics							
DD	11.04	10.19	9.14	8.19	6.27		monotonic
S5	228.13	74.69	71.26	102.28	261.95		U-shaped
MV	36.48	25.16	20.55	14.58	8.09		monotonic
BM	0.76	0.55	0.59	0.63	0.73		U-shaped

CDS expected risk premia and equity returns

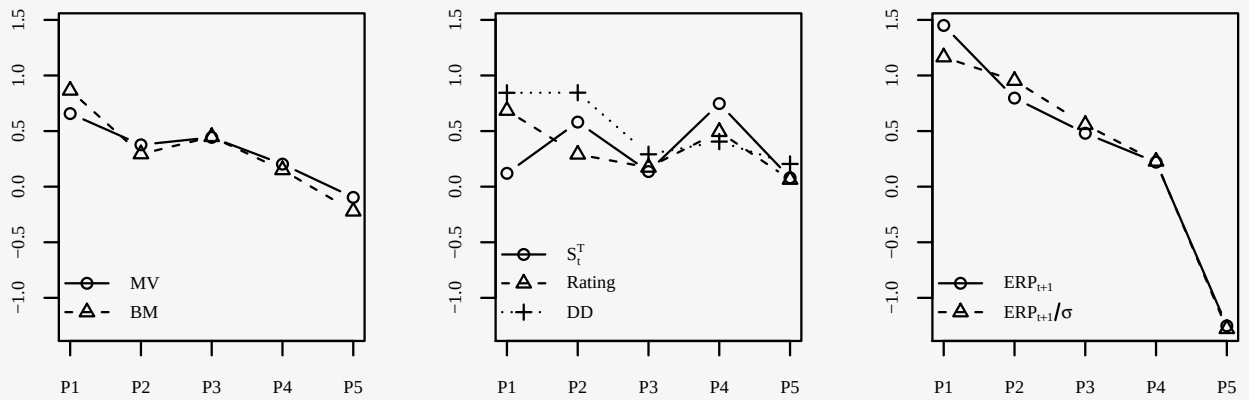
Full Sample (01/2001-04/2010)



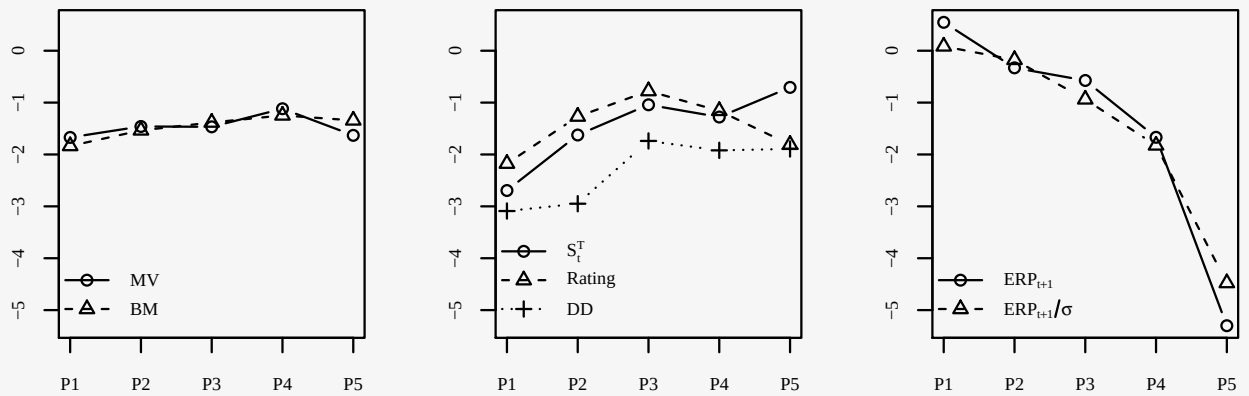
- P1: portfolio of stocks with high credit risk
- P5: portfolio of stocks with low credit risk

CDS expected risk premia and equity returns

Prior to Crisis (01/2001-06/2007)



During Crisis (07/2007-04/2010)



Portfolios sorted by expected risk premia

- Full sample (01/2001 - 04/2010) portfolio returns (value-weighted)

	P1	P2	P3	P4	P5	P1–P5	Summary
Sort Variable: ERP							
mean	33.69	5.1	1.22	-2.26	-39.23		P1: high risk ... P5: low risk
Portfolio Returns							
mean	0.11	0.06	-0.38	-0.51	-1.85	1.96	higher expected risk premia
	(0.13)	(0.09)	(-0.82)	(-0.88)	(-1.77)	(3.3)	$\leftrightarrow$ higher excess returns,
sd	6.62	4.88	4.23	4.55	7.08	4.42	highly significant
SR	0.06	0.04	-0.31	-0.39	-0.9	1.53	
Portfolio Characteristics							
MV	12.36	19.21	26.66	26.98	19.85		risk premia neither monotonically
BM	0.79	0.59	0.54	0.55	0.78		related to size nor to book-to-market
Asset Pricing							
CAPM α	0.12	0.06	-0.38	-0.51	-1.84	1.96	highly significant
	(0.18)	(0.13)	(-1.06)	(-1.14)	(-2.24)	(4.05)	
3-fac α	0.27	0.3	-0.27	-0.4	-1.64	1.91	highly significant
	(0.49)	(0.72)	(-0.7)	(-0.87)	(-2.24)	(3.92)	
4-fac α	0.27	0.3	-0.27	-0.4	-1.65	1.92	highly significant
	(0.5)	(0.73)	(-0.67)	(-0.9)	(-2.13)	(3.5)	

Portfolios sorted by expected risk premia

- High minus low expected risk premium portfolio returns (value-weighted)

All firms included

	Full	Pre-Crisis	Crisis
Portfolio Returns			
mean	1.96	2.49	4.65
	(3.3)	(4.41)	(3.05)
sd	4.42	3.84	6.03
SR	1.53	2.25	2.67
Asset Pricing			
CAPM α	1.96	2.5	4.66
	(4.05)	(3.47)	(2.83)
3-fac α	1.91	2.61	4.35
	(3.92)	(3.92)	(3.16)
4-fac α	1.92	2.58	3.85
	(3.5)	(4.06)	(2.94)
MKT	-0.01	-0.07	-0.02
	(-0.04)	(-0.73)	(-0.09)
SMB	0.16	-0.03	0.83
	(1.53)	(-0.14)	(1.97)
HML	-0.06	-0.1	-0.32
	(-0.35)	(-0.55)	(-0.88)

Excluding Financials and Utilities

	Full	Pre-Crisis	Crisis
Portfolio Returns			
mean	2.02	2.46	3.56
	(3.83)	(4.98)	(3.02)
sd	4.57	4.18	4.78
SR	1.53	2.04	2.58
Asset Pricing			
CAPM α	2.02	2.46	3.41
	(4.12)	(3.76)	(3.45)
3-fac α	2.02	2.53	3.36
	(4.2)	(4.03)	(3.2)
4-fac α	2.03	2.51	3.06
	(3.88)	(4.17)	(3.86)
MKT	-0.03	0	-0.28
	(-0.21)	(0.03)	(-1.94)
SMB	0.04	-0.06	0.14
	(0.38)	(-0.29)	(0.5)
HML	-0.04	-0.04	0.17
	(-0.29)	(-0.2)	(0.86)

Controlling for firm characteristics

- We control for firm characteristics by doing sequential portfolio sorts
  - first, sort firms with respect to a characteristic variable into tercile portfolios
  - second, within each portfolio, sort sub-portfolios based on expected risk premia
- Size: portfolios for small (S), medium (M), and big (B) firms
- Book-to-Market: portfolios for high (H), neutral (M), and low (L) book-to-market firms
- Default probability
  - Risk-neutral PD: level of 5-year CDS spreads
  - Real-world PD: S&P ratings
- Liquidity: number of contributors reported by Markit

Controlling for firm size

- High minus low expected risk premium portfolio returns (value-weighted) for small (S), medium (M), and big (B) firms

	Full			Pre-Crisis			Crisis		
	S	M	B	S	M	B	S	M	B
Portfolio Returns									
mean	3.06	1.55	0.9	2.55	1.78	1.13	5.83	3.49	1.66
	(3.75)	(4.32)	(2.67)	(3.98)	(4.43)	(3.34)	(3.14)	(2.96)	(2.65)
sd	4.99	3.76	2.8	3.53	4.09	2.3	7.03	5.38	3.68
SR	2.13	1.43	1.11	2.51	1.5	1.71	2.87	2.25	1.57
Asset Pricing									
CAPM α	3.09	1.56	0.89	2.66	1.83	1.2	5.6	3.39	1.78
	(5.42)	(4.81)	(2.63)	(5.13)	(4.97)	(3.9)	(3.42)	(3.14)	(2.34)
3-fac α	3.09	1.47	0.88	2.64	1.58	1.34	5.61	3.41	1.63
	(5.37)	(4.23)	(2.68)	(3.39)	(3.56)	(3.75)	(3.15)	(2.77)	(2.84)
4-fac α	3.09	1.47	0.88	2.62	1.58	1.33	5.29	3.2	1.38
	(5.43)	(4.2)	(2.64)	(4.86)	(4.02)	(3.69)	(3.75)	(2.83)	(2.29)

Controlling for book-to-market ratios

- High minus low expected risk premium portfolio returns (value-weighted) for value (H), neutral (M), and growth (L) firms

	Full			Pre-Crisis			Crisis		
	H	M	L	H	M	L	H	M	L
Portfolio Returns									
mean	2.44	0.94	0.92	1.83	1.67	1.48	6.56	2.21	1.38
	(2.54)	(2.6)	(3.02)	(3.33)	(3.94)	(4.78)	(2.04)	(1.62)	(2.04)
sd	6.47	3.62	3.26	4.87	3.25	2.94	12.79	5.26	2.94
SR	1.31	0.89	0.97	1.3	1.78	1.75	1.78	1.45	1.62
Asset Pricing									
CAPM α	2.44	0.94	0.92	1.84	1.76	1.53	6.69	2.17	1.41
	(2.85)	(2.65)	(2.93)	(3.08)	(4.43)	(4.67)	(2.35)	(1.58)	(2.41)
3-fac α	2.65	1.01	0.78	1.72	1.91	1.4	6.2	2.04	1.47
	(2.57)	(2.84)	(3.19)	(2.48)	(4.16)	(5.11)	(2.8)	(1.45)	(2.37)
4-fac α	2.66	1.01	0.78	1.72	1.89	1.38	5.27	1.73	1.51
	(2.89)	(2.6)	(2.77)	(2.84)	(4.05)	(5.12)	(2.56)	(1.2)	(2.13)

Controlling for default probability: S5

- High minus low expected risk premium portfolio returns (value-weighted) for firms with high (H), medium (M), and low (L) 5-year CDS spreads

	Full			Pre-Crisis			Crisis		
	H	M	L	H	M	L	H	M	L
Portfolio Returns									
mean	3.24	1.38	0.39	2.42	1.9	0.49	5.28	2.61	0.53
	(4.45)	(3.28)	(1.66)	(3.75)	(3.77)	(1.49)	(2.56)	(2.3)	(1.26)
sd	6.5	4.02	2.45	4.5	3.94	3.07	9.16	5.71	1.91
SR	1.73	1.19	0.55	1.86	1.67	0.55	2	1.58	0.95
Asset Pricing									
CAPM α	3.26	1.39	0.39	2.5	2.04	0.5	5.09	2.73	0.56
	(4.21)	(3.35)	(1.76)	(4.2)	(4.95)	(1.43)	(3.05)	(2.09)	(1.32)
3-fac α	3.37	1.43	0.3	2.24	1.87	0.6	4.88	2.49	0.52
	(4.23)	(3.4)	(1.43)	(3.54)	(3.65)	(1.76)	(3.82)	(2.12)	(1.72)
4-fac α	3.37	1.43	0.3	2.24	1.87	0.58	4.46	2.1	0.34
	(5.05)	(3.29)	(1.42)	(3.37)	(3.87)	(1.76)	(3.45)	(1.96)	(0.99)

Controlling for default probability: S&P rating

- High minus low expected risk premium portfolio returns (value-weighted) for firms with bad (H), medium (M), and good (L) ratings

	Full			Pre-Crisis			Crisis		
	H	M	L	H	M	L	H	M	L
Portfolio Returns									
mean	3.34	1.64	0.94	2.71	2.07	0.94	5.39	2.3	2.18
	(3.56)	(3.74)	(2.88)	(4.06)	(3.88)	(3.06)	(3.92)	(3.69)	(2.45)
sd	7.26	3.79	2.88	6.47	4.15	2.77	7.01	3.56	4.31
SR	1.6	1.5	1.13	1.45	1.73	1.17	2.66	2.23	1.75
Asset Pricing									
CAPM α	3.36	1.64	0.95	2.72	2.12	0.97	5.16	2.36	2.22
	(4.31)	(3.91)	(3.02)	(3.76)	(4.54)	(3.04)	(4.57)	(3.17)	(2.14)
3-fac α	3.42	1.55	0.87	2.84	2	1.15	5.11	2.29	2.06
	(3.46)	(3.83)	(2.59)	(3.33)	(3.25)	(5.08)	(4.99)	(2.91)	(2.64)
4-fac α	3.42	1.55	0.87	2.81	2.01	1.14	4.78	2.22	1.64
	(3.43)	(3.5)	(2.68)	(3.13)	(3.16)	(4.01)	(6.11)	(2.8)	(2.73)

Controlling for CDS liquidity

- High minus low expected risk premium portfolio returns (value-weighted) for firms with a low (L), medium (M), and high (H) number of contributors reported by Markit

	Full			Pre-Crisis			Crisis		
	L	M	H	L	M	H	L	M	H
Portfolio Returns									
mean	1.4	1.41	1.75	2.48	1.41	1.38	2.3	3.11	4.04
	(3.52)	(2.48)	(3.45)	(5.34)	(4.49)	(3.02)	(3.45)	(2.29)	(3.16)
sd	3.91	4.59	4.7	3.37	3.36	3.11	4.36	5.97	7.36
SR	1.24	1.07	1.29	2.55	1.45	1.54	1.83	1.8	1.9
Asset Pricing									
CAPM α	1.39	1.41	1.73	2.42	1.37	1.55	2.28	3	4.17
	(2.57)	(2.89)	(3.55)	(4.5)	(3.66)	(3.35)	(3.93)	(2.16)	(2.87)
3-fac α	1.33	1.54	1.65	2.48	1.29	1.62	2.29	2.83	3.89
	(2.85)	(2.56)	(3.24)	(4.96)	(3.99)	(3.49)	(4.3)	(2.4)	(3.05)
4-fac α	1.33	1.54	1.65	2.45	1.28	1.6	2.14	2.4	3.6
	(3.52)	(2.81)	(2.82)	(5.17)	(4.03)	(3.54)	(2.76)	(3.46)	(2.36)

Additional results & robustness checks

- We can explain why and how CDS slope predicts equity returns.
- Alternative data set: CDS and equity data from Datastream (01/2004–06/2010).
- Other checks
  - Decile portfolios
  - Remove stocks with price less one dollar

Conclusion

- We analyze whether distress risk is priced in equity returns by exploring the joint cross-section of CDS and stocks for US firms from 2001 to 2010.
- While previous research uses either real-world or risk-neutral probabilities of default, we argue that credit risk premia priced in stock returns depend on both.
- We estimate expected risk premia from the term structure of CDS spreads using a single-factor model à la Cochrane and Piazzesi (2005).
- Consistent with predictions from structural models, our empirical results reveal a strong positive relation between stock returns and expected risk premia.
- We find that risk premia embedded in CDS spreads contain information beyond size and book-to-market but also that equity excess returns are highest for small firms and value stocks.
- Our results are robust to splitting the sample into the pre-crisis and the crisis period and conclusions also remain unchanged when conducting other robustness checks.