Cross-Market Strategies:
CDS Information for Bond and Equity Investors

Josef Zechner
WU Vienna University of Economics and Business

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Agenda

- Introduction
- CDS markets and equity returns
- CDS markets and higher moments of equity returns
- CDS markets and sovereign bond returns

Introduction

- In general: the same information is relevant in several markets
- Thus, conditioning on information from several markets is optimal
- Even more so if
  - price discovery is less noisy in one market relative to another
  - price discovery is faster in one market compared to another
  - one market provides a finer information partition than another (e.g. stock price versus CDS prices)

- This presentation: Survey of cross-market strategies based on CDS information and equity, equity derivatives and sovereign bonds

Why look at CDS markets?

- CDS information is structurally related to other markets:
  - Corporate CDS spreads are directly related to all other corporate securities via Merton-type structural models
  - Sovereign CDS spreads are directly related to sovereign bonds via structural models (see, e.g. Mayer (2013), Jeanneret (2014))
- CDS markets offer a relatively clean measure of credit risk
  - frequency
  - standardization
  - liquidity
  - ....
- Empirical evidence suggests that price discovery occurs in the CDS market
  - e.g. Blanco et al. (2005), Longstaff et al. (2005), Ericsson et al. (2007).

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- Introduction
- **CDS markets and equity returns**
- CDS markets and higher moments of equity returns
- CDS markets and sovereign bond returns

CDS markets and equity returns

This section based on

The Cross-Section of Credit Risk Premia and Equity Returns

Nils Friewald (WU Vienna), Christian Wagner (CBS), Josef Zechner (WU Vienna)

forthcoming in The Journal of Finance

Motivation

- 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).

Paper in a nutshell

- We show that firms' risk premiums in equity and credit markets are related in structural models à la Merton (1974).
- We explore this relation using the joint cross-section of stock returns and risk premia estimated from CDS spreads.
- Consistent with structural models we find that
    - equity returns and Sharpe ratios increase with estimated credit risk premia;
    - the returns of buying high and selling low credit risk premium firms cannot be explained by size, book-to-market, and momentum.
- Credit risk premia contain information beyond actual and risk-neutral PDs → insights for the 'distress puzzle'.
- Results are robust across pre-crisis and crisis sub-samples, return weighting schemes, full- and out-of-sample parameter estimation.

Motivation using the Merton (1974) model

- Asset dynamics follow: $dV_t = \mu V_t dt + \sigma V_t dW_t^{\mathbb{P}}$
- Firm's Sharpe ratio (market price of risk) is defined as: $\lambda \equiv \frac{\mu - r}{\sigma}$
- Any contingent claim on a firm's assets must have the same Sharpe ratio:

$$\lambda_E \equiv \frac{\mu_E - r}{\sigma_E} = \lambda \qquad \lambda_S \equiv \frac{\mu_S^{\mathbb{P}} - \mu_S^{\mathbb{Q}}}{\sigma_S} = -\lambda$$

- The relation between expected excess returns in equity and CDS markets is given by

$$\begin{aligned}(\mu_E - r) &= -\lambda_S \cdot \sigma_E \\ &= -(\mu_S^{\mathbb{P}} - \mu_S^{\mathbb{Q}}) \cdot \left[S^T \cdot \frac{V}{E} \cdot \frac{E_V}{|S_V|} \right].\end{aligned}$$

- To test these implications empirically, we define measures for the CDS-implied market price of risk and credit risk premia.

CDS-implied risk premium measures

- CDS-implied market price of risk

$$MPR^T_{t+\tau} \equiv \frac{\log \mathbb{E}^{\mathbb{Q}}_t \left[S^T_{t+\tau}\right] - \log \mathbb{E}^{\mathbb{P}}_t \left[S^T_{t+\tau}\right]}{\sqrt{\int_t^{t+\tau} \sigma^2_{S,u} du}}$$

- CDS-implied equity risk premium

$$ERP^T_{t+\tau} \equiv MPR^T_{t+\tau} \cdot \sqrt{\int_t^{t+\tau} \sigma^2_{E,u} du}$$

- CDS-implied relative credit risk premium

$$rel.RP^T_{t+\tau} \equiv \log \mathbb{E}^{\mathbb{Q}}_t \left[S^T_{t+\tau}\right] - \log \mathbb{E}^{\mathbb{P}}_t \left[S^T_{t+\tau}\right]$$

- CDS-implied credit risk premium

$$RP^T_{t+\tau} \equiv \mathbb{E}^{\mathbb{Q}}_t \left[S^T_{t+\tau}\right] - \mathbb{E}^{\mathbb{P}}_t \left[S^T_{t+\tau}\right]$$

Risk premia in the CDS term structure

- Our empirical approach is guided by the literature on risk premia in bond markets. (Fama and Bliss, 1987; Campbell and Shiller, 1991; Cochrane and Piazzesi, 2005.)

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

$$F_t^{\tau \times T} = \mathbb{E}_t^{\mathbb{Q}}\left[S_{t+\tau}^T\right]$$

- If investors demand compensation for bearing risk

$$F_t^{\tau \times T} = \mathbb{E}_t^{\mathbb{P}}\left[S_{t+\tau}^T\right] + RP_{t+\tau}^T.$$

- We define the expected excess change in CDS spreads as

$$\mathbb{E}_t^{\mathbb{P}}\left[RX_{t+\tau}^T\right] \equiv \mathbb{E}_t^{\mathbb{P}}\left[S_{t+\tau}^T\right] - F_t^{\tau \times T} = -RP_{t+\tau}^T.$$

- We estimate expected excess changes in CDS spreads using a single-factor approach in the spirit of Cochrane and Piazzesi (2005).

Estimating CDS-implied credit risk premia

- On a *firm-by-firm basis* we calculate cross-maturity averages

$$\overline{RX}_{t+\tau} \equiv \frac{1}{4} \sum_{T_k \in T} RX^{T_k}_{t+\tau}.$$

- We regress $\overline{RX}_{t+\tau}$ on the firm's term structure of forward CDS spreads $\mathbf{F_t}$, i.e.

$$\overline{RX}_{t+\tau} = (\gamma^{RX})^\top \mathbf{F_t} + \varepsilon^{RX}_{t+\tau}.$$

- The estimate of the firm's CDS-implied credit risk premium is thus given by

$$\widehat{RP}_{t+\tau} = -\gamma^{RX} \mathbf{F}_t.$$

- Analogously, we obtain the estimates $\widehat{MPR}_{t+\tau}$, $\widehat{ERP}_{t+\tau}$, and $\widehat{rel.RP}_{t+\tau}$.

- Using these firm-specific estimates, we explore the cross-section of equity returns.

Data

- All data is 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 credit ratings from Compustat.
  - Fama-French Factors from Kenneth French's online library.
- After extensive data quality checks we are left with 838,632 joint observations of CDS, equity, firm, and rating data for a total of 491 firms.
- Our core results are based on
  - monthly sampling frequency,
  - equally- and value-weighted equity returns.

Portfolios sorted by credit risk premia

- Monthly portfolio excess returns (value-weighted), Full sample: 01/2001 – 04/2010

	P1	P2	P3	P4	P5	P1–P5
Sort Variable: $\widehat{RP}_{t+\tau}$						
mean	30.65	4.98	1.20	−2.14	−29.52	
Portfolio Characteristics						
MV	12.41	18.89	29.34	31.93	18.05	
BM	0.77	0.60	0.53	0.55	0.77	
S5	251.64	100.02	67.92	72.17	196.57	
Rating	9.71	8.06	7.19	7.34	8.85	
Liquid	7.16	7.61	7.90	8.31	8.40	
Coskew	−3.33	−3.72	−4.61	−4.78	−2.65	
Portfolio Returns						
mean	−0.06	0.11	−0.48	−0.48	−1.81*	1.75***
	(−0.08)	(0.20)	(−0.95)	(−0.86)	(−1.79)	(3.65)
sd	6.90	4.76	4.30	4.34	7.32	4.16
SR	−0.03	0.08	−0.38	−0.39	−0.86	1.45
Asset Pricing						
CAPM α	−0.16	0.04	−0.53***	−0.54***	−1.91***	1.75***
	(−0.60)	(0.37)	(−2.96)	(−2.67)	(−4.85)	(3.28)
3-fac α	−0.26	−0.07	−0.49***	−0.56***	−2.03***	1.77***
	(−0.92)	(−0.54)	(−3.05)	(−2.97)	(−5.44)	(3.54)
4-fac α	−0.24	−0.07	−0.50***	−0.57***	−2.03***	1.79***
	(−0.90)	(−0.54)	(−3.00)	(−3.20)	(−5.39)	(3.90)

Portfolios sorted by credit risk premia

- Monthly excess returns (value-weighted): high minus low credit risk premium portfolios

All firms included

	Full	Pre-Crisis	Crisis
Portfolio Returns			
mean	1.75***	2.67***	4.16***
	(3.65)	(4.00)	(3.36)
sd	4.16	3.98	5.79
SR	1.45	2.33	2.49
Asset Pricing			
CAPM α	1.75***	2.71***	4.10***
	(3.28)	(4.02)	(3.43)
3-fac α	1.77***	3.14***	3.93***
	(3.54)	(3.94)	(3.83)
4-fac α	1.79***	3.14***	3.62***
	(3.90)	(4.01)	(3.99)
MKT	−0.11	−0.33**	−0.17
	(−1.07)	(−2.18)	(−0.90)
SMB	0.36***	0.13	0.43
	(2.48)	(0.80)	(0.85)
HML	−0.33*	−0.53**	−0.41
	(−1.85)	(−2.12)	(−0.76)

Excluding Financials and Utilities

	Full	Pre-Crisis	Crisis
Portfolio Returns			
mean	1.88***	2.56***	3.76***
	(4.04)	(3.95)	(3.52)
sd	4.21	4.29	4.71
SR	1.54	2.07	2.77
Asset Pricing			
CAPM α	1.87***	2.60***	3.76***
	(3.95)	(4.17)	(3.10)
3-fac α	1.83***	2.79***	3.70***
	(3.73)	(3.97)	(3.46)
4-fac α	1.84***	2.78***	3.42***
	(3.66)	(3.96)	(4.29)
MKT	−0.00	−0.30***	0.03
	(−0.03)	(−3.20)	(0.16)
SMB	0.30*	0.31	0.18
	(1.93)	(1.09)	(0.58)
HML	−0.17	−0.37**	−0.26
	(−1.26)	(−2.05)	(−1.51)

Controlling for firm characteristics

- We control for firm characteristics by doing sequential portfolio sorts:
  - sort firms with respect to a characteristic variable into tercile portfolios;
  - within each sub-portfolio, sort firm based on credit risk premia.
- We find that credit risk premia are priced in almost all portfolios sorted by
  - Size,
  - Book-to-market,
  - Probability of default (Credit Rating, 5-Year CDS spread),
  - CDS Liquidity (number of contributors reported by Markit),
  - Conditional coskewness (Harvey and Siddique, 2000).
- Buying high and selling low credit risk premium firms generates highest excess returns for small firms, value stocks, and firms with high default probabilities.

Out-of-sample parameter estimation

- Regression forecasts of credit risk premia using monthly and weekly data, rolling and expanding windows, OLS and quantile regressions, standard intercept corrections to account for potential changes in the dgp.

4-Factor Fama-French Alphas (annualized)

OLS Regressions

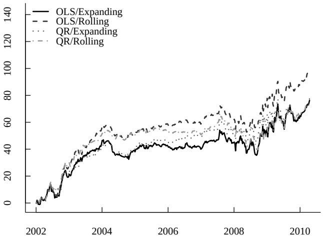
	P1–P5	P1–P10
monthly	5.26*	5.77
	(1.82)	(1.45)
weekly	9.18**	16.36***
	(2.02)	(2.70)

Quantile Regressions

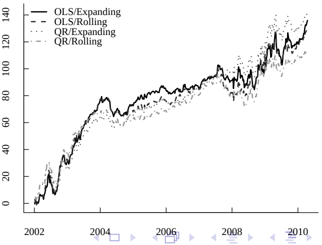
	P1–P5	P1–P10
monthly	4.61	8.36*
	(1.68)	(1.82)
weekly	9.34**	17.17***
	(2.14)	(2.81)

Cumulative 4-Factor Fama-French Alphas

Quintile Portfolios



Decile Portfolios



Insights for the 'distress puzzle'

- Recall that the equity excess return is given by

$$\mu_E - r = \lambda \cdot \sigma_E.$$

- We can rewrite the market price of risk in terms of default probabilities:

$$\lambda = \left(\Phi^{-1}(PD^{\mathbb{Q}}) - \Phi^{-1}(PD^{\mathbb{P}})\right) \frac{1}{\sqrt{T}}$$

- The relation of stock returns and default probabilities depends on the sources driving differences across firms:

	$\frac{\partial(\mu_E - r)}{\partial}$	$\frac{\partial PD^{\mathbb{P}}}{\partial}$		$\frac{\partial PD^{\mathbb{Q}}}{\partial}$	
$\frac{\partial}{\partial L}$	$+$	$+$		$+$	
$\frac{\partial}{\partial \mu}$	$+$	$-$	'distress puzzle'	0	
$\frac{\partial}{\partial \sigma}$	$-$	$+$	'distress puzzle'	$+$	'distress puzzle'

- Our credit risk premium estimates account for, both, actual and risk-neutral information.

Conclusion

- While previous research considers either actual or risk-neutral probabilities of default, we argue that credit risk premia priced in stock returns depend on, both, real-world *and* risk-neutral default risk information.
- We estimate credit risk premia from the term structure of CDS spreads.
- Consistent with structural models, firms' equity returns and Sharpe ratios increase with estimated credit risk premia.
- Returns of buying high and selling low risk premium firms cannot be explained by traditional risk factors.
- We offer insights on the 'distress puzzle'.
- Our results are robust across pre-crisis and crisis sub-samples, return weighting schemes, full- and out-of-sample parameter estimations.

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- CDS markets and equity returns
- **CDS markets and higher moments of equity returns**
- CDS markets and sovereign bond returns

CDS markets and higher moments of equity returns

This section based on

The Cross-Section of Credit, Variance, and Skew Risk

Paul Schneider (University of Lugano), Christian Wagner (CBS), Josef Zechner (WU Vienna)

Motivation

- We know a lot about the cross-section of expected equity returns...
  ... but relatively little about
  - the cross-section of equity option returns
  - the cross-section of risk premiums implicit in higher moments of equity returns, e.g. variance swaps, skew swaps. .
- Higher moments of equity returns matter because
  - risk-averse investors care about variance and skewness.
  - investors hedging equity exposure need to understand (the relation of) risk premia on underlying and derivatives.
  - informed traders prefer to trade options rather than the underlying.
  - investors trade premia on variance and skewness risk and skew risk.
  - ...

Understanding higher moments in a structural framework

- We use insights from a simple structural model following Merton (1974) to explore the cross-section of higher equity moments:
  - model features a single return driver for claims issued by the same firm,
  - risk premia and higher moments of all claims related to same source,
  - return characteristics of one corporate claim represent relevant information for all other claims' characteristics.
- Treating equity as an option generates
  - stochastic variance and skewness of equity returns,
  - premia compensating for variance and skew risk.
- Expectations can be interpreted in terms of default risk
  - $\mathbb{Q}$-expectations for all moments of all corporate claims are related to risk-neutral probabilities of default ($PD^{\mathbb{Q}}$).
  - Expected excess returns are related to credit risk premia.

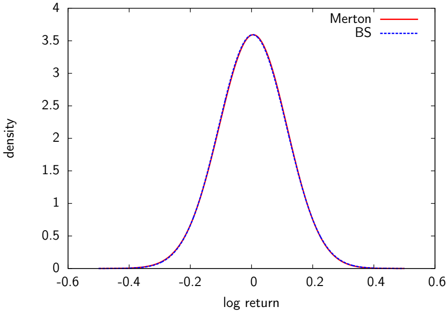
Empirical challenge

- In reality, the link between return characteristics of different corporate securities may be more complex, because of
  - additional risk factors,
  - market segmentation,
  - limits-to-arbitrage,
  - investor constraints, ...

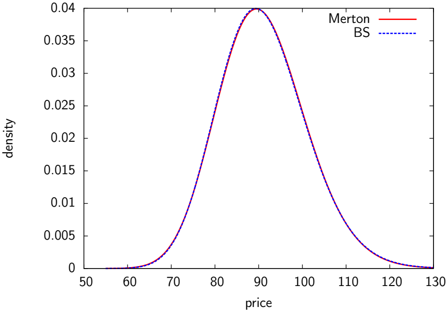
  $\rightarrow$ options are not just a function of underlying and risk-free rate.
- It is an empirical question whether there is a first-order relation between return moments of different claims.
- We investigate this question!

Equity distribution: Merton vs. Black-Scholes I

- *Low credit risk:* $V_0 = 100$, $\sigma = 0.1$, $r = 0.01$, $D = 10$.



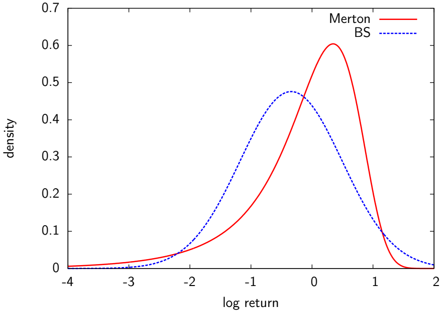
(a) Return density



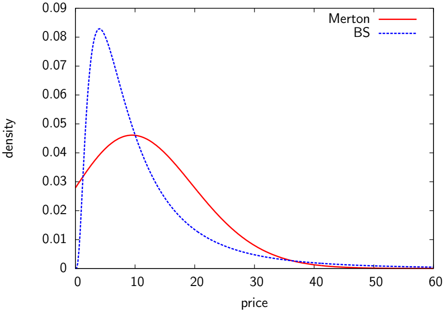
(b) Price density

Equity distribution: Merton vs. Black-Scholes II

- *High credit risk:* $V_0 = 100$, $\sigma = 0.1$, $r = 0.01$, $D = 90$.



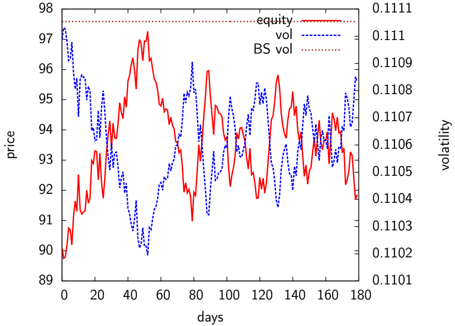
(c) Return density



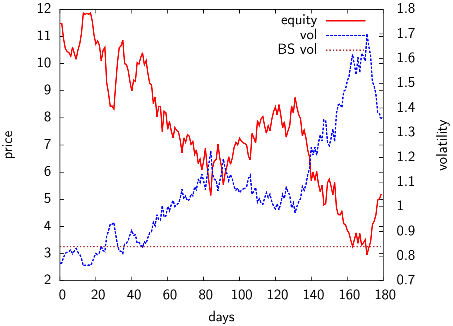
(d) Price density

Equity volatility: Merton vs. Black-Scholes

- Equity variance is stochastic.
- Same is true for other higher moments of equity returns.



(e) Low credit risk



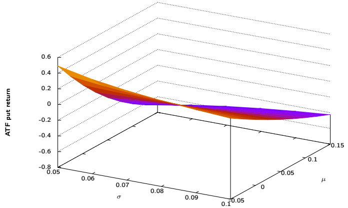
(f) High credit risk

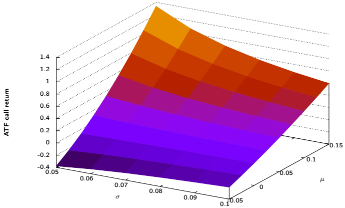
Credit risk and expected returns on equity options (1)

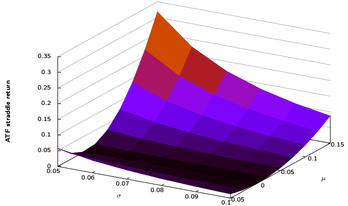
- We can simulate the expected stock options returns in a Merton framework
- To this end we assume that time to maturity $T = 1/12$, value of the firm's assets today $v_0 = 100$, the face value of debt $D = 80$, the risk-free rate $r = 0.01$. Asset volatility σ, and the drift of asset value process, μ will be plotted on the x-axis and y-axis, respectively.
- We will consider puts, calls, straddles (a long call and a long put with the same strike price and maturity) and risk-reversals (a long OTM call and a short OTM put at the same moneyness).

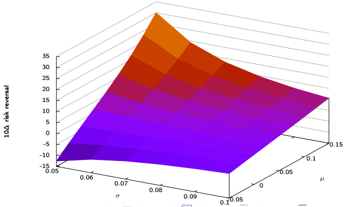
Credit risk and expected returns on equity options (2)

- Risk premiums on puts negatively related to μ and positively to σ (like CDS risk premiums)
- The opposite is true for risk premiums on calls and risk reversals (opposite to CDS risk premiums)
- Straddles: also negatively related to CDS risk premiums but least pronounced comp. statics









Ex-ante measures of variance

- $\mathbb{Q}$-expectations of higher equity moments can be computed from prices of equity option portfolios.
- Ex-ante variance is a portfolio of OTM put and OTM call options:
  - Using simple returns

$$v^s_{t,T} \equiv \mathbb{E}^{\mathbb{Q}}_t \left[RV^s_{t,T} \right] = \frac{2}{p_{t,T} F^2_{t,T}} \left(\int_0^{F_{t,T}} P_{t,T}(K) dK + \int_{F_{t,T}}^{\infty} C_{t,T}(K) dK \right).$$

- We use the simple return specification in the core analysis.

Ex-ante measures of variance and skewness (ctd.)

- We decompose $v^s_{t,T}$ into lower and upper semi-variances

$$lsv^s_{t,T} \equiv \frac{2}{p_{t,T} F^2_{t,T}} \left(\int_0^{F_{t,T}} P_{t,T}(K) dK \right),$$

$$usv^s_{t,T} \equiv \frac{2}{p_{t,T} F^2_{t,T}} \left(\int_{F_{t,T}}^{\infty} C_{t,T}(K) dK \right).$$

- Ex-ante skewness

$$sk^s_{t,T} \equiv usv^s_{t,T} - lsv^s_{t,T} = \frac{2}{p_{t,T} F^2_{t,T}} \left(\int_{F_{t,T}}^{\infty} C_{t,T}(K) dK - \int_0^{F_{t,T}} P_{t,T}(K) dK \right).$$

Trading higher moments with swap contracts

- Ex-ante variance $v^s_{t,T}$ also represents the fixed leg of a variance swap that pays the difference between realized and ex-ante variance at T

$$RV^s_{t,T}(N) - v^s_{t,T}, \qquad \text{where} \qquad RV^s_{t,T}(N) \equiv \sum_{i=1}^{N} \left(\frac{F_{t_i,T} - F_{t_{i-1},T}}{F_{t,T}} \right)^2 .$$

- The variance risk premium is given by:

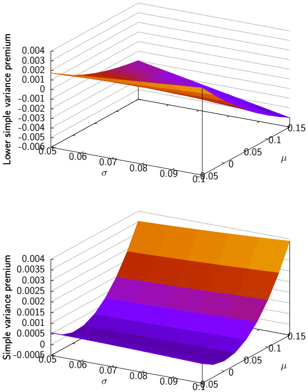
$$\begin{aligned} VRP^s_{t,T} &= \mathbb{E}^{\mathbb{P}}_t \left[RV^s_{t,T}(N) \right] - \mathbb{E}^{\mathbb{Q}}_t \left[RV^s_{t,T}(N) \right] \\ &= \mathbb{E}^{\mathbb{P}}_t \left[RV^s_{t,T}(N) \right] - v^s_{t,T} \\ &= \frac{2}{p_{t,T} F^2_{t,T}} \left(\int_0^{F_{t,T}} P^{\mathbb{P}}_{t,T}(K) - P_{t,T}(K) dK + \int_{F_{t,T}}^{\infty} C^{\mathbb{P}}_{t,T}(K) - C_{t,T}(K) dK \right) \end{aligned}$$

$\Rightarrow$ $VRP^s_{t,T}$ is an integral over option risk premia.

- Corresponding expressions for $LSVRP^s_{t,T}$, $USVRP^s_{t,T}$, $SKRP^s_{t,T}$

Credit risk and premia for variance and skew risk

- Since swap risk premia are portfolios of option risk premia, the intuition derived for equity options applies.



Data

- Equity data from CRSP.
- CDS spreads from Markit, maturities 1, 3, 5, 7, and 10 years.
- Equity option data from Option Metrics, maturity $\sim$ 1 month.
- Sample period: 01/2001 to 04/2010.
- Various filters to ensure data quality.
- Cross-section of approximately 500 firms.
- From daily data, we generate two monthly series:
  - option expiration dates of each month.
  - end of month.

CDS-implied risk premia (Friewald et al, 2013)

- As in Friewald Wagner Zechner (2013) we calculate forward CDS spreads: $\mathbf{F_t} = (F_t^{1\times1}, F_t^{3\times1}, F_t^{5\times1}, F_t^{7\times1})$
- We then regress excess returns $RX_{t+\tau}^{T_k} \equiv S_{t+\tau}^{T_k} - F_t^{\tau\times T_k}$ and $rx_{t+\tau}^{T_k} \equiv \log S_{t+\tau}^{T_k} - \log F_t^{\tau\times T_k}$ on $\mathbf{F_t} = (1, S_t^1, F_t^{1\times1}, F_t^{3\times1}, F_t^{5\times1}, F_t^{7\times1})$
- This results in estimated CDS-implied risk premiums:

$$\widehat{CRP}_{t+\tau} = -(\gamma^{RX})^\top \mathbf{F_t},$$
$$\widehat{crp}_{t+\tau} = -(\gamma^{rx})^\top \mathbf{F_t}.$$

$\widehat{crp}$-sorted portfolios and equity option returns

	ATM				Δ10			
	P	C	ST	RR	P	C	ST	RR
Panel A. Full Sample (01/2001 - 04/2010)								
P_1	-20.68	13.79	-6.89	36.62	-47.21	11.77	-23.28	3.31
P_2	-18.14	5.69	-6.55	16.91	-25.26	-51.02	-43.06	-6.59
P_3	-7.18	2.71	-7.78	12.16	-35.36	-40.84	-33.04	-6.74
P_4	-6.05	-2.93	-5.81	-16.31	-31.98	-14.45	-18.63	-3.79
P_5	6.62	-8.54	-7.61	-18.66	1.28	-54.85	-21.69	-15.44
$P_1 - P_5$	-27.30	22.32	0.72	55.27	-48.50	66.62	-1.58	18.75
	[-3.30]	[6.10]	[0.24]	[4.30]	[-2.42]	[3.31]	[-0.14]	[2.76]

$\widehat{crp}$-sorted portfolios and swap returns

	Semi-variance swaps		Variance swaps	Skew swaps
	$lsvrp^s$	$usvrp^s$	vrp^s	$skrp^s$
	Panel A. Full Sample (01/2001 - 04/2010)			
P_1	0.81	29.36	13.21	3.52
P_2	3.84	20.41	10.07	0.93
P_3	15.03	19.29	15.70	-0.46
P_4	13.33	16.28	13.47	-0.74
P_5	24.06	11.48	16.46	-2.61
$P_1 - P_5$	-23.25	17.88	-3.24	6.13
	[-3.61]	[3.26]	[-0.94]	[3.17]

Intermediate summary

- There is a link of firms' credit risk to
  - IVs and returns of options traded on its equity,
  - the higher moments of its equity returns and associated risk premia.
- Our findings are robust to
  - sub-sample periods (results more pronounced during the crisis),
  - the log specification for swap contracts,
  - alternative measures for CDS-implied risk premia.
- The empirical findings are consistent with the structural framework.

Some evidence on the cross-section of equity returns

- Empirical research suggests, for instance, that
  1. (1) firms with high default risk earn low returns ("distress puzzle").
  2. (2) ex-ante variance negatively predicts stock returns.
  3. (3) evidence on the link between ex-ante skew and equity returns is mixed.
- From a structural model perspective,
  - results (1) and (2) are essentially equivalent.
  - the relation between results (1) and (3) should depend on the specification of the skew measure.

Portfolios sorted by CDS spreads and ex-ante moments

- Correlations of high-minus-low equity returns of quintile portfolios sorted by CDS spreads and ex-ante moments.

	Full Sample (01/2001-04/2010)	Pre-Crisis (01/2001-06/2010)	Crisis (07/2007-04/2010)
	Panel A. Ex-Ante Variance		
lsv^s	89.76	83.01	94.58
usv^s	89.16	80.50	95.16
v^s	89.80	82.90	94.70
	Panel B. Ex-Ante Skewness		
sk^s	15.75	10.35	20.50
sk^l	-83.27	-71.68	-90.92
sk^{KNS}	-71.27	-52.42	-82.96
sk^{BKM}	36.30	38.88	35.32

A single source of risk across corporate claims ?

- Sizable covariation in returns on variance swaps, skew swaps, equity, and CDS spreads ⇒ single-factor paradigm not overly restrictive.

Panel B. *Pooled* PCA of Returns on Variance Swaps, Skew Swaps, Equity, and CDS

	Variance	
	Proportion	Cumulative
PC_1	77.05	77.05
PC_2	11.75	88.80
PC_3	10.37	99.17
PC_4	0.83	100.00

	Loadings			
	PC_1	PC_2	PC_3	PC_4
vrp^s	0.08	-0.77	0.63	-0.05
$skrp^s$	-0.04	-0.18	-0.15	0.97
r^E	-0.15	-0.61	-0.74	-0.24
r^{CDS}	0.98	-0.04	-0.17	0.00

Credit risk premia and returns on corporate claims

	Variance swap vrp^s	Skew swap $skrp^s$	Equity r^E	CDS r^{CDS}
Panel A. Full Sample (01/2001 - 04/2010)				
P_1	13.21	3.52	15.81	-39.65
P_2	10.07	0.93	6.08	14.67
P_3	15.70	-0.46	3.00	28.24
P_4	13.47	-0.74	-3.37	44.04
P_5	16.46	-2.61	-6.48	78.01
$P_1 - P_5$	-3.24	6.13	22.29	-117.65
	[-0.94]	[3.17]	[4.65]	[-7.40]
Alpha	-3.66	6.14	22.64	-126.68
	[-1.12]	[3.94]	[5.01]	[-9.29]

Conclusion

- We use a structural framework to derive the relation between credit risk and higher moments of the equity return distribution.
- Consistent with the model implications, we find that
  - equity option IVs as well as ex-ante variance and skewness increase with CDS spreads,
  - returns to trading options, variance, and skewness are related to CDS-implied risk premia.
- A structural model perspective is further supported by finding that
  - previous results on the cross-section of equity returns can be connected,
  - there is covariation in returns across different corporate claims.

Agenda

- Introduction
- CDS markets and equity returns
- CDS markets and higher moments of equity returns
- **CDS markets and sovereign bond returns**

CDS markets and sovereign bond returns

This section based on

Sovereign Bond Risk Premiums

Engelbert Dockner (WU Vienna), Manuel Mayer (OeNB),
Josef Zechner (WU Vienna)

Motivation (1)

- In this paper we construct an asset pricing model, that exploits information from both default-free interest rates and sovereign CDS information to predict sovereign bond risk premiums.
- We thereby build on Fama & Bliss (1987) and Cochrane & Piazzesi (2005) who show that U.S. government bond risk premiums can be predicted by a linear combination of one-year forward rates.
- We cover eurozone countries with the German term-structure of interest rates plus each country's CDS term structure to estimate market and credit factors.

Strategy

- Use sovereign CDS term structure to compute forward CDS spreads, then use forward CDS spreads to construct a common **euro-zone credit factor** and **country-specific credit factors:**
    - Extract the first PC from each country's forward CDS curve.
    - Compute the first PC of the country-specific PCs and identify this as the **common euro-zone credit factor.**
    - Regress each country-specific PC on the common euro-zone credit factor and define the residual (orthogonal component) as the **country-specific credit factor.**

Market Risk Factor

- Focus on euro zone, use **German term structure** as risk-free benchmark.
- Take term structure of German forward interest rates and extract the first three PCs:

$$\boldsymbol{MF}_t' = \left[PC_t^{DE(1)} \quad PC_t^{DE(2)} \quad PC_t^{DE(3)} \right].$$

- Market risk factor is the same for all euro-zone countries (common monetary policy).

Credit Risk Factors

- Extract first PC from each country's forward CDS curve.
- Extract the first PC from the individual country's first PCs, common euro-zone credit factor, $CF_t^{(Euro)}$.
- For each country i, regress first PC from step one on $CF_t^{(Euro)}$:

$$PC_t^{(i)} = \beta^{(i)} \, CF_t^{(Euro)} + \epsilon_t^{(i)}.$$

with $CF_t^{(Country,i)} \equiv \epsilon_t^{(i)}$, country-specific credit factor.

Model Specification (1)

- Basic model: regress average excess HPR on market and credit factors:

$$\overline{rx}_{t+1}^{(i)} = \delta_0^{(i)} + \gamma' \boldsymbol{MF}_t + \delta_1^{(i)} CF_t^{(Country,i)} + \delta_2^{(i)} CF_t^{(Euro)} + \varepsilon_{t+1}^{(i)}$$

  - $\overline{rx}_t^{(i)} = \frac{1}{8} \sum_{n=1}^{8} rx_t^{(i,n)}$, $rx_t^{(i,n)} = r_t^{(i,n)} - r_t^{(DE,n)}$
  - $r_t^{(i,n)}$ ... holding period return of country i and maturity n $(n = 1, ..., 8)$.
  - $\gamma' = [\gamma_1 \quad \gamma_2 \quad \gamma_3]$.

Model Specification (2)

- Redo regression also for individual maturities to confirm that main results hold not only for the average excess HPR but also for the returns of individual bond maturities:

$$
\begin{aligned}
rx_{t+1}^{(i,n)} &= \delta_0^{(i,n)} + \gamma'^{(n)} \boldsymbol{MF}_t + \delta_1^{(i,n)} CF_t^{(Country,i)} \\
&\quad + \delta_2^{(i,n)} CF_t^{(Euro)} + \varepsilon_{t+1}^{(i,n)}
\end{aligned}
$$

Dataset

- Weekly CDS spreads for 9 euro-zone countries (Austria, Belgium, France, Ireland, Italy, Netherlands, Portugal, Slovakia, Spain).
- Weekly spot rates for Germany are used as the risk-free term structure.
- For our forward interest rates and forward CDS spreads we use maturities of one year, starting in 1, 3, 5, and 7 years.
- Holding period returns are based on zero coupon bond prices with maturities from 1 to 8 years, computed on a yearly basis.
- Data sources are Bloomberg and Datastream with the sample period ranging from January 2006 to July 2013.

Constructing the Market Factor

PC Analysis – Forward Interest Rates

Principal Component	**Percent explained**	**Total**	
First	0.89	0.89	
Second	0.09	0.98	
Third	0.02	1.00	
Loadings	**First**	**Second**	**Third**
$f^{2,DE}$	0.4684	0.7534	0.3420
$f^{4,DE}$	0.5259	0.1254	-0.2761
$f^{6,DE}$	0.5168	-0.2495	-0.6311
$f^{8,DE}$	0.4868	-0.5954	0.6391

Constructing Credit Factors (1)

PC Analysis – Forward CDS Austria

Principal Component	**Percent explained**	**Total**	
First	0.98	0.98	
Second	0.02	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Austria}$	0.4930	0.8477	0.1943
$cf^{4,Austria}$	0.5032	-0.0991	-0.8118
$cf^{6,Austria}$	0.5023	-0.3316	0.0787
$cf^{8,Austria}$	0.5013	-0.4020	0.5450

Constructing Credit Factors (2)

PC Analysis – Forward CDS Belgium

Principal Component	**Percent explained**	**Total**	
First	0.99	0.99	
Second	0.00	1.00	
Third	0.00	1.00	
Loadings	**First**	**Second**	**Third**
$cf^{2,Belgium}$	0.4980	0.8661	0.0049
$cf^{4,Belgium}$	0.5006	-0.3048	0.7694
$cf^{6,Belgium}$	0.5008	-0.2466	-0.1542
$cf^{8,Belgium}$	0.5006	-0.3101	-0.6199

Extracting a European Credit Risk Factor

Principal Components Analysis of Countries' First PCs

Principal Component	Percent explained	Total	
First	0.92	0.92	
Second	0.05	0.97	
Third	0.02	0.99	
Loadings	**First**	**Second**	**Third**
Austria	0.3232	0.4976	0.3709
Belgium	0.3420	-0.1606	0.0257
France	0.3432	-0.0732	-0.2916
Ireland	0.3243	-0.3612	0.6936
Italy	0.3417	-0.0127	-0.3738
Netherlands	0.3320	0.4087	0.1704
Portugal	0.3276	-0.4434	-0.1742
Slovakia	0.3285	0.4071	-0.3006
Spain	0.3368	-0.2476	-0.0787

Estimation Results - Basic Model

Model: $\overline{rx}^{(i)}_{t+1} = \delta^{(i)}_0 + \gamma^{(i)} MF_t + \delta^{(i)}_1 CF^{(Euro)}_t + \delta^{(i)}_2 CF^{(Country,i)}_t + \varepsilon^{(i)}_{t+1}$

	Austria	Belgium	France	Ireland	Italy	Netherl.	Portugal	Slovakia	Spain
$\delta^{(i)}_0$	0.0020	0.0036	0.0007	0.0153	-0.0022	0.0005	0.0221	0.0020	-0.0071
	(0.09)	(0.01)	(0.80)	(0.01)	(0.75)	(0.27)	(0.31)	(0.08)	(0.27)
$\gamma^{(i)}_1$	-0.0019	0.0110	0.0009	0.0452	0.0186	-0.0005	0.0216	-0.0022	-0.0015
	(0.16)	(0.00)	(0.44)	(0.01)	(0.00)	(0.33)	(0.07)	(0.22)	(0.74)
$\gamma^{(i)}_2$	0.0132	0.0277	0.0063	0.1260	0.0233	0.0033	0.1824	0.0059	0.0362
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
$\gamma^{(i)}_3$	0.0164	0.0064	-0.0126	0.0304	-0.0429	0.0003	0.1590	-0.0056	0.0010
	(0.02)	(0.00)	(0.09)	(0.07)	(0.02)	(0.78)	(0.00)	(0.25)	(0.93)
$\delta^{(i)}_1$	0.0034	0.0156	0.0040	0.0583	0.0209	0.0014	0.0655	0.0030	0.0069
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.06)
$\delta^{(i)}_2$	0.0180	-0.0153	0.0190	0.0442	0.0985	0.0102	-0.0231	0.0163	0.0027
	(0.00)	(0.02)	(0.22)	(0.00)	(0.00)	(0.00)	(0.41)	(0.00)	(0.85)
R^2	0.65	0.60	0.43	0.80	0.61	0.67	0.60	0.66	0.45
R^2_M	0.35	0.36	0.34	0.40	0.34	0.31	0.48	0.35	0.42

Risk Premium Volatility

Country	$\sigma_{\overline{rx}}$	σ_{MRP}	σ_{ECRP}	σ_{CCRP}	σ_{TCRP}
Austria	0.0201	0.0098	0.0099	0.0129	0.0163
Belgium	0.0359	0.0269	0.0451	0.0050	0.0454
France	0.0172	0.0053	0.0114	0.0053	0.0126
Ireland	0.1168	0.1153	0.1683	0.0309	0.1711
Italy	0.0540	0.0393	0.0603	0.0334	0.0689
Netherlands	0.0089	0.0022	0.0040	0.0058	0.0071
Portugal	0.2182	0.1255	0.1891	0.0150	0.1897
Slovakia	0.0201	0.0057	0.0087	0.0104	0.0136
Spain	0.0426	0.0224	0.0198	0.0013	0.0198
Average	0.0593	0.0392	0.0574	0.0133	0.0605

$MRP = \widehat{\gamma}^{(i)} MF_t$; $ECRP = \widehat{\delta_1}^{(i)} CF_t^{(Euro)}$; $CCRP = \widehat{\delta_2}^{(i)} CF_t^{(Country,i)}$;

$TCRP = \widehat{\delta_1}^{(i)} CF_t^{(Euro)} + \widehat{\delta_2}^{(i)} CF_t^{(Country,i)}$

Conclusion

- Extend approach of Cochrane & Piazzesi (2005) by using information contained in the term structure of sovereign CDS spreads.
- Use sovereign CDS term structure to construct a common euro-zone and country-specific credit factors.
- Adding credit factors significantly increases fit of our model, represented by an increase in average R^2 from 0.37 to 0.61.
- The common euro-zone credit factor is significant for all countries in the sample (marginally for Spain).
- Volatility of bond risk premiums can be attributed primarily to the common euro-zone credit factor. The country-specific credit factor plays a limited role.

Concluding remarks

- CDS information seems to be very useful in other, related markets
- Corporate CDS forward term structure predicts the cross-section of equity risk premiums
- Corporate CDS forward term structure predicts risk premiums associated with higher moments, i.e. variance and skewness
- The structural model sheds light on puzzles such as the distressed firms puzzle or the low-vol puzzle
- Country CDS forward term structure predicts sovereign bond risk premiums
- Exploring cross-market linkages seems to be an interesting direction for academic research and for practical asset management strategies