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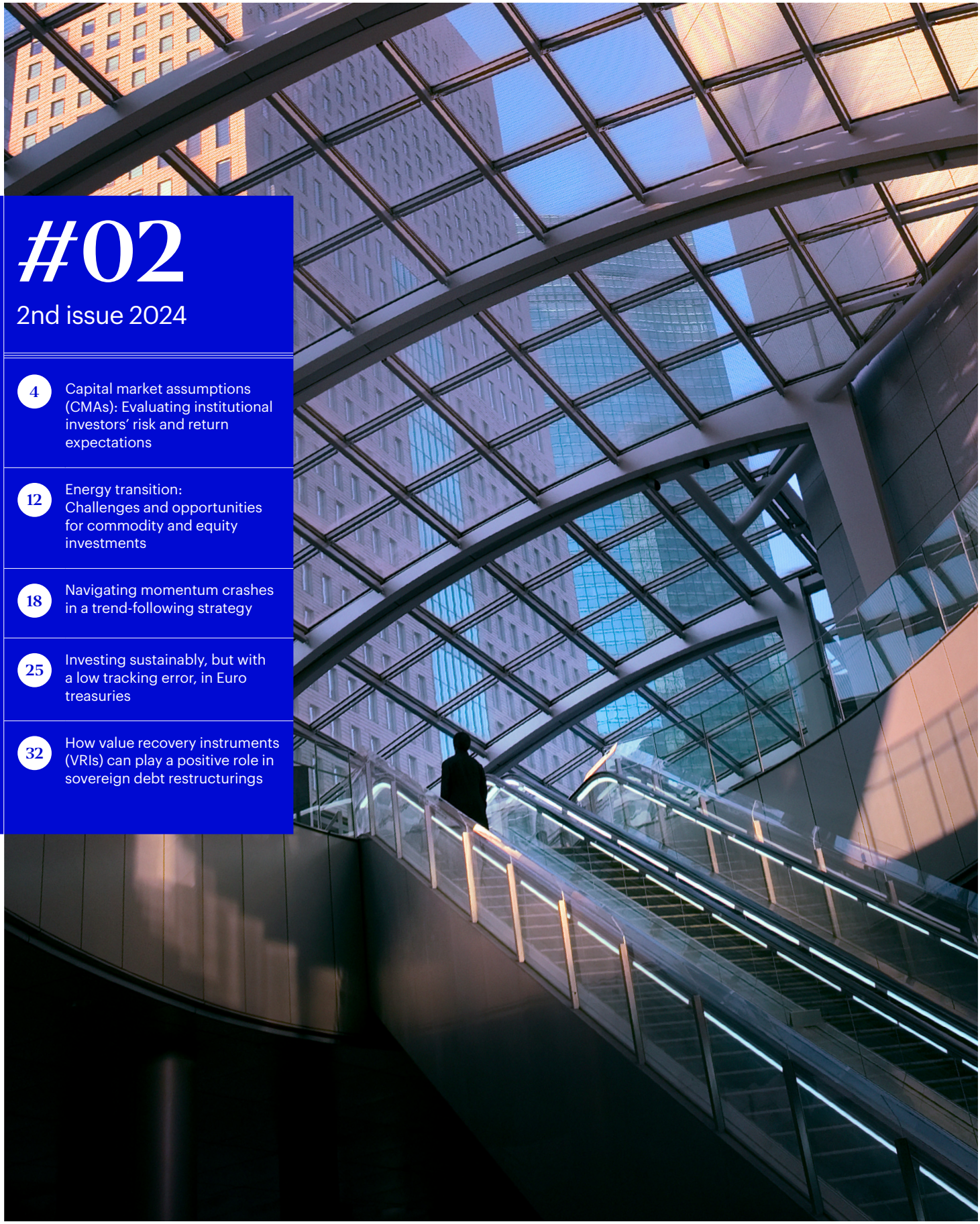
Risk & Reward

Research and investment strategies



#02

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Risk & Reward #02/2024

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The new edition of Risk & Reward showcases the breadth of our research: from querying subjective expectations to examining sophisticated risk-mitigation strategies for equities and bonds, ESG and sovereign debt restructuring.

Our lead article is a testament to the success of our ongoing collaboration with leading academics. Together with three experts from the finance departments of renowned US universities, we analyzed the capital market assumptions (CMAs) of institutional investors to find out whether their subjective beliefs could be used to mitigate risk and generate alpha. A review of their paper points to promising results, far more relevant information than retail investor surveys. After presenting their work, we also spoke to the three authors of the study in an exclusive interview.

In this issue, we also take a closer look at the energy transition, a monumental task for decades to come. But the challenge is not without its opportunities for equity and commodity investors, as huge amounts of capital will be needed. Read to learn why we think decarbonization and healthy returns aren't mutually exclusive. In fact, we believe you can't have one without the other.

Our focus then turns to the merits of trend-following strategies, particularly in times of market stress when they lead to lower investment ratios – and thus lower portfolio risk. But strong market rebounds can have a limiting impact on their success. Discover how our researchers deal with these 'momentum crashes' to smooth returns.

And ESG is growing ever more popular among fixed income investors. But investing in green bonds issued by governments often comes with higher interest rate risk. For Euro treasuries, the average duration of green bonds is almost twice that of their conventional counterparts. We examine a concept that allows sustainability-tilted bond investments without risking huge deviations from a traditional benchmark. Yes, you can have a sustainable bond portfolio with a low tracking error.

Our final article looks at how value recovery instruments (VRIs) can make sovereign debt restructuring easier for everyone. Learn how they work and what makes them such an interesting tool for issuers and investors.

We are certain you'll enjoy the latest issue of Risk & Reward.

Best regards,

Stephanie Butcher
Senior Managing Director and
Co-Head of Investments

Tony Wong
Senior Managing Director and
Co-Head of Investments

Capital market assumptions (CMAs): Evaluating institutional investors' risk and return expectations

This article is a review of The Subjective Risk and Return Expectations of Institutional Investors, a paper in the Fisher College of Business Working Paper Series written by Spencer J. Couts, Andrei S. Gonçalves and Johnathan A. Loudis.

Financial market research generally assumes that the beliefs of market participants are rational and homogenous. But both assumptions have recently been questioned. This article explores the relationships between subjective beliefs, alpha, beta, and future realized returns based on the long-term capital market assumptions (CMAs) of leading financial institutions.

Academic financial market research traditionally uses realized returns to measures risk.[1] This approach implicitly assumes that market participants' forecasts are objective and based on all available information – and consequently identical.

But if investors have subjective expectations that deviate from the rational ideal, empirical tests might "reject" a valid asset-pricing model if they are too optimistic, or "accept" an invalid one if they are too pessimistic – which necessitates more research into how subjective risk perceptions are related to the risk premia investors demand for holding risky assets.[2] The authors attempt to help fill this gap by exploring the long-term capital market assumptions (CMAs) of major asset managers and institutional investor consultants.

CMAs are important for the business of numerous large financial institutions, many of which have teams of highly trained experts dedicated to their creation. They are also used by institutional investor consultants to advise their clients on portfolio allocation. Usually, CMAs comprise long-term return, standard deviation (volatility), and correlation estimates for various asset classes. Since they are fully developed documents that institutions produce of their own volition, it seems reasonable to suppose that they typically encapsulate more sophisticated beliefs than what is conveyed by surveys of households or individual investors.

The sample

This analysis encompasses 34 institutions – 18 asset managers and 16 consultants. Most of the data comes from direct requests and/or online searches for CMAs, with a small proportion coming from pension funds' internal reports (which usually report their third-party consultants' CMAs) if the two other means are not available.

There are several major asset managers and leading consultants in the sample. At the end of 2021, the aggregated assets under management (AuM) of all 18 asset managers was more than USD 23.6 trillion, representing more than a quarter of the combined AuM of the world's 50 biggest managers. Furthermore, the sample includes the primary consultant of more than half of all US public pension from 2001 to 2021.

Table 1
Sample coverage by year

Panel A: Number of managers, consultants, and asset classes

	1987	1996	1997	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022
# of institutions	1	1	3	4	5	8	7	10	11	14	17	14	16	20	21	24
# of institutions (direct data)	0	1	3	4	5	5	5	7	8	10	12	12	13	17	20	22
# of managers	0	0	1	1	1	1	1	1	4	5	6	5	6	10	11	15
# of consultants	1	1	2	3	4	7	6	9	7	9	11	9	10	10	10	9
# of asset classes	4	7	13	13	13	16	16	18	18	19	20	20	20	20	20	20
Avg # of asset classes per institution	4	7	9	9	9	9	10	12	12	12	13	14	14	13	14	14

Panel B: Number of institutions covering each asset class

US cash	1	1	3	4	5	8	7	10	11	14	17	14	16	20	21	24
US TIPS	0	0	0	1	1	5	6	9	10	14	16	13	14	17	17	21
US bonds	1	1	3	4	5	8	7	10	11	12	16	13	16	17	17	19
US government bonds	0	0	1	0	1	2	2	2	3	3	7	8	10	14	12	18
US municipal bonds	0	0	0	0	0	1	1	1	3	4	6	6	6	8	8	10
US inv grade corporate bonds	0	0	0	0	0	1	1	1	1	2	7	4	5	6	9	13
US high yield corporate bonds	0	0	2	3	5	5	5	7	9	11	13	11	13	16	17	21
Global bonds ex US	0	1	3	4	4	4	4	7	8	9	13	11	12	12	14	19
Private debt	0	0	0	0	0	0	0	0	0	1	2	1	3	4	7	11
US equities large cap	1	1	3	4	5	8	7	10	11	14	17	14	16	20	21	24
US equities small cap	0	1	2	2	2	4	3	7	7	9	12	11	12	13	13	17
Global equitites developed ex US	0	0	2	3	5	7	7	9	10	12	15	14	16	19	21	22
Global equities emerging	0	0	2	3	5	5	5	7	9	11	14	12	14	18	18	22
Private equity	0	1	1	1	3	6	7	9	9	12	15	12	13	16	17	19
REITS	0	0	1	2	2	3	2	5	6	7	11	10	12	14	16	17
Private real estate	1	1	2	2	3	4	6	10	9	11	16	13	14	15	16	19
Hedge funds	0	0	0	0	0	3	3	7	6	9	12	10	11	14	17	18
Commodities	0	0	1	1	0	0	0	6	7	10	13	11	13	17	17	19
Venture capital	0	0	0	0	0	0	0	0	0	0	1	2	3	2	2	3
Infrastructure	0	0	0	0	0	0	0	1	2	2	4	4	4	6	10	10

Source: Couts, S., Gonçalves, A., and J. Loudis (2023).

CMAs for 19 asset classes that are significant for institutional investors and covered by a reasonable number of institutions over a reasonable period of time are included. They are broadly divided into four categories: debt, equity, real estate, and alternatives. As shown in table 1 – from which some years are omitted for space reasons – both the number of asset classes and the number of institutions increase over the 35-year study period from 1987 to 2022. A risk-free 20th asset, proxied by US cash is also included, which is covered by all institutions at all times.

The subjective risk-return trade-off

For every institution, asset class and year, the dataset provides expected returns, volatilities, and correlations between asset classes (table 2, panel A), from which expected excess returns as well as their volatilities and correlations were derived (table 2, panel B).

Subjective market betas were constructed for every institution, asset class, and year, based on two market proxies, US large-cap equities ("Equity CAPM") and the aggregate portfolio of US pension funds ("Pension CAPM"). By combining these betas with the subjective expected return on the respective market proxy, subjective risk premia and subjective alphas can be calculated.

Irrespective of the proxy used, deviations from market risk premia are economically small, as is the average subjective alpha of each asset class. Overall, most of the variation in subjective expected returns is driven by variation in subjective risk premia – that is, compensation for market beta – rather than subjective alphas.

Specifically, in the Equity CAPM, over 75% of the variation in subjective expected returns is driven by subjective risk premia. In the Pension CAPM the percentage is even higher, with subjective risk premia driving more than 90% of the variation.

These findings indicate a strong and positive subjective risk-return trade-off, which plots subjective expected returns against subjective market betas in the Equity CAPM.

Heterogenous beliefs

The views reflected in the CMAs can be heterogenous in two distinct forms.

Table 2
Average beliefs in 2022 (expected returns, volatilities, and correlations), pooled across institutions

Panel A: Raw returns

	E[R]	σ[R]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) US cash	3.0	0.9	1																			
(2) US TIPS	4.1	6.0	0.07	1																		
(3) US bonds	4.5	5.0	0.15	0.74	1																	
(4) US government bonds	4.1	7.4	0.16	0.65	0.84	1																
(5) US municipal bonds	3.7	4.9	0.06	0.60	0.75	0.61	1															
(6) US inv grade corp bonds	5.5	7.4	0.03	0.66	0.84	0.60	0.71	1														
(7) US high yield corp bonds	6.9	9.8	-0.05	0.35	0.30	-0.02	0.38	0.51	1													
(8) Global bonds ex US	3.8	7.6	0.09	0.59	0.68	0.62	0.54	0.66	0.31	1												
(9) Private debt	8.7	12.1	-0.06	0.14	0.02	-0.21	0.10	0.35	0.67	0.14	1											
(10) US equities large cap	7.6	16.6	-0.04	0.19	0.18	-0.09	0.17	0.35	0.69	0.19	0.59	1										
(11) US equities small cap	8.9	21.2	-0.05	0.11	0.09	-0.18	0.13	0.32	0.67	0.12	0.58	0.89	1									
(12) Global equities developed ex US	8.5	18.3	-0.04	0.20	0.19	-0.09	0.18	0.36	0.67	0.29	0.55	0.83	0.78	1								
(13) Global equities emerging	10.4	23.4	-0.01	0.20	0.17	-0.12	0.17	0.33	0.64	0.19	0.51	0.72	0.69	0.80	1							
(14) Private equity	10.8	22.7	-0.03	0.15	0.05	-0.17	0.10	0.29	0.61	0.16	0.62	0.76	0.73	0.70	0.63	1						
(15) REITS	8.0	19.8	-0.05	0.28	0.27	0.05	0.26	0.38	0.64	0.28	0.48	0.71	0.69	0.65	0.56	0.58	1					
(16) Private real estate	6.8	13.6	0.00	0.17	0.14	-0.02	0.10	0.17	0.38	0.11	0.43	0.44	0.44	0.38	0.34	0.49	0.61	1				
(17) Hedge funds	6.3	7.8	0.00	0.20	0.13	-0.18	0.15	0.35	0.65	0.19	0.56	0.74	0.74	0.74	0.68	0.62	0.56	0.39	1			
(18) Commodities	5.6	17.9	-0.02	0.17	-0.06	-0.22	-0.05	0.11	0.35	0.06	0.34	0.33	0.33	0.40	0.40	0.33	0.28	0.21	0.43	1		
(19) Venture capital	14.5	29.5	0.01	0.04	-0.09	-0.25	-0.04	0.19	0.59	-0.07	0.63	0.73	0.71	0.67	0.59	0.76	0.46	0.47	0.58	0.31	1	
(20) Infrastructure	8.2	16.5	-0.03	0.28	0.19	-0.09	0.21	0.32	0.62	0.26	0.58	0.70	0.66	0.70	0.63	0.66	0.64	0.51	0.61	0.40	0.55	1

Panel B: Excess returns

(1) US cash	0.0	0.0	1																			
(2) US TIPS	1.1	6.0	0.00	1																		
(3) US bonds	1.5	5.0	0.00	0.74	1																	
(4) US government bonds	1.1	7.3	0.00	0.65	0.84	1																
(5) US municipal bonds	0.6	4.9	0.00	0.60	0.75	0.61	1															
(6) US inv grade corp bonds	2.4	7.4	0.00	0.67	0.85	0.61	0.71	1														
(7) US high yield corp bonds	3.9	9.9	0.00	0.36	0.31	0.00	0.39	0.52	1													
(8) Global bonds ex US	0.6	7.6	0.00	0.59	0.67	0.61	0.53	0.66	0.31	1												
(9) Private debt	5.5	12.2	0.00	0.17	0.03	-0.19	0.11	0.36	0.67	0.15	1											
(10) US equities large cap	4.6	16.6	0.00	0.20	0.20	-0.08	0.18	0.36	0.69	0.20	0.59	1										
(11) US equities small cap	5.8	21.3	0.00	0.12	0.11	-0.17	0.14	0.32	0.67	0.12	0.58	0.89	1									
(12) Global equities developed ex US	5.4	18.4	0.00	0.21	0.20	-0.09	0.19	0.37	0.67	0.29	0.55	0.83	0.78	1								
(13) Global equities emerging	7.3	23.4	0.00	0.20	0.18	-0.11	0.17	0.33	0.64	0.20	0.51	0.72	0.69	0.80	1							
(14) Private equity	7.8	22.7	0.00	0.16	0.06	-0.17	0.11	0.29	0.61	0.17	0.62	0.76	0.73	0.70	0.64	1						
(15) REITS	4.9	19.9	0.00	0.30	0.28	0.07	0.27	0.39	0.64	0.29	0.49	0.71	0.69	0.65	0.56	0.58	1					
(16) Private real estate	3.8	13.7	0.00	0.18	0.15	-0.02	0.10	0.18	0.39	0.11	0.44	0.45	0.44	0.39	0.34	0.49	0.62	1				
(17) Hedge funds	3.0	7.9	0.00	0.21	0.14	-0.17	0.16	0.36	0.65	0.19	0.57	0.74	0.74	0.73	0.68	0.63	0.56	0.39	1			
(18) Commodities	2.6	18.0	0.00	0.18	-0.05	-0.21	-0.04	0.11	0.36	0.06	0.34	0.33	0.34	0.41	0.41	0.33	0.28	0.21	0.43	1		
(19) Venture capital	11.9	29.5	0.00	0.04	-0.10	-0.26	-0.03	0.19	0.59	-0.07	0.62	0.72	0.71	0.67	0.59	0.75	0.46	0.47	0.56	0.31	1	
(20) Infrastructure	5.0	16.6	0.00	0.29	0.20	-0.07	0.22	0.33	0.63	0.26	0.59	0.70	0.67	0.70	0.63	0.66	0.65	0.51	0.62	0.40	0.55	1

Source: Couts, S., Gonçalves, A., and J. Loudis (2023). E[R] = average nominal returns; σ[R] = average volatilities.

First, they may differ between institutions, i.e., institutions may disagree. Second, asset class views can differ, allowing for a risk-return trade-off across asset classes.

To explore this further, the within-year variation in expected returns were decomposed through fixed effects for institutions and asset classes. Fixed effects for asset classes explain more than 80% of variation in subjective expected returns in a typical year. This striking result sheds additional light on why expected return variation is driven largely by subjective risk premia. Alphas are important in explaining the variation in expected returns across institutions within a specific asset class (i.e., disagreement), but this is overwhelmed

by the much larger variation in risk premia across asset classes. Belief distortions play a relatively modest role, with average subjective expected returns, volatilities, and betas all lining up well with their respective realized return counterparts.

On the whole, this reinforces the general finding that the institutional investors' CMAs are more grounded in financial reality than the documented subjective beliefs of individual or retail investors. However, there are still some mismatches; for example, expected alphas (mispricing), on average, do not predict subsequent realized alphas. Moreover, expected volatilities and betas predict cross-sectional variation but not time-series variation in their subsequent realized counterparts. These more nuanced results suggest that institutions can further improve the process of formulating their beliefs and return expectations.

The subjective beliefs of large financial institutions tend to better reflect market reality than the often studied surveys of retail investors' beliefs and may therefore serve as a useful guide for retail investors.

Conclusion

Overall, their research provides three stylized facts about the subjective risk and return expectations of major asset managers and institutional investor consultants. Importantly, these findings apply across multiple asset classes:

(1) There is a strong and positive subjective risk-return trade-off, with most of the variation in subjective expected returns coming from variation in compensation for market beta (subjective risk premia).

(2) Both this trade-off and belief variation are stronger across asset classes than across institutions, showing that, even though institutions disagree on their beliefs about these assets, this disagreement is small relative to their agreement on the variation in risk premia across asset classes.

(3) The subjective expected returns of the institutions in the sample effectively predict subsequent realized returns over time and across asset classes.

Together, these findings imply that, when modeling the subjective beliefs of institutional investors, researchers should incorporate a risk-return trade-off. In addition, accounting for this trade-off when modelling multiple asset classes appears more important than incorporating disagreement across institutions or belief distortion.

The findings also have implications for non-institutional investors: The subjective beliefs of large financial institutions tend to better reflect market reality than the often studied surveys of retail investors' beliefs and may therefore serve as a useful guide for retail investors.

Notes

1 E.g. Fama and MacBeth (1973).
2 Adam and Nagel (2023).

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This article is based on The Subjective Risk and Return Expectations of Institutional Investors, a paper in the Fisher College of Business Working Paper Series. The full study can be downloaded from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4458499.

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INTERVIEW

“CMAs represent beliefs that are more rational than those of most individual or retail investors”

Historically, many studies of the risk-return trade-off had little choice but to assume a financial landscape populated by rational investors with shared beliefs. Yet a wealth of research has shown households, individual investors, and even some financial professionals do not fit this assumption. Risk & Reward spoke to Spencer J. Couts, Andrei S. Gonçalves, and Johnathan A. Loudis, authors of the research behind our feature article, who delved deeper into whether institutional investors might be closer to the rational ideal.

“

We wanted to understand whether the beliefs of institutional investors display some important irrationalities that have been documented for their individual or retail investor counterparts.

Risk & Reward
How might we define the role of CMAs in developing a portfolio?

Andrei S. Gonçalves
We perhaps first need to ask why people invest in financial markets. The objective is to obtain the highest possible reward for the lowest possible risk. In baseline models, we typically define reward as the expected return and risk as the volatility of a portfolio over time. The aim of portfolio allocation is to use a set of assets to achieve the best possible risk-reward combination. This requires three elements to be considered: The first is the expected return of each asset or asset class; the second is the volatility of each asset or asset class; and the third is the correlation across different assets or asset classes.

CMAs are assumptions about these inputs. From the perspective of an institution, if these three inputs are known, mathematical models can be used to combine different assets to produce an optimum risk-reward balance. So the role of CMAs for institutional investors is basically to help build portfolio allocation models. By applying quantitative approaches and incorporating their beliefs or expectations, institutions try to come up with the most effective allocation decisions to maximize the welfare of their clients conditioned on their beliefs about financial markets.

Risk & Reward
Was there anything specific that sparked your interest in CMAs as a research subject?

Spencer J. Couts
There’s a long list of academic literature that analyzes what are called the subjective beliefs of investors. There have been some interesting findings over time, including that these beliefs are irrational (or not necessarily consistent with what actually happens in the financial markets) in important ways. However, these findings have typically been based on the beliefs of individual or retail investors, who may not be as sophisticated as institutional investors. That was really a springboard for this project. We wanted to understand whether the beliefs of institutional investors display some important irrationalities that have been documented for their individual or retail investor counterparts.

Our hypothesis in approaching this study was that the beliefs implied from CMAs are a little more rational than those survey-based beliefs of retail investors. Whether or not this is the case has important implications for asset pricing because asset prices, fundamentally, are driven by the expectations of marginal investors in the marketplace – a group that likely includes institutional investors.

Risk & Reward
Why has work in this field been relatively limited to date?

Johnathan A. Loudis
Historically, a major challenge in studying institutional investor beliefs was the lack of access to comprehensive data in a single dataset. A major challenge and accomplishment of this project was to gather and synthesize the CMAs of many institutional investors in a consistent and coherent manner, not the least of which included securing buy-in from institutions.

This lack of accessible beliefs data, whether it be from institutions or individual investors, is one reason why the approach of the vast majority of financial economists up until the 1990s – or even the 2000s – was to assume all investors had rational expectations. This wasn’t necessarily a theoretical limitation – rather, it was a limitation given the data at the time. This is also why researchers focused on readily available realized return data. The catch was that, to use realized return as a proxy for investor expectations, researchers had to assume investors had rational beliefs. Today, of course, we can measure investor beliefs that deviate from this benchmark, which is why this gap in the literature is now being filled.

Risk & Reward
Your analysis identifies a strong and positive subjective risk-return trade-off. What does your work tell us about the roles of alpha and beta in this trade-off?

Andrei S. Gonçalves
Many models in finance start from a set of investors’ preferences, beliefs, and demands – for example, how much of a particular asset they are going to want to hold given those preferences and beliefs. An equation that tends to be common across these models is that expected returns in equilibrium are a function of two components.

The first component is the risk premium, meaning how much compensation is required for beta (or market risk exposure), and the second is the deviation of expected returns from the risk premium – which is typically called alpha (or mispricing). In a perfect model – one without any frictions or any problems in financial markets –

the alphas would all be zero, so all the expected returns would be driven by the risk premium, or compensation for beta.

What's great about CMA data is that we can observe betas and expected returns, so we can understand what proportion of the expected returns is driven – at least as reflected in the beliefs of these institutions – by risk premium versus alpha. We find the majority of the variation in expected returns in CMAs seems to be connected to the variation in risk premium, not the variation in alpha.

Risk & Reward
What about variation in beliefs?

Spencer J. Couts
We find most of the belief variation is driven by variation across asset classes rather than across institutions. Consider, for example, equities and bonds. While institutions disagree about the expected returns on equities and bonds, their disagreement is small relative to their agreement on the difference in expected returns between equities and bonds.

Again, this is the beauty of using CMA data. Historically, if you had to make the "rational expectations" assumption, you would have to estimate risk exposures to an individual asset by running a regression of realized asset returns on the realized risk factor returns (such as the market return in the CAPM). With subjective investor beliefs, we don't need to rely on realized return data. We can just directly measure how much investors think they're being compensated for risk exposure versus how much they think they're being compensated, in the form of an expected return on a given asset, for subjective mispricing.

Risk & Reward
You mentioned the importance of determining whether institutions' beliefs are more rational. Does this research tell us anything about how their subjective beliefs relate both to objective beliefs and to realized returns?

Johnathan A. Loudis
Yes, documenting the relationship between institutions' subjective beliefs and future realized returns was a key goal of our analysis. If institutions have beliefs that display some rationality, then their forecasts of expected future returns should be positively related to future realized returns – and that's what we find. This is in stark contrast to the results in many prior studies of individual investors, which typically find a null or negative relationship.

This isn't to say that if an expected return published in a CMA this year is 10% then return next year is going to be exactly 10% (or even close to 10%), because there is a large amount of noise in realized returns. That is, returns have a large component that cannot be anticipated even by perfectly rational investors. But expected returns in our sample do predict future returns in the sense that, roughly speaking, a 1 percentage point increase in expected returns through these CMAs corresponds to a 1 percentage point increase in future realized returns, on average.

Risk & Reward
Is it fair to infer that institutions' beliefs, as encapsulated in CMAs, are well grounded in what happens in financial markets?

Andrei S. Gonçalves
To answer this question, we first need to go back to the broader literature and the tremendous amount of research into the subjective beliefs of individual or retail investors. A key finding from that work is that those investors as a whole seem to be disconnected from the reality of financial markets.

One reason for this is that these investors tend to look to past returns. They assume that the returns that materialized in the recent past are a good representation of what will happen going forward – which is to say they're backward-looking. We certainly find the beliefs of institutional investors, as expressed in their CMAs, are much more forward-looking. In particular, CMAs seem to rely more heavily on valuation ratios than on recent past returns. As financial economists well know, valuation ratios are a good predictor for long-run returns in financial markets. Of course, anyone in charge of CMAs already knows this. It's not a revelation that's going to make their heads explode. Their methodologies are inevitably going to result in beliefs that are much more solid and much more grounded in the reality of financial markets.

That said, there is one important detail that sometimes gets overlooked. There is a long literature on equity return predictability showing that it's hard to use valuation ratios (and other return predictors) in real time to predict returns quantitatively. That is, it is easy to know whether future average returns are high or low based on whether valuation ratios are low or high. However, it is not easy to know just how high or low future average returns are based on current valuation ratios. What's striking in our results is that CMAs correctly predict future average returns quantitatively. For instance, when CMAs collectively state an expected equity return of 10%, then future equity returns are indeed 10%, on average.

Also, there's another important dimension here. If you ask individual or retail investors, as several studies have, about their views on expected returns for different asset classes, or over time, you often find that they perceive a high risk to have a low expected return – and vice versa. In reality, as we know, this is not the case. At the asset class level, when there's high risk, there's less demand, which – in equilibrium – produces high expected returns. And it seems CMAs reflect this quite well.

"

What's striking in our results is that CMAs correctly predict future average returns quantitatively. For instance, when CMAs collectively state an expected equity return of 10%, then future equity returns are indeed 10%, on average.

> Institutions think about capital market assumptions in depth and reflect on them thoroughly, often in the form of quantitative models.

Risk & Reward
Does your research challenge previous findings?

Spencer J. Couts
It would be fairer to say that it builds on them. There's now a growing amount of work in this field, and we like to think of our study as complementary to the efforts of other researchers. There is one earlier paper that makes use of CMAs.[1] Its authors deserve a lot of credit for their data gathering efforts and for providing evidence of how CMAs deviate from the expected beliefs of individual or retail investors in terms of rationality. But it only studied one asset class – equities – with their sample based mostly on post-2010 data, whereas we study 19 asset classes using data going back to the late 1980s. We build on that valuable contribution by considering a much wider range of asset classes, by exploring whether there's a subjective risk-return trade-off in the cross section of those asset classes, and by investigating whether asset classes with higher betas demand a higher risk premium.

This is important from the perspective of rationality. One could argue that, for equities, it is a bit more straightforward to come up with valuation ratios and other considerations that inform CMAs – whereas it might be more difficult for other asset classes. But we're able to demonstrate some signs of rationality in CMAs across the board.

Our dataset also goes much further back in terms of time series, which allows us to evaluate these questions over multiple market cycles. In the very earliest years, we only have the data from one institution. But we're able to add to that dimension over the 35-year period of the study. This is obviously central to evaluating and demonstrating how our findings hold over time.

Risk & Reward
What are the most important messages that investors can take away from your research?

Johnathan A. Loudis
Maybe the message for an individual or retail investor is that, unless you're especially sophisticated or you're putting a lot of time and energy into thinking through your beliefs, it may be beneficial to use the CMAs these institutions create as a key input to form your own beliefs. This is especially the case if you're investing for the long term.

As our research shows CMAs represent beliefs that are more rational than those of typical individual or retail investors as reflected in prior surveys. This is because the institutions that create them think about capital market assumptions in depth and reflect on them thoroughly, often in the form of quantitative models.

It's vital to emphasize, though, that you shouldn't be using CMAs to try to time the market. Rather, you should understand that CMAs do a good job of capturing what's likely to happen going forward on average – both across asset classes and over time – and that this means they can provide a solid foundation for long-term asset allocation.

As we've discussed, a wealth of research shows individual or retail investors typically think markets are going to continue to perform as they did in the recent past, which we know is not generally true. If these investors need inputs on portfolio allocation or on risks and rewards – to return to where this conversation began – grounding their beliefs in the assumptions that institutions provide through CMAs is a reasonable starting point, and one that is certainly closer to the rational expectations benchmark than those based on existing surveys of individual investors.

Risk & Reward
Thank you!

Note
1 Dahlquist and Ibert (2024).

References

Dahlquist, Magnus and Markus Ibert (2024): Equity Return Expectations and Portfolios: Evidence from Large Asset Managers, The Review of Financial Studies, Volume 37, Issue 6, 1887-1928.

Energy transition: Challenges and opportunities for commodity and equity investments

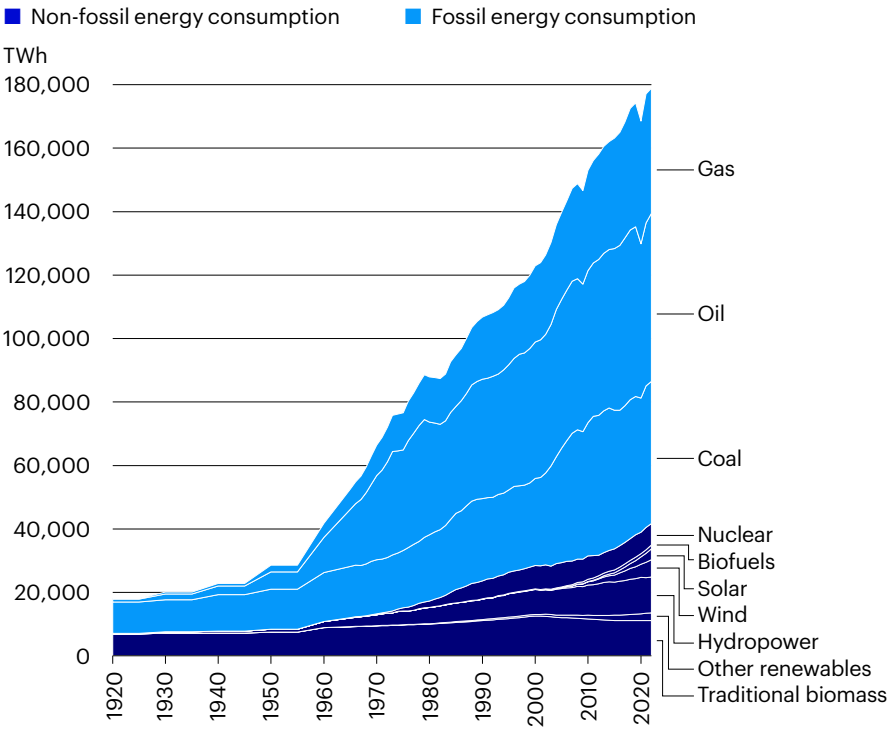
By David Gluch, CFA®, Tim Herzig and Viorel Roscovan, PhD

To combat climate change, the global community has committed to the monumental task of achieving net-zero carbon emissions by 2050. We examine the complexities of the energy transition, emphasizing the pivotal role of commodity and equity investments as well as exploring the intricate dynamics of transition to sustainable energy sources and the investment opportunities presented by this shift.

Echoing the resolve of President John F. Kennedy, who called on Americans in 1962 to get behind tackling the most ambitious of goals, global leaders today are calling on the world to embrace the challenge of eliminating fossil fuels to mitigate climate change. Legislative initiatives like the US Inflation Reduction Act and the European Green Deal underscore worldwide recognition of the urgent need for environmental action.

Beyond mere political consensus, however, transitioning to sustainable energy sources poses substantial technical and logistical hurdles. A report by McKinsey (2022) estimates that the cost of achieving net-zero could necessitate a staggering USD 275 trillion (about USD 850,000 per person in the US) in cumulative spending on physical assets by 2050. Though the challenge is immense, it also implies a vast array of investment opportunities in commodities and equities.

Figure 1
Global energy consumption by source 1920 – 2022



Source: Our World in Data.

> “ Commodities, particularly critical minerals including copper, are integral to the energy transition.

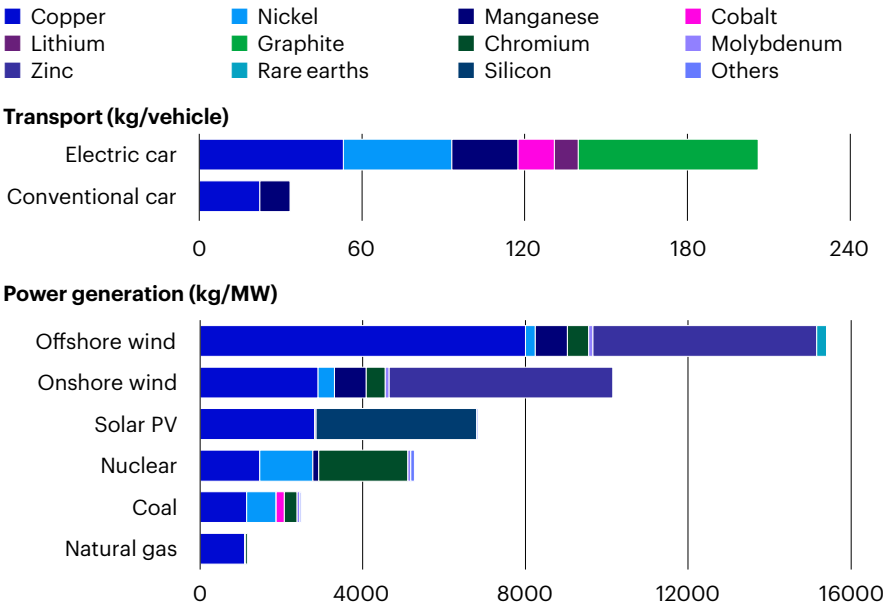
More than decarbonization

The energy transition demands more than just a reduction of carbon emissions. It will also require maintaining and expanding energy production to sustain economic growth. And because fossil fuels serve vital functions in many sectors, their complete replacement by renewables is a daunting prospect. Historical energy consumption trends highlight the persistence of energy sources despite transitions (figure 1). Thus, while decarbonization is paramount, it must align with ongoing energy demands and address specialized fossil fuel applications.

Commodity investment opportunities

Considering these challenges, investments in commodities, particularly critical minerals including copper, are integral to the energy transition. Figures from the International Energy Agency underscore the significant mineral demand for renewable energy

Figure 2
Minerals used in various technologies



Source: International Energy Agency (2022), The Role of Critical Minerals in Clean Energy Transitions. License CC by 4.0.

technologies and electric vehicles (figure 2). Copper plays a pivotal role due to its electrical conductivity – an essential characteristic for renewable energy infrastructure. However, challenges like declining ore grades and geopolitical constraints underscore the imperative for sustainable mining practices and technological innovation to meet demand.

A transition to sustainable energy sources will require a substantial expansion of renewable energy infrastructure, in turn necessitating significant investment in critical minerals such as copper, lithium, and nickel. These minerals are essential components of renewable energy technologies, electric vehicles, and energy storage systems, and demand for them is projected to surge in the coming decades, driven by the global transition to clean energy. Investors can capitalize on this growing demand by strategically allocating funds to companies involved in mineral exploration, mining, and processing. When evaluating investment opportunities in commodities, however, it is essential to consider factors such as geopolitical risks, environmental sustainability, and technological advancements.

Geopolitical implications and supply chain risks

The energy transition introduces novel geopolitical dynamics and supply chain risks. For instance, critical minerals required for clean energy technologies are geographically concentrated, leading to concerns about resource nationalism and strategic tensions. For example, China dominates the production of rare earth elements crucial for wind turbines and electric vehicle batteries. This raises concerns about supply disruptions. Furthermore, the reliance on fossil fuels for the extraction, transportation, and processing of minerals highlights the interconnectedness of transitioning and existing energy systems. As such, diversification of supply sources and investment in sustainable mining practices are imperative to mitigate geopolitical and supply chain risks.

Technological innovation and resource efficiency

Furthermore, technological innovation is essential for overcoming the challenges of the energy transition and maximizing resource efficiency. Advanced mining techniques such as in-situ leaching and biomining hold out promise for reducing environmental impacts and improving resource recovery rates. Advancements in material science and recycling technologies can also enhance resource efficiency by minimizing waste and extending the lifespan of critical minerals. Moreover, digitalization and data analytics enable predictive maintenance and optimization of mining operations, which can enhance productivity and sustainability. Investments in research and development are thus crucial for driving technological innovation and ensuring the long-term sustainability of resource extraction.

Equity investments in energy transition

As the world grapples with the consequences of climate change, the role of equities in driving the energy transition has come into sharper focus. Equities offer a strategic avenue for investors to allocate capital towards companies at the forefront of sustainable practices and technologies.

On one hand, there is a growing consensus regarding the urgency of addressing climate change, which has catalyzed regulatory initiatives worldwide (figure 3). Governments and international organizations are enacting policies to mitigate carbon emissions and promote environmental sustainability. This regulatory environment has heightened scrutiny of carbon emissions

> “Critical minerals required for clean energy technologies are geographically concentrated.

Figure 3
Impact and likelihood of global risks (survey results) – top 10 risks
“Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period.”

Risk categories:
Economic Environmental Geopolitical Societal Technological

2-year period

1st	Cost of living crisis
2nd	Natural desasters and extreme weather events
3rd	Geoeconomic confrontation
4th	Failure to mitigate climate change
5th	Erosion of social cohesion and societal polarization
6th	Large-scale environmental damage incidents
7th	Failure of climate-change adaption
8th	Widespread cybercrime and cyber insecurity
9th	Natural resource crisis
10th	Large-scale involuntary migration

10-year period

1st	Failure to mitigate climate change
2nd	Failure of climate-change adaption
3rd	Natural desasters and extreme weather events
4th	Biodiversity loss and ecosystem collapse
5th	Large-scale involuntary migration
6th	Natural resource crisis
7th	Erosion of social cohesion and societal polarization
8th	Widespread cybercrime and cyber insecurity
9th	Geoeconomic confrontation
10th	Large-scale environmental damage incidents

Source: World Economic Forum, The Global Risks Report 2023.

and environmental impacts, compelling companies to prioritize sustainability and transition to cleaner energy sources.

Initiatives such as the US Inflation Reduction Act (IRA) and the European Green Deal underscore the significance of investments in clean energy and sustainable infrastructure. These policy frameworks aim to overcome the challenges associated with transitioning to renewable energy while stimulating economic growth and job creation. For investors, the alignment of regulatory imperatives with investment opportunities in renewable energy and sustainability-themed equities is increasingly evident, highlighting the importance of equity investments in advancing the energy transition agenda.

While the transition away from fossil fuels may not yield immediate results, the long-term vision emphasizes the inevitability of decarbonization. As the global economy shifts towards cleaner alternatives, fossil fuel companies face the risk of becoming stranded assets. Investors are thus reevaluating their portfolios to mitigate exposure to carbon-intensive industries and capitalize on emerging opportunities in renewable energy and sustainable technologies. And equity investments offer the flexibility and adaptability to navigate these evolving investor preferences and market dynamics.

With the transition to a low-carbon economy poised to disrupt traditional markets and reshape industry valuations, companies that embrace sustainability and innovation are positioned to thrive – while those reliant on fossil fuels may face declining valuations. This market dynamic demonstrates the importance of identifying transition leaders and adapting investment strategies to capitalize on evolving market trends. Through equity investments, investors are positioned to influence corporate behavior by engaging with companies and advocating for sustainable practices.

On the other hand, renewable energy presents significant growth opportunities for investors seeking exposure to transitioning energy markets. Massive investments in renewable technologies, coupled with consumer demand for sustainable solutions, are driving innovation and market expansion. Companies involved in solar, wind, and hydroelectric power, as well as electric vehicles, represent compelling investment opportunities in the transition to a low-carbon economy.

Equities will play a pivotal role in driving the energy transition by providing indirect financing to companies leading the charge towards sustainability. By investing in renewables and sustainability-themed equities, investors can lower the cost of capital for these companies and incentivize further innovation and expansion. Moreover, active engagement with companies will serve to influence corporate strategies and accelerate the transition to a sustainable future.

> “Equities will play a pivotal role in driving the energy transition.

Challenges and considerations for equity investments

Despite the compelling investment case for equities in the energy transition, several challenges and considerations merit attention. A key question for equity investors, for instance, is how to identify transition leaders. Identifying companies poised to

Figure 4
Common themes for energy transition investments

Energy & climate change
- Afforestation
- Bicycles
- Building materials from wood
- Electric engine
- Electric vehicle technology
- Electric vehicles
- Energy demand-side management
- Energy from waste
- Energy storage
- Fuel cell engine
- Green buildings
- Hybrid engine
- Hybrid vehicles
- Insulation materials
- LED
- Materials allowing energy efficiency
- Photocatalytic materials
- Renewable energy
- Renewable energy technology
- Smart grid
- Smart grid technology
- Smart meters
- Sustainably-sourced biofuel
- Transportation-sharing services

Responsible finance
- Green lending

Infrastructure
- Sustainable transportation

Water & sanitation
- Building materials allowing water efficiency
- Rainwater harvesting

Protection of ecosystems
- Services facilitating environmental progress
- Bio-based chemicals
- Recycling services
- Pollution abatement technology
- Contaminated site rehabilitation
- Organic fertilizers

Source: Invesco, Moody’s ESG Solutions. For illustrative proposes only.

The energy transition represents a monumental endeavor with profound implications for both commodities and equities.

lead the energy transition requires careful analysis and evaluation. Defining transition themes (see examples in figure 4) and identifying companies actively engaged in these areas can aid in identifying potential investment opportunities. Alternative approaches such as natural language processing (NLP) can offer insights into companies' future prospects as well as their commitment to sustainability.

Moreover, structural shifts such as technological advancements and emerging business models pose challenges when it comes to accurately identifying transition leaders. Companies that appear promising today may face obsolescence tomorrow due to rapid technological advancements. Investors must therefore remain vigilant and adapt their investment strategies to effectively navigate such uncertainties.

Finally, the energy transition may face setbacks that lead to market volatility and concerns about valuations. Companies operating in this space, particularly those in the nascent stages of development, may experience fluctuations in their stock prices. Investors need to consider these factors and adopt strategies to mitigate risks associated with market volatility.

Conclusion

The energy transition represents a monumental endeavor with profound implications for both commodities and equities. By understanding the regulatory landscape, market dynamics, and investment imperatives, stakeholders can strategically allocate capital towards companies dedicated to sustainable practices and technologies. Equities serve as catalysts for change, enabling investors to actively participate in the transition to a low-carbon economy while generating attractive returns and contributing to global sustainability goals. The complexities and investment opportunities inherent in this transition can help investors navigate the path towards a sustainable future. As the world confronts the urgent imperative of climate action, strategic investments in commodities and equities will be indispensable drivers of meaningful change and enable realization of the net-zero carbon future.

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World Economic Forum (2023): Global Risk Report

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Navigating momentum crashes in a trend-following strategy

By Mark Ahnrud, CFA®, Alexandar Cherkezov, CFA®, Scott Hixon, CFA® and Hua Tao, PhD, CFA®

Trend-following strategies are a well-established source of portfolio diversification, and have historically served to buffer losses in times of equity market stress. But sharp market rebounds after prolonged weakness (aka 'momentum crashes') can stand in the way of their success. We analyze ways of mitigating the impact of such setbacks to reduce maximum drawdowns and smooth returns.

Trend-following is very straightforward: Go long the winners and sell short the losers. Despite this simplicity, however, trend following has successfully delivered attractive results over extended periods. Hurst et al. (2017) provide significant out-of-sample evidence of how a trend-following strategy has worked consistently over the last roughly 140 years in different economic environments and across multiple asset classes, such as equities, bonds, commodities, and currencies.

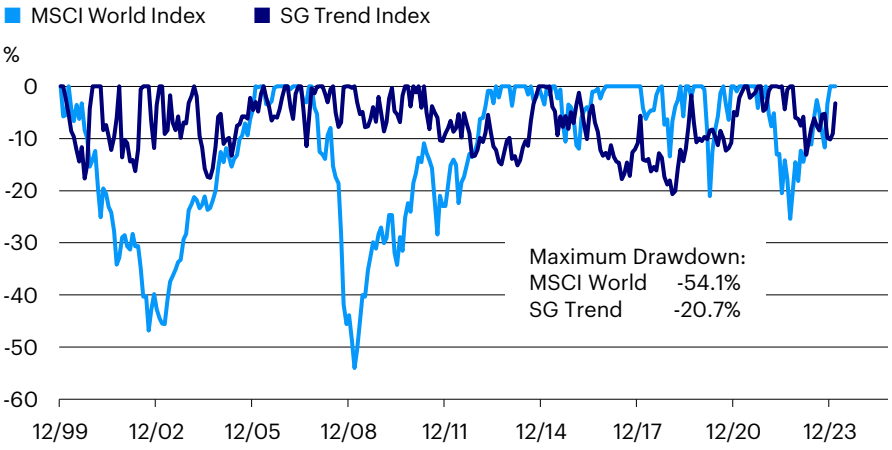
Available since December 31, 1999, the SG Trend Index (Bloomberg ticker NEIXCTAT) tracks the net daily return of ten trend-following commodity trading advisors (CTAs), showing live performance of managed futures strategies over the past 24 years. During that period, the SG Trend Index achieved higher returns with lower volatility than the MSCI World Index – and thus a higher Sharpe ratio (table 1).

Table 1
Trend-following in comparison

	MSCI World Index	SG Trend Index
Return p.a. (%)	5.49	5.90
Volatility p.a. (%)	15.70	13.55
Sharpe ratio	0.23	0.30
Cash rate (%)*	1.83	

Source: Bloomberg. Average cash rate: 1.83% (Bloomberg 3-Month US Treasury Bill Index); data from December 31, 1999 to February 29, 2024. **Past performance is not a guarantee of future results. An investment cannot be made in an index.**

Figure 1
Simulated drawdowns in comparison



Source: Bloomberg. Data from December 31, 1999 to February 29, 2024.

Since inception, the SG Trend Index has a modest negative correlation to the MSCI World Index (-0.09) and a significantly smaller maximum drawdown (figure 1). Additionally, with a near-zero correlation to the Bloomberg Barclays Global Aggregate Bond Index (0.02), an allocation to a trend-following managed futures strategy can enhance the risk/return profile of traditional multi-asset portfolios.

“

The success of trend-following strategies is often explained using various behavioral biases.

The success of trend-following strategies is often explained using various behavioral biases. According to Kahneman and Tversky (1974, 1979), anchoring leads to the underreaction of prices to the latest information. The disposition effect noted by Frazzini (2006) further slows the development of a trend as investors continue to respond to the news. And, herding behavior, as discussed by De Long et al. (1990), results in more investors jumping in, so that the trend becomes self-reinforcing. The profitability of investing based on a behavioral approach is confirmed by Jegadeesh and Titman (1993, 2001). Additionally, non-profit-seeking participants in financial markets, such as central banks and corporations executing hedging strategies can also contribute to persistent price trends.

Building a trend-following managed futures strategy

Despite the general success of trend-following strategies, occasional ‘momentum crashes’ – sharp market rebounds after a prolonged period of weakness – can stymie their success. To analyze this phenomenon and highlight possible ways of mitigating the consequences of a momentum crash, we have constructed a baseline simulation. Based on a simulation period from December 31, 1999 to February 29, 2024, our approach comprises four steps:

1. Defining the asset universe

When selecting assets for a trend-following managed futures strategy, three sometimes competing factors need to be considered: liquidity, trading costs, and diversification. While, in theory, maximum diversification is ideal, the high turnover of a strategy traded weekly requires thoughtful consideration of liquidity and trading costs. We evaluated a wide range of assets and included only those with a minimal difference between gross and net performance over the simulation period. As an example, based on the full bid/ask spread from daily transaction data, 10-year US Treasury futures and S&P 500 futures exhibited differences of only 18 and 34 bp, respectively, between gross and net returns. In contrast, live cattle futures and lean hog futures experienced 412 and 656 bp differences and were thus excluded. As a result, we selected fifty-one assets across equities (15), fixed income (14), commodities (15), and FX (7 pairs against the USD); table 2 shows our selection.

Table 2
Assets in our analysis

Equities (Ticker)	Fixed Income (Ticker)	Commodities (Ticker)	FX (Ticker)
Australia (XP1)	Australia 3yr (YM1)	Aluminum (BCC2LA0P)	AUD (AD1)
Canada (PT1)	Australia 10yr (XM1)	Copper (BCC2LP0P)	CAD (CD1)
Emerging Markets (MES1)	Canada 10yr (CN1)	Corn (BCC2CN0P)	CHF (SF1)
Euroland (VG1)	France 10yr (OAT1)	Gas Oil (BCC2GO0P)	EUR (EC1)
France (CF1)	Germany 2yr (DU1)	Gold (BCC2GC0P)	GBP (BP1)
Germany (GX1)	Germany 5yr (OE1)	Natural Gas (BCC2NG0P)	JPY (JY1)
Hong Kong (HI1)	Germany 10yr (RX1)	Brent Crude (BCC2CO0P)	NZD (NV1)
Italy (ST1)	Germany 30yr (UB1)	WTI Crude (BCC2CL0P)	
Japan (TP1)	Italy 10yr (IK1)	Heating Oil (BCC2HO0P)	
Netherlands (EO1)	UK 10yr (G)	Silver (BCC2SI0P)	
Spain (IB1)	US 2yr (TU1)	Soybeans (BCC2SO0P)	
Sweden (QC1)	US 5yr (FV1)	Soybean Oil (BCC2BO0P)	
UK (Z)	US 10yr (TY1)	Soy Meal (BCC2SM0P)	
US Large Cap (ES1)	US 30yr (US1)	Unleaded Gas (BCC2XB0P)	
US Small Cap (RTY1)		Wheat (BCC2WH0P)	

Source: Bloomberg.

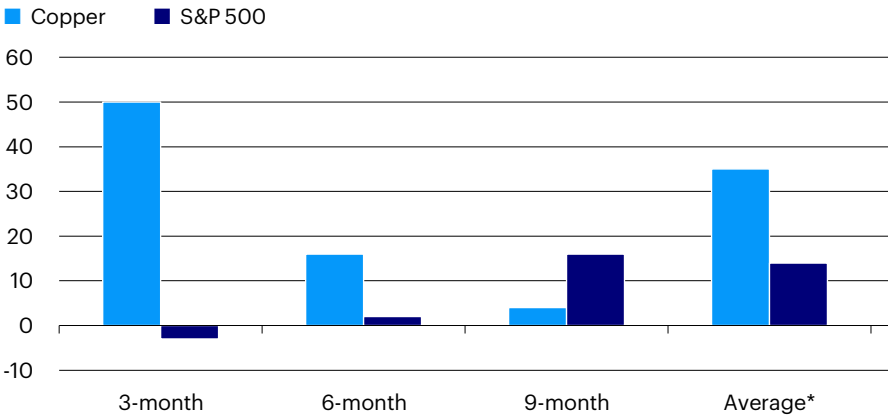
2. Choosing the lookback window

To determine the direction of the trend, today's asset price is compared with a price in the past. Signals based on different lookback windows react to market changes at different speeds. With a shorter window, the signal can adapt faster but may lead to whipsaws in choppy markets. A longer lookback window can avoid this but will react less quickly to changes in the direction of the trend. A single binary signal also results in positions that are 100% long (or short), which can create more turnover and unnecessary volatility.

A comparison of two assets over this simulated period provides a good illustration. Examining the S&P 500 over 3, 6, and 9-month lookback windows evidences higher Sharpe ratios for longer windows, since the index mostly rose over the simulation period. Copper, on the other hand, proved more volatile, resulting in better performance with a shorter lookback window (figure 2).

Due to the drawbacks of a single lookback window, we chose to average the signals from twelve windows varying from 1 to 12 months in length. This has a number of benefits: First, we get a more continuous signal, adding an element of risk management by reducing exposure when the individual signals are mixed while retaining maximum exposure when they align. Averaging the signals from 1 to 12 months also alleviates data mining biases that may arise from picking the best signal for each asset in the backtest. Importantly, averaging the signals retains the strategy's low correlation to the underlying asset (S&P 500 = 0.14, Copper = 0.07),

Figure 2
Sharpe ratio for different lookback periods



* Average is the average of 12 lookback windows from 1 to 12 months.
Source: Bloomberg. Data from December 31, 1999 to February 29, 2024.

Volatility scaling is essential.

confirming the diversification benefits of a trend-following managed futures strategy.

3. Volatility scaling

Volatility scaling is essential and happens in two distinct ways: To avoid risk imbalances, we first scale individual assets to 10% volatility using a one-year half-life, and average the signals thereafter. Averaging the positions before risk scaling the individual assets would lead to the riskier assets and asset classes dominating the portfolio. The second round of volatility scaling occurs by targeting 10% risk at theportfolio level. Beyond making the strategy flexible to target different volatility levels, this also improves risk-adjusted returns. Risk targeting results in larger positions in a low-risk environment and smaller positions when the general level of volatility increases. This helps to exploit the power of compounding – earning and losing 50%, for example, is not the same for consecutive geometric returns. Avoiding large losses has a substantial impact on the final portfolio value.

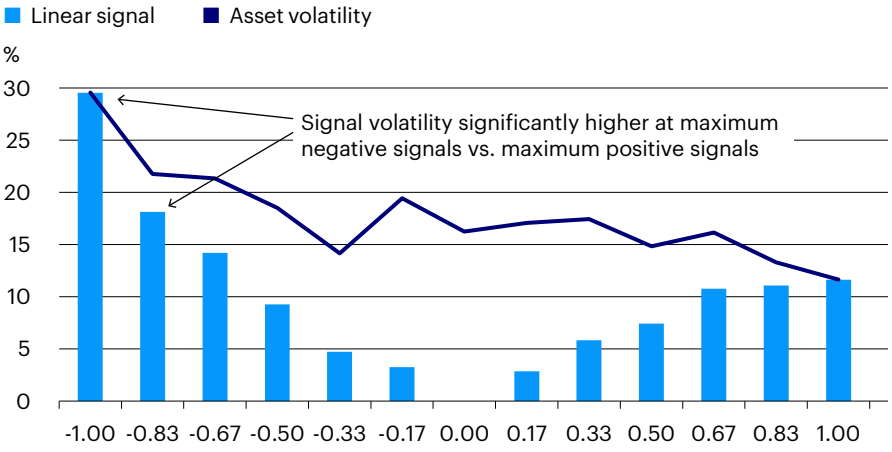
4. Signal mapping

For trend-following strategies, signals are used to determine two things: (1) position direction (long or short) and (2) position size. We use various binary signals, leading to a blended signal of -1 if all of them indicate a negative trend and a blended signal of +1 if all indicate a positive trend. Thus, our blended trend signal for each asset ranges from -1 to +1, with 13 distinct values.

Figure 3 groups asset volatility and returns by each of the possible trend signals. A blended signal of -1 indicates significant market stress, coinciding with a high volatility of both the signal and the S&P 500. For lower values, the blended signal is less volatile than the S&P 500 (or about as high for a value of +1). This mutes volatility in all but the most extreme observations.

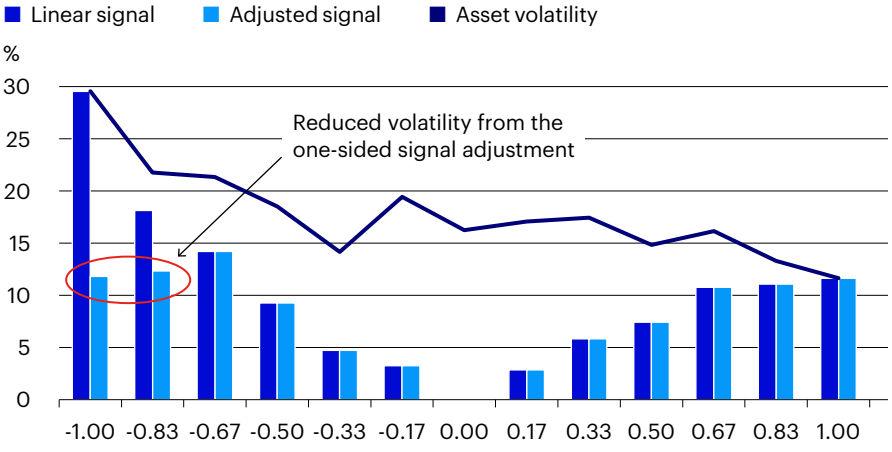
We find similar behavior across all the assets in our universe, reflecting the tail risk observed when an asset suffers a significant drawdown. As this example highlights, asset volatility is 2-3x higher for the lowest signal values than for the highest. This indicates that, even with

Figure 3
Simulated volatility in comparison: Trend signal and S&P 500



Source: Bloomberg. Data from December 31, 1999 to February 29, 2024.

Figure 4
Simulated volatility in comparison: Trend signal, adjusted trend signal and S&P 500



Source: Bloomberg. Data from December 31, 1999 to February 29, 2024.

Adjusting the signals in an extreme negative trend high volatility market environment can lead to a meaningful drawdown reduction.

asset and portfolio risk scaling combined with a blended trend signal, a momentum crash can still be a significant risk at these extreme signal values.

Navigating momentum crashes

Our trend-following managed futures simulation can suffer momentum crashes from abrupt price reversion after periods of market stress. While asset diversification helps to reduce the impact at the portfolio level, positive correlation across assets can aggravate it. This observation – in line with the literature on momentum crashes – leads us to seek improvements when signals are at negative extremes.

Given the heightened asset volatility when signals are the most negative, a one-sided adjustment can be applied to improve the asset and portfolio volatility scaling from our third step (figure 4). We prefer a one-sided adjustment since there are multiple small positive returns when all the signals are positive and market volatility is low, but a few big negative returns when they are negative. This is evident from the much smaller dispersion of returns when the signal is +1 relative to when it is -1, in addition to the imbalance in the number of observations.

After analizing many approaches, we settled on a simple linear adjustment. Overall, our signal adjustment looks like a checkmark with the most negative signals reduced towards zero (figure 5). Being mindful that portfolio risk targeting can increase extreme negative signal exposures, we apply portfolio risk targeting on the raw signal, then adjust position size based on the adjusted signals.

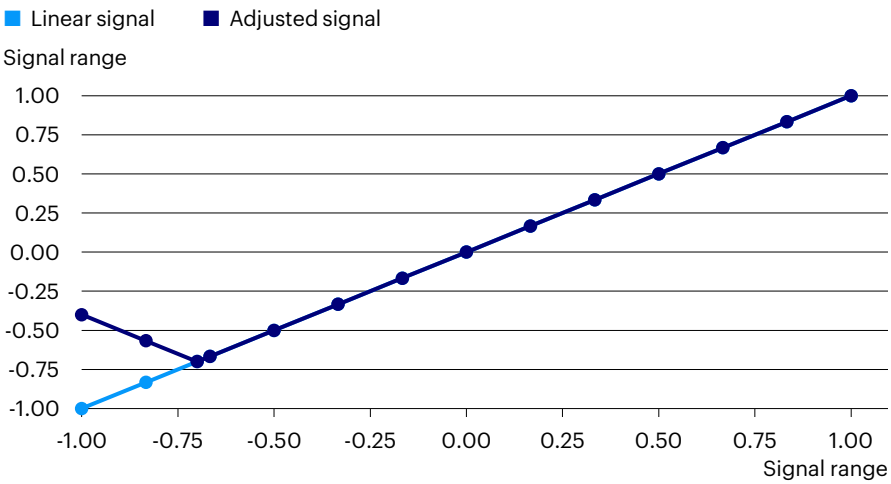
Evaluation of the approaches

In short, adjusting the signals in an extreme negative trend, high volatility market environment can lead to a meaningful drawdown reduction.

While both signal strategies lead to results considerably above those of the SG Trend Index, adjusting brings further improvements (table 3): The total return of the adjusted signal strategy is only modestly lower, the maximum drawdown is reduced from about 21% to about 13%, i.e., 40% less. Risk-adjusted returns and volatility also improve meaningfully.

In periods of momentum crashes, therefore, a blended signal combined with downside signal adjustment can serve to mitigate the negative impact of the market rebound. A one-sided signal adjustment may generate lower volatility and higher Sharpe ratios. Compared to the linear signal, the one-sided adjusted signal generates a more consistent return profile over time.

Figure 5
Linear and adjusted signal



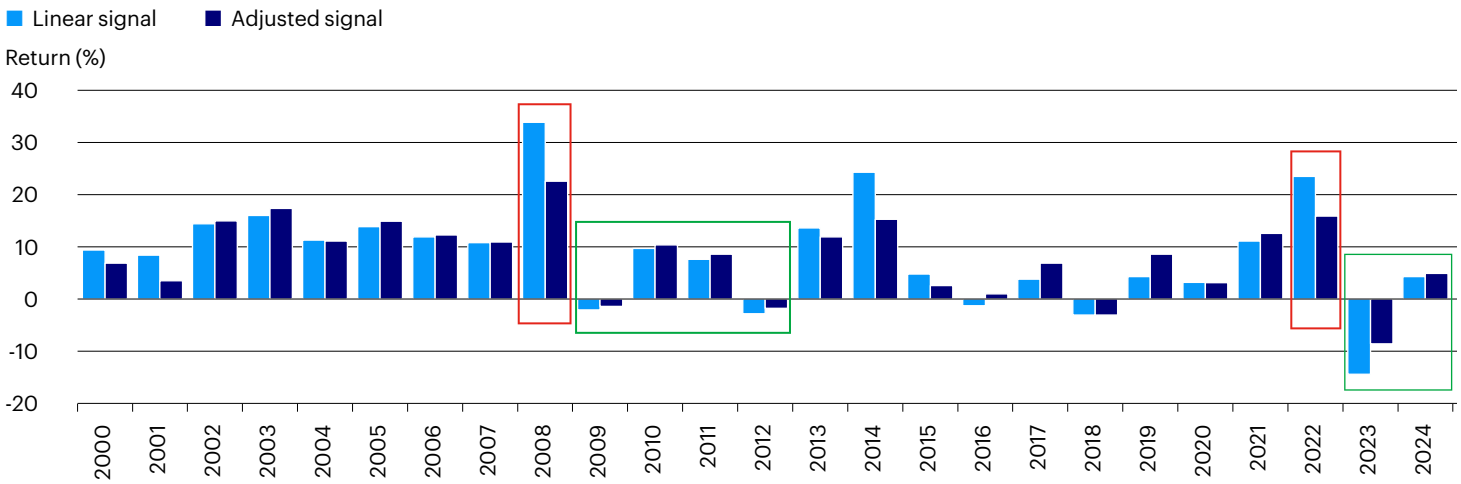
Source: Invesco analysis.

Table 3
Signal adjusting in comparison

	MSCI World	SG Trend Index	Linear signal	Adjusted signal
Return p.a. (%)	5.49	5.90	8.48	8.03
Volatility p.a. (%)	15.70	13.55	10.04	8.52
Sharpe ratio	0.23	0.30	0.66	0.73
Maximum drawdown (%)	-54.1	-20.7	-20.5	-12.8

Source: Bloomberg, Invesco analysis. **Past performance is not a guarantee of future results. An investment cannot be made in an index.**

Figure 6
Simulated annual return comparison



Source: Bloomberg, Invesco analysis. Data from December 31, 1999 to February 29, 2024. **There is no guarantee that the simulated performance will be achieved in the future.**

> A trend-following managed futures strategy can provide attractive return potential and diversification.

'Crisis alpha'

One-sided signal adjustment often results in better upside capture. But, since investors typically use trend-following managed futures strategies to mitigate losses in times of market stress, we also need to ask whether the adjustment causes downside mitigation properties to deteriorate.

Indeed, signal adjustment would have led to lower returns in 2008 and 2022 – but it still enabled sizeable positive returns. We do not believe the 'crisis alpha' property was materially changed. On the other hand, the linear trend-following strategy struggled in subsequent periods (2009-2012 and 2023-2024), whereas using the adjusted signal led to consistent outperformance. The adjustment works as a trade-off between a smoother ride overall and higher positive returns when markets persistently decline. Additionally, the adjustment ameliorates negative strategy returns (2009, 2012, 2016, and 2023).

Conclusion

A trend-following managed futures strategy can provide attractive return potential and diversification. But strategy parameters such as asset selection, binary or more continuous lookback signals, risk scaling, and signal mapping can have a material impact on the results. With the objective of smoother returns over a full market cycle and reduced drawdowns, this approach – with a dynamic adjustment of extreme negative signals – may mitigate losses in times of market stress and provide attractive risk-adjusted returns over time.

The performance results shown are hypothetical (not real) and were achieved by means of the retroactive application of the statistical model. It may not be possible to replicate the hypothetical results. The simulation is for informational and educational purposes only and is not an offer of any investment product.

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Investing sustainably, but with a low tracking error, in Euro treasuries

By Khanika Gadzhieva, Reed McDonnell, James Ong, CFA®, and Nancy Razzouk, CFA®

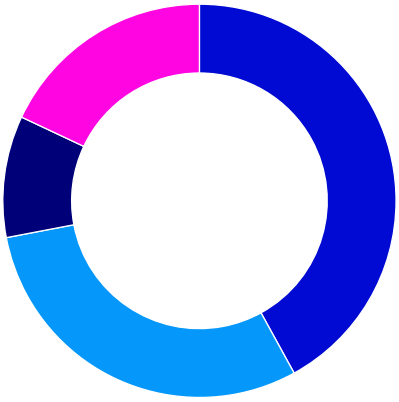
We propose a unique approach to incorporating environmental, social, and governance (ESG) objectives in a Euro treasury portfolio: maximizing the share of green bonds while minimizing tracking error to the Bloomberg Euro Aggregate Treasury Index. The method offers a risk profile similar to the benchmark, but with significantly better ESG characteristics.

Green bonds are fixed income securities that finance projects with environmental benefits, including large-scale initiatives aimed at mitigating climate change or promoting sustainability. Structurally similar to traditional bonds, green bonds can be issued by central governments (treasuries) as well as government-related entities such as local authorities, agencies, or intergovernmental organizations.

In the euro area, 58% of all green bonds, by market value, are issued by government-related issuers – and only 42% by central governments (figures 1 and 2). Non-treasury, government-related issuers include large, well-known agencies and supranationals such as the European Union, the European Investment Bank (EIB), and the German state-owned development bank KfW. All three rank among the top five issuers, closely behind France and Germany.

Figure 1
Composition of the Euro green bond market (by market value)
58% of green bonds are government-related

Treasuries	42%
Agency	30%
Local Authority	10%
Supranational	18%



Source: Bloomberg L.P., Invesco. Data as of February 29, 2024.
Green bonds as included in the treasury and government-related bonds segment of the Bloomberg Euro Aggregate Index.

Figure 2
Two examples of green bond-financed projects

Federal Republic of Germany
Green Bond Framework by the Federal Republic of Germany

- **Total amount allocated:** 14.6 bn EUR in 2022
- **Example of disbursement:** Research and innovation project investigates how to compensate for fluctuations in electricity supply related to the increasing share of renewable energies. The project is conducted by SynErgie, a Kopernikus Project in cooperation with industrial partners.

European Investment Bank (EIB)
Climate Awareness Bond Framework by the European Investment Bank

- **Total amount allocated:** 12.7 bn EUR in 2022
- **Example of disbursement:** Investments in the energy-efficient modernization of office buildings and the construction of nearly-zero energy buildings (NZEB). The project contributes to the reduction of energy use and greenhouse gas (GHG) emissions as well as the promotion of the concept of energy building standards in Spain.

Source: German Federal Agency of Finance (Green Bond Project Allocations), European Investment Bank (Climate Awareness Bond Allocations).

> We must be aware of the different risk profiles of green and traditional bonds.

> The median duration of Euro green treasuries is nearly twice as long as that of their non-green counterparts.

Green treasuries are different, and so are green government-related bonds

The Bloomberg Euro Aggregate Treasury Index, which is used by the largest index-based ETFs, consists of bonds issued by eurozone governments with at least a one-year maturity. On February 29, 2024, green treasuries represented only 2.6% of its total market value of EUR 7.4 billion, suggesting significant potential for expansion. To understand the risks of increasing the green bond share of a portfolio tracking this index, we must be aware of the different risk profiles of green and traditional bonds.

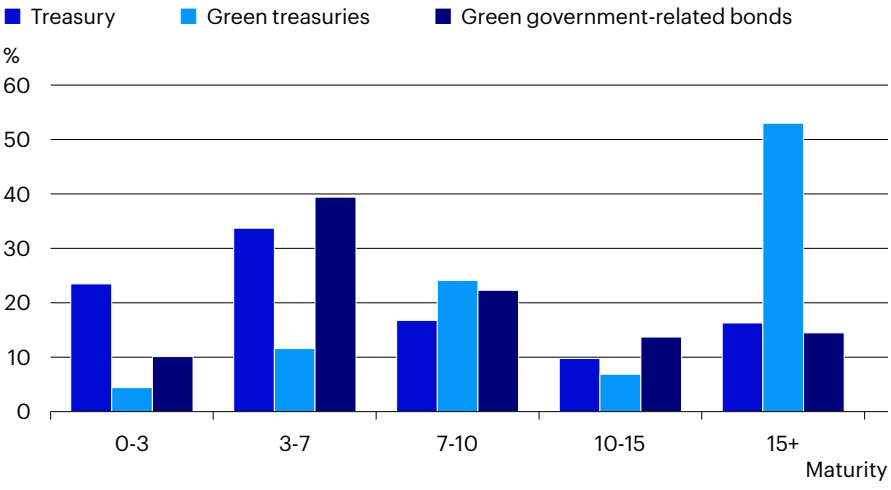
Duration, or interest rate risk, is the predominant performance driver, accounting for about 84% of the index return.[1] However, at 12.5 years, the median duration of Euro green treasuries is nearly twice as long as that of their non-green counterparts (6.8 years).[2] Figure 3 shows that over half the green bond market has a maturity of more than 15 years. Including more green treasuries therefore leads to a higher duration risk.

Country of issuance is another risk factor. Economic, political, or financial instability in a particular country can impact the performance of its bonds, making country exposure an important consideration. Although the country distribution of traditional and green treasuries is largely similar, the median duration of green treasuries is significantly higher in all countries (figure 4). This is particularly relevant for countries with small index weights, as adding a meaningful number of green treasuries would disproportionately increase these countries' duration contribution and drive up the tracking error.

Government-related green bonds, however, may allow for more effective duration management, as their median durations deviate less from those of traditional treasuries and they offer better diversification due to a greater variety of maturities.

Moreover, it is important to consider that the composition of the green bond market

Figure 3
Euro government bonds by maturity bucket



Source: Bloomberg Euro Aggregate Treasury Index as of February 29, 2024.

Figure 2
Two examples of green bond-financed projects

	Country Weights			Median OAD		
	Traditional treasuries	Green treasuries	Green government-related bonds	Traditional treasuries	Green treasuries	Green government-related bonds
France	24.0%	25.8%	16.5%	7.9	17.3	7.8
Italy	21.8%	16.4%	3.4%	5.7	8.9	4.6
Germany	18.5%	25.8%	21.9%	5.4	7.4	4.9
Spain	14.2%	4.0%	2.6%	6.6	16.1	3.9
Belgium	5.2%	8.1%	1.3%	8.7	10.3	7.3
Netherlands	4.4%	9.8%	10.6%	7.6	14.9	6
Austria	3.5%	5.0%	0.6%	7.9	11.9	2.3
Ireland	1.7%	5.2%	0.5%	8	10.7	9.4
Other	6.7%	0.0%	42.6%	–	–	–
Total	**100.0%**	**100.0%**	**100.0%**	**6.8**	**12.5**	**5.2**

Source: Bloomberg L.P., Invesco. Data as of February 29, 2024. Figures refer to the subsegments of the Bloomberg Euro Aggregate Index. "Other" refers to countries which do not issue green treasuries. Due to rounding, figures may not add up to 100%.

changes over time. Initially, almost all green bonds were issued by government-related entities, with sovereign issuers entering only later.[3] Here again, incorporating government-related issuers helps better account for the dynamic nature of the green bond market.

How would a pure green treasury index have performed?

Before creating an ESG strategy that minimizes tracking error against the benchmark, we first need to consider a portfolio consisting only of green treasuries, with no risk controls. As mentioned, green treasuries have a higher average duration than the index. Thus, a simple strategy tracking a pure green bond index (such as the iBoxx EUR Eurozone Sovereigns Green Bonds Capped Index or the Solactive Euro Government Green Bond Index) would diverge when interest rates change. As figure 5 shows, this has been especially true since 2022, when interest rates began to increase dramatically. In the three years from February 2021 to February 2024, market value-weighted green treasuries returned -26.7% compared to -15.0% for the benchmark index, resulting in a sizable tracking error (p.a.) of 6%.[4]

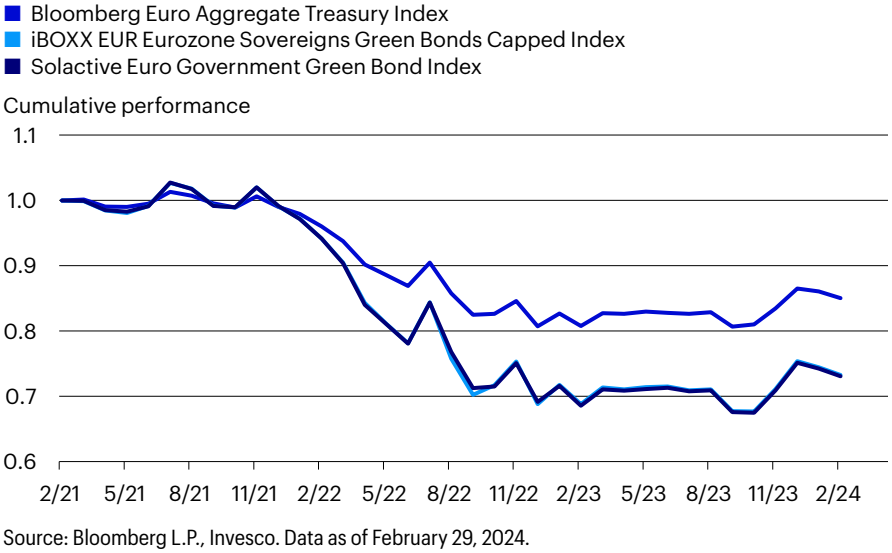
In the next section we present a simple index-based approach for reducing tracking error.

Tracking error reduction I: simple index-based approach

The first method we use to reduce tracking error begins by dividing the EUR treasury index into buckets, based on country of issuance and maturity. Then, we increase the weight of green treasuries in each bucket while keeping the weight of the buckets constant. Within this framework, the overall green treasury allocation is increased in increments of 10 percentage points.

Figure 6 shows that a 10% green treasury allocation leads to country weights in line

Figure 5
Performance in comparison



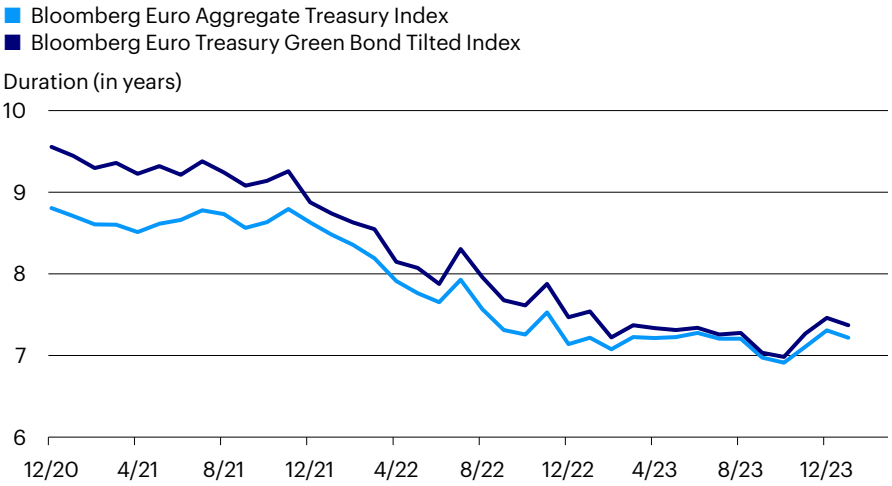
Source: Bloomberg L.P., Invesco. Data as of February 29, 2024.

Figure 6
Simulated characteristics of a simple green treasury-tilted strategy

Target green bond share	10.0%				20.0%				30.0%				40.0%			
Achieved green bond share	10.0%				19.9%				29.3%				37.9%			
	Wgt (%)	New Wgt (%)	OAD	New OAD	Wgt (%)	New Wgt (%)	OAD	New OAD	Wgt (%)	New Wgt (%)	OAD	New OAD	Wgt (%)	New Wgt (%)	OAD	New OAD
	100.0	100.0	7.28	7.21	100.0	100.0	7.28	7.20	100.0	100.0	7.28	7.33	100.0	100.0	7.28	7.49
France	23.9	23.9	1.79	1.73	23.9	24.2	1.79	1.72	23.9	24.6	1.79	1.82	23.9	24.5	1.79	1.87
Italy	21.8	21.8	1.40	1.40	21.8	21.7	1.40	1.39	21.8	21.3	1.40	1.37	21.8	21.5	1.40	1.41
Germany	18.5	18.5	1.36	1.38	18.5	18.4	1.36	1.42	18.5	18.1	1.36	1.45	18.5	18.5	1.36	1.55
Spain	14.2	14.2	0.99	0.99	14.2	14.1	0.99	0.99	14.2	13.9	0.99	0.97	14.2	13.5	0.99	0.95
Belgium	5.2	5.2	0.46	0.45	5.2	5.2	0.46	0.44	5.2	5.4	0.46	0.43	5.2	5.4	0.46	0.40
Netherlands	4.4	4.4	0.36	0.34	4.4	4.4	0.36	0.35	4.4	4.5	0.36	0.37	4.4	4.5	0.36	0.38
Austria	3.5	3.5	0.31	0.30	3.5	3.5	0.31	0.28	3.5	3.6	0.31	0.31	3.5	3.6	0.31	0.32
Portugal	2.0	2.0	0.14	0.14	2.0	2.0	0.14	0.13	2.0	2.0	0.14	0.13	2.0	1.9	0.14	0.13
Ireland	1.7	1.7	0.13	0.13	1.7	1.7	0.13	0.14	1.7	1.9	0.13	0.15	1.7	2.0	0.13	0.16
Finland	1.5	1.5	0.12	0.12	1.5	1.5	0.12	0.12	1.5	1.5	0.12	0.11	1.5	1.5	0.12	0.11

Source: Bloomberg L.P., Invesco. Data as of February 29, 2024.

Figure 7
Duration differences between a traditional index and one with a 30% green bond tilt



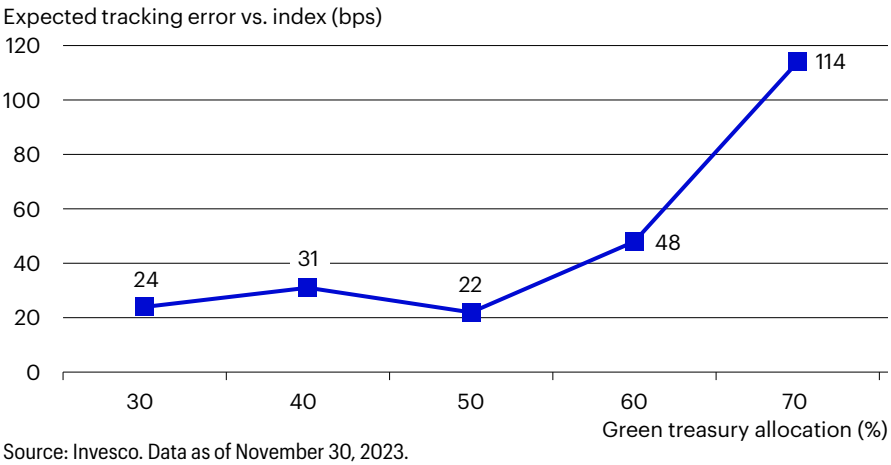
Source: Bloomberg L.P., Invesco. Data from December 31, 2020 to January 31, 2024. **Past performance does not guarantee future results. An investment cannot be made directly in an index.**

with the index. But the duration contribution of France is noticeably lower, making the overall duration of the strategy lower than that of the index. Beyond 10%, country weights start diverging from the index and at the same time it becomes more difficult to maintain the desired green allocation. With a 29% green treasury allocation, the overall duration of the strategy comes closest to the index duration. Clearly, a simple index-based approach that tilts to green treasuries within risk buckets fails to deliver a constant green treasury allocation with consistent country and interest rate risk exposures.

Furthermore, the quality of the results can vary over time as the composition of the green bond market evolves. This is evidenced by the Bloomberg Euro Treasury Green Bond Tilted Index, which seeks to maintain a 30% allocation to green bonds while controlling for country weights. Despite the consideration of duration exposures, the primary objective remains focused on green treasury and country allocations by market value. Consequently, when the trade-off between maintaining a 30% green bond share and managing duration exposures cannot be resolved, the strategy tends to compromise on its duration exposure, as shown in figure 7.

These results show a conflict between significantly increasing the green bond share and aligning the portfolio's duration with the index, both at the country level and overall. This is important since duration, or interest rate risk, is the primary driver of risk in a government bond strategy and aligning country exposures based solely on market value is not sufficient to address these risks. Therefore, our strategy puts particular emphasis on managing duration exposures while significantly increasing the green bond share.

Figure 8
Expected tracking error of different green treasury allocations



Source: Invesco. Data as of November 30, 2023.

> A more sophisticated approach is required.

Tracking Error reduction II: active systematic approach

Given these drawbacks, a more sophisticated approach is required. An active, systematic strategy aimed at creating a portfolio that maximizes green bond allocation while effectively managing the primary risk drivers may be the answer. The proposed approach differs from an index-based approach in two important ways: (1) controlled key risk drivers and (2) the use of government-related green bonds.

Controlling key risk drivers

Our systematic approach aims first to manage the main risk drivers in the Euro treasury market, defined by the country of issuance and the duration curve. This strategy applies tight controls on aggregate duration and aims to minimize deviations along the curve. The country allocation, meanwhile, is not constrained to track the index as closely as in the index-based approach. Although country allocation and country duration contributions are controlled, the constraints are more relaxed.

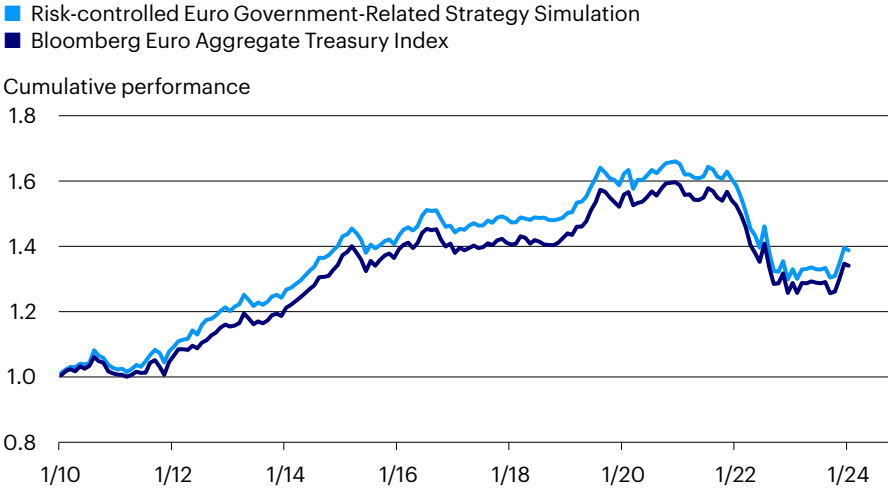
To determine the desired level of green treasury allocation, we run several optimizations, adding 10 percentage points with each iteration while matching the risk characteristics according to the method described above. We observe that, with a green treasury allocation of more than 50%, the expected active risk increases significantly, as shown in figure 8.

Therefore, through the first element of our approach, we can increase the green bond share to 50% using green treasuries only.

Incorporating green government-related bonds

But remember that there are only a few green treasuries, with large issue amounts and long durations, but far more government-related green bonds, with

Figure 9
Simulated performance of a risk-controlled Euro government-related strategy vs. the Bloomberg Euro Aggregate Treasury Index
Cumulative performance of a simulated EUR-denominated government-related bond strategy that targets the interest rate and credit risk of the Bloomberg Euro Aggregate Treasury Index



Source: Bloomberg L.P., Invesco. Data from January 31, 2010 to January 31, 2024. **There is no guarantee that the simulated performance will be achieved in the future.**

Green bonds are the best way to integrate investor sustainability preferences in Euro treasuries.

shorter durations on average. Adding these significantly expands our opportunity set. This distinguishes our concept from a passive or index-based approach and helps investors achieve the two goals of attaining the desired green bond share and matching the main risk characteristics of the index.

We now allocate up to 10% to European government-related green bonds. The interest rate and country risk controls described above are still effective since the main risk driver of government-related bonds is also duration risk. In fact, government-related bonds closely align with the EUR treasury bond index when controlled for duration and spread risk as shown in figure 9.

Adding government-related green bonds with effective risk controls helps diversify the opportunity set and allows investors to maintain high levels of green bond exposure without subjecting the strategy to undesired risks. The proposed systematic portfolio construction strategy, coupled with the active management of the green bond allocation and related risk imbalances, helps achieve a consistently high green bond share while matching the risk characteristics of the index.

Summary

We believe green bonds are the best way to integrate investor sustainability preferences in Euro treasuries. However, sustainability-minded investors seeking to avoid excessive risks compared to a passive replication of the Bloomberg Euro Aggregate Treasury Index will likely face several challenges given the features of the European green bond market – namely the longer duration of green bonds, which increases their interest rate risk, and the prevalence of government-related green bonds, which are not part of the index. Moreover, the structure of the green bond market varies over time, meaning that sector and maturity compositions change as the market evolves.

All this adds to the problem of how to increase a portfolio's green bond share while controlling risk. Index-based approaches seem poorly suited to solve this multidimensional problem, so that investors seeking to increase their green bond allocations with low tracking error against the index may be better served by an active and systematic approach – systematic, to deal with the multidimensionality of the problem, and active, to accommodate the dynamic nature of the green bond market.

Notes

1 The total return of the Bloomberg Euro Aggregate Treasury Index was regressed on the duration component of total return. Bloomberg data from Jan. 1, 2000 to Feb. 29, 2024.
2 Bloomberg, as of February 29, 2024.
3 Baker et al. (2018).
4 Source: Invesco. February 28, 2021 – February 29, 2024.

The performance results shown are hypothetical (not real) and were achieved by means of the retroactive application of the statistical model. It may not be possible to replicate the hypothetical results. The simulation is for informational and educational purposes only and is not an offer of any investment product.

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How value recovery instruments (VRIs) can play a positive role in sovereign debt restructurings

By H. Daniel Phillips

In the context of sovereign debt restructurings, VRIs have become increasingly prevalent. We view them as a potentially valuable tool for Eurobond investors to recoup some losses in the event of a sovereign debt default. However, there is still room for improvement in several elements of their design and implementation.

When Suriname completed its Eurobond restructuring in late-2023, bondholders exchanged two traditional bonds for two new bonds. One of them looked much like the original two, while the other offered a range of potential cash flows based on the timing and size of the country's future oil production.

The second bond was a so-called value recovery instrument (VRI),[1] which is not an entirely new idea. Similar instruments have long been issued to help bondholders preserve their original capital. In recent sovereign debt restructurings, however, they have been used more often, and they will probably also play a role in the upcoming restructurings in Ghana, Sri Lanka, and Zambia. If investor demand for Suriname's VRIs is any indication, appetite for them is strong, and we welcome the continued refining and reintroduction of these innovative instruments.

When a sovereign debt restructuring takes place, bondholders traditionally receive new bonds, with fixed cash flows even when the economic and political situation is in flux. But in the case of VRIs, investors' cash flow depends at least in part on the evolving facts on the ground. This makes them an effective way to capture financial upside if economic conditions turn out better than expected at the time of restructuring.

Aligning incentives between bondholders and issuers

Suriname has been producing oil for decades. However, it was not until massive deposits were found offshore in neighboring Guyana that the current oil bonanza began. Suriname borrowed on the Eurobond market in 2016, partly to recapitalize its state-owned oil company and make it more capable of managing the expected boom. At the same time, the country borrowed from development banks, the International Monetary Fund (IMF), the Chinese government, and local banks – ultimately bringing public debt to unsustainable levels. Not all of this money was well spent, and when Suriname eventually defaulted in late 2020, it set about restructuring some USD 675 million in Eurobonds.[2] These bonds made up a substantial portion of the country's debt load, which totaled 148% of GDP.[3]

The country insisted that its debt stock was too large and, after years of difficult negotiations, it agreed with bondholders on a haircut on the original principal owed. In exchange, the bondholders received a new bond that looked much like the old ones – along with a VRI.[4]

The cash payout of the VRI depends on multinational oil companies' successful exploitation of Suriname's immense, newly discovered oil reserves. The bondholders argued – successfully – that giving the country a steep discount on its original debt to make its new debt sustainable under prevailing economic forecasts was fair. However, in the high likelihood that this transformational amount of oil production dramatically improved economic outcomes, bondholders believed that a VRI should help compensate them for their earlier haircut with part of this newly materialized wealth.

In our view, this arrangement better aligns Suriname's incentives with those of its bondholders. Suriname wants the massive amount of financial gain that comes with being a substantial oil exporter, while bondholders want to recover their initial loan. If Suriname achieves its target oil production, bondholders will be paid more. If it doesn't, bondholders will receive no additional compensation. A final investment decision by the international oil companies is due later this year, and the first cash that Suriname would see from oil sales would not be available until 2028. Any number of things could delay or halt the production of oil and reduce the likelihood or timing of VRI payments, but bondholders seem happy to hold them nonetheless.

Figure 1 shows the price of each instrument since debt restructuring. The price of the VRI is up 89% since the restructuring, while the more traditional bond is worth only 8% more, suggesting that investors see potential value in Suriname's future oil revenues.

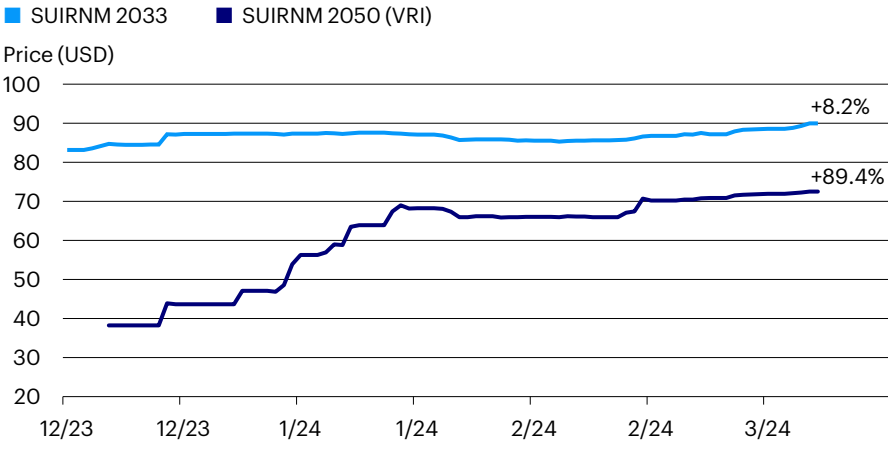
The increasing popularity of capturing potential future gains

The IMF has played a dominant role in almost all sovereign Eurobond restructurings. In a typical scenario, a country runs into balance of payment problems and finds itself without the hard currency needed to service its debts. With no available market financing, the IMF typically steps in to provide an emergency loan with conditions attached. Usually, the conditions involve a host of reforms designed to prevent future crises and the restructuring of existing debts to free up cash in the near term. The newly restructured debt must conform to the IMF's economic and financial projections for the country or the IMF will stop disbursing its emergency support. This has long been problematic for bondholders, as it leaves potential debt repayment on the table by locking in future cash flows.

But the IMF's projections often prove pessimistic. If, for instance, the IMF limits external debt service to a certain percentage of projected GDP, and a new bond is negotiated and issued based on those projections, this locks in a fixed

> The price of the VRI is up 89% since the restructuring, while the more traditional bond is worth only 8% more.

Figure 1
Suriname sovereign bond prices since restructuring



Source: Bloomberg L.P. Data from December 8, 2023 to March 7, 2024.

payment based on an uncertain economic indicator – sometimes 10-15 years into the future. If the country's growth recovers faster than anticipated, it could end up with a larger discount on its original debt than it legitimately needed.

Like Suriname, Zambia is currently considering a VRI to restructure its debt. The proposal, not yet sanctioned by Zambia's bilateral creditors (China, France, etc.), includes two bonds as well. One is fairly commonplace and the other is a VRI. The VRI would feature both substantially higher interest rates and earlier maturities if either (i) the IMF increases Zambia's Composite Indicator[5] past a certain threshold or (ii) the following two conditions hold: the three-year rolling average of Zambia's US dollar exports (largely copper) and the US dollar-equivalent of government revenues exceed the IMF's July 2023 projections.

Two other countries currently negotiating Eurobond restructurings, Sri Lanka and Ghana, are also discussing VRIs as a way to compensate bondholders for possible principal haircuts.

Old idea, new design?

Markets tend to shun instruments like VRIs when offered outside of a restructuring scenario because of the complexities involved in price discovery and the novel nature of the underlying contract language. Some older, local currency-denominated versions called 'state-contingent instruments', such as France's infamous Le Giscard bonds,[6] or external bonds issued by small island states that reduce or extend cash flows in the event of a natural disaster,[7] can in some ways be seen as a predecessor.

We focus here on upside VRIs that have emerged from recent Eurobond restructurings – including their potential benefits and risks. Since 2000, Argentina, Ukraine, and Greece have issued VRIs alongside more traditional bonds when exiting restructurings of their Eurobond debt. In each case, bondholders saw VRIs as the "least bad" option for recovering their initial investments. Each country's VRI differed regarding its payment triggers and legal language, and each presented its own unique problems.

During the Greek debt crisis of 2011-12, bondholders were vulnerable given the broader political questions at play surrounding the unity and future of the eurozone. The enormous debt load Greece had accumulated – coupled with the broad implications for the stability of the eurozone and thus the involvement of powerful institutions such as the European Central Bank, the IMF, and the European Commission (the so-called 'troika') – resulted in a harsh restructuring for bondholders. In exchange for deep haircuts, they received VRIs in the form of GDP warrants designed to pay only if the country ended up growing faster than anticipated at the time of the restructuring. However, high hurdles for growth meant that the complex pay-out formula[8] seemed unlikely to trigger, leaving the warrants for years with little value in the secondary market and thus offering minimal value to the original bondholders.

Almost the opposite happened in Ukraine in 2015, when a densely concentrated creditor group – many of whom were spooked by the Greek restructuring only a few years prior – pushed for warrant targets that were easier to meet and had uncapped payouts. Once the triggering of these payments seemed like a real possibility, worries mounted that the payments would become a substantial drag on Ukraine's debt sustainability. The war in 2022 made the issue moot by making a restructuring all but inevitable, but the criticisms of those warrants began well before Russian tanks rolled over Ukraine's border.

In Argentina in 2005, GDP warrants emerged as a component of that country's sovereign restructuring package. However, the country's government eventually unilaterally changed the way it calculated certain official statistics that the bond contract relied upon to determine the payment size and timing. Litigation over this methodological change and its warrant payment implications continues to this day.

Each of these previous warrants presented different problems and attracted different criticisms, but the new class of warrants in Suriname and elsewhere have sought to address these issues.

Potential issues ahead

We believe VRIs have the potential to be useful elements in future debt restructurings. But there are several impediments that could delay the design improvements needed to help establish them as accepted elements of a restructuring.

First, the IMF seems to want a greater say in their design and implementation, which could add a third party to debt negotiations in addition to the debtor country and bondholders. While the IMF's stewardship of the restructuring process is welcomed by everyone, their processes can be opaque, lengthy, and seemingly arbitrary to bondholders.

Second, despite advances in how these instruments are currently structured (such as enhanced data verification by independent third parties, increased clarity on the relevant triggering formulas, caps to prevent payouts perceived as egregious, etc.), there will likely still be concerns about data and definitions. Unfortunately, until a standard set of practices emerges, it seems that potential mistakes and disagreements are likely unavoidable and can only be addressed by clarifying language in each subsequent VRIs.

Since 2000, Argentina, Ukraine, and Greece have issued VRIs.

> The successful cases will establish a precedent for fairer and more universally accepted instruments.

Third, difficulty pricing these option-like instruments and the inability of certain fixed income funds to hold them mean that they will likely enjoy less liquidity in the secondary market than traditional bonds.

Conclusion: The future of VRIs

The potential for VRIs to make investors whole after a haircut to their principal is clearly positive, but we believe investors should be very aware of some of the risks involved. For instance, these instruments are not eligible for inclusion in indices and can be difficult to price, causing liquidity to be low and risk premia high. Moreover, we emphasize the importance of being thoroughly informed about the specific triggering and payment characteristics of each bond and recognizing their potential risks. As time goes by, we believe the successful cases will establish a precedent for fairer and more universally accepted instruments, substantially reducing these two risks. The broader adoption and standardization of VRIs is thus valuable, as they provide another tool that can allow investors to help distressed countries restructure in a sustainable way while retaining potential upside for bondholders in a more positive scenario.

Notes

1 VRIs are also referred to as state-contingent debt instruments (SCDIs), as the cash flows are contingent on certain future developments, or 'states'.
2 Source: IMF (2021).
3 Ibid
4 At the time of default, Suriname had issued 2023 bonds at 9.875% and 2026 bonds at 9.25%. For each bond investors held, the final restructuring terms in November 2023 offered bondholders one new 2033 bond (a 7.95% cash coupon with 14 equal amortizations starting in 2027) and one VRI bond. The VRI stipulates that, once Suriname has earned USD 100 million from oil proceeds, the VRI bonds receive 30% of royalties thereafter, or 6.25% of overall revenues from a specified oil concession. To encourage repayment, the VRI grows at 9% annually until it is paid off, but its size is capped at 2.5 times the size of the initial VRI.
5 The Composite Indicator incorporates a decade of macroeconomic indicators and assessments of a country's institutional strength and capacity. The score determines a country's debt-carrying capacity as judged by the IMF. The higher the score, the more debt a country is deemed capable of carrying.
6 In 1973, French Finance Minister Valery Giscard d'Estaing devised and sold 'Le Giscard' bonds that carried a 7% coupon but included safeguard clauses stating that, if the French franc ever dropped its peg against a basket of gold and other currencies, the coupon and principal would then be linked to the price of gold. Eventually, the franc was floated and the price of gold rallied. By 1980, the government was paying 40% interest on the original principal, and the principal due at maturity was more than six times the amount initially raised.
7 In 2004, Hurricane Ivan inflicted damage on the small island nation of Grenada equivalent to 200% of GDP and even rendered the Prime Minister homeless for a brief period. Eventually the restructured Eurobond debt included a catastrophe clause that would lead to a moratorium on payments in the event of another major hurricane. Barbados followed suit in 2019.
8 The IMF summary of payment triggers: "These warrants are again characterized by three rules: (i) a level condition: nominal GDP must exceed a base case nominal GDP specified to be a certain value from 2014 to 2020, then equal to the 2020 value; (ii) a growth condition: the real GDP growth rate must exceed the baseline growth rate; (iii) a cap: 1% of the nominal value of the original instrument. Payout then equals a notional amount that decreases each year multiplied by 1.5 times the difference between the real growth rate in that year and a baseline growth rate."

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