Marketing Communications - For Professional Investors

ALLOCATING TO THEMATIC INVESTMENTS

BENEFITING FROM LONG-TERM PERFORMANCE DRIVERS

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BNP PARIBAS
ASSET MANAGEMENT

The sustainable investor for a changing world

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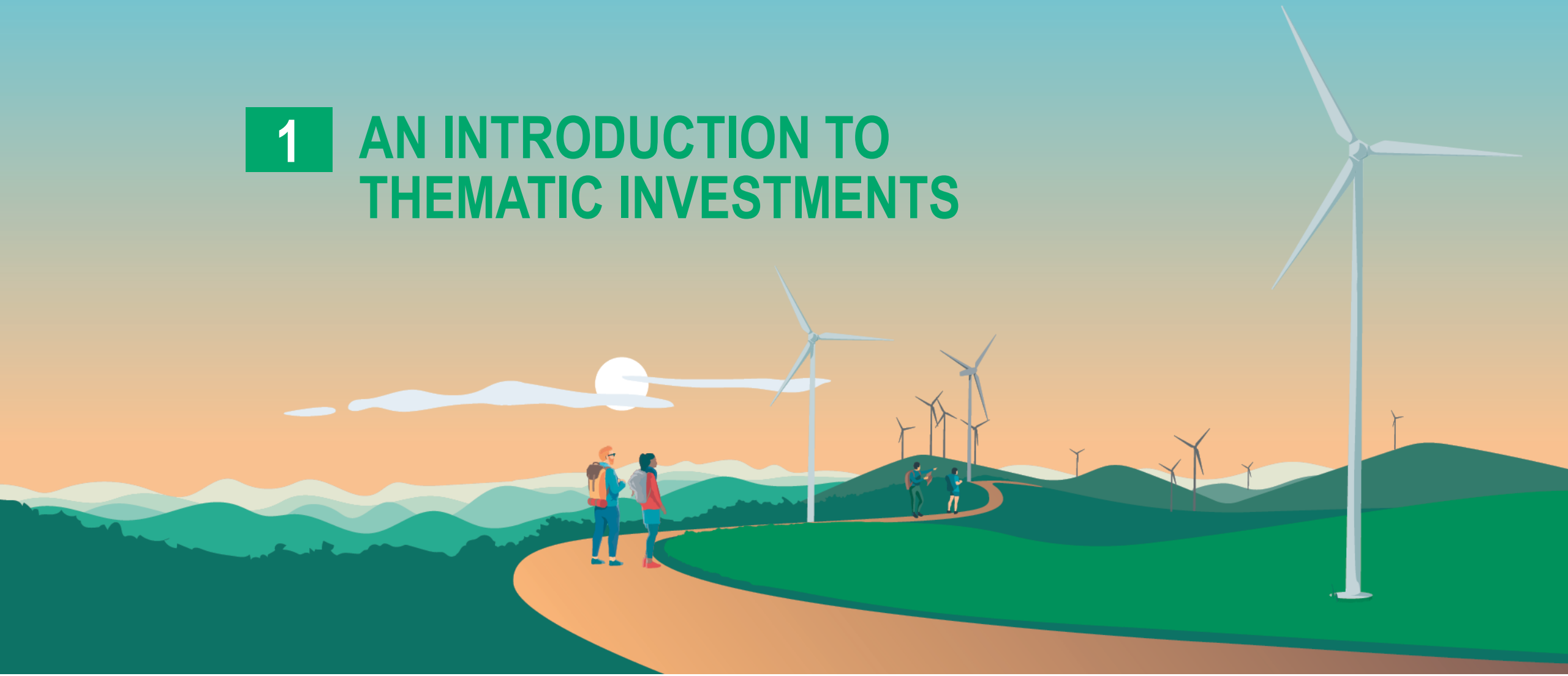
1 AN INTRODUCTION TO THEMATIC INVESTMENTS



Thematic investments

Transform megatrends into investible opportunities

Long-term

Companies that focus on solving challenges with long-lasting effect

High-conviction

Focused exposure to one theme

Multi asset

Dominance of equity, fixed income & private markets increasing

Global

Benefits of structural trends at global level

Accelerating trend for clear reasons

Diversification benefits

enhance diversification by adding thematic investments to portfolio

Clarity of investible theme

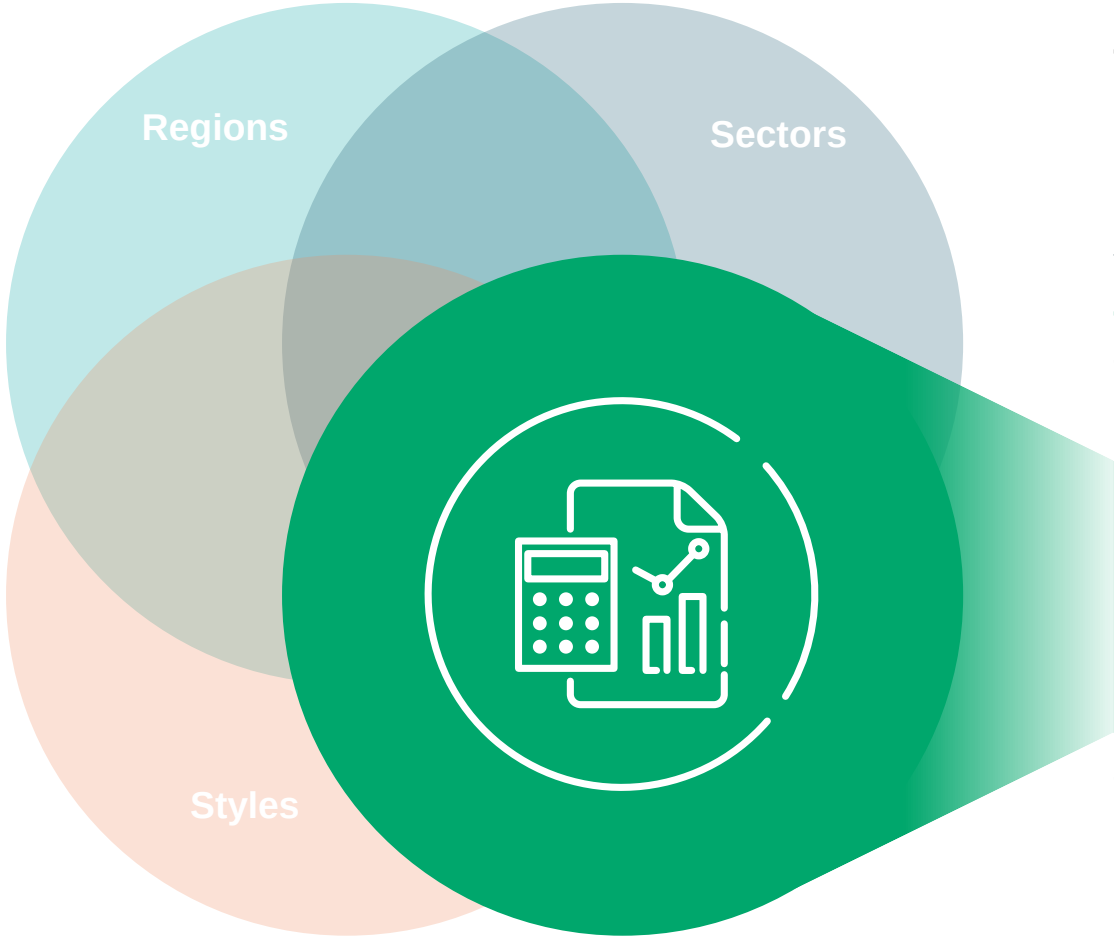
benefit from knowing what investments are capturing

Aligned with investor convictions

choose themes that fit values and convictions

Source: BNP Paribas Asset Management. For illustration purposes only.

New dimension to portfolio construction



Traditionally, investors seek to:

- Categorise investments into asset classes
- Diversify across and within asset classes distinguishing:
  regions, **sectors** and **styles**

Thematic investing introduces an additional dimension

Transcends those classifications **while not being fully independent from them** and accounting for the **Megatrends** shaping society:

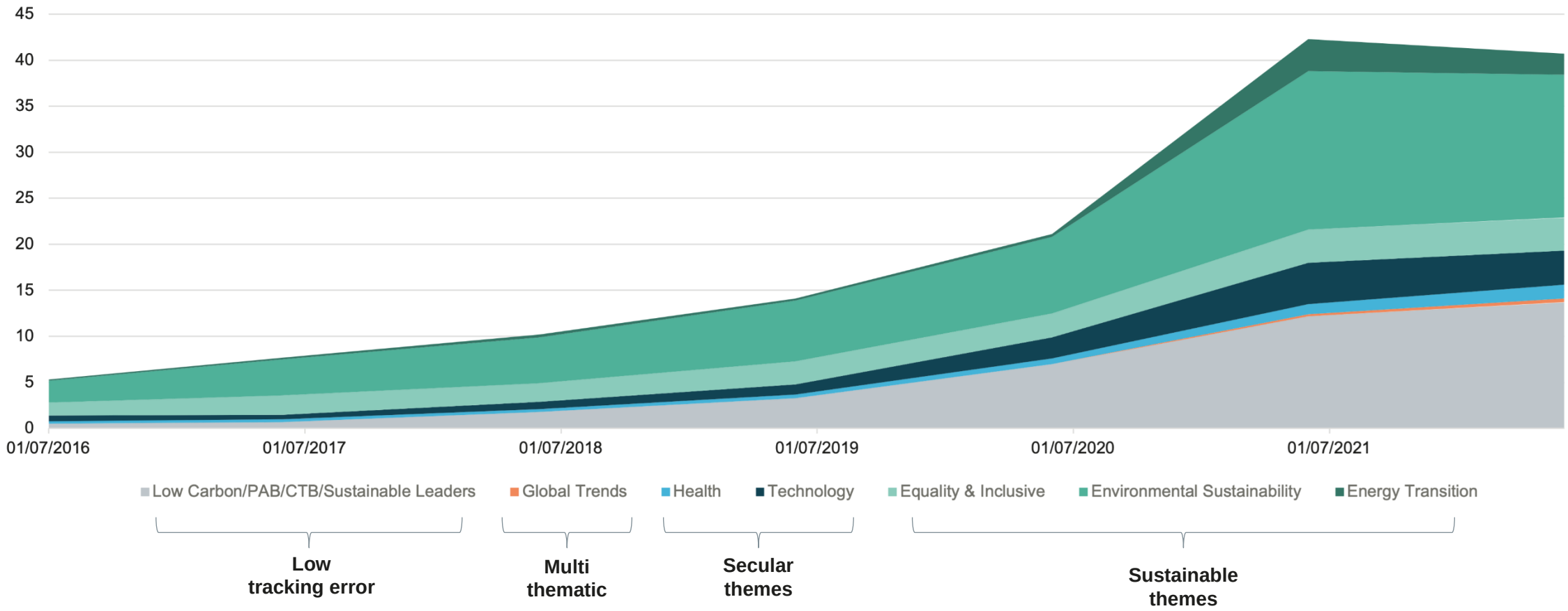
- Demographic shifts
- Social & behavioural shifts
- Environmental developments
- Resource scarcity
- Economic imbalances
- Transfer of power
- Technological advances
- Regulatory/political change

Thematic investing is:

investing in assets more likely to benefit from value creation derived from structural trends

Stellar growth in thematic investing

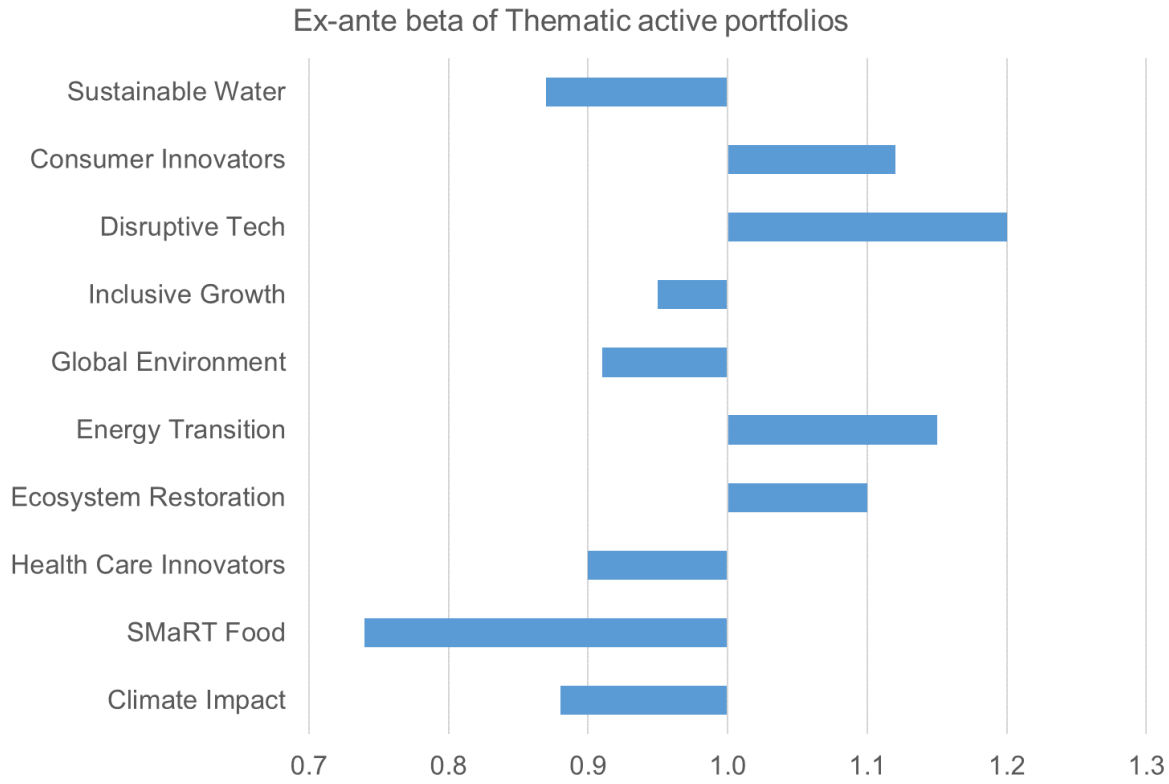
Growth of thematic funds in Europe – AUM (bn €)

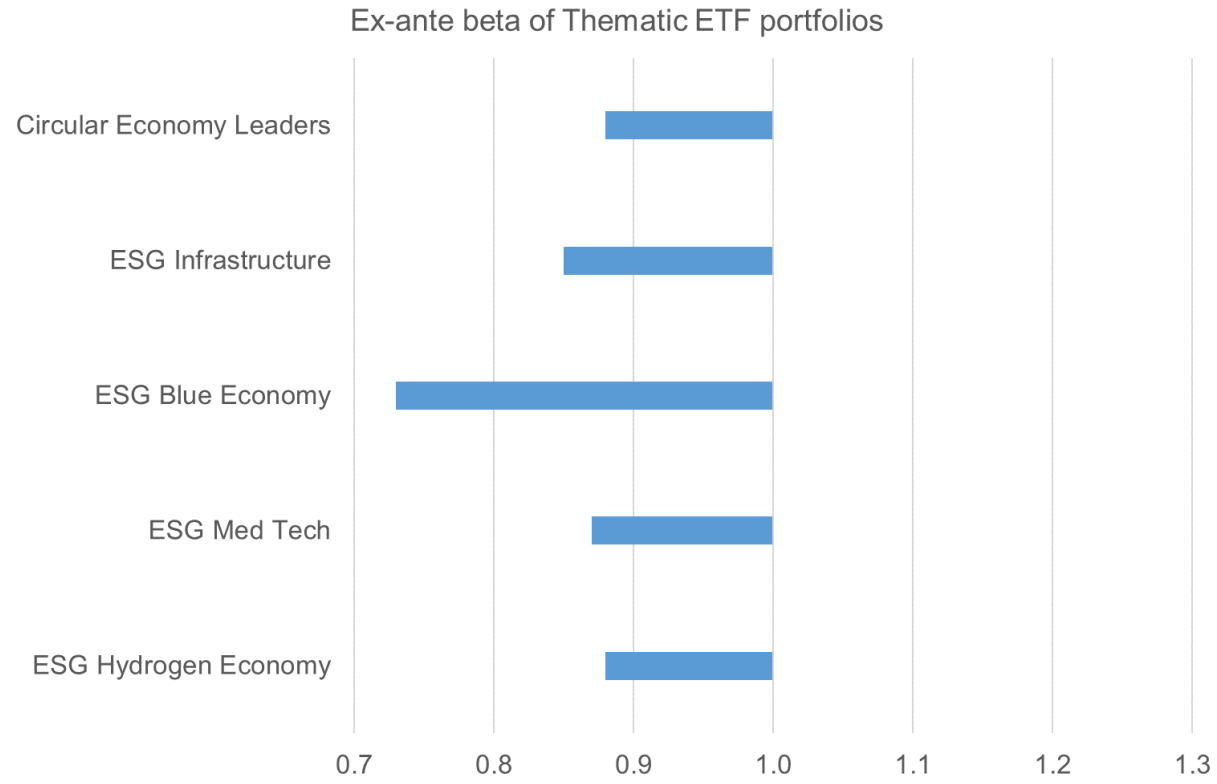


Source: Internal BNPPAM as end of June 2022; Scope: European cross-border & local funds, all asset classes, active & passive

2 RISK EXPOSURES OF THEMATIC EQUITIES

Beta of Thematic investments: ex-ante analysis

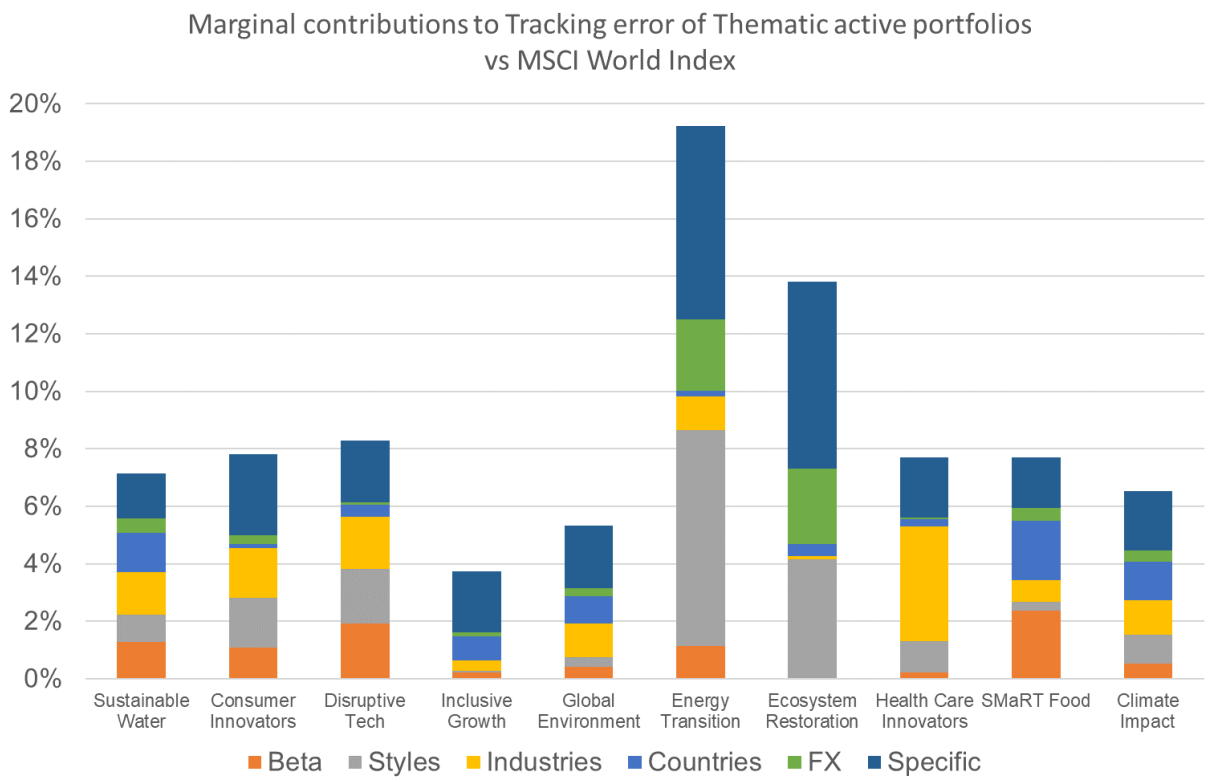


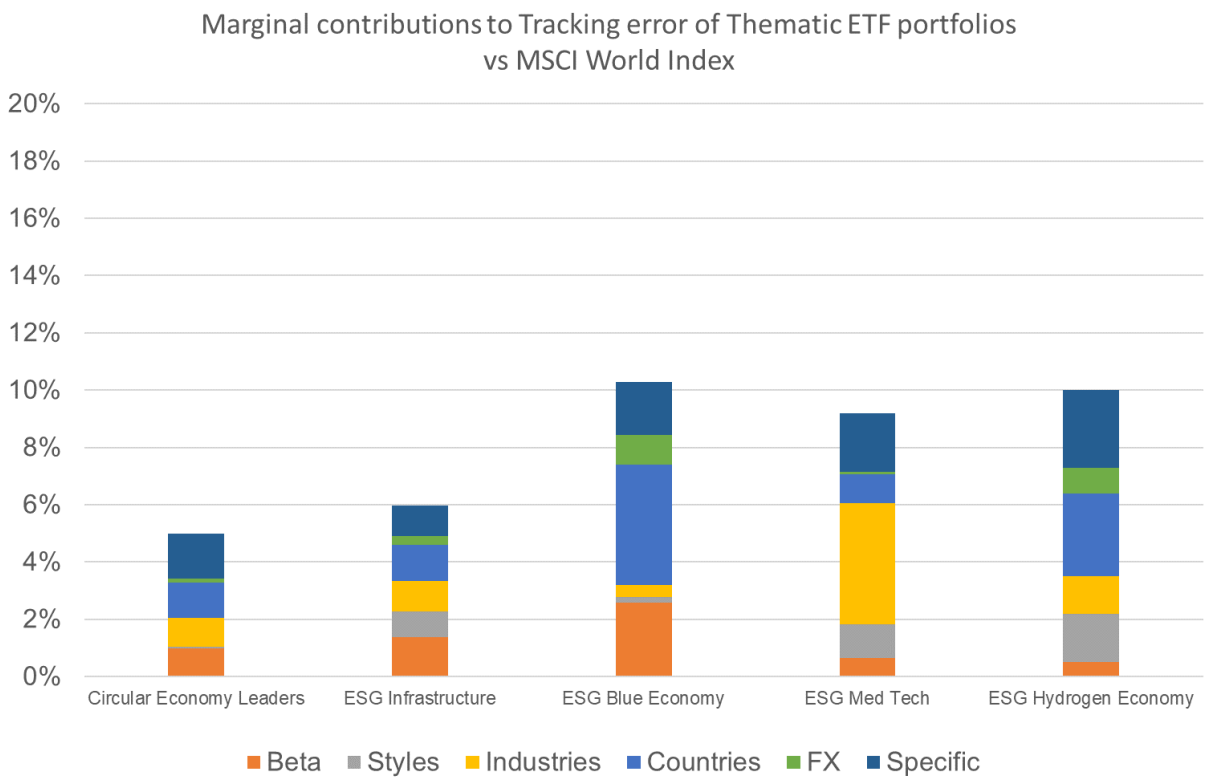


Significant dispersion of beta

Source: BNP Paribas Asset Management, MSCI, Solactive. 2nd March 2023. Based on BNPP AM front office equity risk models. Beta relative to the MSCI World index as benchmark. For illustration purposes only.

Thematic exposures to style, industry and country factors: ex-ante analysis





Dispersion of factor contributions to tracking error and dispersion in contribution of specific risk.

Source: BNP Paribas Asset Management, MSCI, Solactive. 2nd March 2023. Based on BNPP AM front office equity risk models. Beta relative to the MSCI World index as benchmark. For illustration purposes only.

Disruptive Technology

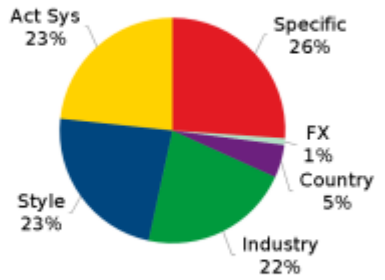
Benchmark: MSCI World Net TR Index (MSCIWLDTRX)

Active Risk: **8.30%** Portfolio Beta: **1.21** Portfolio Risk: **23.96%** Benchmark Risk: **18.82%**

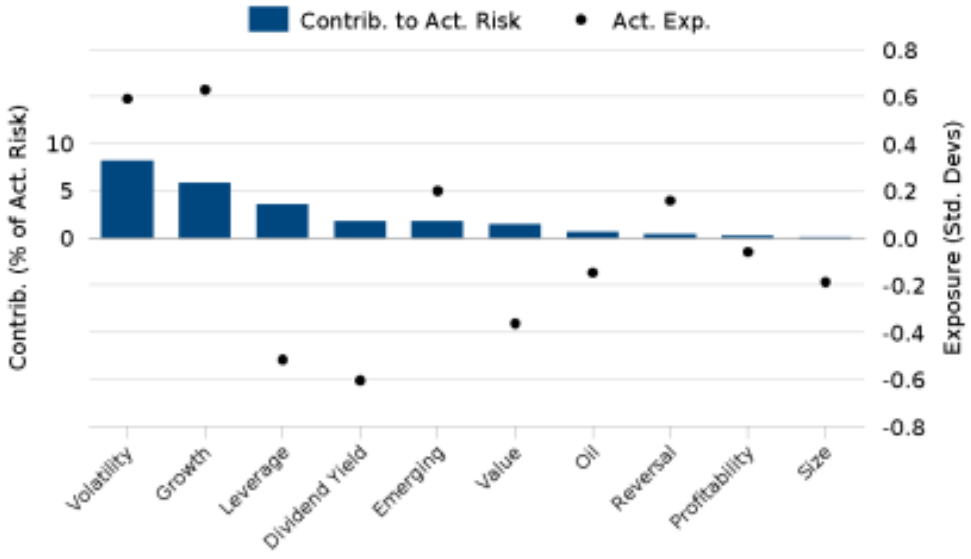
Thu, 2 Mar 2023

53 Assets
Base Currency: EUR

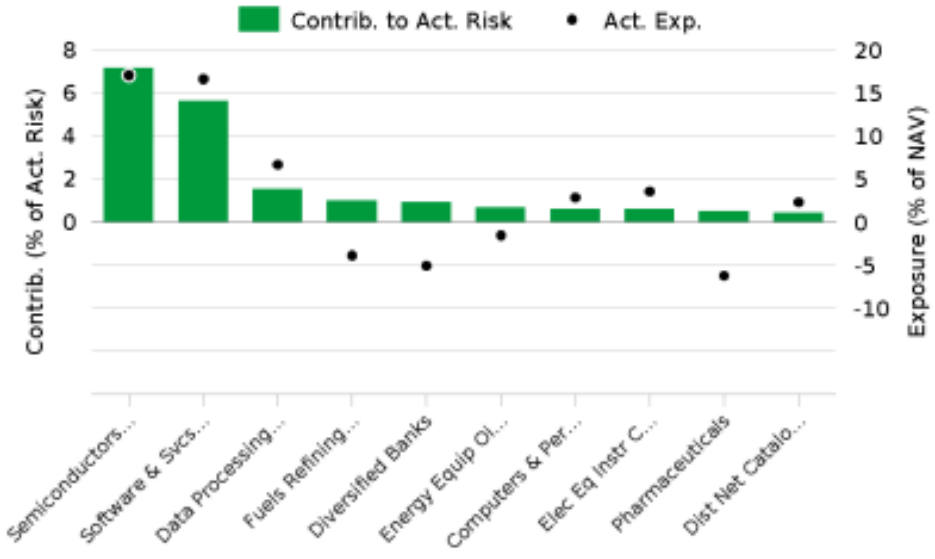
Active Risk Contributions by Block



Top Style Contributions



Top Industry Contributions



Source: BNP Paribas Asset Management, MSCI. 2nd March 2023. Based on BNPP AM front office equity risk models. Relative to the MSCI World index as benchmark. For illustration purposes only.

Circular Economy Leaders

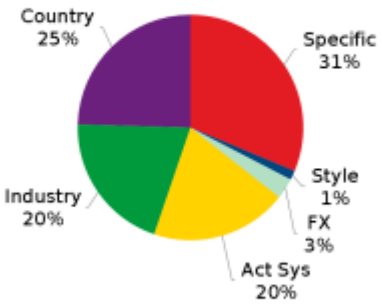
Benchmark: MSCI World Net TR Index (MSCIWLDTRX)

Active Risk: **4.98%** Portfolio Beta: **0.88** Portfolio Risk: **17.20%** Benchmark Risk: **18.82%**

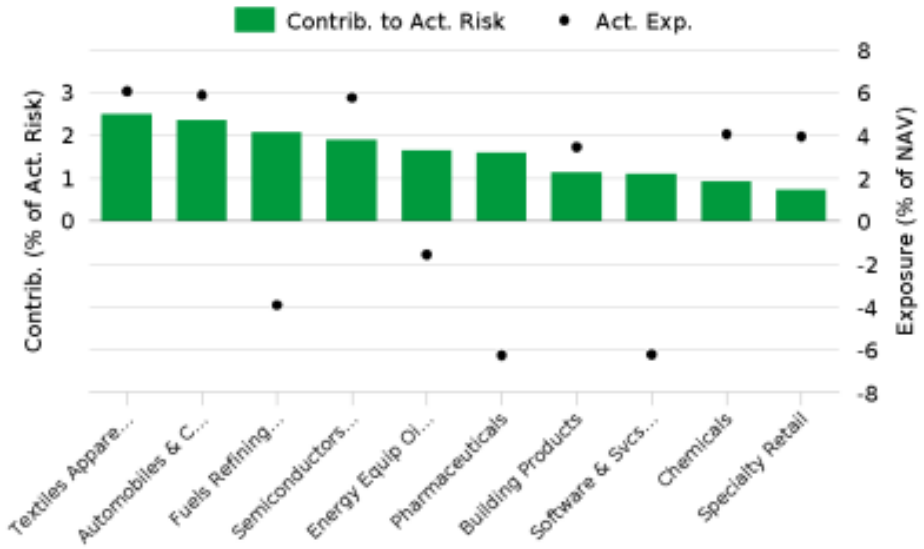
Thu, 2 Mar 2023

57 Assets
Base Currency: EUR

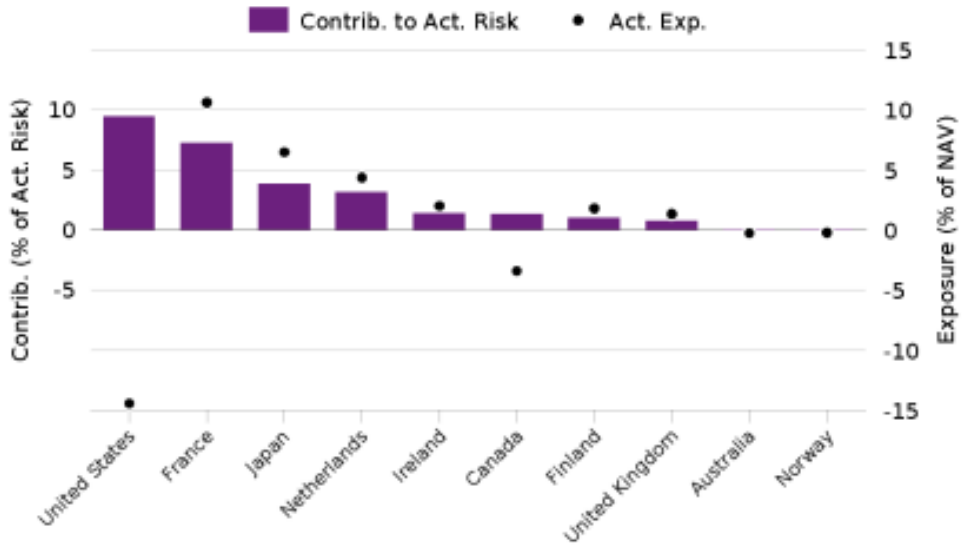
Active Risk Contributions by Block



Top Industry Contributions



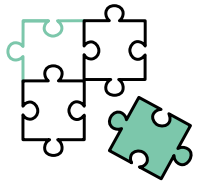
Top Country Contributions



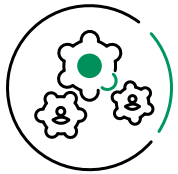
Source: BNP Paribas Asset Management, MSCI. 2nd March 2023. Based on BNPP AM front office equity risk models. Relative to the MSCI World index as benchmark. For illustration purposes only.

3 ALLOCATION TO THEMATIC INVESTMENTS

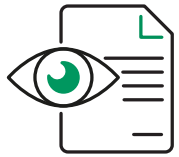
Diving into portfolio construction is key to defining a thematic allocation



Size and level of portfolio diversification is paramount



Core-satellite approach is often easiest and adequate for most investors



Requires adhering to a rigorous risk management protocol

Defining a thematic allocation

1. **How much is a given theme exposed to traditional risk factors, sectors or styles?**
2. **How much alpha is a given theme likely to add in excess of traditional risk exposures?**

To which extent do expected returns, risk and correlations can be derived from exposure to traditional risk factors vs a specific theme-related component?

Proposed framework to add Thematics to a Strategic Asset Allocation portfolio

Core-satellite approach using robust optimization

Use thematic indices as benchmarks for thematic investments

Use the risk factor model for asset classes and thematic investments

Use asset class long-term expected returns*

Use robust portfolio optimization**

Information ratio = 0.3 for uncorrelared risk of thematic benchmarks

* from BNP Paribas Asset Management
** following implementation advised in “A Practical Guide to Robust Portfolio Optimization”, Quantitative Finance, 2021

Thematic benchmarks

Asset Class	Themes	Thematic Benchmarks
Equities	Disruptive Tech	Morningstar Exponential Tech Net Total Return USD Index Nasdaq CTA AI NTR Index
	Sustainable Water	MSCI Global Sustainable Water Net Return Index FTSE Environmental Opportunities Water Technology Index
	Sustainable Food	MSCI ACWI IMI Food Revolution Index Foxberry Tematica Research Sustainable Future of Food NTR Index
	Energy Transition	ECPI Global Renewable Energy Liquid NTR FTSE Environmental Opportunities Renewable and Alternative Energy Index
	Environmental Sustainability	MSCI ACWI IMI Efficient Energy Index Net USD MSCI Global Environment Net Return USD Index
Bonds	Environmental Sustainability	Bloomberg MSCI Global Green Bond Index Unhedged USD

Two thematic indices used for each theme for simplicity
More could be used

Source: BNP Paribas Asset Management. 25 August 2022. For illustration purposes only.

Statistical risk factors for Asset Allocation based on PCA*

		Statistical risk factors					
Traditional Asset Classes	Tickers	Market Risk	Duration	Emerging /Commodities	Corporate Spreads	US	Asia/Japan
Equity EMU	NDDLEURO Index	28.2%	-14.7%	-25.6%	-16.5%	3.1%	-10.3%
Equity EMU Small Cap	NCLDEMU Index	29.1%	-12.0%	-21.2%	-2.9%	0.6%	-12.5%
Equity UK	NDDLUK Index	27.5%	-9.3%	-10.1%	-23.2%	-4.1%	-22.1%
Equity USA	NDDUUS Index	28.8%	-12.8%	-2.4%	-19.6%	8.1%	-9.4%
Equity USA Small Cap	RU20INTR Index	27.0%	-16.7%	-3.3%	-16.8%	12.4%	-15.4%
Equity Pacific Japan	NDDLJN Index	21.8%	-20.9%	-17.4%	-18.2%	-14.9%	79.7%
Equity Emerging Global	NDUEEGF Index	28.2%	-5.5%	27.8%	-17.6%	6.6%	14.0%
Bond EMD HC Sov Global	JPGCCOMP Index	26.0%	26.4%	19.4%	4.3%	19.2%	5.8%
Bond EMD LC Sov Global	JGENVUUG Index	24.4%	13.1%	38.4%	-25.1%	22.8%	15.9%
Bond EUR Sovereign	LEATTREU Index	3.0%	47.8%	-32.5%	-22.9%	-38.4%	10.0%
Bond USD Sovereign	LUATTRUU Index	-6.6%	49.6%	7.8%	-39.3%	18.1%	-10.8%
Bond EUR Corporate Investment Grade	LECPTREU Index	21.8%	33.5%	-19.0%	25.6%	-30.6%	9.4%
Bond USD Corporate Investment Grade	LUACTRUU Index	19.5%	42.5%	6.0%	14.3%	12.5%	2.8%
Bond EUR High Yield	LF88TREU Index	28.3%	2.4%	-2.4%	51.2%	1.9%	8.8%
Bond USD High Yield	LF89TRUU Index	28.8%	3.8%	9.6%	40.9%	21.1%	-2.0%
Diversification Real Estate Pan Europe	TRNHUE Index	25.4%	1.6%	-32.6%	-0.9%	-7.3%	-36.1%
Diversification Commodity Global	BCOMXAL Index	17.9%	-8.4%	56.3%	-1.7%	-72.1%	-19.9%

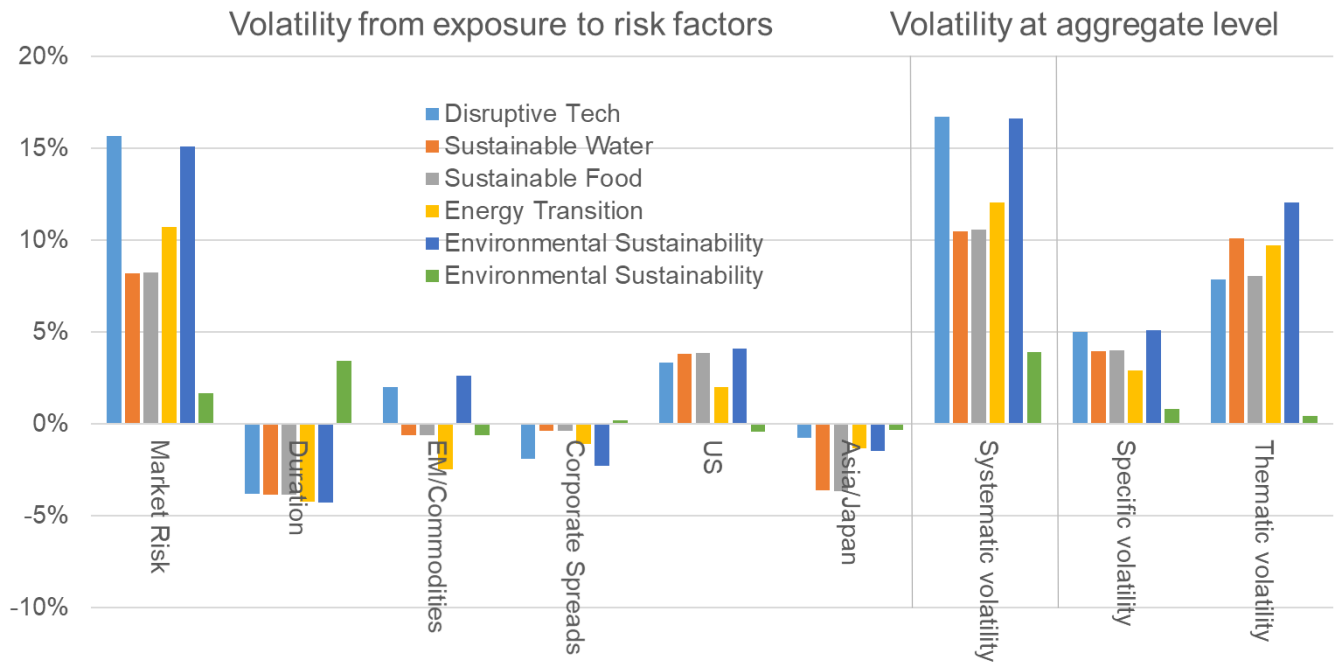
Risk factor expected returns

Expected Returns Traditional Asset Classes → Expected Returns Statistical Risk Factors

Source: BNP Paribas Asset Management, MSCI and Bloomberg. 25 August 2022. For illustration purposes only.

*Principal Component Analysis

Thematic exposures to risk factors



Different systematic factor exposures for different thematic investments

Thematic expected returns

Expected Returns Statistical Risk Factors ⟹ Systematic Expected Returns of Thematics

Expected Returns of Thematics = Systematic Expected Returns of Thematics + Thematic Alpha

Thematic Alpha = Thematic IR x Thematic Volatility

Source: BNP Paribas Asset Management. 25 August 2022. For illustration purposes only.

Core-Satellite approach: portfolio statistics

		Portfolio Statistics				Portfolio weights (%)						
Risk Profile		Annualized excess return over cash (%)	Annualized volatility (%)	Sharpe ratio	Tracking error relative to Core (%)	Equities	Bonds	Cash	Core	Satellite	Satellite	
											Diversification	Thematic Investments
A	Conservative	0.8	1.8	0.46		13.4	27.8	58.8	100.0			
	Moderate	3.3	8.0	0.41		60.3	39.7	0.0	100.0			
	Aggressive	5.2	14.0	0.37		100.0	0.0	0.0	100.0			
B	Conservative	1.1	2.2	0.51	0.7	14.3	30.3	55.4	91.7	8.3	8.3	
	Moderate	3.6	8.3	0.44	0.9	60.0	40.0	0.0	84.6	15.4	15.4	
	Aggressive	5.3	14.0	0.38	0.7	100.0	0.0	0.0	85.0	15.0	15.0	
C	Conservative	1.4	2.3	0.62	0.8	15.2	31.2	53.6	71.1	28.9	4.2	24.7
	Moderate	4.1	8.3	0.49	1.1	61.5	38.5	0.0	59.4	40.6	7.5	33.0
	Aggressive	5.7	13.9	0.41	1.0	100.0	0.0	0.0	77.7	22.3	7.9	14.4

Thematic investments improve Sharpe ratios of similar risk profile portfolios thanks for thematic alpha and diversification

Source: BNP Paribas Asset Management. 25 August 2022. Based on EUR gross monthly returns. For illustration purposes only. Past performance is not indicative of future performance.

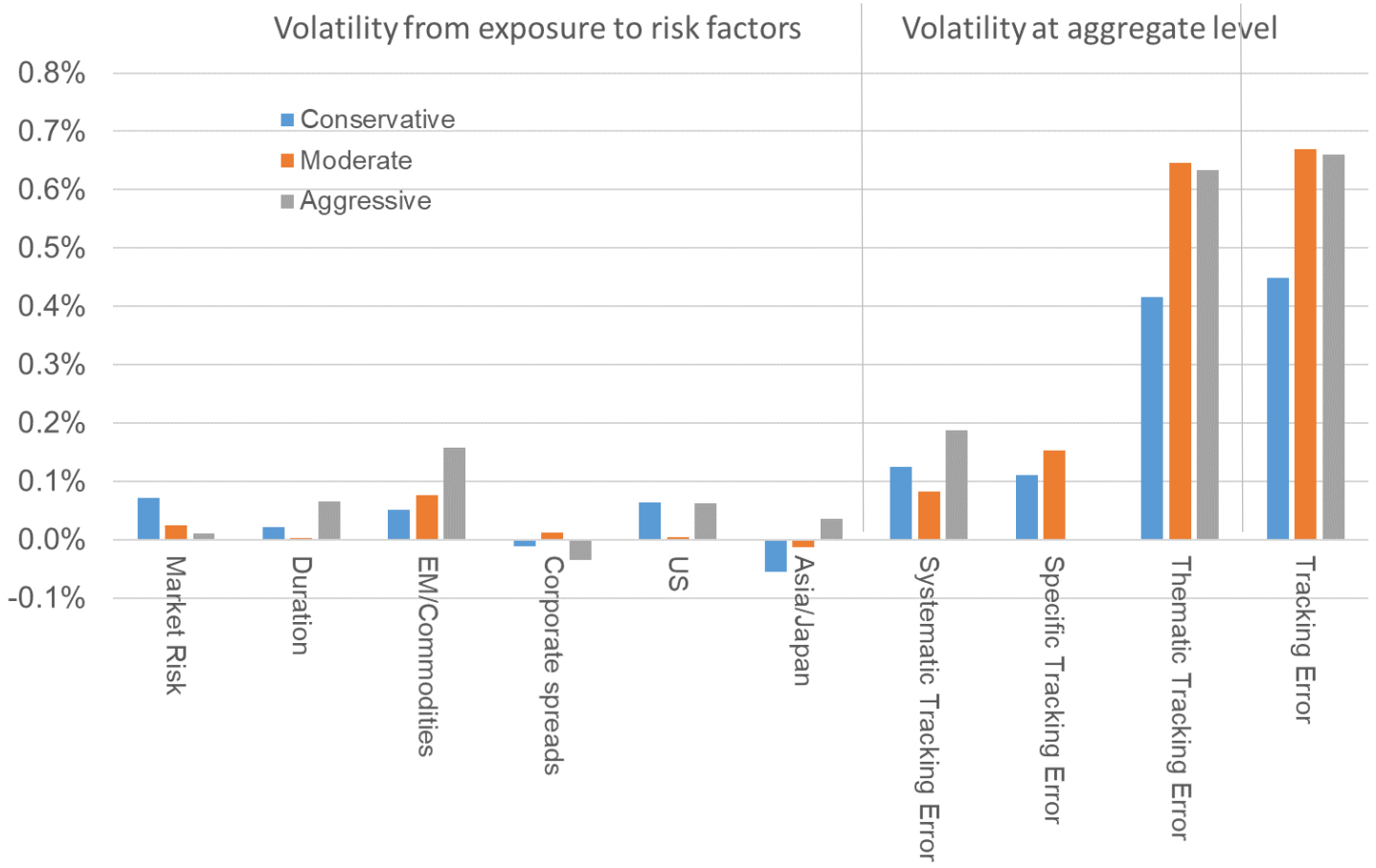
Core-Satellite approach: portfolio allocation

		Portfolio Weights (%)																		
		Core					Satellite													
		Equities		Bonds		Cash	Diversification						Thematic Investments							
							Equities					Bonds	Equities					Bonds		
Risk Profile		Europe	North America	EUR Investment Grade Agg.	USD Investment Grade Agg.	Cash	Euro zone Small Cap.	North America Small Cap.	Pacific Japan	Global Emerging Markets	Listed Real Estate Pan Europe	Global Emerging Markets	Disruptive Tech	Sustainable Water	Sustainable Food	Energy Transition	Global Environment - Equities	Env Sustainability - Bonds		
A	Conservative	6.1	7.3	10.2	17.6	58.8														
	Moderate	27.4	32.8	12.9	26.8	0.0														
	Aggressive	49.2	50.8	0.0	0.0	0.0														
B	Conservative	4.4	3.8	13.6	14.5	55.4	1.3	1.8	0.7	0.8	1.5	2.2								
	Moderate	23.6	24.2	15.9	20.9	0.0	2.8	4.8	0.9	1.1	2.5	3.2								
	Aggressive	44.0	40.9	0.0	0.0	0.0	4.0	5.2	1.9	1.6	2.3	0.0								
C	Conservative	2.9	0.0	6.4	8.2	53.6	1.0	0.0	0.2	0.0	1.3	1.6	3.0	1.6	1.6	2.3	1.1	15.1		
	Moderate	21.2	19.2	7.5	11.5	0.0	2.6	0.0	0.4	0.0	2.6	1.9	3.8	2.8	3.3	3.3	2.1	17.7		
	Aggressive	42.1	35.6	0.0	0.0	0.0	3.9	0.8	0.9	0.0	2.2	0.0	5.2	1.9	1.9	2.8	2.6	0.0		

Source: BNP Paribas Asset Management. 25 August 2022. For illustration purposes only.

Core-Satellite approach: portfolio relative factor risk exposures

Tracking error of Portfolios C with Thematics against same risk profile Portfolios B without Thematics



Source: BNP Paribas Asset Management. 25 August 2022. For illustration purposes only.

Thematics added to portfolio using robust optimization

No major change in exposures to systematic risk factors consistent with no change in expected returns and risk for traditional asset classes

But exposure to thematic risk added to portfolio to capture thematic of alpha

Tracking error limited by constraint could be set larger

4 TAKEAWAYS

Takeaways

Investment themes transform megatrends into investible opportunities

capture new sources of alpha

transcend classifications of sectors, regions and styles

However, thematic investments have

different levels of beta

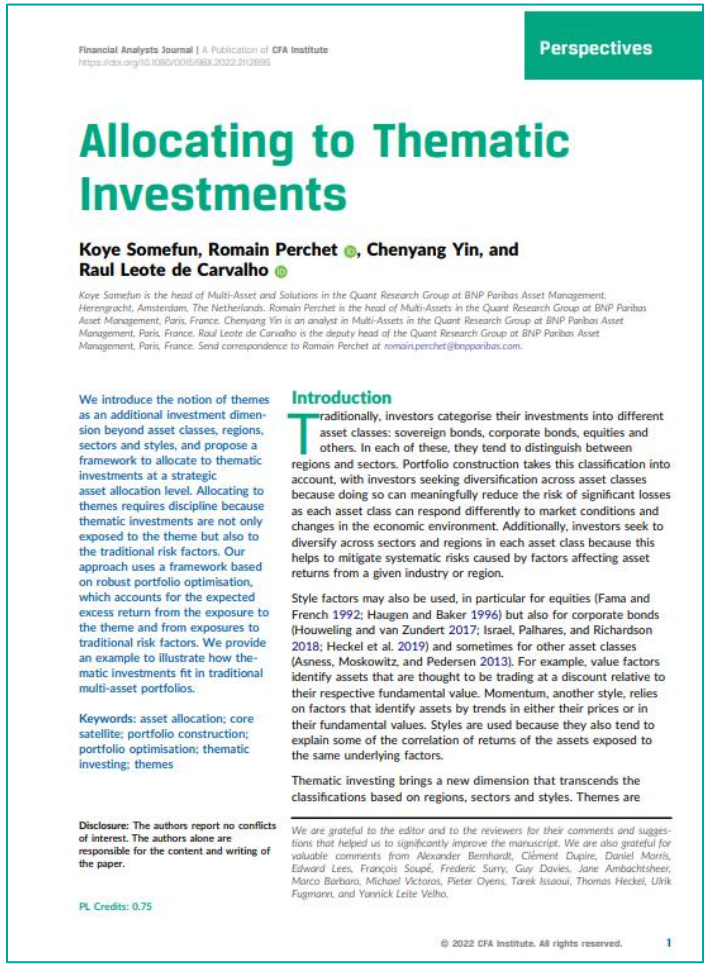
exposures to traditional risk factors

different levels of thematic volatility

different levels of alpha

Portfolio construction with adequate risk management

is key for successful integration of thematic investments in portfolios



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Perspectives

Allocating to Thematic Investments

Koye Somefun, Romain Perchet, Chenyang Yin, and Raul Leote de Carvalho

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We introduce the notion of themes as an additional investment dimension beyond asset classes, regions, sectors and styles, and propose a framework to allocate to thematic investments at a strategic asset allocation level. Allocating to themes requires discipline because thematic investments are not only exposed to the theme but also to the traditional risk factors. Our approach uses a framework based on robust portfolio optimisation, which accounts for the expected excess return from the exposure to the theme and from exposures to traditional risk factors. We provide an example to illustrate how thematic investments fit in traditional multi-asset portfolios.

Keywords: asset allocation; core satellite; portfolio construction; portfolio optimisation; thematic investing; themes

Disclosure: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

PL Credits: 0.75

Introduction

Traditionally, investors categorise their investments into different asset classes: sovereign bonds, corporate bonds, equities and others. In each of these, they tend to distinguish between regions and sectors. Portfolio construction takes this classification into account, with investors seeking diversification across asset classes because doing so can meaningfully reduce the risk of significant losses as each asset class can respond differently to market conditions and changes in the economic environment. Additionally, investors seek to diversify across sectors and regions in each asset class because this helps to mitigate systematic risks caused by factors affecting asset returns from a given industry or region.

Style factors may also be used, in particular for equities (Fama and French 1992; Haugen and Baker 1996) but also for corporate bonds (Houweling and van Zundert 2017; Israel, Palhares, and Richardson 2018; Heckel et al. 2019) and sometimes for other asset classes (Asness, Moskowitz, and Pedersen 2013). For example, value factors identify assets that are thought to be trading at a discount relative to their respective fundamental value. Momentum, another style, relies on factors that identify assets by trends in either their prices or in their fundamental values. Styles are used because they also tend to explain some of the correlation of returns of the assets exposed to the same underlying factors.

Thematic investing brings a new dimension that transcends the classifications based on regions, sectors and styles. Themes are

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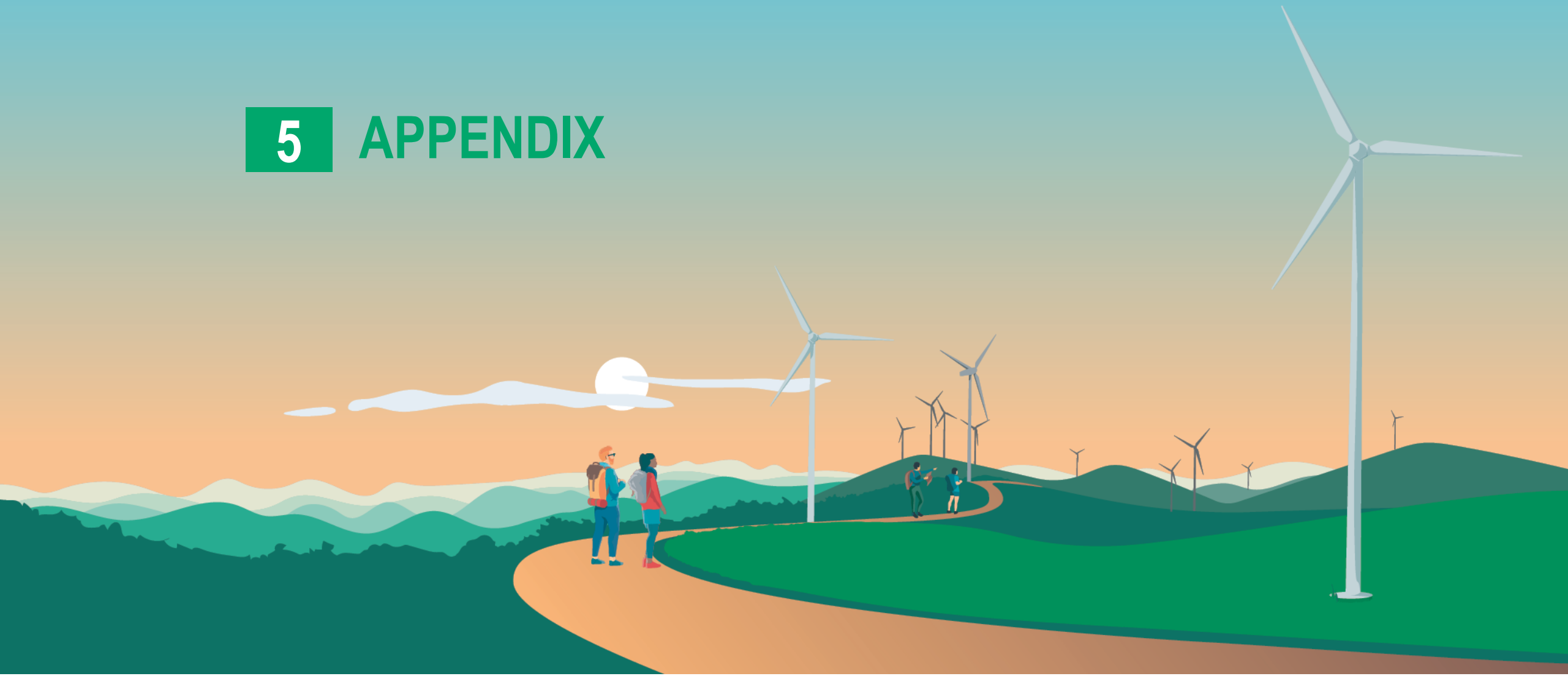
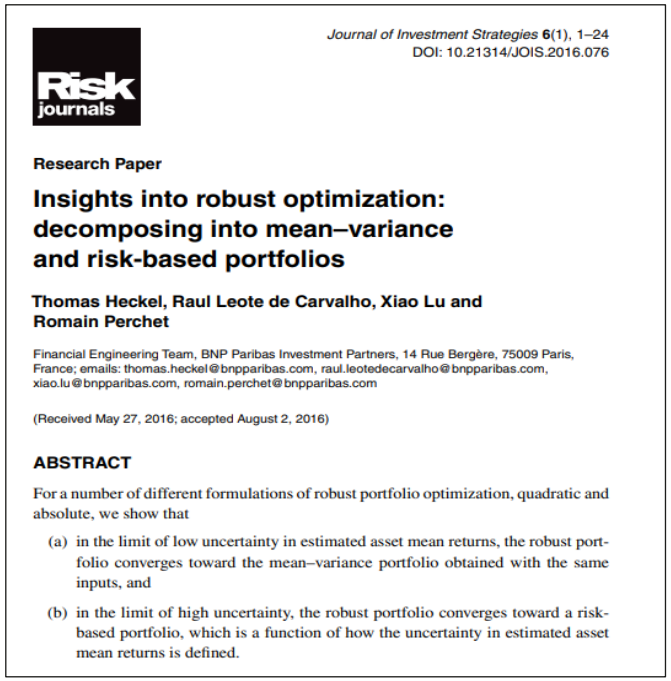
Source: Koye Somefun, Romain Perchet, Chenyang Yin, Raul Leote de Carvalho from BNP Paribas AM. (2022) “Allocation to Thematic Investments” *Financial Analysts Journal*, https://doi.org/10.1080/0015198X.2022.2112895

5 APPENDIX



BNPP AM Papers on Robust Portfolio Optimization



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Risk journals

Research Paper

Insights into robust optimization: decomposing into mean–variance and risk-based portfolios

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(Received May 27, 2016; accepted August 2, 2016)

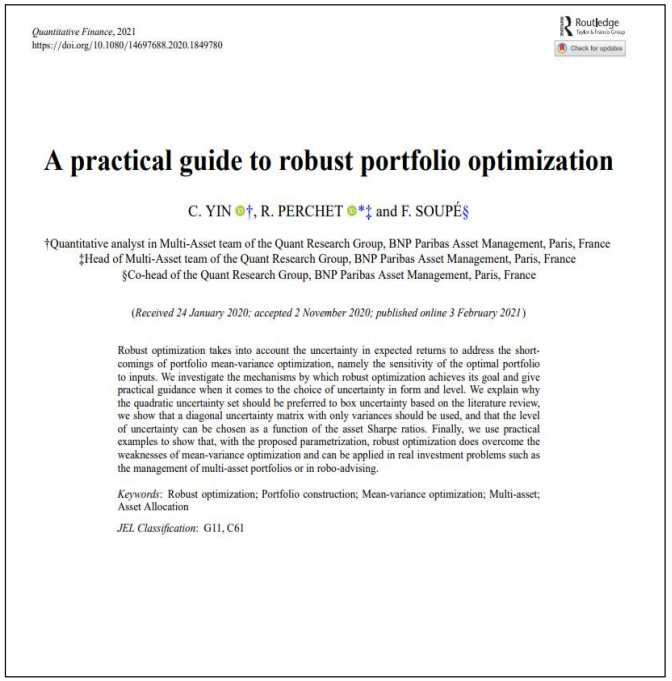
ABSTRACT

For a number of different formulations of robust portfolio optimization, quadratic and absolute, we show that

(a) in the limit of low uncertainty in estimated asset mean returns, the robust portfolio converges toward the mean–variance portfolio obtained with the same inputs, and

(b) in the limit of high uncertainty, the robust portfolio converges toward a risk-based portfolio, which is a function of how the uncertainty in estimated asset mean returns is defined.

Journal of Investment Strategies
Volume 6, Issue 1, 2016



Quantitative Finance, 2021
https://doi.org/10.1080/14697688.2020.1849780

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A practical guide to robust portfolio optimization

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Robust optimization takes into account the uncertainty in expected returns to address the shortcomings of portfolio mean-variance optimization, namely the sensitivity of the optimal portfolio to inputs. We investigate the mechanisms by which robust optimization achieves its goal and give practical guidance when it comes to the choice of uncertainty in form and level. We explain why the quadratic uncertainty set should be preferred to box uncertainty based on the literature review, we show that a diagonal uncertainty matrix with only variances should be used, and that the level of uncertainty can be chosen as a function of the asset Sharpe ratios. Finally, we use practical examples to show that, with the proposed parametrization, robust optimization does overcome the weaknesses of mean-variance optimization and can be applied in real investment problems such as the management of multi-asset portfolios or in robo-advising.

Keywords: Robust optimization; Portfolio construction; Mean-variance optimization; Multi-asset; Asset Allocation

JEL Classification: G11, C61

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Use uncertainty in returns to reduce sensitive of optimal portfolios to changes in expected returns

Reduce impact of correlations in determining the final optimal portfolio allocation

Robust Portfolio Optimization

Modify MVO problem into maximum–minimum problem

$$\mathbf{w}_{robust} = \arg\max\left(\min\left(\boldsymbol{\mu}^{\mathrm{t}}\mathbf{w}\right) - \frac{\lambda}{2}\mathbf{w}^{\mathrm{t}}\,\boldsymbol{\Sigma}\mathbf{w}\right)$$

$\boldsymbol{\Sigma}$ = covariance of returns
λ = risk aversion

Maximize returns of worst case scenario for target risk

Estimated mean returns in uncertainty box about true mean returns

- Case of ellipsoidal uncertainty box

$$(\boldsymbol{\mu} - \bar{\boldsymbol{\mu}})^{\mathrm{t}}\boldsymbol{\Omega}^{-1}(\boldsymbol{\mu} - \bar{\boldsymbol{\mu}}) \leq \kappa^2$$

$\boldsymbol{\mu}$ = estimated mean returns (excess cash)
$\bar{\boldsymbol{\mu}}$ = true mean returns (excess cash)
$\boldsymbol{\Omega}$ = covariance of errors
κ = uncertainty aversion

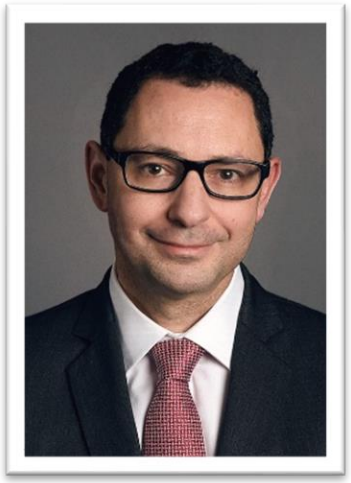
Then:

$$\mathbf{w}_{robust} = \arg\max\left(\bar{\boldsymbol{\mu}}^{t}\mathbf{w} - \kappa\sqrt{\mathbf{w}^{t}\boldsymbol{\Omega}\mathbf{w}} - \frac{\lambda}{2}\mathbf{w}^{\mathrm{t}}\,\boldsymbol{\Sigma}\mathbf{w}\right)$$

Return Uncertainty Volatility

- Choice 1: $\boldsymbol{\Omega}$ set proportional to the diagonal matrix with variances in diagonal
- Choice 2: $\boldsymbol{\kappa}$ set to 1/2 the average of Sharpe ratios of assets in the investment universe

Biography



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Deputy Head - Quant Research Group

Raul Leote de Carvalho is Deputy Head of the Quant Research Group at BNP Paribas Asset Management since October 2017.

This team with 30 quantitative researchers is responsible for supporting research and development of quantitative investment strategies, for providing quantitative inputs across all investment teams, for delivering quantitative services and innovation and for leveraging the use of alternative data and machine learning for investments. The team is based in Paris, Amsterdam, Hong Kong and London.

Raul joined BNPP AM in 1999 and held several positions related to quantitative research and investments in equities, fixed income and asset allocation covering the development of strategies, portfolio optimization, risk modelling and portfolio management.

Raul started his career in 1996 as a researcher in Computational and Theoretical Physics first at the University of Wuppertal, then at the Ecole Normale Supérieure de Lyon and finally at the University College of London. He earned a PhD in Theoretical Physics from the University of Bristol and an MSc in Condensed Matter Physics and a BSc in Chemistry both from the University of Lisbon.

Raul is Board Member and Chair of the Programme Committee of the Institute for Quantitative Research in Europe (Inquire Europe), Fellow of the Louis Bachelier Institute (France) and Member of the Institute of Physics (UK). He is also member of the editorial board of the Journal of Investing and referee for a number of journals. He passed the Investment Management Certificate in London in 2001.

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