

Capturing Risk: Finding the Right Measures and Metrics (and Data)

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Risk typology

1990-2020: A myriad of 'banking' risks

- **Credit Risk (1988)**
 - Basel I & II, Merton model, default risk, migration risk, ratings, etc.
- **Market Risk (1996)**
 - Basel I & III, Volatility modeling, Value-at-Risk, expected shortfall, stress testing, risk factors, etc.
- **Counterpart Credit Risk (1995)**
 - Basel I & III, potential future exposure, risk neutral vs. historical risk measure, etc.
- **Credit Valuation Adjustment & Collateral Risk (2003)**
 - Basel III, CVA/DVA, wrong way risk, etc.
- **Valuation & Model Risk (1996)**
 - Basel I & III, Black-Scholes model, pricing risk, hedging risk, volatility risk, liquidity risk, etc.
- **Operational Risk (2000)**
 - Basel II, loss distribution approach, extreme value theory, etc.
- **ALM Risk (2008)**
 - Basel III, LCR, NSFR, etc.
- **Systemic Risk (2008)**
 - Basel III, G-SIB, CoVaR, MSES, etc.

The case of asset management

1990-2020: Asset management benefits from the experience of the banking industry & regulation

- Credit Risk
- Market Risk (**value-at-risk, stress testing**)
- CCR, CVA & Collateral Risk
- Valuation/Model Risk (dual pricing)
- Operational Risk

2020+: New challenges for the asset management industry

- **Liquidity Risk** (**liability**, regulatory framework, funding, liquidation policy, management tools)
- **Sustainability Risk** (**fiduciary**, greenwashing, regulatory framework, reputational risk)
- **Diversification Risk** (**business**, size of investment universe, liquidity, esg exclusion, voluntary delisting, supply/demand imbalance)

What are the issues?

- No (or very few) academic models
- Cannot benefit from the experience of the banking sector
- **Data are not market-based**: most of data are proprietary (e.g., funding liquidity) or heterogeneous (e.g., extra-financial data)

Impact on asset pricing

“[...] there is also broad belief among users of financial liquidity — traders, investors and central bankers — that the principal challenge is not the average level of financial liquidity ... but its variability and uncertainty” (Persaud, 2003)

- The liquidity management problem does not concern **illiquid assets**,... but **liquid assets**
- Two types of risk:
 - Micro (reputational) risk
 - Macro (systemic) risk (e.g., municipal bonds markets)

The dot.com crisis (2000-2003)

- If we consider the S&P 500 index, we obtain:
 - 55% of stocks post a negative performance (75% of market capitalization)
 - 45% of stocks post a positive performance
- Maximum drawdown = 49 %
- Systematic (valuation) risk crisis
- **Small cap stocks ↗**

The GFC crisis (2008)

- If we consider the S&P 500 index, we obtain:
 - 95% of stocks post a negative performance (97% of market capitalization)
 - 5% of stocks post a positive performance
- Maximum drawdown = 55 %
- Systemic (liquidity) risk crisis
- **Small cap stocks ↘**
- Network risk between illiquid and liquid assets: Subprime crisis ⇔ banks (credit risk) ⇔ asset management (funding & leverage risk) ⇔ equity market (volatility risk) ⇔ banks (asset-price & collateral risk)
- The equity market is the ultimate liquidity provider: **1/3 of the GFC losses in the equity market is explained by the liquidity supply of the equity market**

A perfect case of a blank page exercise?

Liquidity risk in an ALM framework: (1) Liability Liquidity Risk Modeling, (2) Asset Liquidity Risk Modeling, (3) Managing the Asset-Liability Liquidity Risk

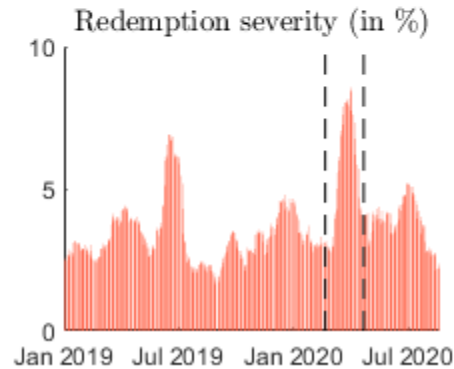
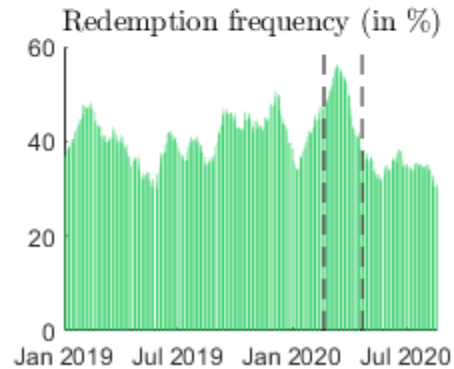
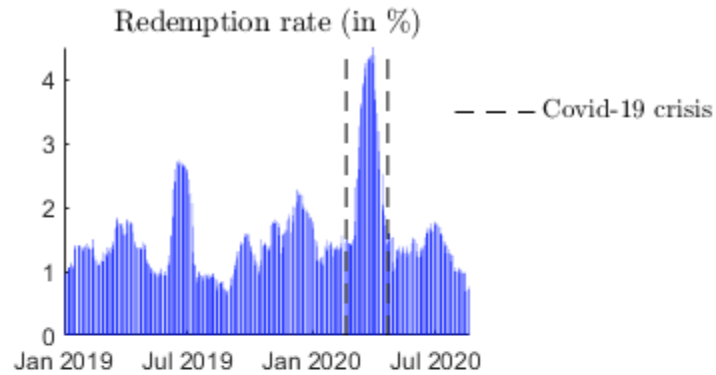
- **European Securities and Markets Authority (2019), Guidelines on Liquidity Stress Testing in UCITS and AIFs, Final Report, ESMA 34-39-882, September**
- No normative/prescriptive framework (e.g., definition of the RCR, holding period, risk measure, confidence level)
- Lack of academic research (funding risk, ALM risk, asset risk such as sovereign bonds or corporate bonds)
- Lack of (public) data
- Lack of coordination between asset managers
- No formulas
- Bouveret, A. (2017), Liquidity Stress Tests for Investment Funds: A Practical Guide, IMF Working Paper, 17/226
- Roncalli *et al.* (2021), **Liquidity Stress Testing in Asset Management: Comprehensive Report**, SSRN, <https://ssrn.com/abstract=3981920>, 336 pages

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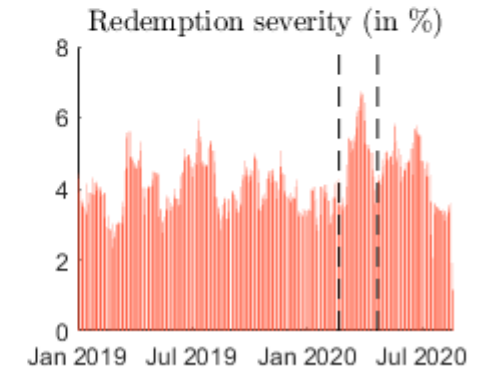
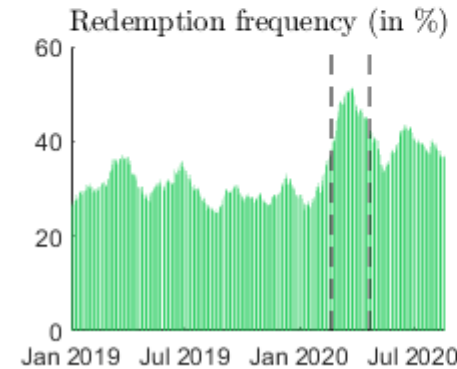
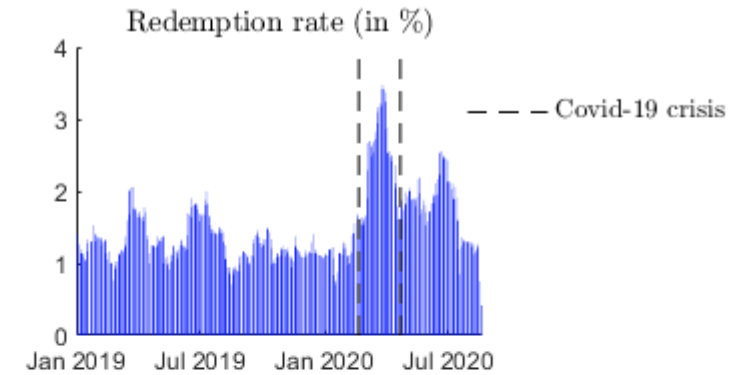
Liability Liquidity Risk Modeling

- Liability modeling
 - Historical approach
 - Frequency-severity approach (zero-inflated models)
 - Individual-based models
 - Copula models
- **Data dependency**
 - Historical period
 - Proprietary data
 - Enough data?
- **Three main LST factors**
 - Liability structure (e.g., mandates \neq flagships, Herfindahl index)
 - Frequency or severity risks
 - Stationarity risk (e.g., behavioral risk, lead/lag effects, network risks)
- Some figures & findings
 - Skewness risk (x 5) \approx operational risk
 - 99% Historical VaR = 0.10% - 25%
 - 99% Historical ES = 1% - 40%
 - 1Y Parametric Stress Testing = 2% - 50%
 - Redemption shocks
 - Balanced funds < equity & bonds funds < enhanced treasury < MMFs
 - Corporates > institutionals > third-party distributors > retail > employee saving plans (PEE)
 - Cross-section correlation: Equity funds > Bond funds > Balanced funds > MMFs
 - Cross-section correlation: (Third-party, retail) > (corporates, institutionals)
 - Time-series correlation: MMFs \rightarrow self-herding & spillover risk

Corporates / Money Market

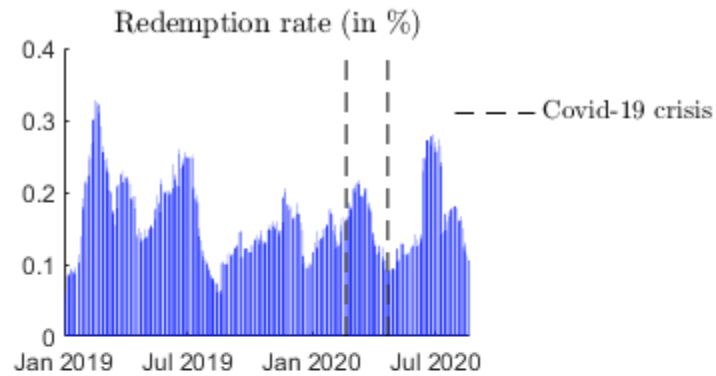


Institutional / Money Market

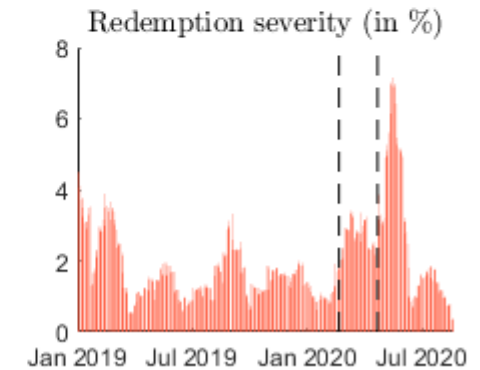
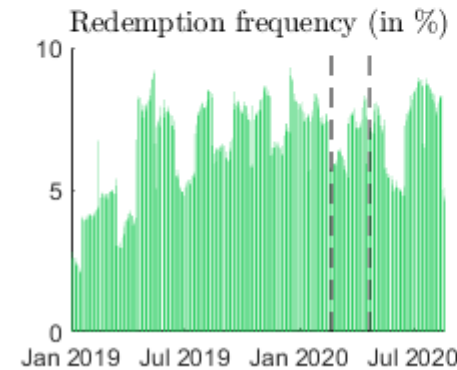
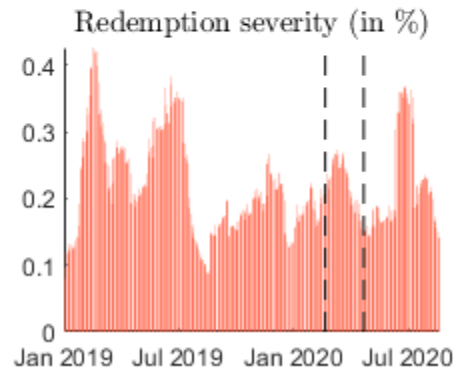
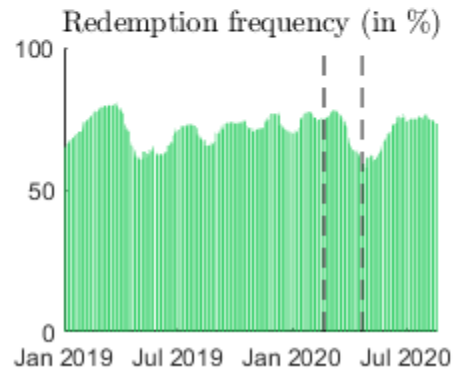
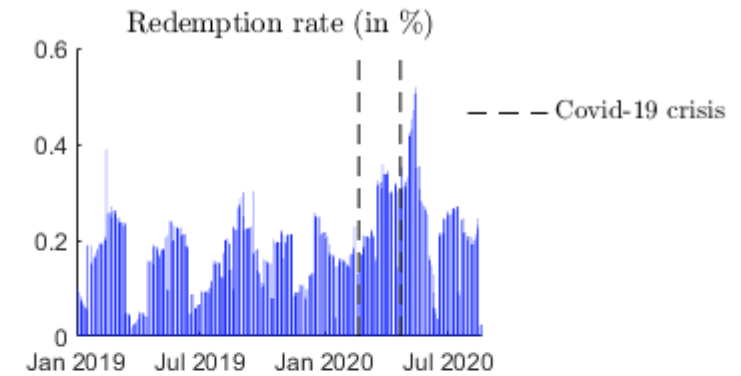


Source: Roncalli et al. (2021)

Retail / Equity



Institutional / Equity



Source: Roncalli et al. (2021)

A perfect case of a blank page exercise?

Asset Liquidity Risk Modeling

- Asset modeling
 - Transaction cost & price impact
 - Liquidation policy
- Stress testing
 - Bid-ask spread
 - Volatility
 - Volume
- Pitfalls
 - EU data \neq US data
 - Corporate bonds: size & price impacts
 - Zero-trading days & the price risk measure
 - Trades with negative costs (opportunistic trades)
 - Rejected inference (rejected trades because high/prohibitive costs)

- We note
 - x the volume-based participation rate
 - y the outstanding-based participation rate
 - s the half bid-ask spread
 - σ the daily volatility
 - DTS the duration-times-spread

Benchmark formulas (power law property)

Asset class	$c(q; s, \sigma, v)$
Large caps	$1.25 \cdot s + 0.40 \cdot \sigma \cdot \sqrt{x}$
Small caps	$1.50 \cdot s + 0.50 \cdot \sigma \cdot \sqrt{x}$
Sovereign bonds	$1.25 \cdot s + 3.00 \cdot \sigma \cdot y^{0.25}$
Corporate bonds	$1.50 \cdot s + 0.125 \cdot \text{DTS} \cdot y^{0.25}$

Source: Roncalli et al. (2021)

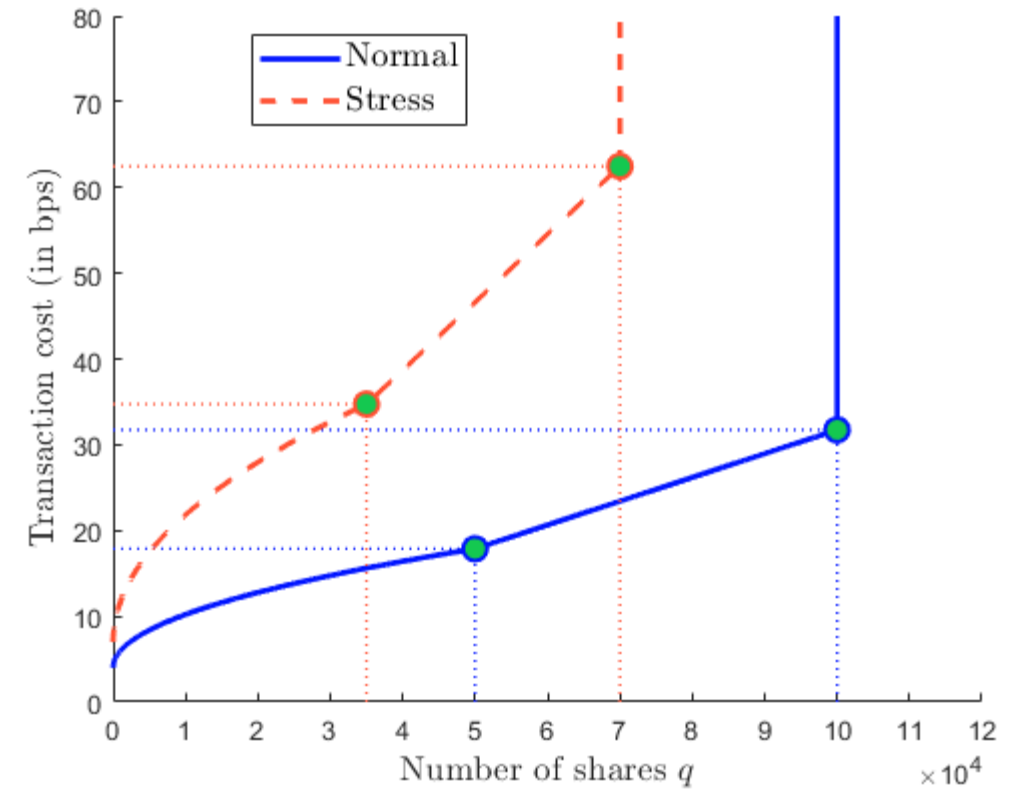
Liquidity Stress Testing

A perfect case of a blank page exercise?

Asset Liquidity Risk Modeling

- In the normal period, we can sell 100 000 shares at 31.7 bps
- In the stress period, we can sell 70 000 shares at 62.5 bps

Comparing the unit transaction cost in the normal and stress periods



Source: Roncalli et al. (2021)

A perfect case of a blank page exercise?

Liquidity measurement tools

- RCR
- Reverse stress testing

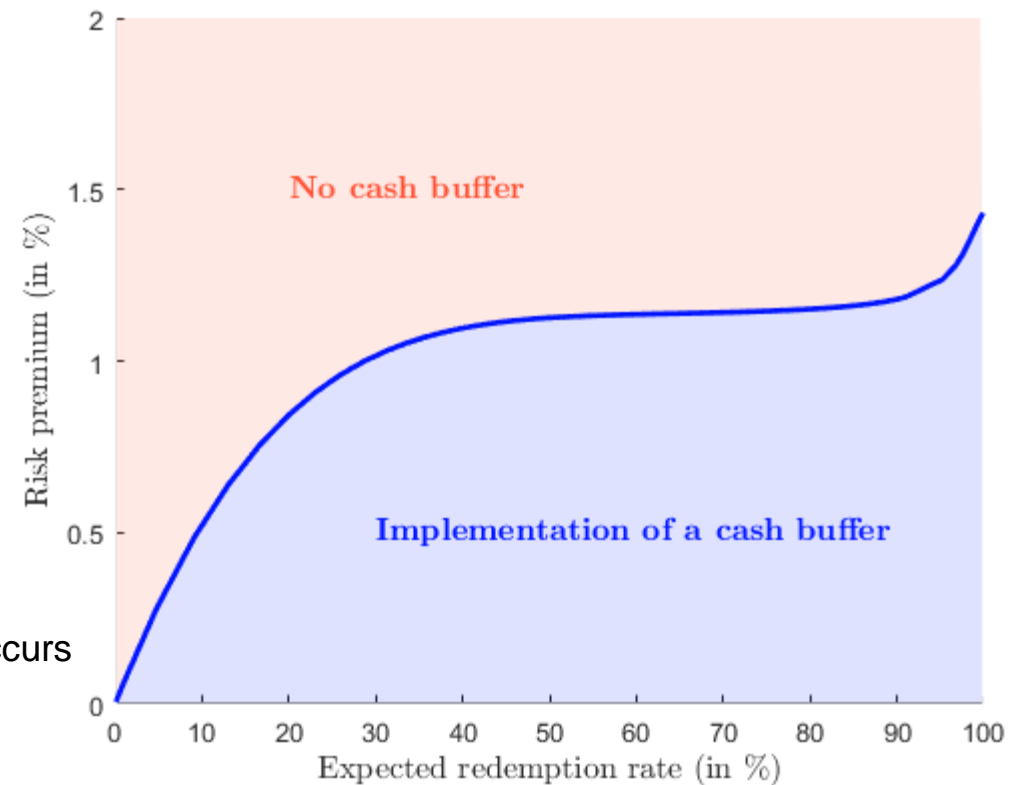
Liquidity management tools

- Liquidity buffer
- Special arrangements
- Swing pricing vs ADL

The debate of liquidity buffers

- Cash holding (**fire sales may be stabilized**)
 - The fund manager implements the cash buffer before the redemption occurs
 - He uses the cash buffer during the liquidity stress period
- Cash hoarding (**fire sales are amplified**)
 - He does not liquidate the cash buffer during the liquidity stress period
 - He preserves the liquidity of the portfolio

The case of cash buffers



Source: Roncalli et al. (2021)

The Emperor's New Clothes?

The Three Lines of Defense Model

- 1st line of defense: Fund Management & Commercial Activity
- **2nd line of defense: Risk Management & Compliance**
- 3rd line of defense Internal Audit

ESG & Climate-related financial risks

- SFDR
 - Articles 6, 8 and 9
 - Principal adverse impact (PAI)
- Climate risk disclosure rules (e.g., CSRD, SEC, etc.)
- Green Taxonomy
- Climate & ESG Benchmarks (e.g., S&P 500 ESG, PAB)
- MIFID
- **ESG & Greenwashing**
- Basel Committee: Principles for the effective management and supervision of climate-related financial risks (November 2021)

Data is the crux of ESG & Climate Investing

Data issues (availability, heterogeneity, quality)

- Credit ratings: correlation > 95% within credit rating agencies
- Global ESG ratings: low correlation within ESG rating agencies (2019)
 - ≈ 50% for European issuers
 - ≈ 30% for American issuers
 - ≈ 0% for Japanese issuers
- E, S & G ratings: higher correlation but significant differences
- Berg *et al.* (2022), **Aggregate Confusion: The Divergence of ESG Ratings**, *Review of Finance*, <https://ssrn.com/abstract=3438533>

- Carbon footprint
 - The case of Scope 3

Data is the crux of ESG & Climate Investing

The GHG Protocol corporate standard classifies a company's greenhouse gas emissions in three scopes

- Scope 1: Direct GHG emissions
- Scope 2: Consumption of purchased energy
- Scope 3: Other indirect GHG emissions
 - Scope 3 upstream: emissions associated to the supply side
 - First tier direct
 - Tier 2 and 3 suppliers
 - **Scope 3 downstream: emissions associated with the product sold by the entity**
 - Use of the product
 - Waste disposal & recycling

Data is the crux of ESG & Climate Investing

Examples of carbon emissions and intensity

Company	Emission (in tCO ₂ e)			Revenue (in \$ mn)	Intensity (in tCO ₂ e/\$ mn)		
	Scope 1	Scope 2	Scope 3		Scope 1	Scope 2	Scope 3
Alphabet	74462	5 116 949	7 166 240	161 857	0.460	31.614	44.275
Amazon	5 760 000	5 500 000	20 054 722	280 522	20.533	19.606	71.491
Apple	50463	862 127	27 618 943	260 174	0.194	3.314	106.156
BP	49 199 999	5 200 000	103 840 194	276 850	177.714	18.783	375.077
Danone	722 122	944 877	28 969 780	28 308	25.509	33.378	1 023.365
Enel	69 981 891	5 365 386	8 726 973	86 610	808.016	61.949	100.762
Juventus	6 665	15 739	35 842	709	9.401	22.198	50.553
LVMH	67 613	262 609	11 853 749	60 083	1.125	4.371	197.291
Microsoft	113 414	3 556 553	5 977 488	125 843	0.901	28.262	47.500
Nestle	3 291 303	3 206 495	61 262 078	93 153	35.332	34.422	657.647
Netflix	38 481	145 443	1 900 283	20 156	1.909	7.216	94.277
Samsung Electronics	5 067 000	10 998 000	33 554 245	197 733	25.625	55.620	169.694
Total	40 909 135	3 596 127	49 831 487	200 316	204.223	17.952	248.764
Volkswagen	4 494 066	5 973 894	65 335 372	282 817	15.890	21.123	231.016

Source: Trucost reporting year 2019, Le Guenedal and Roncalli (2022)

The Validation of ESG & Climate Risk Models

The case of Net Zero Portfolio Modeling

- How to define net zero investing?
 - Decarbonization dimension
 - Transition dimension
- **Net zero carbon metrics**
 - Carbon footprint
 - Forward-looking metrics
 - Carbon momentum
 - Carbon temperature
- **Net zero transition metrics**
 - Green revenue share
 - Forward-looking metrics
 - Green CAPEX/R&D
 - Transition score

The Net Zero Transition: What it would Cost, What it could Bring

- McKinsey' Report (2022)
- Capital requirements under the NGFS Net Zero 2050 scenario: \$275 trillion in cumulative spending on physical assets over the next 30 years
- This represents approximately \$9.2 trillion per year between 2021 and 2050

“The transition to net-zero greenhouse emissions by 2050 will require an extra \$3.5 trillion a year in capital spending on physical assets for energy and land-use systems”

- That amount is the equivalent of 4.1% of the World GDP
- **Primary market ≠ secondary market**

The Validation of ESG & Climate Risk Models

The case of Net Zero Portfolio Modeling

- Portfolio decarbonization
 - long on Financials
 - short on Energy, Materials and Utilities
- **Negative correlation between the decarbonization dimension and the transition dimension**

Green revenue share in % (Dec. 2021, Scope 1 + 2 + 3)

Index	Decarbonization rate R									
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
MSCI World	5.47	5.47	5.49	5.37	5.20	5.02	4.81	4.56	3.96	0.02
MSCI USA	6.17	6.13	6.09	6.03	5.93	5.84	5.75	5.45	4.45	0.00
MSCI EMU	5.21	5.16	5.07	4.94	4.73	4.28	3.62	3.19	2.94	0.37
MSCI Canada	2.09	2.00	1.91	1.80	1.82	1.77	1.73	1.69	1.67	1.35

PAB Eurostoxx 50 ($R = 80\%$, Scope 1+2+3)

Stock	Sector	HCIS
Adidas	Consumer Discretionary	✓
Adyen	Information Technology	
Allianz	Financials	
AXA	Financials	
Banco Santander	Financials	
BNP Paribas	Financials	
EssilorLuxottica	Consumer Discretionary	✓
Inditex	Consumer Discretionary	✓
ING	Financials	
Intesa Sanpaolo	Financials	
Kering	Consumer Discretionary	✓
Muenchener Rueckver	Financials	
Sanofi	Health Care	✓
SAP	Information Technology	

Source: Trucost reporting year 2019, MSCI (2022), Roncalli et al. (2022)

The Validation of ESG & Climate Risk Models

What is Greenwashing?

- When the concepts of climate investing are not well-defined, this opens the door to greenwashing, not necessarily intentional and explicit greenwashing, but unintentional greenwashing
- We must distinguish:
 - **Explicit & deliberate greenwashing (= mis-selling risk)**
 - **Unintentional greenwashing (= misinterpretation risk)**
 - The practices & definitions are not unique (divergence confusion, e.g., voting policy)
 - The practices & definitions change over time (convergence confusion, e.g., net zero investing)
- What is the role of risk management?
 - Mis-selling risk is easy to detect and manage
 - Mis-interpretation risk is difficult to detect and manage

Asset interconnectedness

Liquid markets are less diversified since 20 years

- Why?
 - Regulation
 - Benchmarking
 - Globalization
 - Diversification
 - Voluntary delisting
 - Liquidity management
 - Climate investing

The Timing Issue

- **Old vision of regulation (explicit knowledge)**
 - 3-step process:
 1. Models →
 2. Data →
 3. Regulation (→ Measurement improvement)
 - Some examples:
 - Credit risk: Merton model → EAD, PD, LGD, M → Basel II
- **New vision of regulation (Learning by doing)**
 - Reverse process:
 1. Regulation →
 2. Data →
 3. Models?
 - Some examples:
 - Liquidity Stress Testing
 - PAB → scope 3 & net zero definition
 - SFDR → Green taxonomy → Data → CSRD (→ Data → SFDR)

THANK YOU!

Thierry Roncalli

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