FINRISK
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«Stock Market Performance and the Term Structure of Credit Spreads»

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Motivation

- **Corporate credit spreads are counter-cyclical:**
  - **Chen (1991), Fama & French (1989), Friedman & Kuttner (1992), Guha & Hiris (2002)**

- **Corporate credit spreads are negatively related to the stock index performance;**
  - **Collin-Dufresne, Goldstein & Martin (2001), Van Landschoot (2003)**

- **None of the existing structural credit risk models accounts for the business climate**

Objectives

- **To incorporate the stock market index into a structural model of corporate default through modeling the dynamics of the firm´s leverage ratio;**
- **To study the impact of the „recent“ performance of the stock market index on credit spreads;**
- **To examine the impact of the correlation between firm‘s assets and index returns on credit spreads;**
- **To compare the explanatory power of our model with the one of other structural models.**

Main results

- **Within the structural model of default, we show how the performance of the stock index and the correlation between firms´ assets and index returns affect credit spreads;**
- **Our model is consistent with firms´ debt-equity issuance policies across business cycles;**
- **Our model can explain why credit spreads are counter-cyclical and why they may be different within the same credit rating groups (correlation matters);**
- **Our model yields higher credit spreads than other well known structural models.**

Theoretical models of default

- **Structural credit risk models**

  Merton (1974)

  Longstaff and Schwartz (1995)

  Collin-Dufresne and Goldstein (2001)

  Leland (1994)

  Leland & Toft (1996)

  …

Modeling approach

- **The recent performance of the stock market index serves as a proxy for the business climate;**

- **Our model is based on the evidence that**
  - **firms´debt-equity issuance policy depends on the business climate – <u>market timing theory</u>**
  - **firms have target leverage ratios – <u>trade-off theory</u>**

Firm’s capital structure: market timing theory

- There are no empirical studies which would examine the relationship between firms´debt issuance policy and the stock market performance explicitly
- Thus, we look at equity-related studies
  - Choe, Masulis and Nanda (1993): firms tend to issue more equity than debt in expansionary periods of the business cycle
  - Baker and Wurgler (2002): firms are more likely to issue additional equity when their market values are high, relative to past market values
  - Marsh (1982) and Taggart (1977): firms prefer to issue equity when the value of equity is relatively high, and to issue debt when interest rates are relatively low

Firm’s capital structure: trade-off theory

- **Firms have target leverage ratios**
  - **Marsh (1982)**
  - **Hovakimian, Opler and Titman (2001)**

The determinants of securities' issuance policies

The results of a survey of European firms on the determinants of capital structure choice: the three most frequent answers regarding equity and debt issuances. Source: Bancel and Mittoo (2002), tables IV and VI).

		Important or very important (%)
Most important factors influencing ***common stock*** *issuance*		
b)	Maintaining a target dent-to-equity ratio	59.26
c)	If the stock price has resently risen, the price at which we can issue is "high"	59.26
Most important factors influencing ***debt*** *issuance*		
c)	We issue debt when our equity is undervalued by the market	43.68

Modelling the dynamics of the leverage ratio

- **Changes in the firm´s target leverage ratio are negatively related to the recent performance of the stock market index**

  <u>(as follows from the market timing theory)</u>

- **The leverage ratio is mean-reverting**

  <u>(as follows from the trade-off theory)</u>

The Model

- **Firm value**

$$\frac{dV_t}{V_t} = (r - \delta_V)dt + \sigma dW_t^Q$$

- **Stock market index dynamics**

$$\frac{dI_t}{I_t} = (r - \delta_I)dt + \gamma dZ_t^Q$$

$$E[dW_t, dZ_t] = \rho dt$$

The Model – cont.

- **Log-distance between the current and historical average index values:**

$$\psi_t = \log I_t - \log \bar{I}_t$$

$$\bar{I}_t = \exp\left(\theta \int_{-\infty}^{t} e^{-\theta(t-s)} x_s ds\right)$$

- **The dynamics of the firm's log-leverage ratio** $l_t = \log(D_t/V_t)$

$$dl_t = \lambda[\bar{l}^Q - \phi\psi_t - l_t]dt - \sigma dW_t^Q$$

The Model – cont.

Assumption 7: *The firm defaults when the value of its assets V hits an endogenously specified boundary (threshold) for the first time. This threshold is assumed to be equal to the firm's book value of debt D. Equivalently, default occurs when the firm's log-leverage ratio l_t becomes equal to zero for the first time. The corresponding stopping time is defined as:*

$$\tilde{\tau} = \inf\{t > 0, V_t = D_t \Leftrightarrow l_t = \log \frac{D_t}{V_t} = 0\}$$

The Model – cont.

ASSUMPTION 8: *Following Longstaff and Schwartz (1995) we assume that in the case of default each bondholder receives* $(1 - w)$ *units of the identical risk-free bond (i.e. with the same face value and maturity) in exchange for the defaulted risky bond.*

The Model – cont.

- **Pricing corporate bonds**

$$B(0,T) = e^{-rT} E_0^Q [\mathbf{1}_{\tilde{\tau} > T} + (1-w)\mathbf{1}_{\tilde{\tau} \leq T}]$$

$$B(0,T) = e^{-rT}(1 - wQ(l_0, T))$$

Q(*l*,*T*) : from Collin-Dufresne and Goldstein (2001)

- **Credit spread**

$$S_T = -\frac{\log B(0,T)}{T} - r$$

Numerical results

- **Base-case parameter values**

Assets's volatility, σ	30%
Index volatility, γ	20%
Risk-free rate, r	*3%*
$\delta_V = \delta_I$	1%
Correlation coefficient, ρ	0.5
The speed of adjustment, λ	0.05
Recovery rate, $(1 - w)$	0.51
Initial index performance, ψ_0	20%
Parameter θ	2

Credit spreads under the base-case parameter values.

	Aaa	Aa	A	Baa	Ba
Time to maturity					
T=1	0.0	0.0	0.1	2.0	50.8
T=2	0.0	2.2	9.5	44.2	230.0
T=4	0.6	33.8	71.4	159.9	385.2
T=7	7.8	89.4	141.7	233.1	401.8
T=8	11.5	102.7	155.1	242.1	393.2
T=10	19.6	122.1	172.2	249.2	371.3

The impact of the initial index performance (ψ_0) on credit spreads.

	Aaa	Aa	A	Baa	Ba
			Time to maturity: T=1		
Psi (0) = 0.5	0.0	0.0	0.0	0.9	28.1
Psi (0) = 0.2 (base)	0.0	0.0	0.1	2.0	50.8
Psi (0) = -0.5	0.0	0.1	0.7	10.7	173.5
			Time to maturity: T=10		
Psi (0) = 0.5	16.9	110.1	156.8	229.5	347.3
Psi (0) = 0.2 (base)	19.6	122.1	172.2	249.2	371.3
Psi (0) = -0.5	27.4	154.3	212.8	299.5	429.8

The impact of the correlation between assets' and index returns (ρ) on credit spreads.

	Aaa	Aa	A	Baa	Ba
			Time to maturity: T=1		
Corr =0.9	0.0	0.0	0.2	3.0	62.4
Corr =0.5 (base)	0.0	0.0	0.1	2.0	50.8
Corr = -0.5	0.0	0.0	0.0	0.6	26.5
			Time to maturity: T=4		
Corr =0.9	1.1	42.4	84.7	178.7	406.5
Corr =0.5 (base)	0.6	33.8	71.4	159.9	385.2
Corr = -0.5	0.1	15.0	39.1	108.3	321.3
			Time to maturity: T=10		
Corr =0.9	24.6	132.9	183.0	258.5	376.3
Corr =0.5 (base)	19.6	122.1	172.2	249.2	371.3
Corr = -0.5	8.6	90.8	139.8	220.6	356.3

The comparison of the performance of structural models

	Aaa	Aa	A	Baa	Ba
			Time to maturity: T=4		
Average market yield spread	55	65	96	158	320
			% of spreads due to default		
Our model	1.1%	4.1%	12.6%	36.5%	84.5%
LS model	1.5%	7.0%	7.8%	16.1%	46.6%
CDG model	0.1%	9.7%	10.3%	19.7%	52.5%
Merton model	0.2%	1.1%	5.0%	21.0%	65.5%
			Time to maturity: T=10		
Average market yield spread	63	91	123	194	320
			% of spreads due to default		
Our model	40.7%	44.1%	53.9%	65.4%	84.9%
LS model	9.6%	9.4%	11.8%	19.9%	48.1%
CDG model	18.2%	16.4%	18.3%	26.9%	57.1%
Merton model	11.9%	16.6%	26.3%	41.6%	73.6%

Conclusions

- **Within the structural model of default, we show how the performance of the stock index and the correlation between firms´ assets and index returns affect credit spreads;**
- **Our model is consistent with firms´ debt-equity issuance policies across business cycles;**
- **Our model yields higher credit spreads than other well known structural models.**

Limitations

- **Negligible credit spreads for short-term bonds;**
- **The model requires estimation of a large set of parameters.**
- **Recovery rate is not modeled.**