

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

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# Motivation

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- **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

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- 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

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- **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

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- **Structural credit risk models**

Merton (1974)

Longstaff and Schwartz (1995)

Collin-Dufresne and Goldstein (2001)

Leland (1994)

Leland & Toft (1996)

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# Modeling approach

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- **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 – market timing theory**
  - **firms have target leverage ratios – trade-off theory**



# Firm's capital structure: market timing theory

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- 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

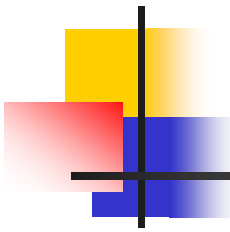
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- **Firms have target leverage ratios**

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).

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

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# Modelling the dynamics of the leverage ratio

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- **Changes in the firm's target leverage ratio are negatively related to the recent performance of the stock market index**  
**(as follows from the market timing theory)**
  
- **The leverage ratio is mean-reverting**  
**(as follows from the trade-off theory)**



# The Model

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- **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.

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- **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.

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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.

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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.

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- **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**

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

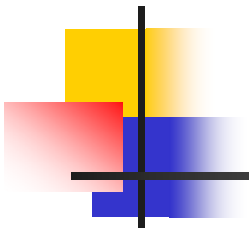


# Numerical results

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## ■ Base-case parameter values

<i>Assets's volatility, <math>\sigma</math></i>	30%
<i>Index volatility, <math>\gamma</math></i>	20%
<i>Risk-free rate, <math>r</math></i>	3%
$\delta_V = \delta_I$	1%
<i>Correlation coefficient, <math>\rho</math></i>	0.5
<i>The speed of adjustment, <math>\lambda</math></i>	0.05
<i>Recovery rate, <math>(1 - w)</math></i>	0.51
<i>Initial index performance, <math>\psi_0</math></i>	20%
<i>Parameter <math>\theta</math></i>	2



## Credit spreads under the base-case parameter values.

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	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

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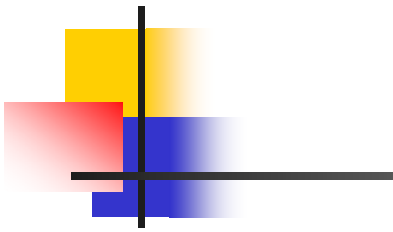
## The impact of the initial index performance ( $\psi_0$ ) on credit spreads.

	Aaa	Aa	A	Baa	Ba
<u>Time to maturity: T=1</u>					
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
<u>Time to maturity: T=10</u>					
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 ( $\rho$ ) on credit spreads.

	Aaa	Aa	A	Baa	Ba
<u>Time to maturity: T=1</u>					
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
<u>Time to maturity: T=4</u>					
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
<u>Time to maturity: T=10</u>					
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
<u>Time to maturity: T=4</u>					
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%
<u>Time to maturity: T=10</u>					
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

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- **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.**