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Junk bonds: Money makers or money takers?

Fuxun Xia

Assupol Life (Ltd)

Wayron Lewis

A & AS

Deloitte Consulting Pty (Ltd)

Agenda

1. Background & Aim of Research
2. Literature Study
3. Our Study
    - 3.1 Microeconomic factors
    - 3.2 Macroeconomic factors
4. Application
5. South African Markets
6. Conclusion

Background of High-yield Bonds

- *"Despite their superior performance, high-yield bonds are seldom mentioned without pejoratives such as 'non-investment-grade,' 'speculative' or 'junk.' ... By creating a false perception of risk, they increase the returns investors receive."*
  - Michael Milken, the "father" of junk bonds.

Background of High-yield Bonds

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- "A high paying bond with a lower credit rating than investment-grade corporate bonds, Treasury bonds and municipal bonds."*
  - Standard & Poor's Rating BB+ or lower
  - Moody's rating Ba1 or lower
  - Higher yields than investment grade bonds
  - Subordinate to conventional debt
- Largest junk bond market is in the USA

*Source : www.investopedia.com

Aim of Research

- Enable junk bond investors take sensible, calculated risks and still get a good night's sleep
- Find objective predictors of default using:
  - Microeconomic factors:
    - Balance sheet and statement of income
    - Financial ratios
  - Macroeconomic factors
- Create models that give probability of future default
- Results in the context of South African markets

Literature Study
Previous studies – general credit default

- Linked single financial ratio to default – Beaver (1966)
  - Conventional ratios were "window dressed"

Ratio → *% Default*

e.g. Cash flow to debt ratio

- Well-known Z-score model – Altman (1968)
  - Used a combination of financial ratios

Ratio
Ratio
Ratio
} → *% Default*

Literature Study
Previous studies - general credit default

- Credit ratings – Hilscher and Wilson (2010)
  - Financial ratios vs. pure credit ratings
- Suggest that rating agencies:
  - Respond slowly to new information
  - Do not have the sole objective of making accurate default predictions

Credit ratings ✗→ *% Default*

Literature Study
Previous studies – Junk bond specific

- Data at time of issue – Huffman & Ward (1996)
  - Regression analysis using financial ratios

Cash flows at issue → *% Default*

- Integrated cash flows with financial ratios – Bryan et al (2004).
  - More accurate predictions

Recent cash flows
Recent ratios } → *% Default*

Literature Study
Other methods

- Merton model
  - Notional exercise of put-option representing risk of default
- Moody's KMV Model
  - Equity based method which extends Black-Scholes-Merton framework
- Competing risks hazard model
  - Bond-age, issue specific characteristics and economic conditions simultaneously taken into account

Literature Study
Actuarial context

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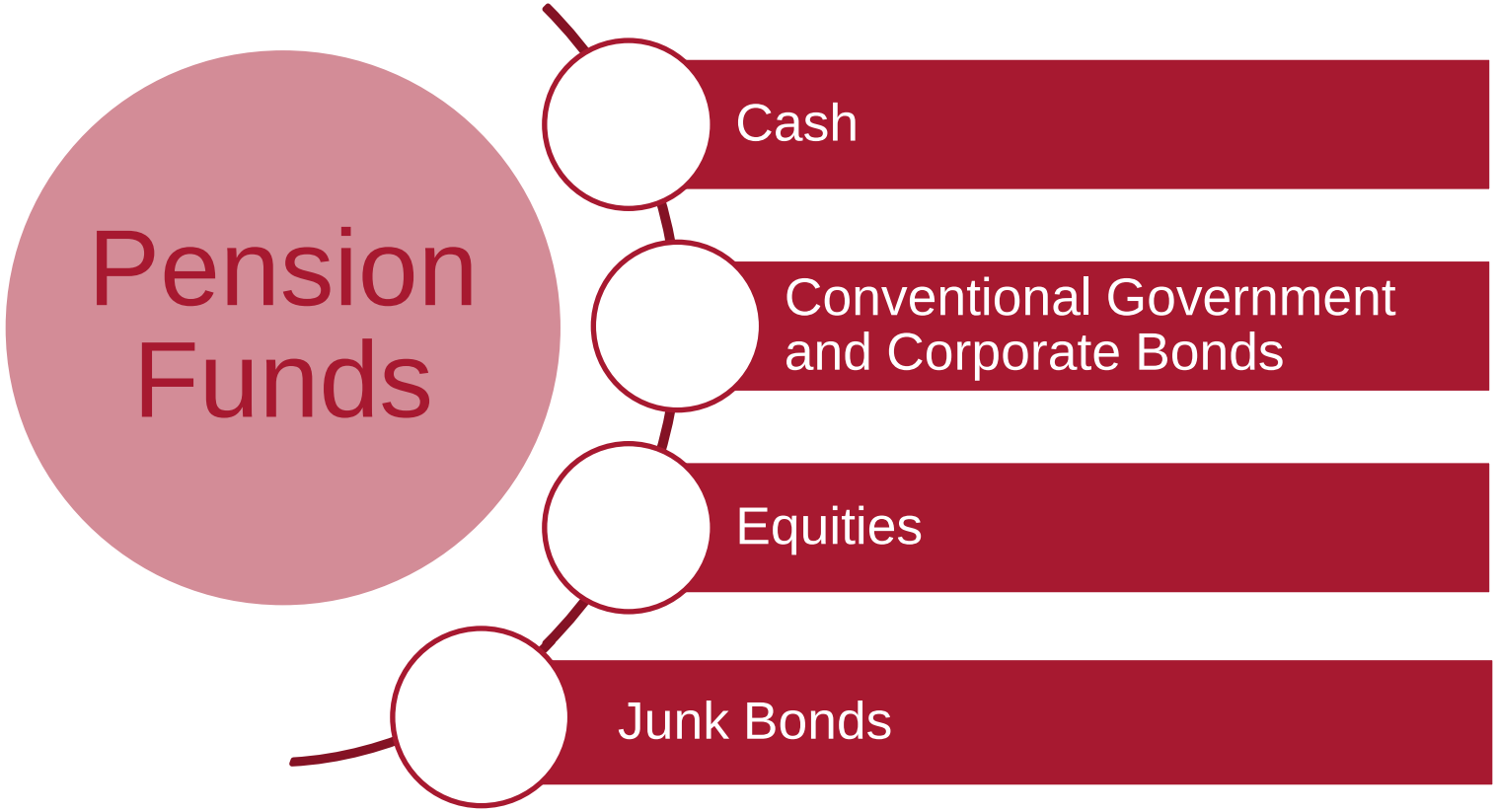
Junk bonds in investment portfolios - Paul Sweeting (2002)



Literature Study
Actuarial context

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- Credit risk playing a bigger role in actuarial profession
  - 2008 economic crisis
  - Risk management in investment context
  - Opportunities
- M.A.R.C model - Miccoci (2000)
  - Stochastic simulation used to determine credit risk
  - Link between Actuarial Science and Credit industry

Literature Study
Insights

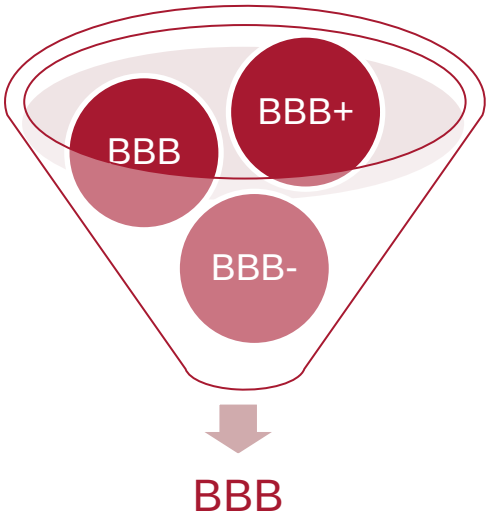
- Missing in previous studies
  - Credit ratings were not significant individually
  - What if they were used in conjunction with financial ratios?
  - Macroeconomic variables were never considered

Our Study

- Aim – Find objective predictors of default
- Microeconomic factors
  - Sampling
  - Preliminary analysis
  - Methodology
  - Results
- Macroeconomic factors
  - NGDP, RGDP, UMICS
  - Aggregate default rates

Our Study – Microeconomic Factors
Sampling

- Data from US junk bond markets
  - Altman reports
  - Bond exchange-trader funds
- 102 different companies
  - 52 defaulted
  - 50 non-defaulted
- Similar credit ratings combined



Our Study – Microeconomic Factors
Sampling

- Definition of default used in Altman reports:

Default

- Missed interest or capital payment
- Bankruptcy
- Regulatory directive
- Distressed exchange

Our Study – Microeconomic Factors
Sampling

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Excerpt of our data

Name	Default	S/P	Sector	Date of default	Issue Amount	Statement Year	Cash	Accounts Receivable	Current Assets	Total assets	…
Builders FirstSource	Yes	CCC	Forest Products	2010/01/21	270	2010	103.2	55.6	235.4	412.8	…
		CC				2009	84.1	60.7	240.3	435	…
		B				2008	107	85	311	521.1	…

From the data we can calculate our ratios (2010):

- Net working capital: 0.38
- Return on assets: -0.23
- Debt ratio: 0.46
- Etc.

Our Study – Microeconomic Factors
Preliminary analysis

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2 years prior to 2010		
Ratings	B and above	CCC or below
Defaulted	13%	87%
Non-defaulted	78%	22%

1 year prior to 2010		
Ratings	B and above	CCC or below
Defaulted	10%	90%
Non-defaulted	78%	22%

- Fairly high percentage of poorly rated , non-defaulted debt
- Results corresponds with Hilscher and Wilson study

Our Study – Microeconomic Factors
Preliminary analysis

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- T-test used to determine significant differences in means
- Items that were significantly different between defaults and non-defaults:
  - Total assets
  - Total Equity
  - Earnings before interest and tax (EBIT)
  - Net Income
  - Operating Cash flows

Our Study – Microeconomic Factors
Methodology

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- Type of ratios & variables (52) used:
  - Credit ratings
  - Cash flows
  - Liquidity
  - Efficiency
  - Profitability
  - Leverage
  - Size
- Regression analysis used to determine the probability of default
  - Multivariate logistic regression
  - Purposeful selection of covariates

Our Study – Microeconomic Factors
Methodology

- 4 models developed in total

	Predicts default in a year	Predicts default in 2 years
Includes credit ratings	Model 1	Model 2
Excludes credit ratings	Model 3	Model 4

Our Study – Microeconomic Factors
Results

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- Model 3: $\ln\left(\frac{\vartheta}{1-\vartheta}\right) = 17.9995 - 22.0935\mathbf{BEPR} - 1.7696\mathbf{LNTA} - 0.9715\mathbf{LNTA_TETA} + 5.4392\mathbf{CFOSALES} - 43.0116\,\mathbf{CFOTA} + 3.1164\mathbf{RETA}$
- Where ϑ is the probability of default

Ratio/Variable	Formula	Description
BEPR	EBIT/Total Assets	Basic Earnings Power Ratio
LNTA	ln(Total Assets)	
CFOSALES	Operating Cash Flows/Revenues	
CFOTA	Operating Cash Flows/Total Assets	
RETA	Retained Earnings/Total Assets	
TETA	Total Equity/Total Assets	
LNTA_TETA	LNTA × TETA	

- All variables were significant within the 10% level

Our Study – Microeconomic Factors
Results

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- Significant ratios consisted of:
  - EBIT*
  - Total assets*
  - Total equity*
  - Operating cash flows*
  - Short term debt
  - Retained earnings
  - EBITDA

e.g. The basic earnings power ratio: $\frac{EBIT}{Total\ assets}$

- ~~Current ratio~~, ~~Debt ratio~~, ~~Return on equity~~
  - Consistent with Beaver's study suggesting that well-known ratios are "window dressed"

Our Study – Microeconomic Factors
Results

R^2	Predicts default in a year	Predicts default in 2 years
Includes credit ratings	Model 1: **67.4%**	Model 2: **59.3%**
Excludes credit ratings	Model 3: **64.7%**	Model 4 **50.8%**

- Including credit ratings increases the R^2

Our Study – Macroeconomic Factors

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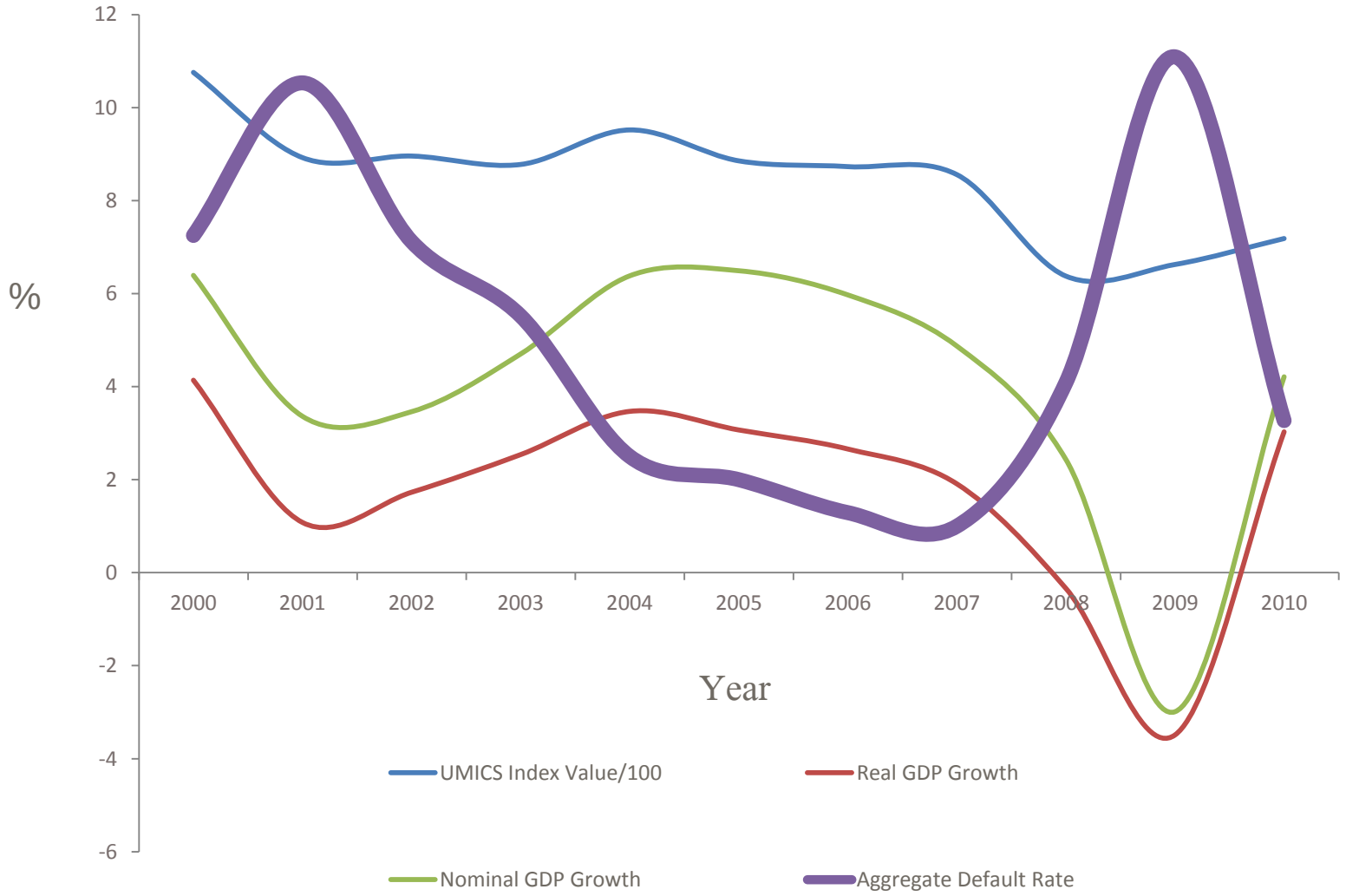
- Do they affect default?
- Aggregate junk bond default rates from 2000 – 2010
- Indicators of state of economy
  - Nominal and real GDP growth
  - University of Michigan Index of Consumer Sentiment (UMICS)

Our Study – Macroeconomic Factors



Our Study – Macroeconomic Factors
Integration with microeconomic factors

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- Nominal GDP growth and UMICS were correlated with aggregate default
  - 70% of variation explained
- Integrate macro with previous micro model
- Acquired additional information for 33 companies over 2000-2010
- A viable model could not be obtained
  - Macroeconomic factors vs. ratios in the long term

Our Study
Application of model

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Goodyear Tire and Rubber

(All monetary amounts are in millions)

Financial data one year prior to 2010		Financial data two years prior to 2010	
Total Assets	15630	Total Assets	15226
Shareholders' Equity	921	PPE	5634
Revenues	18832	Shareholders' Equity	1022
Interest Expense	316	Interest Expense	320
Tax	172	Depreciation & Amortisation	660
Net Income	-216	Tax	209
EBIT	272	Net Income	-77
Retained Earnings	866	EBIT	452
Operating Cash Flows	924	EBITDA	1112

- Model 3 predicts a probability of default of 8.3% in 2010.
- In 2010, Goodyear Tire and Rubber did not default.

Our Study
Application of model

ACTUARIAL SOCIETY OF SOUTH AFRICA

Xerium Technologies Inc.

(All monetary amounts are in millions)

Financial data one year prior to 2010		Financial data two years prior to 2010	
Total Assets	693.5	Total Assets	818.1
Shareholders' Equity	-119.7	PPE	384.6
Revenues	500.1	Shareholders' Equity	-27.6
Interest Expense	68.5	Interest Expense	60.3
Tax	12.3	Depreciation & Amortisation	46
Net Income	-112	Tax	3.9
EBIT	-31.2	Net Income	26.6
Retained Earnings	-330.9	EBIT	90.8
Operating Cash Flows	16.1	EBITDA	136.8

- Model 3 predicts a probability of default of 99.8% in 2010.
- In 2010, Xerium Technologies defaulted.

South African markets

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- Relatively underdeveloped
- Bank lending thought to be more popular form of funding in the past
- 1st junk bond issues off-shore - 2005
- Few domestic junk bonds
  - Almost all trading at discount
  - Indicative of default risk
  - Not enough to create diversified portfolio
- Our model is not suitable for the SA market

Conclusions
Our results

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- Important ratios consist of: EBIT, total assets, operating cash flows
  - Consistent with Huffman and Ward study
- Credit ratings in conjunction with ratios enhances accuracy
  - Contrasts Hilscher and Wilson study
- Model strength: high percentage of variation explained in short term by model
- Model weakness: macroeconomic fluctuation in the long term
- Consumer sentiment index correlated with default rates

Conclusions
Suggestions for further research

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- More data
  - Strenuous data capture exercise
  - Limitations
- Correlations between consumer indices and default rates
  - Subjective sources have some credibility
- Integrating ratios with macroeconomic variables
  - Access to data set that spans a number of years required

Questions

Fuxun Xia	Wayron Lewis
FuxunX@assupol.co.za	walewis@deloitte.co.za

Details of model

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- *Model 1:* $\ln\left(\frac{\vartheta}{1-\vartheta}\right) =$ 15.0025+ 2.0468Θ -51.9534**BEPR** -1.7463**LNTA**+ 50.6348**EBITDATA** -3.3867Ψ- 0.6452**EBITINT**

- *Model 2:* $\ln\left(\frac{\vartheta}{1-\vartheta}\right) =$ 13.9078 + 1.4690Θ -1.3327Ψ -1.6499**LNTA**+ 1.1774**STDEBTE**

- *Model 3:* $\ln\left(\frac{\vartheta}{1-\vartheta}\right) =$ 17.9995 - 22.0935**BEPR** -1.7696**LNTA** - 0.9715**LNTA_TETA**+ 5.4392**CFOSALES** - 43.0116 **CFOTA** + 3.1164**RETA**

- *Model 4:* $\ln\left(\frac{\vartheta}{1-\vartheta}\right) =$ 9.9247 - 30.9643 **BEPR** - 1.3580**LNTA** + 0.1183**TAE**+ 31.7967**EBITDATA**- 0.1551**TAE_PPETA**

Legend

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Ratio/Variable	Formula	Description
RATINGBB		S&P rating in the BB category
RATINGCC		S&P rating in the CC category
EBIT		Earnings Before Interest & Tax
EBITINT	EBIT/Interest Expense	TIE Ratio
BEPR	EBIT/Total Assets	Basic Earnings Power Ratio
STDEBTE	Short Term Debt/Shareholders' Equity	
LNTA	ln(Total Assets)	
CFOSALES	Operating Cash Flows/Revenues	
CFOTA	Operating Cash Flows/Total Assets	
RETA	Retained Earnings/Total Assets	
TAE	Total Assets/Shareholders' Equity	
EBITDA	EBIT + Depreciation & Amortisation	Earnings Before Interest, Tax, Depreciation & Amortisation
EBITDATA	EBITDA/Total Assets	
PPE	Property, Plant & Equipment	
PPETA	PPE/Total Assets	
TAE_PPETA	TAE × PPETA	
TETA	Total Equity/Total Assets	
LNTA_TETA	LNTA × TETA	

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