

# The Impact of Basel II on SME Risk Management

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# Our Research on the Topic

- “Possible Effects of the New Basel Capital Accord on Bank Capital Requirements for SMEs”, Altman & Sabato, Journal of Financial Services Research, October 2005.
- “Modeling Credit Risk for SMEs: Evidence from the US Market”, Altman & Sabato, ABACUS, Forthcoming.

# SME definition

- There is **no common definition** of the segment of small and medium sized enterprises across different countries.
- Usually **qualitative and quantitative variables** are taken into account:
  - Annual turnover
  - Total assets
  - Number of employees
  - Average annual receipts
  - Industry type
  - Work organization
  - Independence
- **EU**: common definition from 1996, updated in 2003 (<250 employees, <€50 million).
- **US**: SBA sets different limits for each industry type in terms of number of employees and average annual receipts.
- **Brazil**: companies with less than 500 employees and R\$ 35 million.
- **Basel II**: all the companies with sales less than €50 million.

# Why so important?

- US President: “**All the countries have to understand that SMEs are the backbone of the economy**” (Brasilia, November the 7<sup>th</sup> 2005).
- In **Brazil**:
  - SMEs represent almost 99% of the total number of firms
  - They are responsible for 78% of the job offer of the country
  - They produce more than one-third of the county’s GDP
  - But, around 80% of SMEs is shut down before one year of activity
- Many public and financial institutions, such as the World Bank or Governments themselves, launch each year **plans in order to sustain this essential player of nation’s economy**.
- **Borrowing**, especially **from commercial banks**, remains undoubtedly the most important source of external SME financing.
- Several reasons for the **Basel II special attention** to this segment.

# SMEs vs Large Corporates

- SMEs have been always considered as **part of the corporate segment** (also inside ABN-AMRO).
- Only from a recent period academics and practitioners have started to think about **small and medium sized enterprises as a different segment**.
- Many **characteristics** of this segment are **shared** more with the **private individuals** than with corporates:
  - Large number of applications
  - Small profit margins
  - Available information (specially for the micro companies)
- **We demonstrate** that banks will have to develop and implement scoring systems and procedures specifically addressed to SMEs in order to manage them in an efficient way and improve the profitability of the SME segment.

# Evidence from US Market

- Our study focuses on the **US markets** gathering financial data from over **2,000 US SMEs** (with sales less than \$65 million) over the **period 1994-2002**.
- We analyze **more than 40 financial measures** and we select the most significant variables of the entities' credit worthiness to construct a **one-year default prediction model**.
- We compare its performance with a well-known generic corporate model and we find a **performance almost 30% higher**.
- We show also the benefits in terms of **lower Basel II capital requirements** of applying a specific SME scoring model.

# Some Literature

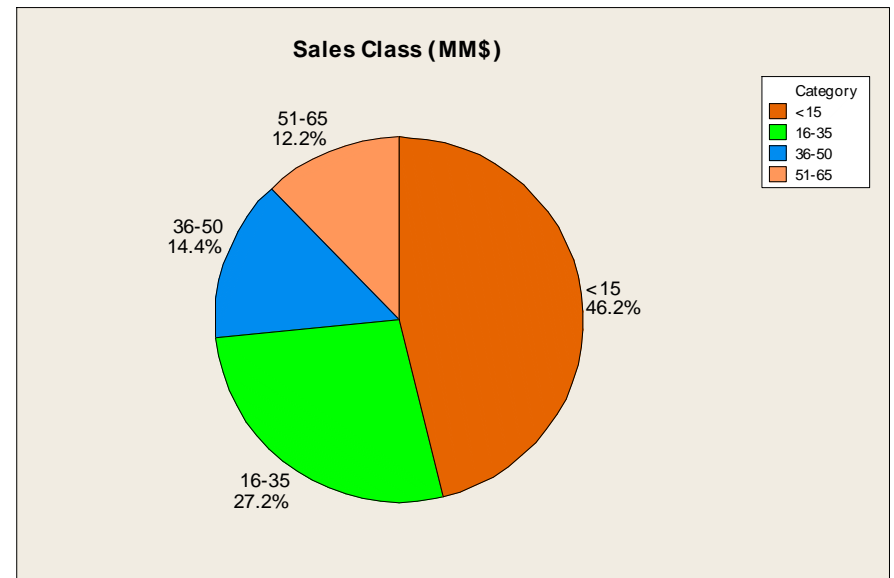
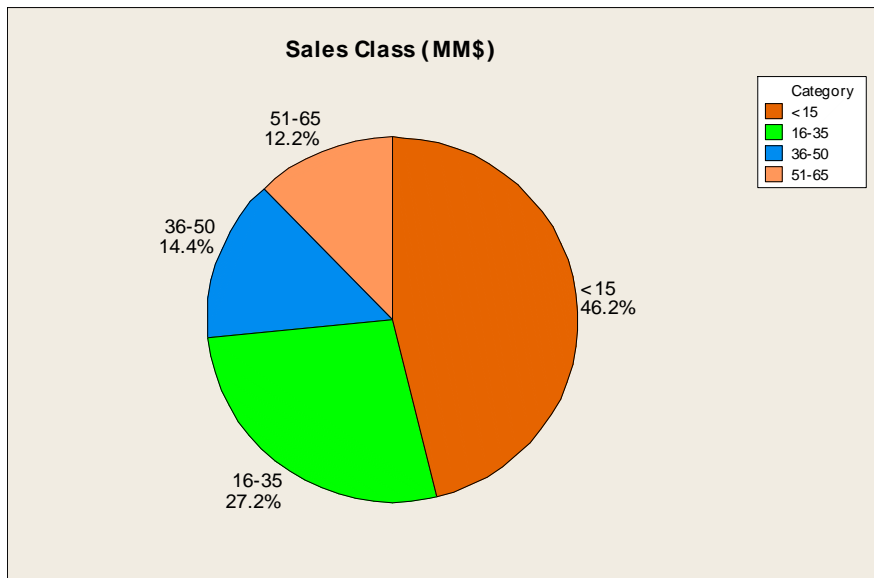
## **Default prediction methodologies:**

- Beaver (1967) and Altman (1968) initial studies.
- Deakin (1972), Blum (1974), Eisenbeis (1977), Taffler and Tisshaw (1977), Altman et al. (1977), Bilderbeek (1979), Micha (1984), Gombola et al. (1987), Lussier (1995), Altman et al. (1995) for MDA modeling.
- Ohlson (1980), Zavgren (1983), Gentry et al. (1985), Keasy and Watson (1987), Aziz et al. (1988), Platt and Platt (1990), Ooghe et al. (1995), Mossman et al (1998), Charitou and Trigeorgis (2002), Lizal (2002), Becchetti and Sierra (2002) for logit modeling.

## **Studies for SMEs:**

- Edmister (1972), Zhou et al. (2005), Duffie (2005).

# US SMEs



- We always observe in the SME portfolios a distribution skewed with **more relatively small borrowers** than relatively large borrowers
- **Legal form:** sole traders, partnerships, limited companies.

# Selection of the variables

- Chen and Shimerda (1981) show that out of **more than 100 financial ratios**, almost 50% were found useful in at least one empirical study.
- Recent literature (e.g. Lehmann (2003) and Grunet et al. (2004)) concludes that **quantitative variables are not sufficient to predict SME default** and that **qualitative variables** (such as the number of employees, the legal form of the business, the region where the main business is carried out, the industry type, etc.) **are essential** to improve the models' prediction power.
- Zhou et al. (2005) develop a model for North America privately held firms (not only SMEs) using **20 explanatory variables** and **four industry-sector indicator variables (qualitative)**.

# The Variables 1/3

Short Term Debt/Equity (Book Value) Equity (Book Value)/Total Liabilities Liabilities/Total Assets	Leverage
Cash/Total Assets Working Capital/Total Assets Cash/Net sales Intangible/Total Assets	Liquidity
Ebit/Sales Ebitda/Total Assets Net Income/Total Assets Retained Earnings/Total Assets Net Income/Sales	Profitability
Ebitda/Interest Expenses Ebit/Interest Expenses	Coverage
Sales/Total Assets Account Payable/Sales Account Receivable/Liabilities	Activity

# The Variables 2/3

Short Term Debt/Equity (Book Value) Liabilities/Total Assets	Leverage
Cash/Total Assets Working Capital/Total Assets	Liquidity
Ebitda/Total Assets Retained Earnings/Total Assets	Profitability
Ebitda/Interest Expenses Ebit/Interest Expenses	Coverage
Sales/Total Assets Account Receivable/Liabilities	Activity

# The Variables 3/3

G3	Short Term Debt/Equity Book Value	Leverage
G9	Cash/Total Assets	Liquidity
G2	Ebitda/Total Assets	Profitability
G5	Retained Earnings/Total Assets	
G10	Ebitda/Interest Expenses	Coverage

# The Models

- We develop **two scoring models**, one using log-transformed predictors and another using unlogged predictors.
- We test their performance on a **hold-out sample** containing 432 firms over the period 2003-2004.
- We **compare the performance** of the developed models with the performance of a well-known generic corporate model **Z''- score** for manufacturing and non-manufacturing firms

Z''-Score=  $6.56X_1+3.26X_2+6.72X_3+1.05X_4$ , where :

X1= working capital/total assets;

X2=retained earnings/total assets;

X3=EBIT/total assets;

X4=book value equity/total assets.

# The model 1/2

Using unlogged predictors

<i>KPG =</i>	+	4.28	
	+	0.18	<i>Ebitda/Total Assets</i>
	-	0.01	<i>Short Term Debt/Equity Book Value</i>
	+	0.08	<i>Retained Earnings/Total Assets</i>
	+	0.02	<i>Cash/Total Assets</i>
	+	0.19	<i>Ebitda/Interest Expenses</i>

# The model 1/2

Using log-transformed predictors

$$\begin{aligned} KPG = & + 53.48 \\ & + 4.09 \quad -LN (1-Ebitda/Total Assets) \\ & - 1.13 \quad LN (Short Term Debt/Equity Book Value) \\ & + 4.32 \quad -LN (1-Retained Earnings/Total Assets) \\ & + 1.84 \quad LN (Cash/Total Assets) \\ & + 1.97 \quad LN (Ebitda/Interest Expenses) \end{aligned}$$

# Results

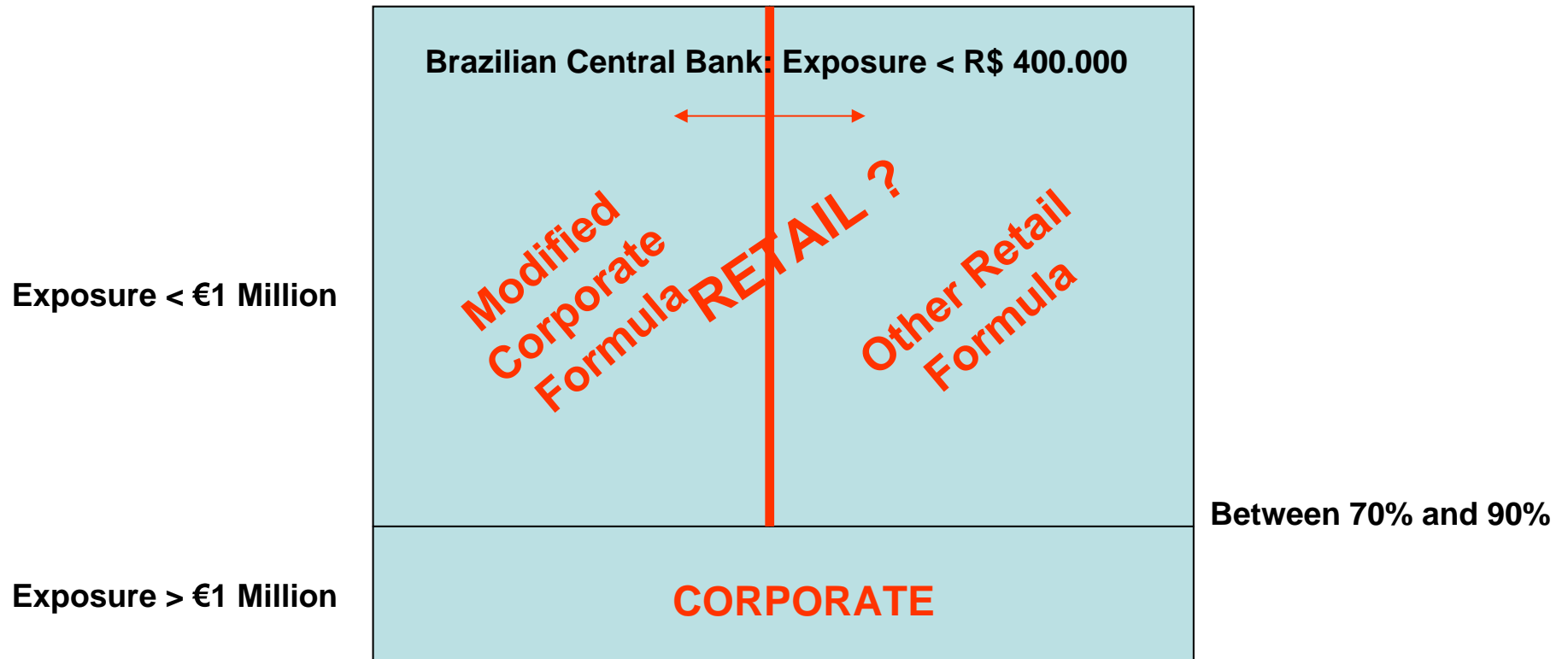
	Type I error rate	Type II error rate	Accuracy ratio
<b>Logistic model developed with logarithm transformed predictors</b>	11.76% (9.23%)	27.92% (24.64%)	87.2% (89.8%)
<b>Logistic model developed with original predictors</b>	21.63% (20.11%)	29.56% (27.86%)	75.4% (77.6%)
<b>Z''-Score Model</b>	25.81% (26.12%)	29.77% (29.52%)	68.7% (68.5%)

# Benefits: Internal Efficiency

- Implementing a scoring model specific for SMEs is likely to have **beneficial effects** on many operational aspects:
  - Decreases approval costs
  - Decreases approval time
  - Increase the quality of the decision (accept/reject)
  - Increase the profitability of the business
- Banks should not only apply **different procedures** (in the application and behavioral process) to manage SMEs compared to large corporate firms, but banking organizations should also use **instruments** (such as scoring and rating systems) **specifically addressed to the SME portfolio**.

# SMEs: Retail or Corporate?

Companies with turnover less than 50 Million of Euro



# Benefits: Lower Capital Requirements

- We show that modeling credit risk specifically for SMEs also results in **slightly lower capital requirements** (around 0.5%) for banks under the A-IRB approach of **Basel II** than applying a generic corporate model.
- This is true **whatever the percentage** of firms classified as **retail** or as **corporates**.
- This is due to the **higher discrimination** power of a specific SME credit risk model applied on a SME sample.

SME as retail	SME as corporate
$\text{Correlation}=R=0.03*(1-\text{EXP}(-35*PD))/(1-\text{EXP}(35)) +0.16*[1-(1-\text{EXP}(-35*PD))/(1-\text{EXP}(-35))]$	$\text{Correlation}=R.= 0.12*(1-\text{EXP}(-50*PD))/(1-\text{EXP}(-50)) +0.24*(1-(1-\text{EXP}(-50*PD))/(1-\text{EXP}(-50))) -0.04*(1-(S-5)/45)$
$\text{Capital requirement}=K=\text{LGD}*N((1-R)^{-0.5}*G(PD) + (R/(1-R)^{0.5})*G(0.999)) -PD*LGD$	$\text{Capital requirement}=K= (\text{LGD}*N((1-R)^{-0.5}*G(PD) + (R/(1-R)^{0.5})*G(0.999)) - PD*LGD)*(1-1.5*b)^{-1*(1+(M-2.5)*b)}$
	$\text{Maturity adjustment}=(b)= (0.11852-0.05478*\text{LN}(PD)^2)$

# Capital requirements applying the Z''-Score

All SMEs as Retail (Exposure<€1mil. & Sales<€50mil.)

Rating	PD	LGD	$R_{sme}$	$K_{sme}$	Weight	Cum. Weighted $K_{sme}$
AAA	0.03%	45%	0.15864	0.0035609	0.0464	0.017%
BBB	0.37%	45%	0.14421	0.0216938	0.0711	0.171%
BB	1.47%	45%	0.10771	0.0424133	0.2730	1.329%
BB-	1.86%	45%	0.09780	0.0455248	0.2979	2.685%
B+	4.73%	45%	0.05483	0.0528520	0.1015	3.221%
B	7.01%	45%	0.04118	0.0554183	0.1000	3.776%
CCC	26.57%	45%	0.03001	0.0889581	0.1100	<b>4.755%</b>

**Where:**

$$R_{sme} = \text{Correlation} = 0.03 * (1 - \text{EXP}(-35 * PD)) / (1 - \text{EXP}(-35)) + 0.16 * [1 - (1 - \text{EXP}(-35 * PD)) / (1 - \text{EXP}(-35))]$$

$$K_{sme} = \text{Capital requirement} = LGD * N((1 - R)^{-0.5} * G(PD) + (R / (1 - R)^{0.5}) * G(0.999)) - PD * LGD$$

**Weight**= Percentage of firms in each rating category

# Capital requirements applying the new SME model

All SMEs as Retail (Exposure<€1mil. & Sales<€50mil.)

Rating	PD	LGD	$R_{sme}$	$K_{sme}$	Weight	Cum. Weighted $K_{sme}$
AAA	0.03%	45%	0.15864	0.0035609	0.0618	0.022%
BBB	0.37%	45%	0.14421	0.0216938	0.1727	0.397%
BBB-	0.58%	45%	0.13612	0.0280984	0.1916	0.935%
BB	1.35%	45%	0.11097	0.0412190	0.1993	1.757%
B+	3.92%	45%	0.06295	0.0519062	0.1196	2.378%
B	7.46%	45%	0.03954	0.0560496	0.1083	2.985%
CCC	28.27%	45%	0.03001	0.0905826	0.1467	<b>4.313%</b>

**Where:**

$R_{sme}$ =Correlation=  $0.03*(1-EXP(-35*PD))/(1-EXP(-35))+0.16*[1-(1-EXP(-35*PD))/(1-EXP(-35))]$

$K_{sme}$ =Capital requirement=  $LGD*N((1-R)^{-0.5}*G(PD)+(R/(1-R)^{0.5})*G(0.999))-PD*LGD$

**Weight**= Percentage of firms in each rating category

# Capital requirements: Results

	Altman Z''-Score	New SME model



We confirm that the part of SMEs classified as retail can enjoy significantly lower capital requirements than the part classified as corporate.

But, if banking organizations should consider their **entire** SME portfolio as corporate and utilizing the A-IRB approach, they will likely face **higher** capital requirements than under the Basel I Capital Accord, even if they will use a model with a very high prediction accuracy.

# The Breakeven Analysis

Percentage of SMEs classified as retail and as corporate		Capital Requirements								
		Italy			United States			Australia		
<b>Breakeven A-IRB and Current</b>										
0% 100%	<b>20%</b> SMEs as retail	Italy			United States			Australia		
10% 90%		A-IRB	Standardized	Current	A-IRB	Standardized	Current	A-IRB	Standardized	Current
20% 80%	<b>80%</b> SMEs as corporate	7.74%	<b>7.60%</b>	8.00%	7.82%	<b>7.60%</b>	8.00%	7.97%	<b>7.60%</b>	8.00%
30% 70%	SMEs as corporate	7.58%	7.40%	8.00%	7.42%	7.40%	8.00%	7.55%	7.40%	8.00%
40% 60%	SMEs as retail SMEs as corporate	7.02%	7.20%	8.00%	7.03%	7.20%	8.00%	7.13%	7.20%	8.00%
<b>Breakeven A-IRB and Standardized</b>										
50% 50%	<b>40%</b> SMEs as retail	Italy			United States			Australia		
60% 40%		A-IRB	Standardized	Current	A-IRB	Standardized	Current	A-IRB	Standardized	Current
70% 30%	<b>60%</b> SMEs as corporate	7.02%	7.20%	8.00%	7.03%	7.20%	8.00%	7.13%	7.20%	8.00%
80% 20%	SMEs as corporate	5.24%	6.20%	8.00%	5.05%	6.20%	8.00%	5.04%	6.20%	8.00%
90% 10%	SMEs as retail SMEs as corporate	4.88%	6.00%	8.00%	4.65%	6.00%	8.00%	4.62%	6.00%	8.00%
100% 0%	SMEs as retail SMEs as corporate	4.88%	6.00%	8.00%	4.65%	6.00%	8.00%	4.62%	6.00%	8.00%

# Conclusions

- Today banks need to **manage as retail clients exposures toward SMEs up to at least €1 million** (if they want to consider the Basel II definition) to be competitive in the credit business.
- We think that the complexity of these companies cannot be managed only with bureau information, but a **financial analysis is needed**.
- A minimum of **20%** of SMEs must be classified as **retail** in order to maintain the SME capital requirement at least at the current level (8%).
- The percentage of SMEs to be considered as **retail** should be at least **40%** if the banks will want to enjoy a lower capital requirement under the Basel II Advanced IRB approach versus the Standardized approach.
- One of the main results of Basel II will be to motivate banks to **update their internal systems and procedures** in order to be able to manage SMEs on a pooled basis through the use of a scoring, rating or some other automatic decision system. **These procedures will be important in managing SMEs as retail accounts.**

# Conclusions

- **Increase the percentage of SMEs managed as retail assets as much as possible, considering the regulatory limit.**
- **Develop specific tools based on the kind of information available:**
  - Sole traders
  - Professionals
  - Partnerships
  - Limited companies (legal entities)
- **Differentiate pricing and products based on the SME type.**

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