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The Art of Tracking Corporate Bond Indices

Amundi working paper

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Tracking corporate bond indices is a **challenge**

since the indices are extensive

- Barclays Global Aggregate - Corporates contains 8615 bonds issued by 1418 firms
- Barclays Global High Yield - Corporates contains 3027 bonds issued by 1424 firms

- Merrill Lynch Global Large Cap IG Index contains 6718 bonds issued by 1201 firms
- Merrill Lynch Global High Yield Index contains 3552 bonds issued by 1687 firms

and disperse

- Firms domiciled in more than 80 countries, under which

Bahrain	Barbados	Bermuda
Oman	Dominican republic	Azerbaijan
Seychelles	Uruguay	Mongolia
Nigeria	Guatemala	Sri Lanka
Dutch Antilles	El Salvador	Macao

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Tracking corporate bond indices is a **challenge**

- Question is whether there is a common price trend and if yes, whether it can be captured by ±150 portfolio holdings.

- We show that YES this is feasible if three elements are combined:

  - **Stratified sampling**[1]
  - **Duration Times Spread measure**[2]
  - **Effective optimization method**[3]

- by empirical tests on two leading global corporate bond indices.

[1] Rudd (1980) "Optimal selection of passive portfolio", *Financial Management* 9

[2] Lehman Brothers Research (2007) "DTS^{SM} (Duration Times Spread)", *Journal of Portfolio Management* 33 n° 2

[3] Satchell and Scowcroft (2003) "Advances in portfolio construction and implementation", *Butterworth Heinemann*

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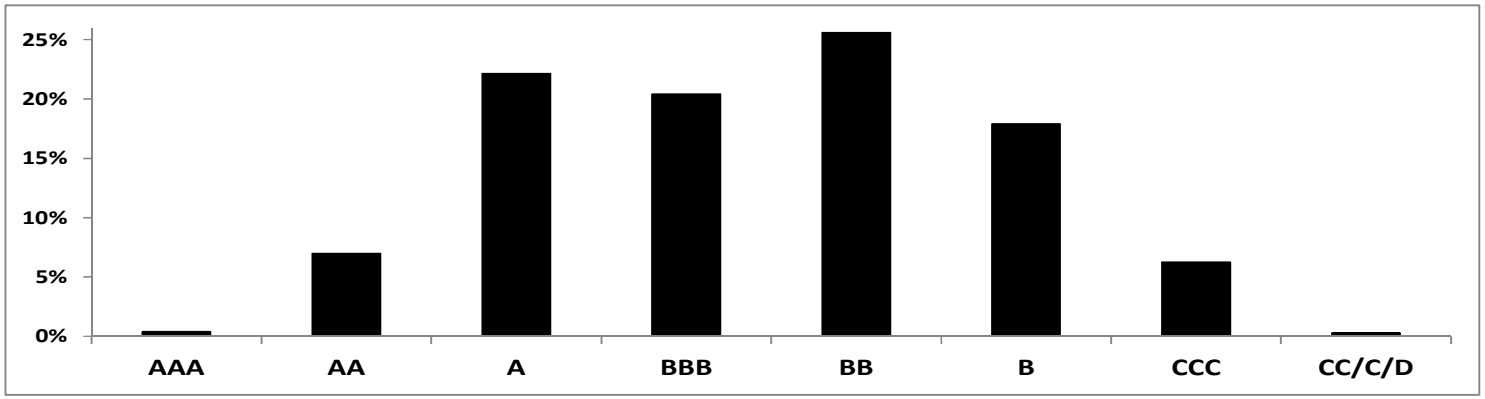
Merrill Lynch Global IG and HY index – index profile

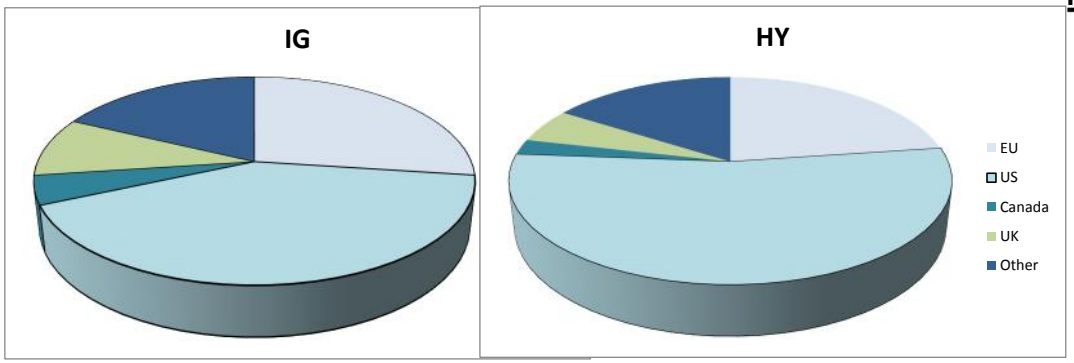
The test indices

Ratings

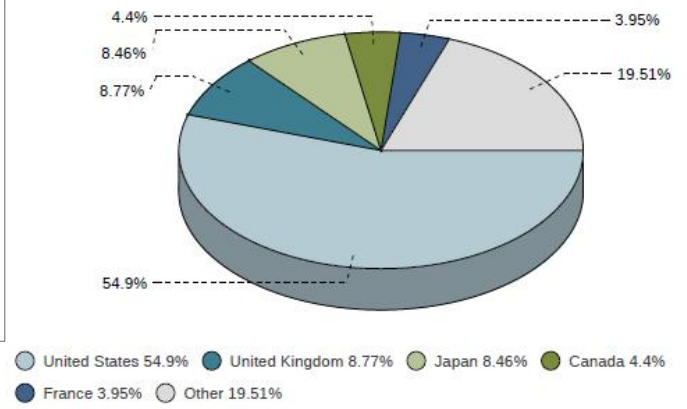
IG HY



Country weights



MSCI World



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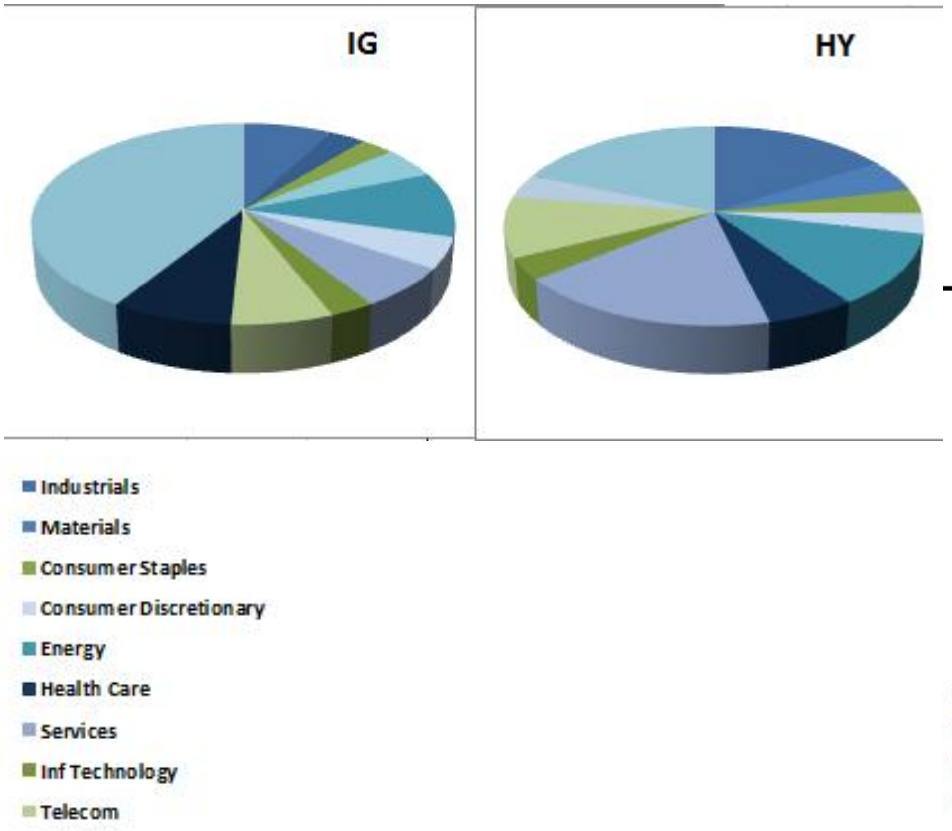
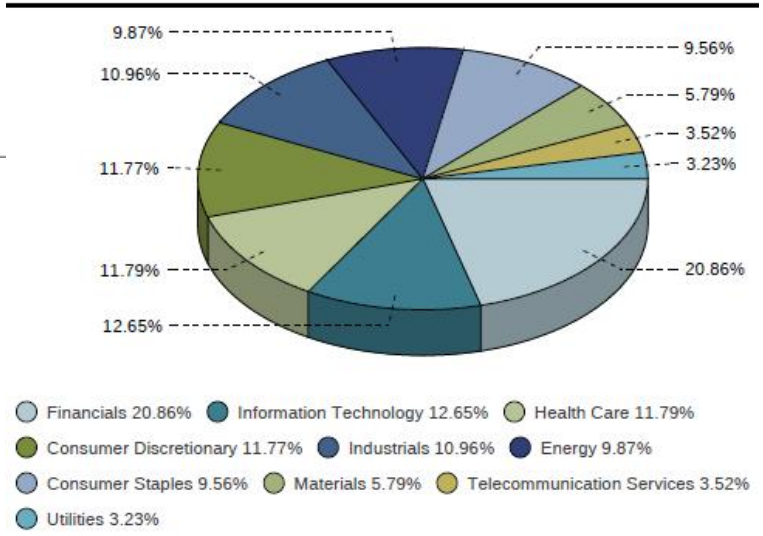
Merrill Lynch Global IG and HY index – index profile

The test indices

Sector weights



MSCI world



Merrill Lynch Global IG and HY index – index profile

Index members

HY index little overlap with equity investment universe

biggest	IG	HY
	General Electric	Telecom Italia
	Bank of America	Sprint Nextel
	JP Morgan	Petroléos de Venezuela
	Goldman Sachs	RBS
	Rabo Bank	Columbia Health Care

exotic

Galaxy Enterprise Macao

Masayoshi's Softbank

Avianca Airways

Nile Finance triple C

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1st element: stratified sampling

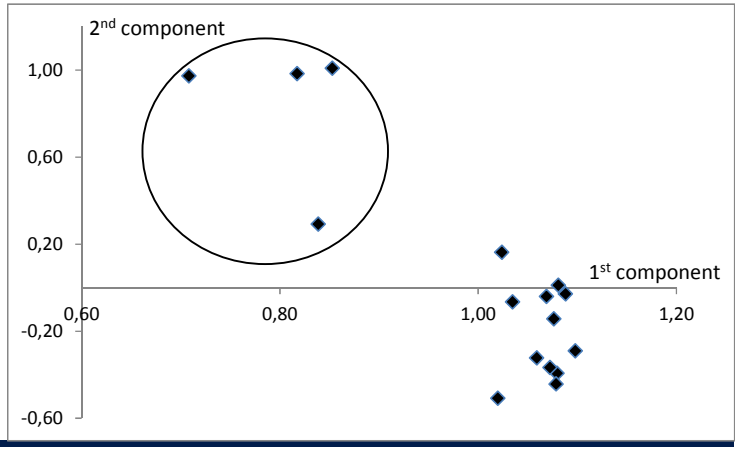
Grinold & Kahn's definition: "*Stratified sampling is glorified screening.*
One deploying this term wants the listener to 1) be impressed and 2) ask no further questions."

Functional definition: "*Divide the investment universe in strata that capture distinct sources of risk and replicate each of them*."

→ The universe is divided in three zones: Europe, North-America and the rest. The first two are split into 13 sectors; the rest is split in financials & industrials as well as develop & emerging & new frontier countries.

Principal component analysis results giving evidence that

the four ML financial sectors are driven by a common risk factor.



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2nd element: DTS^{SM} measure

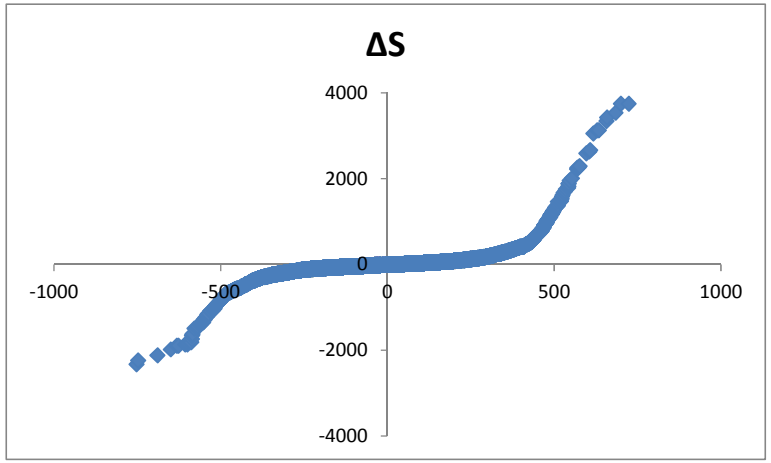
Lehman Bros' insight: augment the linear approximation of bond return by the spread level

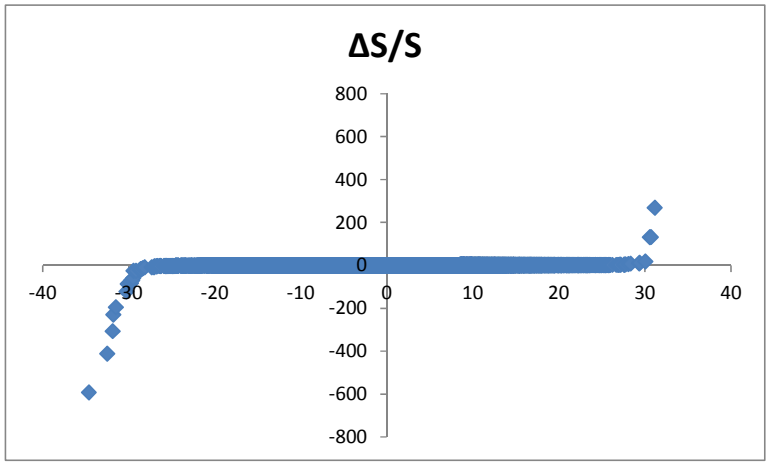
in order to derive a more linear- and stationary variable.

$$R_i^{credit} \approx -d_i \cdot S_i \cdot \left(\Delta S_i / S_i \right)$$

S_i is credit spread, d_i is duration of bond i

QQ plots





Rather than ($w_i \cdot d_i$) take ($w_i \cdot d_i \cdot S_i$) as the selection criterion, called the *bond betas*.

3rd element: effective optimization

The index replication problem is a Quadratic Mixed-Integer Programming problem:

$$\text{Min.} \quad TE^2 \approx 1/T \sum_t \left(\sum_j w_j^b \cdot \sum_{i \in J} (wdS)_i^{b-p} \cdot \left(\frac{\Delta S}{S} \right)_i \right)^2$$

s.t. Positivity nonlinear

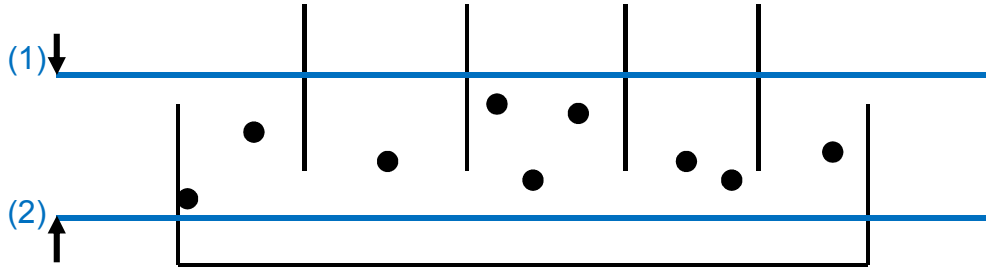
Cardinality nonlinear

Stratification linear

We apply a local-search heuristic that works like a compressor

(1) fixed portion within each stratum

(2) minimum threshold



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3rd element: effective optimization cont.

Local search heuristic

1. Screening

Select the biggest *bond betas* on aggregate firm level per stratum

2. Pairwise fine-tuning

Per pair of two firms weight is redistributed such that the overall DTS alignment improves.

If a weight falls under the minimum threshold, it is eliminated.

3. Bond selection

Pick a maximum of two bonds to represent the firms.

If a weight falls under the minimum threshold, it is eliminated.

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Test results

Foresight-free tests run over a seven-year period from 06/2007 to 05/2014.

corporate bond index	realised tracking error	portfolio holdings	firms
Investment Grade	0.9%	165	120
North-America & Europe	1.0%	129 (71 + 58)	90
Latin-America, Africa & Asia-Pacific	1.3%	36 (7+0+27)	30
High Yield	2.6%	184	135
North-America & Europe	2.7%	152 (107 + 45)	111
Latin-America, Africa & Asia-Pacific	4.2%	32 (8+ 1+ 23)	24

2.5% of the **IG** index members and 5.2% of the **HY** index members are retained,

Achieving a tracking of 0.9% on an **IG** index volatility of 4.9% and 2.6% on a **HY** vol of 12.2%.

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Success lies in the combination of three elements

- Stratified sampling
- Duration Times Spread measure
- Effective optimization method

Algorithm settings		realised tracking error	portfolio holdings
0	The optimal setting	2.7%	152
1	No DTS measure	4.7%	152
2a	No regional stratification	3.0%	150
2b	No sector stratification	4.1%	153
2c	Reduced sector stratification	4.1%	155
3	No pairwise fine-tuning	3.1%	236
4	Twice less rebalancing	2.8%	152

The three elements prove to be vitally useful. Within that, regional stratification -distinguishing between European and American bonds- seems the least critical.