TIME-VARYING CREDIT RISK AND LIQUIDITY PREMIA IN BOND AND CDS MARKETS

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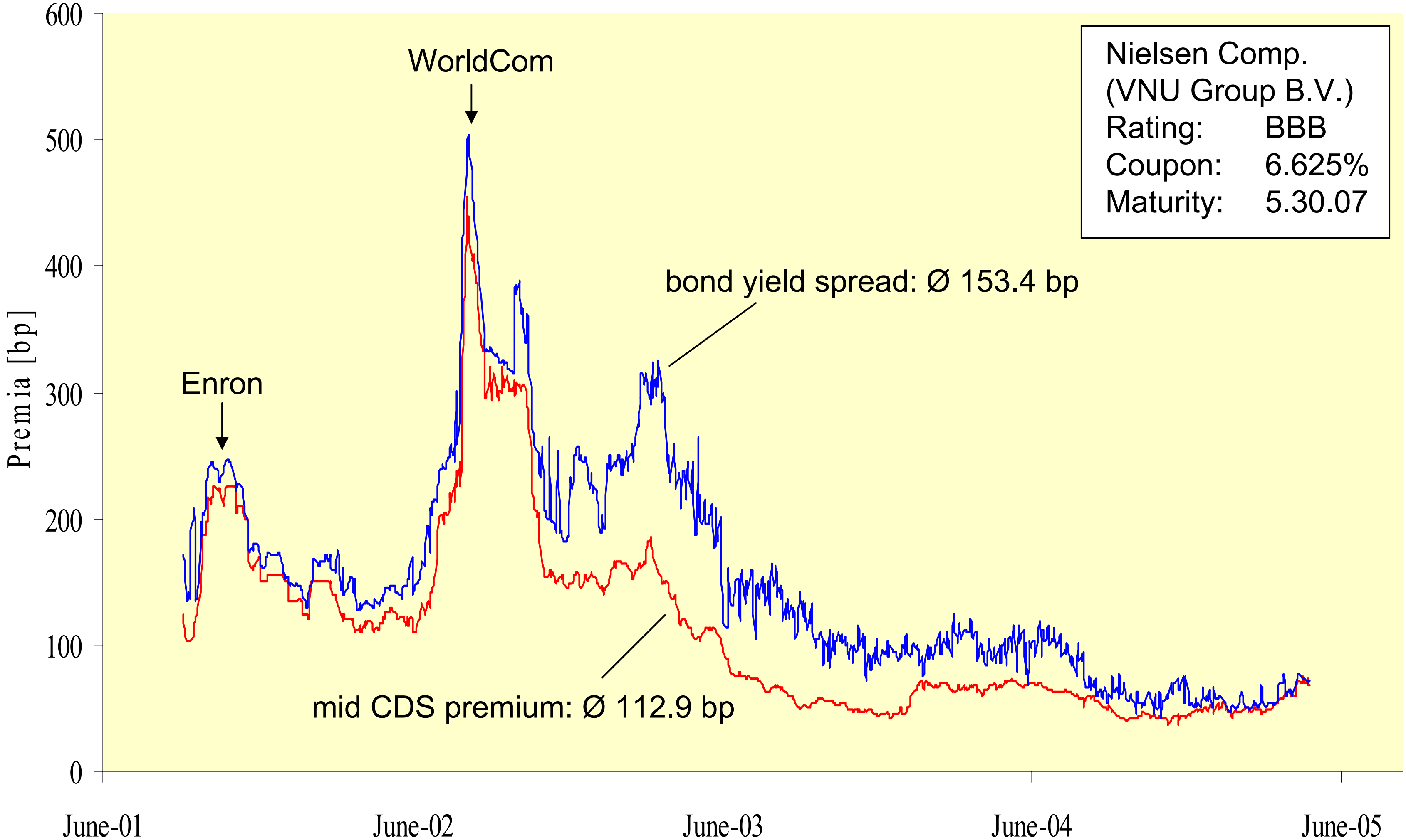
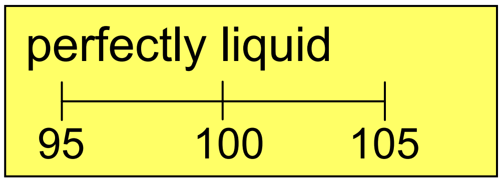
BOND SPREADS AND CDS PREMIA

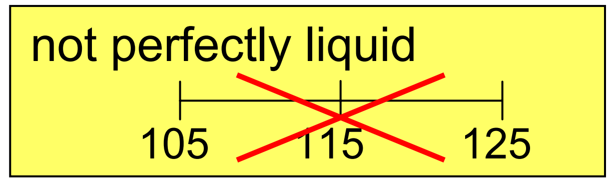


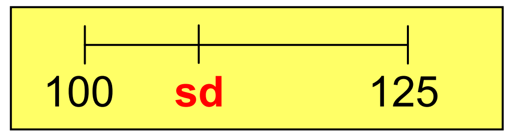
CONTRIBUTION

- CDS not liquidity-risk free

  different effects in bond and CDS markets







- illiquidity spillover from bond market in case of default
- reduced-form model for both markets

  identical credit-risk rates

  bond and CDS bid/ask liquidity rates
- liquidity-risk free bond yield spread and CDS premium
- empirical analysis of credit risk, liquidity, and correlation premia

FINDINGS

- consistently positive liquidity premia in bond market (Longstaff et al. 05)
- bond spread partition : 60% credit risk
  35% liquidity
  5% correlation (Elton et al. 01, Huang/Huang 03)
- CDS market : 95% credit risk
  4% liquidity
  1% correlation (Tang/Yan 07, Nashikkar et al. 07)
- time-varying credit risk, liquidity, and correlation premia
- illiquidity positively related with credit risk (Ericsson/Renault 06)
  - cross-sectional relation of premia
  - changes of illiquidity and credit risk
  - bond liquidity dries up if credit risk increases, CDS depends on rating
- bond and CDS liquidity premia negatively related

THE MODEL

- reduced-form model

$$E\,[\,D_t \cdot P_t \cdot L_t]$$

risk-free discount factor	survival probability	liquidity discount factor
r	λ	$\gamma^{b}, \gamma^{ask}, \gamma^{bid}$

- 5-factor risk structure:

  - independent latent factors r, x, y^{b}, y^{ask}, y^{bid}

  - λ, $\gamma^{b}, \gamma^{ask}, \gamma^{bid}$ linear functions of latent factors

$\Rightarrow$ direct correlation of credit risk and liquidity (via x & y)

$\Rightarrow$ direct (via x) and indirect (via y) correlation of bond & CDS liquidity

THE MODEL

BOND PRICE

Bond Price:

$$c \cdot \sum_{i=1}^{n} E_t\left[D(t_i)\cdot P(t_i, x_{t_0}; f)\cdot L\left(t_i, y_{t_0}^{b}; g\right)\right] + E_t\left[D(t_n)\cdot P(t_n, x_{t_0}; f)\cdot L(t_n, y_{t_0}^{b}; g)\right]$$
$$+R \cdot \sum_{j=1}^{N} E_t\left[D(\theta_j)\cdot \Delta P(\theta_j, x_{t_0}; f)\cdot L(\theta_j, y_{t_0}^{b}; g)\right]$$

CDS ASK PREMIUM

Fixed Leg :

$$s^{ask} \cdot \left(\begin{array}{l} \sum_{i=1}^{m} E_t\left[D(T_i)\cdot P(T_{i-1}, x_{T_0}; f)\cdot L\left(T_i, y_{T_0}^{ask}; g\right)\right] \\ +\sum_{j=1}^{M} E_t\left[\delta_j D(\theta_j)\cdot \Delta P(\theta_j, x_{t_0}; f)\right] \end{array} \right)$$

Floating Leg :

$$\sum_{j=1}^{M} E_t\left[D(\theta_j)\cdot \Delta P(\theta_j, x_{t_0}; f)\cdot \left[1 - R\cdot L(\theta_j, y_{t_0}^{b}; g)\right]\right]$$

CREDIT RISK, LIQUIDITY, AND CORRELATION PREMIA

BOND:

credit spread: par bond price $(y^b = f = g = 0) =: \sum_i CF_{t_i}(1 + y + bd)^{-t_i}$

liquidity spread: par bond price $(y^b,\ f = g = 0) =: \sum_i CF_{t_i}(1 + y + bd + bl)^{-t_i}$

correlation spread: par bond price $(y^b,\ f,\ g) =: \sum_i CF_{t_i}(1 + y + bd + bl + bc)^{-t_i}$

CDS:

credit spread: premium sd $s(y^b,\ y^{ask/bid} = f = g = 0)$

liquidity spread: premium sl mid premium $(y^b,\ y^{ask}, y^{bid},\ f = g = 0) - sd$

correlation spread: premium sc mid premium $(y^b,\ y^{ask}, y^{bid},\ f = g = 0) - sd - sl$

market pressure on demand side $\Rightarrow$ ask $\uparrow$ $\Rightarrow$ sl $\uparrow$
$\Rightarrow$ sd closer to bid side

DATA AND EMPIRICAL DESIGN

- period 06/01 to 07/07 ; daily data; firm-specific estimation
- risk-free term structure of interest rates : German Gov't Bonds
- CDS : large US investment bank (quotes, transaction prices); 5 yrs
  bonds : Bloomberg (mid prices), average notch rating AAA-CCC

Step 1: process parameter values for x, y^{b}, y^{ask}, y^{bid}, correlation f, g

Step 2: estimation of time series (x_t, y_t^{b}, y_t^{ask}, y_t^{bid}), t = 1, …, 1548

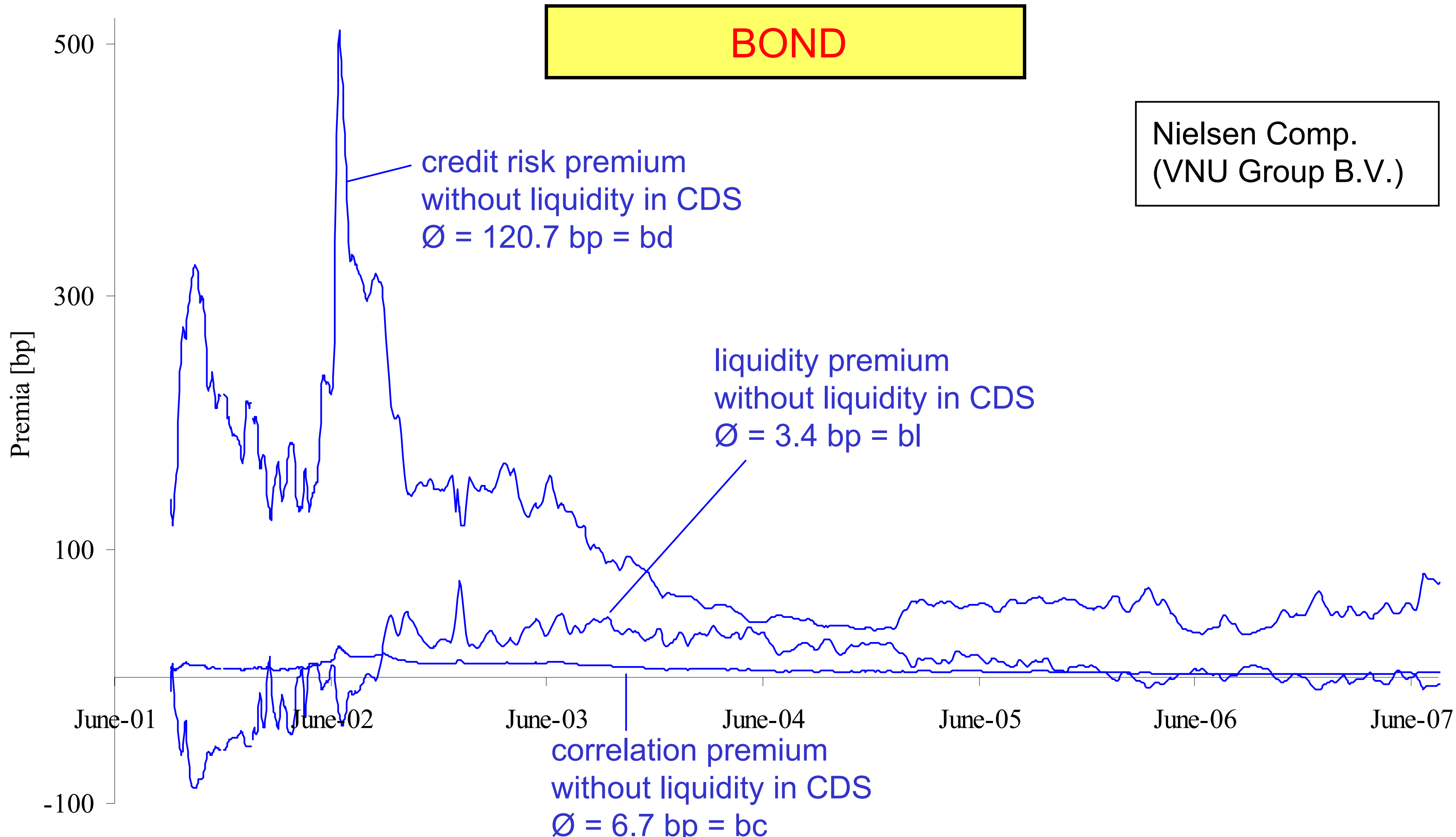
$$\min \sum_t \sum_i \left(P_{t,i}^{theor.}(\alpha,\dots,\eta^{c_b}) - P_{t,i}^{obs.}\right)^2$$

Step 3: update f, g from time series (x_t, y_t^{b}, y_t^{ask}, y_t^{bid}), etc.

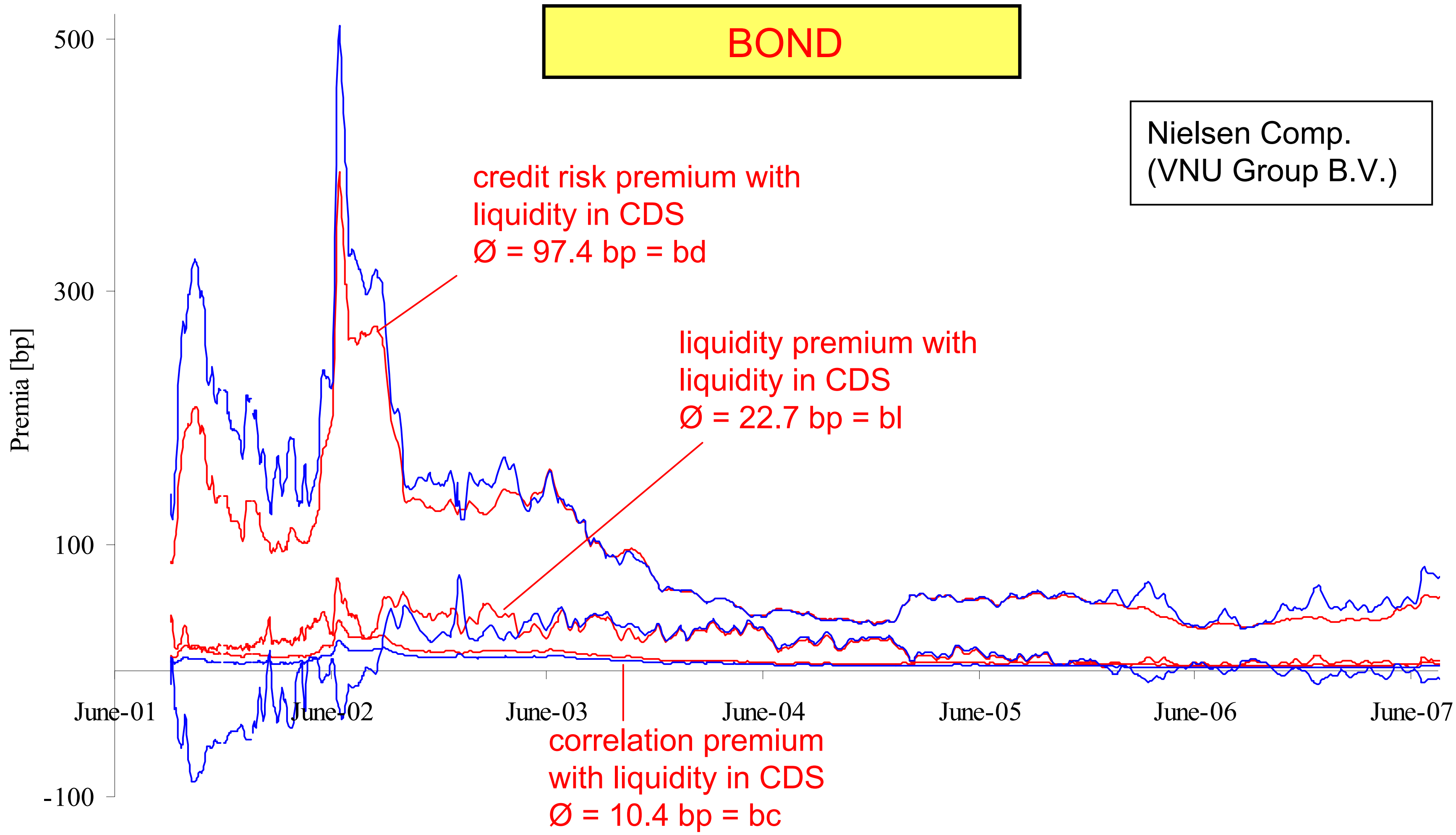
Step 4: synthetic 5 year par bond: bd, bl, bc

5 year CDS: sd, sl, sc

FIRM-SPECIFIC ANALYSIS



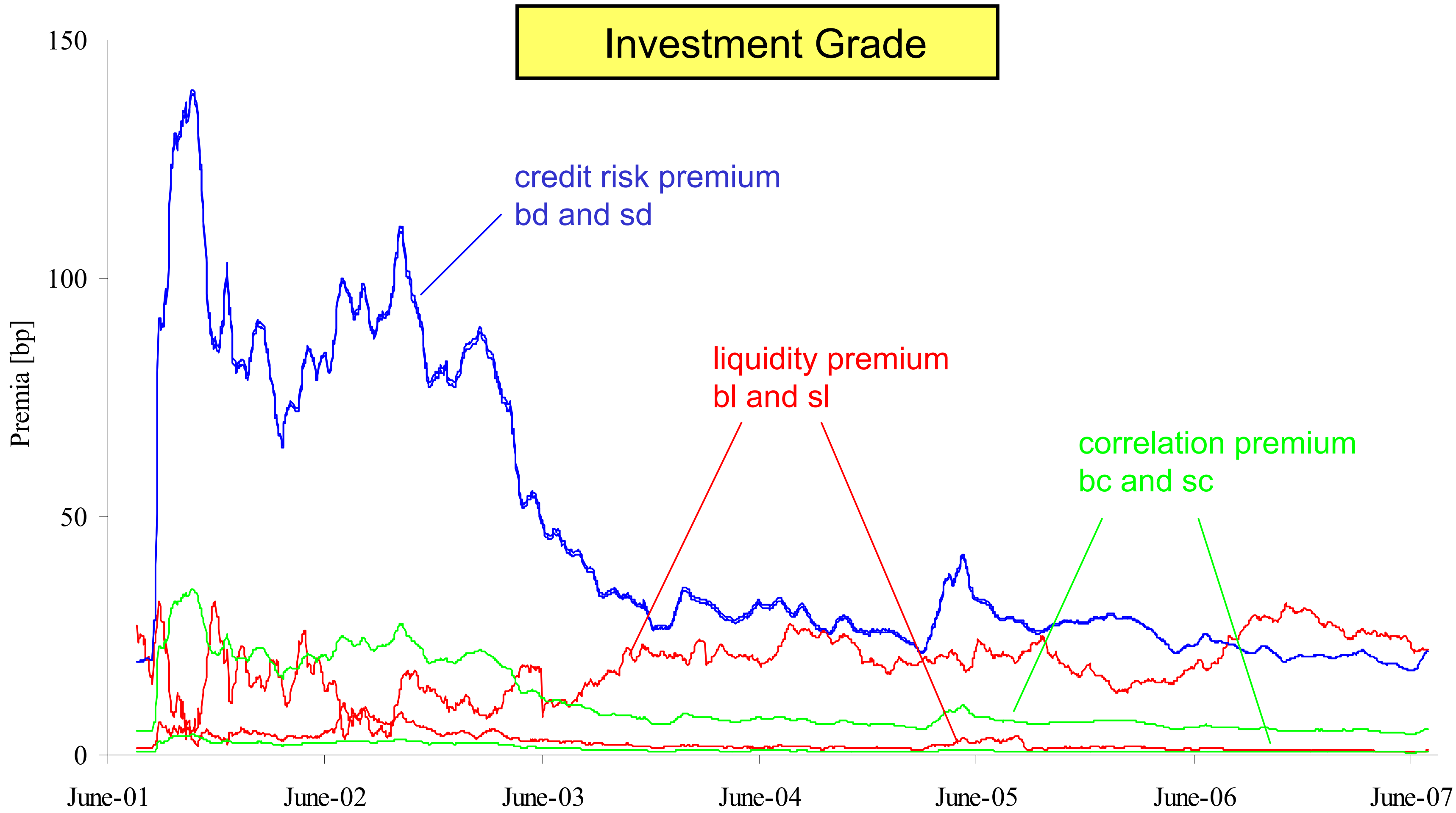
FIRM-SPECIFIC ANALYSIS



ANALYSIS BY RATING CLASS

	AAA-BBB	BB-CCC	All
bd min/max	32.7 1.0 / 1,214.4	274.7 32.6 / 1,807.1	44.4
bl min/max	23.9 0.6 / 567.1	52.6 1.5 / 451.6	26.4
bc min/max	3.9 -1.3 / 251.5	17.3 0.4 / 353.5	3.6
sd min/max	33.4 4.2 / 1,281.9	278.2 34.0 / 1,948.4	44.8
sl min/max	1.9 -0.6 / 27.7	5.8 -153.8 / 194.3	1.9
sc min/max	0.3 -6.7 / 51.8	6.3 -3.2 / 98.9	0.4

MEAN CREDIT RISK, LIQUIDITY, AND CORRELATION PREMIA



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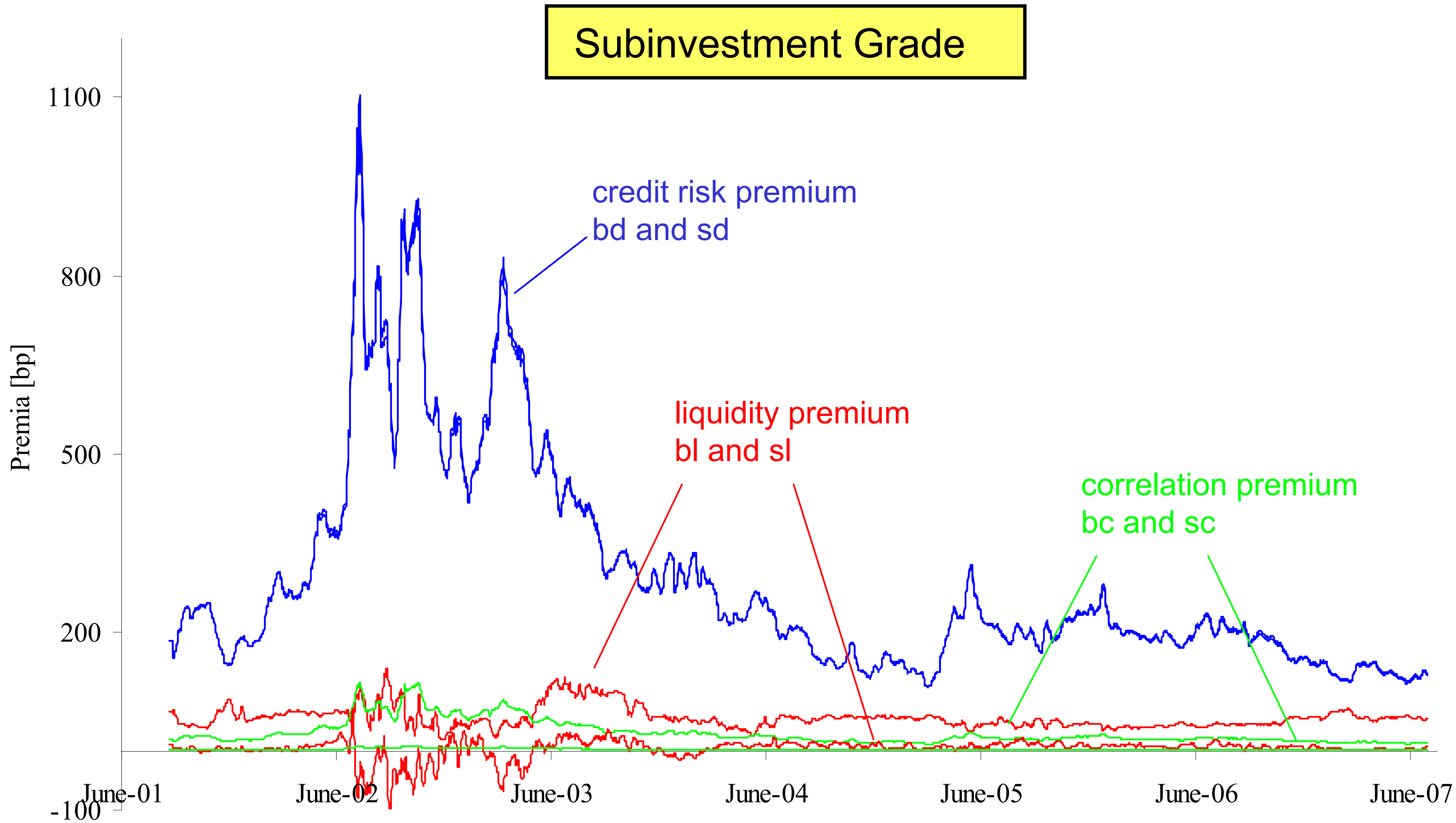


TIME SERIES ANALYSIS

Vector Autoregressive Model

IG	Credit Risk		Liquidity	
	Δbd	Δsd	Δbl	Δsl
Δ bond $_{-1}$	-0.41	0.18	-0.45	-0.01
Δ CDS $_{-1}$	0.14	-0.07	-0.02	-0.53
SubIG				
Δ bond $_{-1}$	-2.54	1.79	-0.46	-0.08
Δ CDS $_{-1}$	2.28	-1.51	-0.01	-0.64

- credit risk premia move jointly, liquidity premia reversely
- bond liquidity premia affect CDS liquidity premia in IG, not vice versa
- SubIG: slight impact of CDS liquidity, but limited economic significance

TIME SERIES ANALYSIS

Vector Error Correction Model

IG	Increasing Risk Phase	
	Credit Risk	Liquidity
Coint. Coef.	-1.02	68.96
ECT bond	-0.14	0.00
ECT CDS	0.07	-0.05
SubIG		
Coint. Coef	-1.02	2.90
ECT bond	-2.92	-0.07
ECT CDS	-2.46	-0.27

CONCLUSIONS

- liquidity in bond and CDS market modelled differently
- credit risk affects liquidity but not vice versa
- 60% credit risk, 35% liquidity, 5% correlation in bond market
- 95% credit risk, 4% liquidity, 1% correlation in CDS market
- CDS liquidity matters
- time-varying liquidity premia

  Explanation : CREDIT CHANNEL
- asymmetric liquidity spill-over
- sensitive to market situation / rating

CORRELATION STRUCTURE

- Correlation structure between default and liquidity rates

$$\begin{pmatrix} d\lambda_t \\ d\gamma_t^b \\ d\gamma_t^{ask} \\ d\gamma_t^{bid} \end{pmatrix} = \begin{pmatrix} 1 & g_b & g_{ask} & g_{bid} \\ f_b & 1 & \omega_{b,ask} & \omega_{b,bid} \\ f_{ask} & \omega_{b,ask} & 1 & \omega_{ask,bid} \\ f_{bid} & \omega_{b,bid} & \omega_{ask,bid} & 1 \end{pmatrix} \begin{pmatrix} dx_t \\ dy_t^b \\ dy_t^{ask} \\ dy_t^{bid} \end{pmatrix}$$

$$= \begin{pmatrix} 1 & g_b & g_{ask} & g_{bid} \\ f_b & 1 & \omega_{b,ask} & \omega_{b,bid} \\ f_{ask} & \omega_{b,ask} & 1 & \omega_{ask,bid} \\ f_{bid} & \omega_{b,bid} & \omega_{ask,bid} & 1 \end{pmatrix} \left(\begin{pmatrix} \alpha - \beta x_t \\ \mu^b \\ \mu^{ask} \\ \mu^{bid} \end{pmatrix} dt + \begin{pmatrix} \sigma \sqrt{x_t} dW_{x,t} \\ \eta^b dW_{y^b,t} \\ \eta^{ask} dW_{y^{ask},t} \\ \eta^{bid} dW_{y^{bid},t} \end{pmatrix} \right)$$

$$Corr(d\lambda_t, d\gamma_t^b) = \frac{f_b\sigma^2 x_t + g_b\eta^{b^2} + g_{ask}\omega_{b,ask}\eta^{ask^2} + g_{bid}\omega_{b,bid}\eta^{bid^2}}{\sqrt{\left(\sigma^2 x_t + g_b^2\eta^{b^2} + g_{ask}^2\eta^{ask^2} + g_{bid}^2\eta^{bid^2}\right)\left(f_b^2\sigma^2 x_t + \eta^{b^2} + \omega_{b,ask}^2\eta^{ask^2} + \omega_{b,bid}^2\eta^{bid^2}\right)}}$$

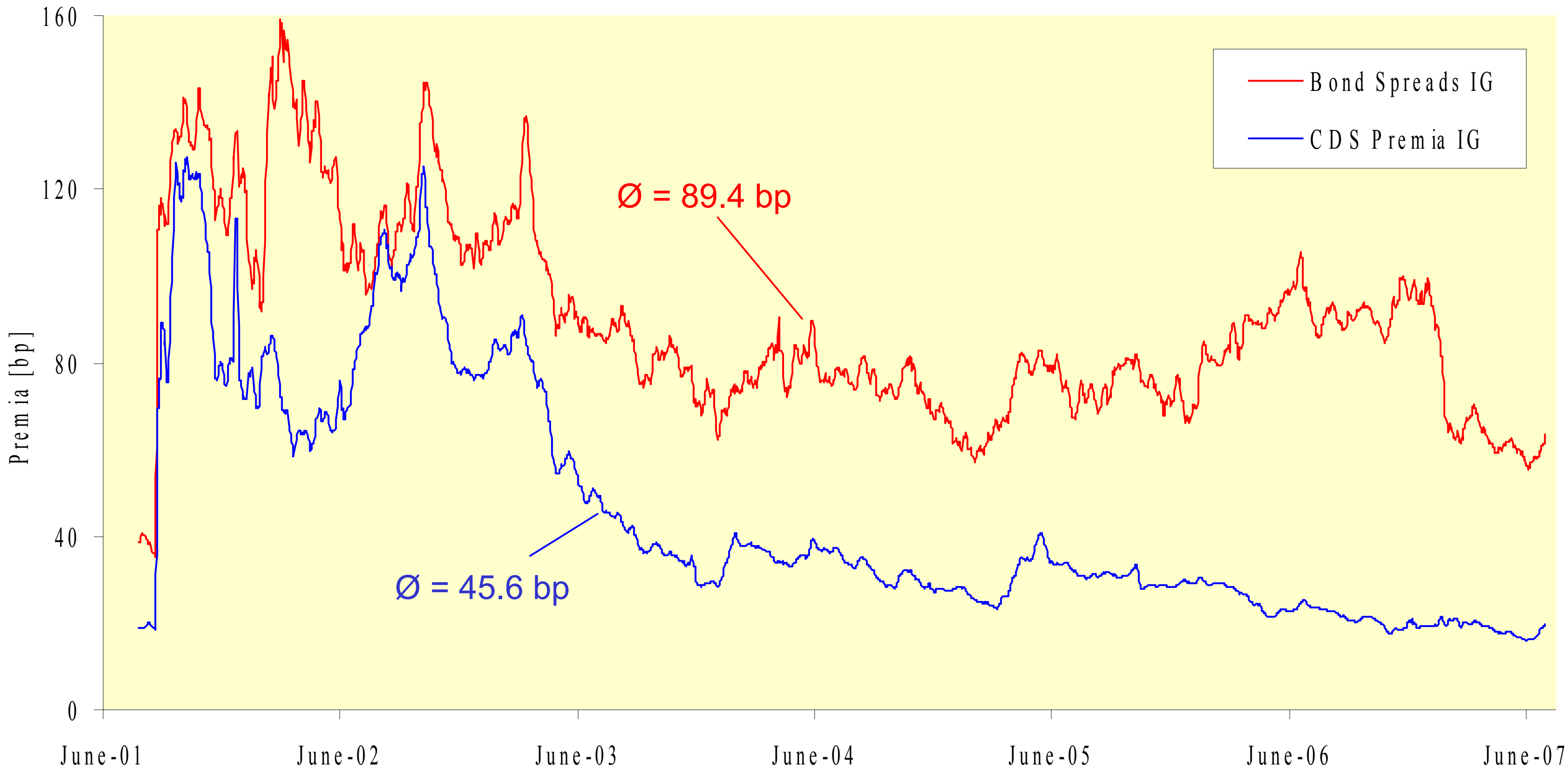
$$Corr(d\gamma_t^{ask}, d\gamma_t^{bid}) = \frac{f_{ask}f_{bid}\sigma^2 x_t + \omega_{b,ask}\omega_{b,bid}\eta^{b^2} + \omega_{ask,bid}\eta^{ask^2} + \omega_{ask,bid}\eta^{bid^2}}{\sqrt{\left(f_{ask}^2\sigma^2 x_t + \omega_{b,ask}^2\eta^{b^2} + \eta^{ask^2} + \omega_{ask,bid}^2\eta^{bid^2}\right)\left(f_{bid}^2\sigma^2 x_t + \omega_{b,bid}^2\eta^{b^2} + \omega_{ask,bid}^2\eta^{ask^2} + \eta^{bid^2}\right)}}$$

STABILITY ANALYSIS

- using CDS bid or ask quotes only

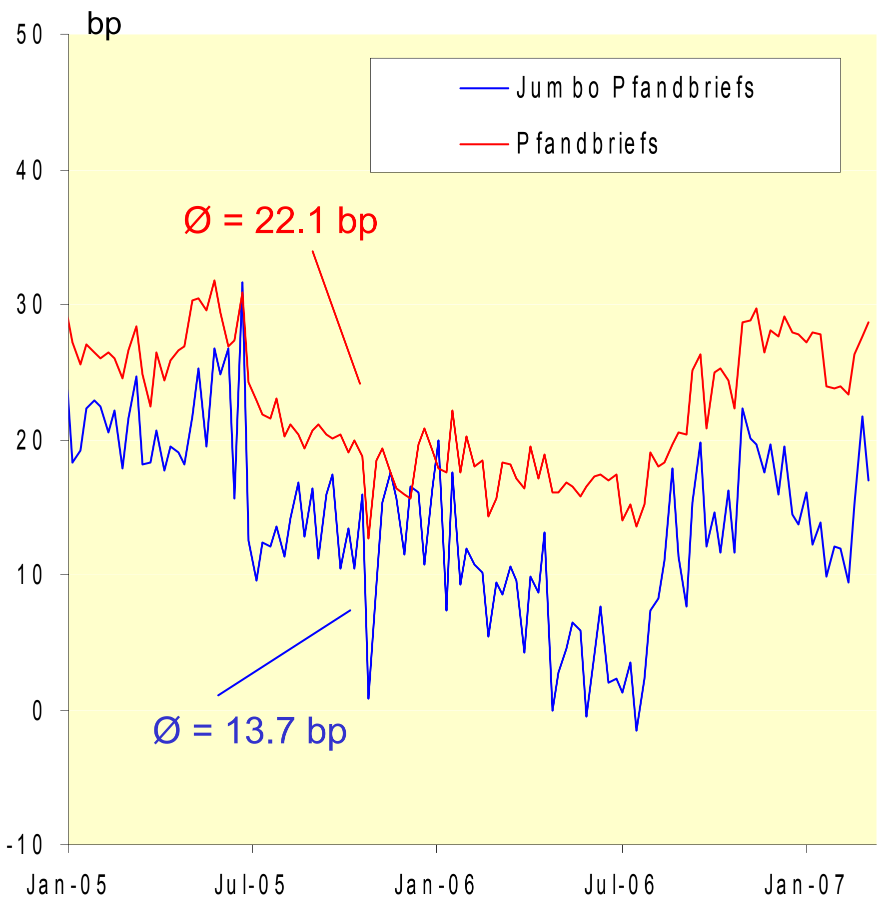
	bid and ask	ask only	bid only
bd	44.38	44.15	44.78
mean abs. diff.	-	0.48	0.55
bl	-	1.37	1.42
bc	-	0.16	0.14
sd	-	0.88	0.85
sl	-	0.87	0.85
sc	-	0.73	0.38

Investment Grade

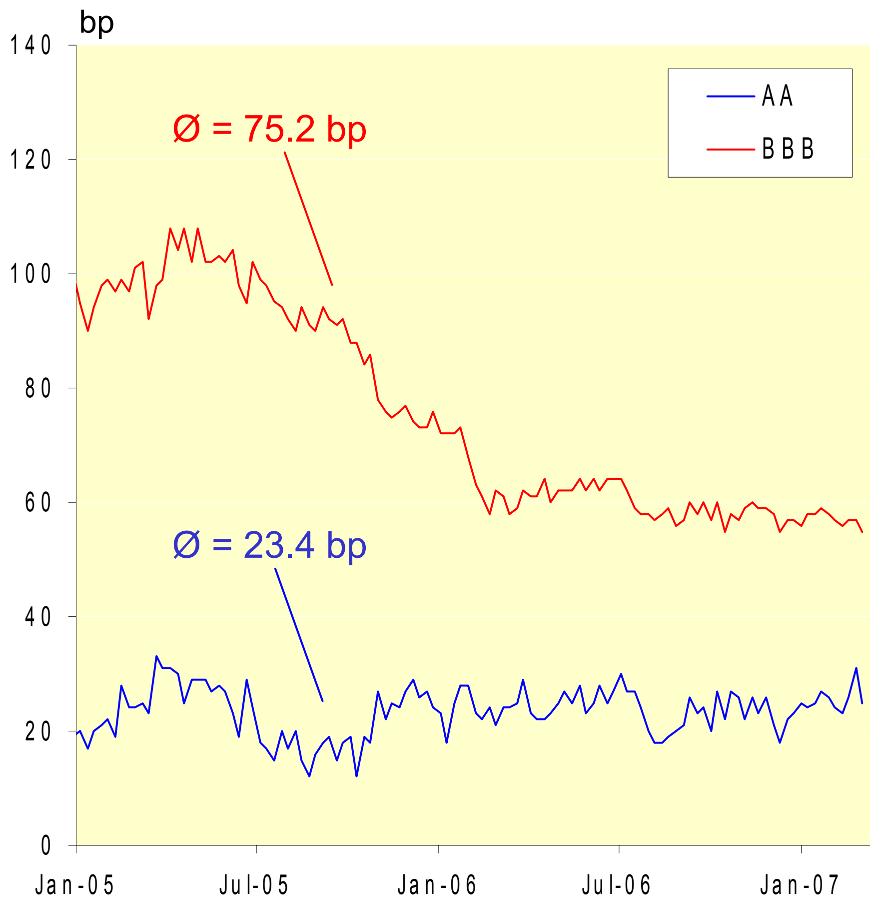


Subinvestment Grade

Primarily Liquidity Premia



Primarily Credit-Risk Premia



Literature

BOND MARKET

Elton et al. (2001); Collin-Dufresne et al. (2001); Eom et al. (2004);
Huang/Huang(2003) : 25% explained by credit risk

De Jong/Driessen (2005) : ≈ 45 bp liquidity premia in expected bond spreads

Ericsson/Renault (2006): level of liquidity spread pos. correlated with credit risk

CDS MARKET

Tang/Yan (2006) : 4 - 17 basis points

BOND AND CDS MARKET

Aunon-Nerin et al. (2002); Houweling/Vorst (2005) : no liquidity analysis

Nashikkar/Subrahmanyam (2006) : no liquidity-risk model

Longstaff et al. (2005) : CDS perfectly liquid
but: partly negative liquidity premia

TIME SERIES ANALYSIS

Vector Autoregressive Model

$$\left.\begin{matrix}\Delta bd_i \\ \Delta bl_i \\ \Delta bc_i \\ \Delta sd_i \\ \Delta sl_i \\ \Delta sc_i\end{matrix}\right\} = \underline{\quad} \mathit{Level} \begin{pmatrix} bd_{i-1} \\ bl_{i-1} \\ bc_{i-1} \\ sd_{i-1} \\ sl_{i-1} \\ sc_{i-1} \end{pmatrix} + \begin{matrix}\mathit{First} \\ \mathit{differences}\end{matrix} \begin{pmatrix} \Delta bd_{i-1} \\ \Delta bl_{i-1} \\ \Delta bc_{i-1} \\ \Delta sd_{i-1} \\ \Delta sl_{i-1} \\ \Delta sc_{i-1} \end{pmatrix}$$

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Step 1: parameter values $(\alpha,\beta,\sigma;\mu^{b},\eta^{b};\mu^{c_a},\eta^{c_a};\mu^{c_b},\eta^{c_b}),\ f,g$

Step 2: estimation of time series $(\lambda_t;\gamma_t^{b};\gamma_t^{ask};\gamma_t^{bid})$ t = 1,…, 1548

$$\min_{(\alpha,\ldots,\eta^{bid})}\sum_t\sum_i(P_{t,i}^{theor.}(\alpha,\ldots,\eta^{c_b})-P_{t,i}^{obs.})^2$$

Step 3: f, g from time series $(\lambda_t;\gamma_t^{b};\gamma_t^{ask};\gamma_t^{bid})$, etc.

Step 4: synthetic 5 year par bond: bd, bl, bc

5 year CDS: sd, sl, sc

FIRM-SPECIFIC ANALYSIS