

For Wholesale Investors only.

ALLOCATING TO THEMATIC INVESTMENTS

An investment rationale for institutional investors



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BNP PARIBAS
ASSET MANAGEMENT

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INTRODUCTION

ALLOCATING TO THEMATIC INVESTMENTS



In this paper we introduce the notion of themes as an additional investment dimension beyond asset classes, regions, sectors and styles, and we propose a framework for allocations at a strategic asset allocation level.

The goal of thematic investments is to provide the means to invest in assets whose returns will be significantly impacted by the structural changes underlying the theme.

Such changes come about through megatrends that shape our societies. These could be demographic shifts, social or behavioural changes, environmental events, resource scarcity, economic imbalances, transfer of power, technological advances and regulatory or political changes.

Allocating to themes requires discipline because thematic investments are not only exposed to the theme but also to the traditional risk factors.

Our approach to allocating to thematic investments uses a framework based on robust portfolio optimisation, which takes into account the expected excess return derived from the exposure to the theme as well as exposures to traditional risk factors. To illustrate this, we provide an example where thematic investments in energy transition, environmental sustainability, healthcare innovation, consumer innovation and disruptive tech are added to a traditional multi-asset portfolio.

Initially, thematic portfolios were mainly restricted to equities. However, there is a growing trend to define themes also in fixed income or even across asset classes.

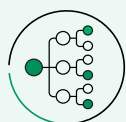
WHAT IS THEMATIC INVESTING?

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.

In addition, 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 within a given industry or region.

Styles are used because they also tend to explain some of the correlation of returns of the assets identified by their underlying factors.



Style factors may also be used, in particular for equities, but also for corporate bonds and sometimes for other asset classes.



Value factors, for example, characterise 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.

Thematic investing brings a new dimension to these classifications. Themes are structural trends expected to significantly impact economies and redefine business models. On this basis it is rational to expect themes to play a role in explaining the returns and risks of those investments more exposed to these structural trends.

However, not all themes matter equally, and thematic investing offers more than just a single compelling opportunity. The goal of thematic investing is to identify assets whose returns will be impacted by the structural changes underlying a theme.

Such changes are the consequence of megatrends that shape societies. Demographic shifts, social or behavioural changes, environmental developments, resource scarcity, economic imbalances, transfer of power, technological advances and regulatory or political changes are all examples of such megatrends.

An investment theme aims to transform one such megatrend into a relevant investment opportunity. In this paper, we consider five different themes. The first two of these are related to sustainable investing, while the latter three involve innovation and disruption:



Initially, thematic portfolios were mainly focused on equities. However, there is a growing trend to also define themes in fixed income or even across asset classes (see, for example, Greenwich, 2021).

Thematic investing transcends the classifications of asset classes, sectors, regions and styles. In the examples we provide, we will consider the environmental sustainability theme played both via equities and fixed-income assets.

IS THEMATIC INVESTING JUST A WAGER ON A PARTICULAR INDUSTRY OR SECTOR?

**THIS IS A QUESTION THAT IS OFTEN ASKED.
THE SHORT ANSWER IS NO, FOR TWO REASONS:**

1 - Themes do not necessarily relate only to equities or corporate bonds. For example, some themes may be played via other assets such as public infrastructure investments.

2 - Even when it comes to equities or corporate bonds, it is not necessarily just about investing in growth companies.

THE LIFE CYCLE OF COMPANIES

Companies come and go. Companies may initially be innovators and disrupters, although these are not always start-ups; they can also be established companies reinventing themselves.

The innovative or disruptive phase of a company's lifecycle is characterised by low demand for products and substantial start-up costs. Those companies that manage to survive this phase go through a growth phase initially marked by little competition and booming sales.

In this phase, product innovation declines and the focus shifts to process innovation. As time goes by, the number of competitors increases, growth slows and, eventually, economies of scale are reached, causing smaller players to be the object of acquisitions or exit altogether. The survivors then reach their maturity phase.

Growth and return on equity are by now distinctly ordinary, with market share and cash flow becoming the primary goals of the surviving companies. This is because consumer power increases as production capacity is now likely to exceed demand.

On the other hand, suppliers' power decreases as increasing volumes translate into a higher risk of suppliers losing large customers.



During the maturity phase, the threat of substitutes grows. Competition is now fierce and prices tend to fall, threatening profitability.

Mature companies that fail to adapt or to reinvent themselves will complete the cycle with a final phase of decline. This is typically characterised by falling growth and revenues as demand shifts to substitute or new products.

The weakest players withdraw from the market, which in turn intensifies rivalry among those remaining.

Ultimately, the winners will be those that successfully manage the decline by transforming it into a cash cow, still managing to generate attractive returns while taking advantage of low spending on new investments.

Themes can be relevant to companies in all stages of their growth cycle. Indeed, some themes may relate more to disruption through innovation, for example disruptive tech, mainly involving small-cap growth firms.

Other themes such as consumer innovation may see a much larger spectrum of companies taking the lead.

What is important when looking for companies exposed to a theme is that those selected have a significant part of their business dedicated to activities related to the theme. That means they generate a significant part of their revenues from selling products or services related to the theme.

Exhibit 1:
The life cycle of companies



IS THEMATIC INVESTING JUST ABOUT INVESTING IN GROWTH COMPANIES?

AGAIN, THE SHORT ANSWER IS NO.

Porter's five forces model, originally proposed by Michael Porter (1979), is a framework to assess how competitive an industry is.

It is useful for companies seeking entrance into that industry to assess how easy it will be to achieve high profits.

Highly competitive industries tend to result in lower profit margins as competition leads to high levels of efficiency.

High profitability is easier to deliver in less competitive industries. Generating high profits in competitive industries, while not impossible, requires a much better understanding of the industry, sufficient to disrupt it.

THE FIRST FORCE IN PORTER'S MODEL IS THE THREAT OF NEW ENTRANTS

Barriers to entrance reduce competitiveness. Barriers can arise from economies of scale, capital requirements, high costs, access to distribution channels and/or government policy and regulations.

Technology and digitalisation can overcome such barriers, often bypassing them and creating disruption. On the other hand, management trends such as pushing for vertical integration can greatly increase the barriers via new economies of scale.

THE SECOND FORCE IS THE THREAT OF SUBSTITUTES

An abundance of substitute products or services that can achieve the same goal in meeting consumer needs increases the competitiveness of an industry.

THE THIRD FORCE IS CONSUMERS' BARGAINING POWER

The greater the power of consumers, the more competitive an industry.

Consumers have bargaining power if, for example, they purchase in large volumes, or purchase standard or undifferentiated products or services, or earn low profits (creating an incentive to lower purchasing costs), or buy products or services that do not produce savings.

THE FOURTH FORCE IS THE BARGAINING POWER OF SUPPLIERS

The higher the bargaining power of suppliers, the more competitive an industry. Suppliers can exert bargaining power by raising prices or reducing the quality of goods and services being purchased.

The smaller the number of suppliers, the more competitive the industry. Unique supplied products with high switching costs also give power to suppliers.

THE FIFTH AND FINAL FORCE IS COMPETITIVE RIVALRY

Competitiveness of an industry tends to be more intense if many companies of roughly equal size and power are competing against one another. Competitive rivalry is also more pronounced in slowly growing industries, where battles for dominance occur. High fixed costs and significant exit barriers also contribute to more rivalry as do situations where products or services are at risk, potentially reducing pricing power.

Exhibit 2:

Porter's five forces model



Themes can be defined around economic moats that resolve the five forces in Porter's model.

That is, a theme may favour a sub-industry or a group of companies that can disrupt an industry because of some cost or size advantage; or because of new products or services (particularly if these require patents or licences).

Anything that can give a group of companies an advantage over their peers in the industry or disrupt entire industries can be useful when identifying themes.

In recent years, globalisation, regulation/deregulation trends, digitalisation and innovation are examples of developments that have played an important role in changing the balance of forces.

THEMATIC, ESG AND LONG-TERM INVESTING ARE EASILY CONFUSED



It is important to make the distinction between thematic investing, investing taking into account environmental, social and governance (ESG) considerations, and long-term investing.

While thematic investing generally entails a focus on trends that often materialise in the medium to longer term, this is not always the case.

Some themes may run their course faster and find themselves discounted by the market sooner than others. It is important to evaluate to what extent a theme still remains a good investment opportunity.

Some themes of the past may have reached maturity and it is important to judge to what extent they remain an attractive investment opportunity.

Moreover, the granularity of themes may be important. This is because sub-themes can run their course while the overarching drivers remain relevant and investable, simply with a different set of companies. In such cases, a bottom-up investment strategy may be a compelling approach to allocate to sub-themes within a given theme.

Thematic investing is more subtle than just finding undervalued opportunities to hold over long investment horizons.

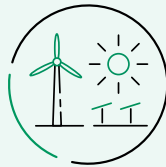
A similar argument can be made for thematic versus ESG investing. Not all ESG investing is necessarily thematic investing.

There is a difference between companies simply pursuing sustainable practices and those deriving a significant proportion of their revenues from services and products related to sustainable themes such as energy transition or environmental sustainability.

Investors turn to ESG in search of investments that integrate material environmental, social or governance factors in the pursuit of greater financial returns, which is something that transcends thematic investing.

ESG integration does not necessarily focus on investing in a specific sustainable theme or themes.

A desire to drive societal change may also be a motive for thematic investing. Energy transition is a good example - a necessary step to address climate change, perhaps the biggest challenge humanity has ever faced that is already having a profound impact on weather systems and economic outcomes.

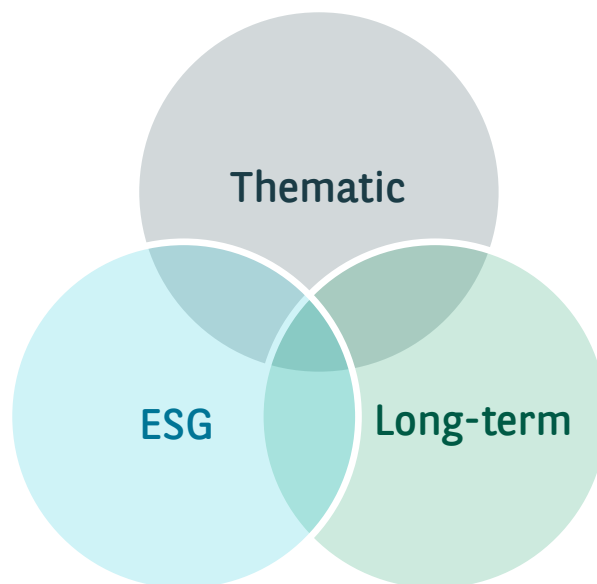


INVESTING AROUND THE ENERGY TRANSITION THEME MEANS IDENTIFYING THOSE COMPANIES WELL POSITIONED TO GENERATE A MEASURABLE IMPACT WHILE PROFITING FROM THIS STRUCTURAL CHANGE.

Indeed, most impact investing is thematic investing. It is worth noting that we would not consider investing in the market capitalisation index re-weighted after excluding just a few of the biggest carbon emitters as an example of thematic or impact investing. We would consider such an approach as a simple climate risk mitigation strategy designed to limit downside risk from the transition to low carbon, rather than as an investment in energy transition leaders.

Exhibit 3 illustrates the overlap between thematic, ESG and long-term investing.

Exhibit 3:
Overlap of ESG, long-term and thematic investing

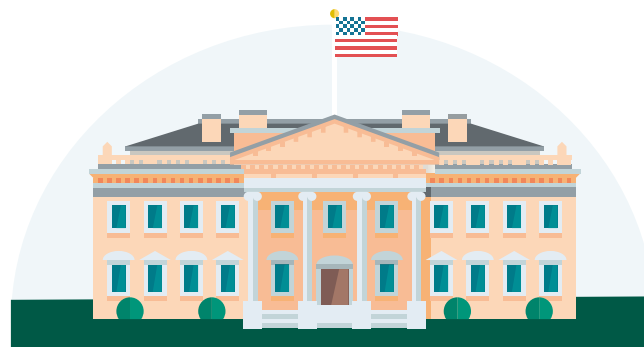


WHAT IS THE APPEAL OF THEMATIC INVESTING?

In an influential paper, Bessembinder (2017) compares the performance of US stocks (in the Center for Research in Security Prices database between 1926 and 2016) with US Treasury bills.

Many people would probably find it surprising that the returns of most individual US common stock buy-and-hold investments actually fell short of those earned on one-month US Treasury bills over the same investment horizons.

Yet it is well known that a broad stock market index greatly outperformed US Treasury bonds. The explanation for this paradox lies in the skewness of stock returns: A small number of stocks generate most of the returns of a broad equity market index. Part of the explanation for these skewed returns lies in some firms being better positioned to take full advantage of transformative change in society.



Thematic investing provides investors with the means to focus on investments well positioned to profit from transformative changes, identifying the current and future champions for each trend.

Those champions should benefit from an outsized impact from value creation.

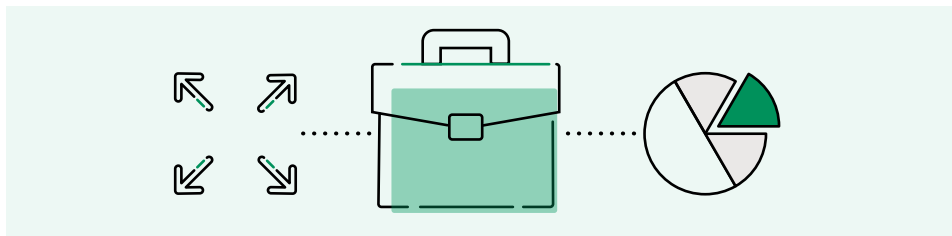
The flipside of the coin is that investors playing a theme may need to accept choppy returns in the shorter term from less diversified portfolios, as the outsized returns are much less frequent and can arrive suddenly.

Moreover, a consequence of higher concentration and lower diversification is typically higher risk (though one benefit of thematic portfolios is that they tend to avoid the companies being disrupted/in decline due to the theme). Portfolio construction is important when it comes to integrating thematic investing into a larger portfolio.

ALLOCATING TO THEMATIC INVESTING

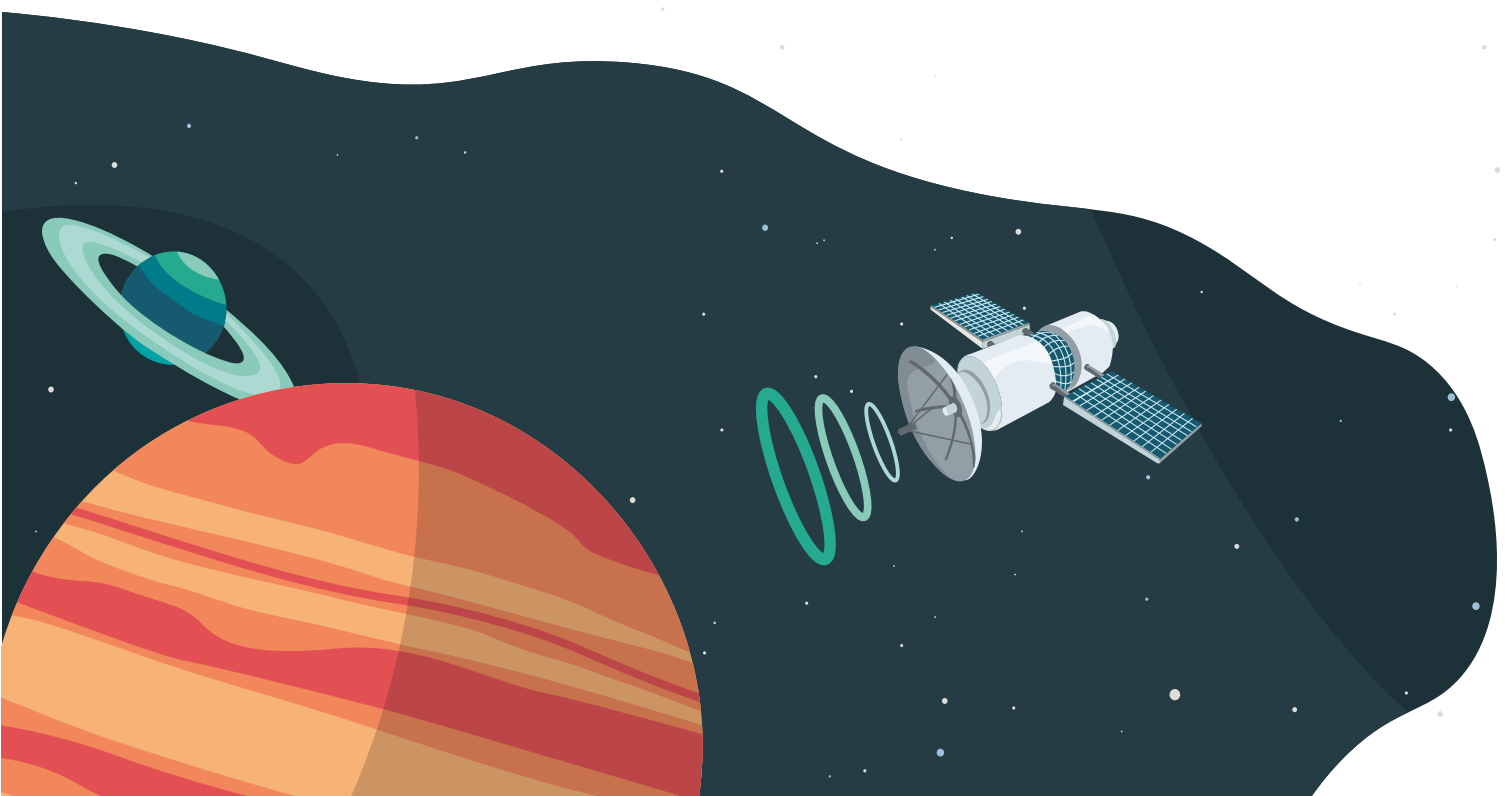
Thematic investing may be appealing, but how can we add it to a portfolio?

There is no single answer as it depends on a number of parameters such as the size and the level of diversification of the portfolio.



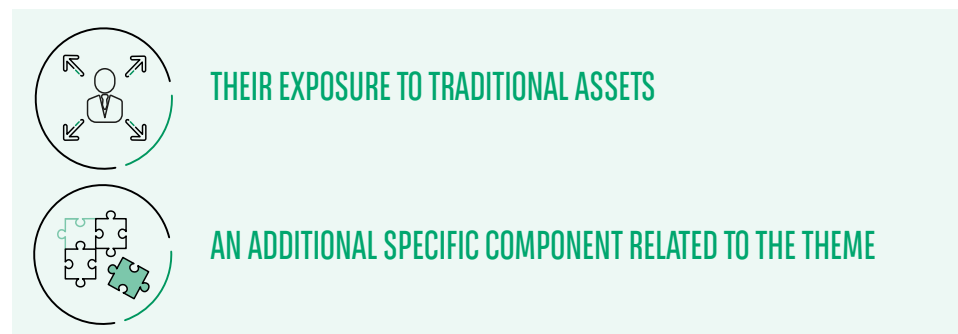
The easiest approach is to rely on a core-satellite framework, adding thematic investments to the satellite. This is an adequate solution for most investors, in particular for large portfolios investing in low-capacity themes, or for smaller investors who prefer to limit their active allocations to thematic investments.

In any case, to do this effectively it is important to investigate the impact of adding thematic investments to the overall risk and return characteristics of the aggregate portfolio. For this reason, it is preferable (and more straightforward) to integrate thematic investments directly in the overall allocation. To do so, it is necessary to understand each thematic investment in terms of expected risk, return and interaction with other investments. While this may not be easy, quantitative approaches can help, as we shall discuss below.



UNDERSTANDING WHAT IS BEHIND EACH THEME

Allocating to thematic investments requires a deep understanding of how they interact with other investments. If thematic investments are constructed from investing in stocks and bonds then their expected returns, risk and correlations can be derived from:



In other words, we need to investigate the extent to which thematic investments bring something new on top of their exposures to traditional assets. This is all that is required to integrate thematic investments into our strategic asset allocation process.



HOW DOES THIS WORK IN PRACTICE?

The more common themes can usually be represented by an existing thematic benchmark index, e.g., those provided by the standard index vendors. These indices are often used as benchmarks for the thematic mutual funds where active management aims to outperform them.

Sometimes such indices are replicated by exchange-traded funds (ETFs). Thus, thematic benchmark indices are a good starting point.

However, while thematic benchmark indices bring the advantage of standardisation, return dispersion of investments related to a theme can be large. This is because there is less consensus on which assets should be part of a portfolio representing the theme than there is for regions, sectors or perhaps even style factor benchmarks.



ONE ALTERNATIVE IS TO USE BENCHMARK INDICES FOR THE SAME THEME FROM MORE THAN ONE INDEX PROVIDER.



ANOTHER ALTERNATIVE IS TO RELY ON THE RETURN TIME SERIES OF THE FUNDS SELECTED TO INVEST IN A GIVEN THEME, COMBINING THEM INTO A REPRESENTATIVE RETURN SERIES.

Finally, for themes that relate to specific sectors of the economy, it is not unusual to see thematic funds only benchmarked against a relevant sector index. In such cases, it is important to assess the expected added value from biasing the selection towards the companies more exposed to the theme.

When more than one benchmark index or fund is used, machine learning algorithms such as Lasso regressions can be used to efficiently select and combine the returns of such funds into a return time series representative of the theme.

Lasso (least absolute shrinkage and selection operator) is a regression analysis method that performs both variable selection and regularisation in order to enhance the prediction accuracy and interpretability of the resulting statistical model. Regularisation is the process of adding information in order to prevent overfitting or solve an ill-posed problem (for more on Lasso regressions see Glen S. (2015)).

Once the times series of returns representing a theme is created, we can assess how it relates to other assets selected for the portfolio. This is important in order to know which investments in the portfolio should be reduced in order to efficiently allocate to thematic investments.

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For example, if 10% of a multi-asset portfolio is invested in the healthcare innovation theme, then we need to know which assets should have their allocation reduced to create room for this thematic fund and what is the impact on the risk and return characteristics of the final portfolio. To do this we estimate the exposures of the time series of returns representing the theme to a fixed set of core assets (e.g., regional equity, sovereign bonds and corporate bonds).

The estimated exposures of themes to the core assets can be taken at face value. In turn, the estimated thematic alpha derived from the model requires further scrutiny because it is based on the past, whereas the value of a theme as an investment is forward-looking.

In exhibit 4, we consider typical benchmark indices used in a number of thematic fields. The third column in the table shows the beta of these benchmark indices against the global market index.

We chose the MSCI World index for equity funds and the Bloomberg Barclays Global Aggregate Corporate index for bond funds.

Some of the benchmark indices, such as disruptive tech and consumer innovation, have a beta of above one while others, e.g., healthcare, have a beta of below one. This is important to take into consideration when forecasting returns and for the construction of the final portfolio.

Exhibit 4:**Typical benchmarks used in thematic funds and their beta against the global market index**

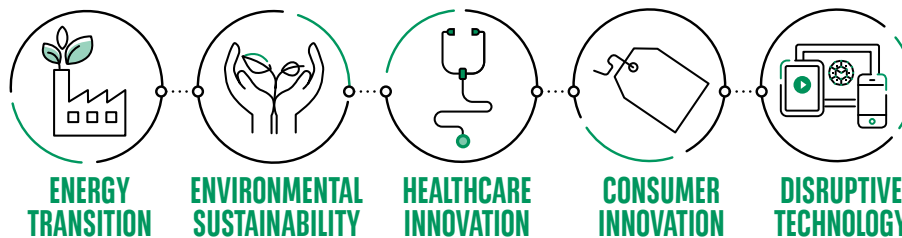
Theme	Benchmark	Beta against global market index*
Energy Transition	MSCI World Climate Change CTB Select Low Carbon 100 Europe	0.98
Environmental Sustainability (equities)	MSCI AC Asia x-Japan ESG Leaders ECPI Circular Economy Leaders MSCI World SRI	0.97
Environmental Sustainability (bonds)	MSCI Global Green Bond	0.98
Health Care Innovation	MSCI World Health Care	0.74
Consumer Innovation	MSCI World Consumer Discretionary	1.15
Disruptive Tech	Nasdaq CTA AI NTR Morningstar Exponential Tech	1.24

* MSCI World index for equities and Bloomberg Barclays Global Aggregate Corporate index for bonds

Source: Bloomberg, FactSet, MSCI, Standard & Poor's, Stoxx and BNP Paribas Asset Management.

ALLOCATING TO THEMATIC INVESTMENTS

In this section we shall go through an example of how to allocate to thematic investments. In this example, we consider five themes:



Each is represented by one or more funds. The environmental sustainability theme is represented by equity and fixed-income funds while the other themes are represented only by equity funds.



EXPOSURE OF THEMATIC INVESTMENTS TO TRADITIONAL RISK FACTORS



The first step towards an allocation to thematic investments is the selection of instruments to invest in those themes, typically mutual funds or ETFs exposed to the themes.

In exhibit 4 we show typical benchmarks of the themes we shall use in the examples. The time series of returns for each theme, based on the returns of those benchmark indices, is useful in order to investigate the exposure of the theme to traditional risk factors.

In exhibit 5, we show the exposures of these benchmark indices to the six factors in a risk model for strategic asset allocation.

We equally weighted the benchmark indices for themes where we considered more than one benchmark.

The first of these factors, market risk, reflects a portfolio invested in risky assets such as equities and corporate credit, while excluding government bonds.

The second factor, duration, reflects the exposure to interest rate-sensitive assets, including government bonds, corporate credit and emerging debt.

The emerging market (EM)/commodity factor reflects exposures to emerging market assets and to commodities while the US and the Asia/Japan factors reflect exposures to US and Asia and Japan assets, respectively.

These factors are orthogonal to each other and are linear combinations of well-known equity, fixed income and commodity investable indices. We used 17 such indices and applied the framework used in our recent research (see, for example, Issaoui et al. 2021).

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Exhibit 5:

Exposures of themes to traditional risk factors in a typical asset allocation risk model, measured in units of volatility of returns. Based on monthly data in USD. Risk estimation from Jan-2003 through May-2021.

Themes		Equities					Bonds
		Disruptive Tech	Consumer Innovation	Health Care Innovation	Energy Transition	Environmental Sustainability	Environmental Sustainability
Factors from the Asset Allocation Risk Model	Market Risk	13.7%	13.1%	9.3%	12.6%	12.9%	1.5%
	Duration	-3.0%	-4.5%	-2.6%	-3.9%	-3.1%	3.5%
	EM/Commodities	1.4%	-2.1%	-0.7%	-2.9%	-1.1%	-0.6%
	Corporate Spreads	3.0%	1.4%	1.6%	1.3%	1.8%	-0.2%
	US	2.2%	0.6%	1.1%	0.9%	1.3%	-0.5%
	Asia/Japan	-3.3%	-2.0%	-3.7%	-0.2%	-0.4%	-0.2%
Model Systematic Risk		14.9%	14.3%	10.6%	13.6%	13.5%	3.9%
Model Specific Risk		9.5%	7.1%	8.7%	4.2%	4.9%	1.0%
Total Risk		17.7%	15.9%	13.7%	14.3%	14.4%	4.0%

Source: Bloomberg, FactSet, MSCI, Standard & Poor's, Stoxx and BNP Paribas Asset Management.

Themes represented by these equity strategies account for a large component of the total risk described by the market risk factor, a small negative exposure to duration risk, a small positive to corporate spreads and a small positive exposure to the US risk factor.

Disruptive tech, healthcare innovation and consumer innovation also have a small negative exposure to the Asia/Japan risk factor.

The disruptive tech theme has an additional small positive exposure to the EM/commodities factor while the other themes have a small but negative exposure to this factor.

The environmental sustainability theme exploited through bonds has a larger exposure to duration risk and a small exposure to the market risk factor. Exposures to all other factors are negative but small.

It should not come as a surprise that some of the risk of these thematic strategies is explained by exposures to the traditional risk factors in the risk model, as shown in the model systematic risk row in exhibit 5. Nevertheless, in all three cases, the risk not explained by the traditional risk factors remains significant, as shown by the model specific risk row in exhibit 5.

For healthcare innovation, about 40% of the total variance of returns (the square of the total risk) of the benchmark of the fund behind this theme is not explained by the traditional risk factors (the square of the model specific risk).

For consumer innovation, the contribution of model specific variance to the total variance of the benchmark fund returns is about 20%, while for the disruptive tech theme, the model specific variance contributes about 29% to the total variance of the returns underlying the benchmark of the funds behind this theme.

When it comes to the sustainable themes, the contribution of specific risk to the variance of the theme is smaller, at 9% for energy transition, and 12% and 7% for environmental sustainability equity and bonds, respectively.

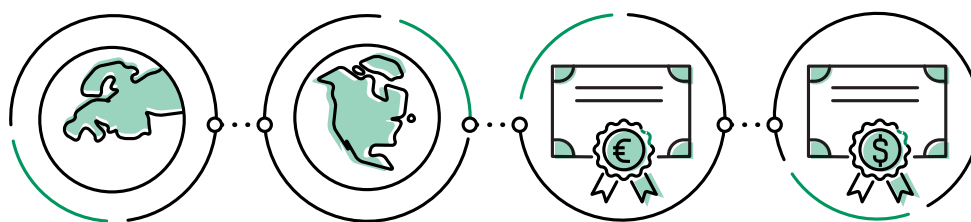
These exposures play an important role in determining the final allocation to themes. The fact that the instruments used to invest in the themes come with exposures to traditional risk factors should be taken into account when deciding about the optimal allocation to each theme.

STRATEGIC ASSET ALLOCATION TO THEMATIC INVESTMENTS

We considered five different risk profiles in our example. This starts with the conservative profile for the most risk-averse investors and goes all the way to the aggressive profile, for those prepared to take the most risk. The three intermediate risk profiles are moderately conservative, moderate and moderately aggressive, in order of falling risk aversion.

We separate assets into four high-capacity core assets and nine lower-capacity satellite assets.

The core assets are Equity Europe, Equity North America, Bond EUR Investment Grade Aggregate and Bond USD Investment Grade Aggregate.




In turn, the 12 satellite assets are divided into three groups. The first is made up of six diversification assets: Equity Eurozone Small Cap, Equity North America Small Cap, Equity Pacific Japan, Equity Global Emerging Markets, Equity Listed Real Estate Pan Europe, Bond Global Emerging Market.


The second group is made up of two sustainable themes with one played via equities and the other via fixed income: Energy Transition equities and Environmental Sustainability equities and bonds. The last group has three thematic investments: Healthcare Innovation equities, Consumer Innovation equities and Disruptive Tech equities.

We shall skip the information about the core and diversification asset exposures to the traditional factors in the asset allocation risk model. However, as should be expected, these were taken into account in the portfolio construction along with the exposures in exhibit 5 for the thematic investments.

We used the BNP Paribas Asset Management long-term estimates of asset returns for core and for diversification assets in the portfolio construction step. These estimates can also be used to construct long-term estimates for the six traditional risk factors in our risk model. These proprietary estimates of long-term returns rely on a time series of asset returns going as far back as 1954. For the thematic investments, the returns were constructed as follows:



BY TAKING INTO ACCOUNT THEIR EXPOSURES TO THE TRADITIONAL RISK FACTORS OVER THE LAST 10 YEARS



BY ADDING A POSITIVE ALPHA TO THE RETURNS DERIVED FROM THE EXPOSURE TO THE TRADITIONAL RISK FACTORS. THE ADDED ALPHA IS CALCULATED BY ASSUMING A LONG-TERM INFORMATION RATIO OF 0.3

The estimated returns for each core asset, for each diversifying asset and for each thematic investment, along with the asset allocation risk model, were used as inputs for the portfolio construction.

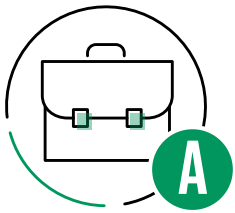
We used a robust optimisation approach to portfolio construction. Unlike mean-variance optimisation, robust optimisation takes into account the uncertainty in the asset return estimates and significantly reduces the sensitivity of the final portfolio to small changes in expected returns.

The description of the framework based on robust optimisation can be found in our recent papers, e.g., Yin et al. (2021). Details of how the allocation of robust portfolios is constructed from the robust optimisation algorithm was explored in our paper by Perchet et al. (2016).

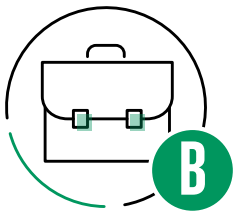
The results from applying this framework to the construction of four portfolios for each of the five risk profiles are shown in exhibit 6 and exhibit 7.

For each risk profile, we constructed four different portfolios. The first, A, is allowed to invest only in core assets. The other three, B, C and D, are based on a core-satellite approach wherein the optimiser is also allowed to invest in diversification assets for B, in diversification and sustainable thematic assets for C, and in diversification and both sustainable thematic and innovation-disruptive thematic assets in D.

The investments in diversification and thematic assets represents the satellite of such portfolios. An aversion to tracking error relative to the portfolio of the same risk profile invested only in core assets, A, regulates the size of the satellite. The portfolios are constrained to be fully invested, i.e., neither leverage nor short-selling is allowed.

**Portfolio A – Core assets only**

As should be expected, for portfolios invested in core assets only, A, the allocation to riskier assets increases as the risk aversion is reduced. While the conservative portfolio invests almost 60% in cash, the riskier aggressive portfolio invests only in equities. The falling Sharpe ratio is a consequence of the fully invested constraint. Nevertheless, despite the lower Sharpe ratios, the riskier portfolio is still expected to deliver higher returns than the less risky portfolios invested only in core assets.

**Portfolio B – Core assets and diversification satellite**

If we allow for a satellite invested in diversifying assets, then we find higher expected returns for the core-satellite portfolios than for their counterparts invested only in core assets. The size of the satellite in portfolio B increases with falling risk aversion from about 8% for the conservative portfolio to more than 15% for the moderate portfolio. The allocation to riskier assets in the satellite increases with falling risk aversion, for example if the aggressive portfolio no longer invests in emerging bonds. As expected, all Sharpe ratios and expected returns are higher for this more diversified portfolio in B than for their respective counterparts in A. The tracking error resulting from the satellite ranges from 0.7% for the conservative portfolio to 0.9% for the moderate and the moderately aggressive portfolios. Long only constraints make it more attractive to reduce slightly the tracking error for the aggressive portfolio.



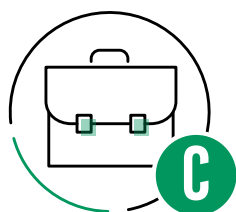
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Exhibit 6:

Asset weights for five strategic asset allocation portfolios with different risk profiles. Based on monthly data in USD. Risk estimation from Jan-2003 through May-2021. Proprietary estimates of long-term returns rely on data from Jan-1954.

	Portfolio Weights (%)																	
	Core					Satellite												
	Equities		Bonds		Cash	Diversification					Thematic Investments							
						Equities		Bonds	Sustainable		Innovation-Disruption							
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 Market	Equities	Bonds	Equities					
											Energy Transition	Environmental Sustainability	Environmental Sustainability	Disruptive Tech.	Consumer Innovation	Health Care Innovation		
A	Conservative	6.1	7.3	10.2	17.6	58.8	-	-	-	-	-	-	-	-	-	-	-	
	Moderately Conservative	17.2	20.8	22.7	39.3	-	-	-	-	-	-	-	-	-	-	-	-	
	Moderate	27.5	32.8	12.9	26.8	-	-	-	-	-	-	-	-	-	-	-	-	
	Moderately Aggressive	36.9	43.9	3.3	15.9	-	-	-	-	-	-	-	-	-	-	-	-	
	Aggressive	49.2	50.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
B	Conservative	4.4	3.8	13.6	14.5	55.4	1.3	1.8	0.7	0.8	1.5	2.2	-	-	-	-	-	
	Moderately Conservative	14.1	13.8	26.0	33.2	-	2.2	3.8	0.8	1.0	2.3	2.8	-	-	-	-	-	
	Moderate	23.8	24.2	15.8	20.9	-	2.8	4.8	0.9	1.1	2.5	3.2	-	-	-	-	-	
	Moderately Aggressive	33.0	34.5	6.1	10.0	-	3.1	5.3	0.9	1.1	2.6	3.4	-	-	-	-	-	
	Aggressive	44.1	40.9	-	-	-	4.0	5.2	1.9	1.6	2.3	-	-	-	-	-	-	
C	Conservative	0.9	-	6.6	9.2	54.1	-	1.5	0.6	-	1.1	1.9	5.4	5.0	13.7	-	-	
	Moderately Conservative	6.8	5.9	17.5	25.6	-	-	3.8	0.8	-	2.1	2.4	10.8	7.8	16.5	-	-	
	Moderate	16.1	15.7	7.8	14.2	-	-	4.9	0.9	-	2.4	2.5	11.5	8.5	15.5	-	-	
	Moderately Aggressive	25.1	25.8	-	2.8	-	-	5.4	1.0	-	2.5	2.9	11.8	8.8	13.9	-	-	
	Aggressive	36.4	32.0	-	-	-	0.7	5.2	1.9	0.2	2.3	-	12.1	9.2	-	-	-	
D	Conservative	1.6	-	7.4	9.7	52.8	-	0.3	0.3	-	1.2	1.5	2.9	2.8	13.3	2.3	1.9	2.0
	Moderately Conservative	6.2	-	18.1	24.8	-	-	2.8	0.5	-	2.2	1.9	8.9	6.4	16.8	3.4	4.0	4.0
	Moderate	15.0	8.5	8.6	13.3	-	-	3.9	0.5	-	2.5	2.0	10.1	7.4	15.8	3.6	4.5	4.3
	Moderately Aggressive	24.0	18.4	-	2.3	-	-	4.4	0.6	-	2.6	2.2	10.4	7.7	14.7	3.7	4.7	4.3
	Aggressive	35.3	24.7	-	-	-	0.7	4.3	1.3	-	2.4	-	10.4	8.0	-	4.0	5.6	3.3

Source: Bloomberg, FactSet, MSCI, Standard & Poor's, Stoxx and BNP Paribas Asset Management. For illustration purposes only. Past performance is not indicative of future performance.

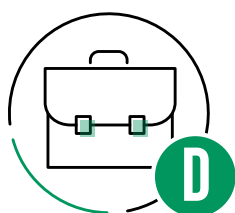


Portfolio C – Core assets, diversification and sustainable thematic satellite

When sustainable thematic investments are also allowed, C, then we find that the Sharpe ratios and expected returns increase further when compared to their respective counterparts in B or A. The size of the satellite portfolio increases further, to about 29% for the conservative portfolio and almost 46% for the moderately aggressive portfolio, resulting in a tracking error relative to their counterparts invested only in core assets in A ranging from 0.7% for the conservative and the aggressive portfolio to 0.9% for the moderate and moderately aggressive portfolio.

It is interesting to see that some sustainable thematic investments in C simply replace some of the diversification assets in B, as is the case for global equity emerging markets. The allocation to core assets is also affected, with the allocation to equity North America disappearing from the most risk-averse profile and the allocation to EUR investment grade agg. disappearing from the most aggressive profiles. Finally, environmental sustainability bonds, less risky than environmental sustainability equities or energy transition equities, take a larger weight in the satellite. Of course, the choice of themes and their exposures to traditional risk factors, as well as the expected returns used as an input, play a key role in explaining these results.

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Portfolio D – Core assets, diversification, and all thematic satellite

Finally, when thematic investments are allowed, D, then we find that the Sharpe ratios and expected returns increase even further when compared to their respective counterparts in C, B or A. The size of the satellite portfolio also increases further, to exceed 55% for the moderately aggressive portfolio. Tracking error levels are similar to those found in C and B. The allocation to innovation-disruption thematics is funded not only by reducing further the allocation to core and diversification assets, but also by reducing the allocation to sustainable themes played with equities.

Overall, we find that with the returns and risks used as inputs in the optimiser, there was a strong interest in allocating to three thematic investments, which would lead to a significant increase in portfolio returns at comparable levels of risk.

Exhibit 7:
Portfolio statistics and aggregated asset weights for five strategic asset allocation portfolios with different risk profiles. Based on monthly data in USD. Risk estimation from Jan-2003 through May-2021. Proprietary estimates of long-term returns rely on data from Jan-1954.

Risk Profile	Portfolio Statistics				Portfolio weights (%)							
	Annualized excess return over cash (%)	Annualized volatility (%)	Sharpe ratio	Tracking error relative to Core (%)	Equities	Bonds	Cash	Core	Satellite	Satellite		
										Diversification	Thematic Investments	
											Sustainable	Innovation-Disruption
A												
Conservative	0.8	1.8	0.46	-	13.4	27.8	58.8	100.0	-	-	-	-
Moderately Conservative	2.3	5.0	0.45	-	38.0	62.0	0.0	100.0	-	-	-	-
Moderate	3.3	8.0	0.41	-	60.3	39.7	0.0	100.0	-	-	-	-
Moderately Aggressive	4.3	11.0	0.39	-	80.8	19.2	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	-	-
Moderately Conservative	2.6	5.4	0.48	0.8	38.0	62.0	0.0	87.1	12.9	12.9	-	-
Moderate	3.6	8.3	0.44	0.9	60.1	39.9	0.0	84.7	15.3	15.3	-	-
Moderately Aggressive	4.6	11.3	0.41	0.9	80.5	19.5	0.0	83.6	16.4	16.4	-	-
Aggressive	5.3	14.0	0.38	0.7	100.0	0.0	0.0	85.0	15.0	15.0	-	-
C												
Conservative	1.3	2.3	0.56	0.7	14.5	31.4	54.1	70.8	29.2	5.1	24.1	-
Moderately Conservative	2.8	5.4	0.52	0.8	38.0	62.0	0.0	55.8	44.2	9.1	35.1	-
Moderate	3.9	8.3	0.46	0.9	60.0	40.0	0.0	53.8	46.2	10.7	35.5	-
Moderately Aggressive	4.8	11.3	0.43	0.9	80.4	19.6	0.0	53.7	46.3	11.8	34.5	-
Aggressive	5.5	14.0	0.40	0.7	100.0	0.0	0.0	68.4	31.6	10.3	21.3	-
D												
Conservative	1.4	2.3	0.60	0.7	15.3	31.9	52.8	71.5	28.5	3.3	19.0	6.2
Moderately Conservative	3.0	5.3	0.56	0.9	38.4	61.6	0.0	49.1	50.9	7.4	32.1	11.4
Moderate	4.1	8.3	0.49	0.9	60.3	39.7	0.0	45.4	54.6	8.9	33.3	12.4
Moderately Aggressive	5.1	11.3	0.45	0.9	80.8	19.2	0.0	44.7	55.3	9.8	32.8	12.7
Aggressive	5.8	13.9	0.42	0.8	100.0	0.0	0.0	60.0	40.0	8.7	18.4	12.9

Source: Bloomberg, FactSet, MSCI, Standard & Poor's, Stoxx and BNP Paribas Asset Management. For illustration purposes only. Past performance is not indicative of future performance.

CONCLUSIONS



Themes are structural trends expected to significantly impact economies and redefine business models. For this reason, they should have an impact on the returns and risks of investments with greater exposure to those structural trends. Thematic investing allows portfolios to earn excess returns generated from assets that have their returns impacted by the structural changes underlying relevant themes.

Thematic investing is an additional dimension in portfolios that transcends the classifications of asset classes, sectors, regions and styles, while not being fully independent from them.

Constructing portfolios with thematic investments requires adequate risk management in order to assess by how much a given theme is exposed to traditional risk factors, or sectors, or styles, and to assess how much alpha a given theme is likely to add to the portfolio in excess of such exposures.

We provide guidance on how to implement the required risk management framework that allows for allocation to themes which takes into account their exposures to traditional risk factors.

We also propose a framework based on robust optimisation as an allocating tool capable of handling the different risk exposures of assets and themes while taking into account the expected returns from the different assets and the expected alphas for themes.

With this, we give a detailed example with an allocation to five different themes played in equities and bonds and show how the allocation changes according to an investor's level of risk aversion. The results shown in the paper are for illustrative purposes only and constitute a framework that could be used in making allocations to thematic investments.

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The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper, not BNP Paribas Asset Management.

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