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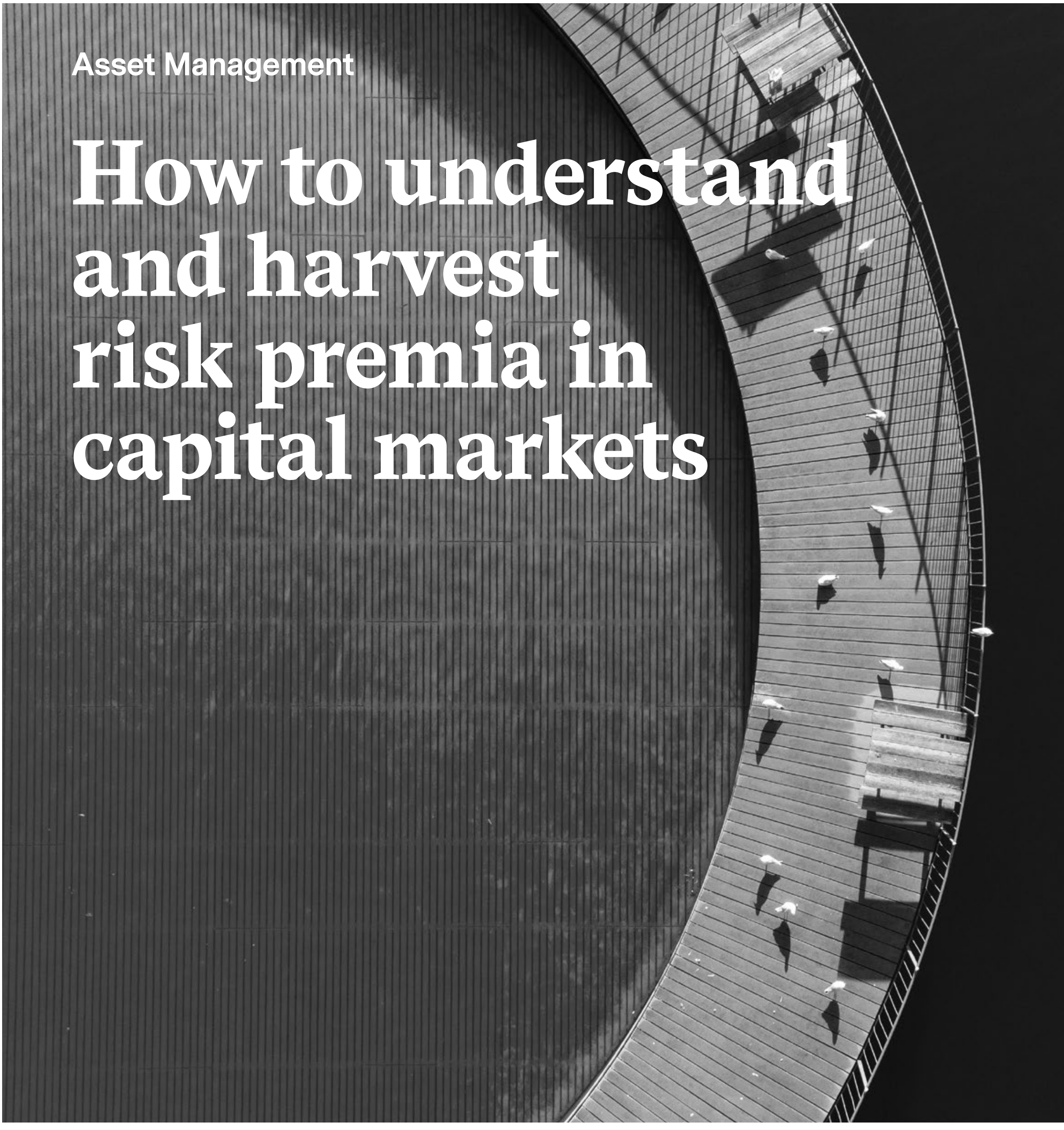

Asset Management

How to understand and harvest risk premia in capital markets

For institutional investors only
February 2018

About the author

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Daniel Seiler heads the Multi Asset Boutique at Vontobel Asset Management. In this role, he oversees systematic and fundamental investment solutions, which are offered by the Vescore and Vontobel brands respectively. He is responsible for the investment processes, driving innovation in product development and managing the investment teams.

Previously, from 2017 to 2018, he was Head of Vescore, the quantitative investing franchise of Vontobel Asset Management. Daniel Seiler became Chief Investment Officer at Vescore Solutions AG in 2009 and was instrumental in operating the company's portfolio and investment management division.

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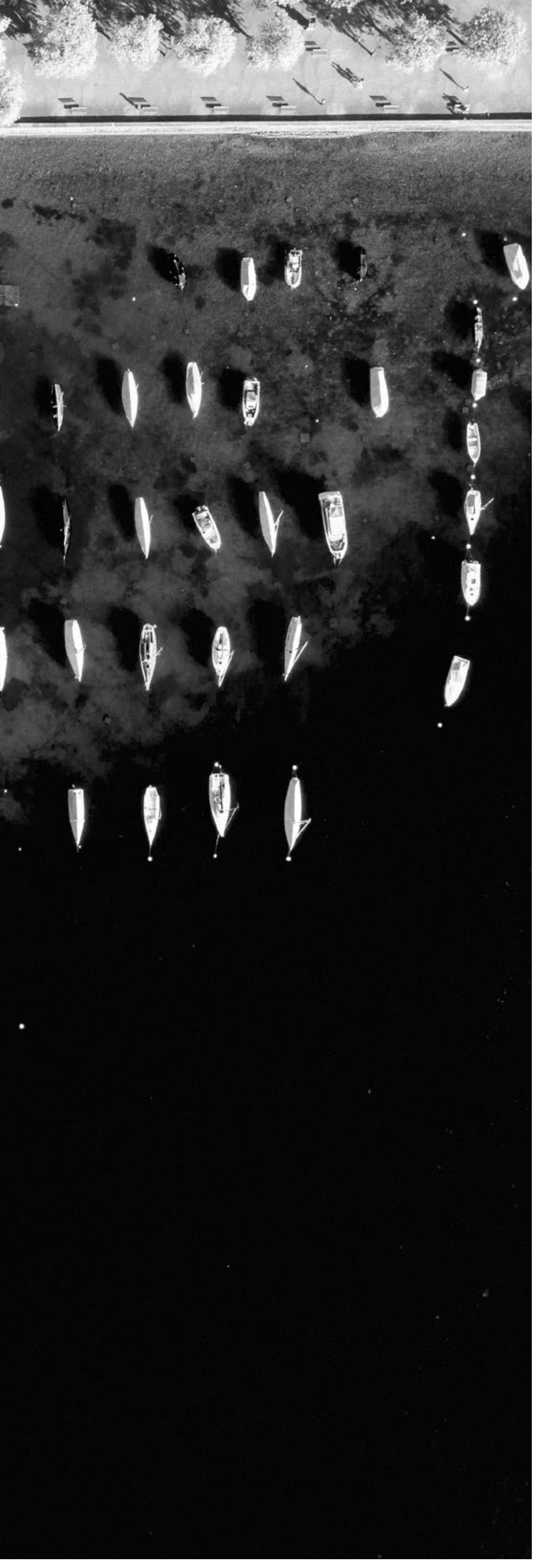
Introduction

Risk premia in capital markets pose a challenge to those who want to harvest them. This is because globalized markets are becoming increasingly interconnected and efficient at transferring risks, which slowly erodes the average premium earned by investors for taking on risk. Essentially, risk premia are spread over an ever-growing number of participants that operate in global capital markets. This means that harvesting risk premia with the goal of achieving decent returns has become a difficult undertaking.

In the long run, the expected return of any investment strategy is related to its exposure to systematic, undiversifiable risk. This fundamental concept of valuation has been widely accepted in academia and investment practice since the Capital Asset Pricing Model (CAPM) was introduced as an equilibrium model of asset returns within Harry Markowitz's mean-variance framework, also called Modern Portfolio Theory (MPT). Today's understanding is that expected asset returns are related to various sources of systematic risk. In addition, we have come to accept that risk premia are capricious in nature since they vary over time. As a result, capturing risk premia in a globalized environment is not an easy task. On the one hand, it requires an in-depth understanding of the sources of risk as well as of the dynamics of the associated rewards. On the other hand, it is only the skillful application of quantitative investment tools in a portfolio implementation process that makes risk premia ultimately exploitable. So, what do we know about risk premia in capital markets?

Before we jump into the topic, it is important to point out that we are still not able to pin down exactly the sources of systematic risk and the determinants of risk premia in capital markets. As investors we find that asset prices are influenced by a wide variety of unanticipated events and that some have a more pervasive effect than others. The scientific exploration of return drivers in capital markets starts with the assumption that so-called latent state variables exist that have a systematic impact on the pricing of assets by market participants. Rather than



being observable, latent state variables are inferred from other variables that can be measured directly. It seems that the observable co-movement of asset prices is consistent with the presence of common exogenous driving forces related to the macroeconomy. However, we find that reversing this relationship works as well as capital markets may influence macroeconomic developments. So, all economic variables and asset prices are part of a mutually reinforcing relationship within the same system and are endogenous factors in some ultimate sense. Therefore, grasping the core of the capital market pricing mechanism is a sophisticated task.

Over the past 50 years, two major strands of knowledge development have shaped the industry's understanding of priced sources of risk in capital markets. Both of them have primarily focused on equity markets as the equity risk premium is the most prominent source of investment returns and has captured most of academic attention. The first knowledge strand took a bottom-up approach to explaining equity returns by focusing on fundamental company factors that, in addition to market beta, drive equity prices. The single-factor CAPM first dominated the discussion but was soon called into question, particularly by the work of Eugene Fama and Kenneth French at the University of Chicago in the late 1980s, which expanded the CAPM by additional factors that contributed to equity returns. This proved to be fertile ground for other researchers from around the globe who developed a wide variety of multi-factor equity valuation models. These models, and the empirical evidence that they uncovered, form the foundation of today's smart beta and factor investment strategies in equities.

In contrast, the second collection of academic research adopted a top-down view of the factors shaping equity risk premia by linking capital markets to the business cycle. These researchers investigated the larger economic and market forces driving global equity risk premia in internationally diversified portfolios. The discussion gathered momentum in the 1990s with the studies of Wayne Ferson and Campbell Harvey on conditional asset pricing models. They used directly observable market information and sentiment indicators to model the time-variance in risk premia, which provided the foundation for today's tactical asset allocation and risk management in global portfolios.

Overall, the scope of empirical findings on priced factors in capital markets along the above two knowledge strands is well grounded in academic research, yet enormous. This paper's intention is to highlight the most important academic milestones that shaped our understanding of risk premia in capital markets. In addition, it illustrates the most efficient tools to harvest risk premia in today's globalized marketplace.

Exploring the equity premium

Expected return is related to systematic risk

Academic research on equity markets began in 1900 when the French mathematician Louis Bachelier used a stochastic process, also called Brownian motion, to describe the variation of equity prices as a random walk. The first notion of the equity risk premium emerged when, in 1924, Edgar Lawrence Smith demonstrated in a seminal publication that stocks are a better long-term investment than bonds. Smith's work was so influential that it is thought to have fueled the stock market boom of the 1920s.

However, the first truly consistent theory on the relation between risk and return in equity markets was the CAPM contributed by William Sharpe, John Lintner and Jan Mossin around 1965. The model introduced the market factor as the single source of systematic risk and claimed that the expected return of an asset is linearly related to its covariance with the market's return. The CAPM is an equilibrium theory building on the mean-variance framework of Harry Markowitz. Therefore, the efficiency of the market (tangency) portfolio in the mean-variance framework and the validity of the CAPM depend on each other. This connection between the unobservable "true" market portfolio and the equilibrium model for asset returns makes the CAPM – strictly speaking – untestable. This severe dilemma is called the joint hypotheses problem.

Empirical tests of the CAPM following the seminal study of Eugene Fama and James MacBeth published in 1973 use stock market indices as proxies for the theoretical market portfolio which is, in principle, an acceptable approach. However, the results for the empirical testing of the CAPM are mostly disappointing. In many cases, the assumed positive linear relation between market beta and average return, as specified by the Security Market Line (SML) of the CAPM, is not reflected in the data. In some time periods, the empirical SML seems to be flat or even negatively sloped. Numerous empirical studies in the 1970s and 1980s showed that the CAPM does not sufficiently explain expected equity returns which was, of course, bad news for the only existing asset pricing theory at that time.

The puzzle of return anomalies contradicting the CAPM

While the CAPM was being subjected to numerous tests, researchers started looking for other explanations for what drives equity returns. They used firm-specific information such as market capitalization, dividend-to-price (D/P), earnings-to-price (E/P) or book-to-price (B/P) ratios as explanatory variables in addition to a company's market beta. These studies contributed hard evidence to the hypothesis that such fundamental factors capture a significant portion of the variation in equity returns after controlling for beta. As a result, the findings, which contradict the CAPM, are called return anomalies.

The two most prominent return anomalies are the size and the value effect. The former, discovered by Rolf Banz in 1981, refers to the observation that companies with a low market capitalization tend to outperform companies with a high market capitalization after a CAPM-based adjustment for systematic risk. The latter is linked to a company's valuation in the capital market in comparison to accounting-based measures of cash flow or book value in the corporate balance sheet. Empirical research shows that firms with high intrinsic value, as reflected by a high E/P, B/P or D/P ratio, deliver higher returns (after controlling for market beta) than firms with low intrinsic value. As early as in 1934, Benjamin Graham and David Dodd were the first to encourage the pursuit of value-based investment strategies, even before the CAPM was invented. Pioneers of the discussion of the value effect in the context of the CAPM include Sanjoy Basu, Ray Ball and Marc Reinganum, among many others.

The exploration of the various return anomalies dominated empirical research on equity markets throughout the 1980s. In 1992, Eugene Fama and Kenneth French capitalized on compelling evidence revealed by academic literature and introduced a three-factor model as an extension of the CAPM to describe the time-series behavior of equity returns. They included traded proxy portfolios for the size and the value (B/P ratio) factors in addition to the CAPM-based market factor to model the relation between systematic risk and return in equity markets. Their findings showed that size and value factors captured a significant portion of the cross-sectional variation in equity returns, suggesting that these two fundamental factors are representations for additional sources of risk that the CAPM did not include. From that moment on, the Fama-French (FF) model became a widely accepted starting point for research on equity pricing.

The FF three-factor model's proposition that the market risk premium was not the only driver of stock returns was not easy to digest for many market participants and researchers. Firm size and value are essentially idiosyncratic risks that, according to widely accepted financial research, can be diversified away. Therefore, they should not be compensated for in the long run. This puzzle became the subject of numerous academic studies in the 1990s, searching for an economic rationale of the two factors' systematic influence on stock returns. Although empirical evidence revealed that size- and value-based return premia vary considerably over time, research findings converged towards the understanding that the value premium is likely to be a compensation for a company's financial distress risk while the size premium rewards the investor for accepting the risks associated with the low liquidity of a small capitalized company's stock.

Multi-factor models take over from the CAPM

In 1997, Mark Carhart made an addition to the FF model by extending it by the stock price momentum factor. This four-factor model of equity returns took into account the empirical finding that trends in stock prices are, to some extent, stable and predictable. This way, Carhart paid tribute to the work of Narasimhan Jegadeesh and Sheridan Titman, published in 1993, which demonstrated that stocks that had outperformed in the past are likely to outperform again in the future. In academic discussions, the momentum effect, also labeled as a return anomaly, is commonly considered to be the result of behavioral biases of market participants who tend to underreact to news published on a “winner”, such as earnings announcements. At the same time, it remains difficult to attribute the momentum effect to tangible risks carried by investors, as it is the case with the size and value factors.

As soon as these various return anomalies were discovered, they stimulated the concoction of new investment strategies that swiftly advanced small cap, value, and momentum strategies to mainstream market adoption in the asset management industry. They became a widely respected way of harvesting risk premia in equity capital markets, attracting many billions of investment capital over the years. A little further removed from the mainstream hustle and bustle, the so-called quality premium made its debut on the academic research scene. Becoming widely popular among practitioners, it was finally recognized by Eugene Fama and Kenneth French who, in 2015, agreed to expand their classic three-factor model by two additional factors that serve as proxies for the “quality” of a stock. Doing so, Fama and French acknowledged growing empirical research documenting that the variation in average stock returns is related to a company's expected future earnings as well as investment activities. They made use of the dividend discount model as a conceptual starting point for their argumentation, adding two factors – profitability and investment - to their specification. The resulting five-factor model is the most recent contribution of the two famous researchers to explaining risk premia in equity markets. It has already raised a controversial discussion among academics as well as investment practitioners concerning the specification of the new factors and, particularly, the setup of their empirical design.

In addition to risk premia in equity markets associated with size, value, momentum, profitability, and investment, the so-called low-risk premium was brought into play in 2006 by Andrew Ang, Robert Hodrick, Yuhang Xing and Xiaoyan Zhang in their study on the pricing of volatility risk in the cross-section of equity returns. Low-risk investing is a strategy exploiting the empirical finding that low-risk stocks, i.e. stocks exhibiting low volatility or beta, tend to deliver higher returns than high-risk stocks. This effect is a significant challenge to standard theories on the trade-off between risk and return in capital markets and, therefore, carries the label of a return anomaly. Low-risk strategies in equity markets have become very popular over recent years.

After four decades of research, a new zeitgeist enters the discussion

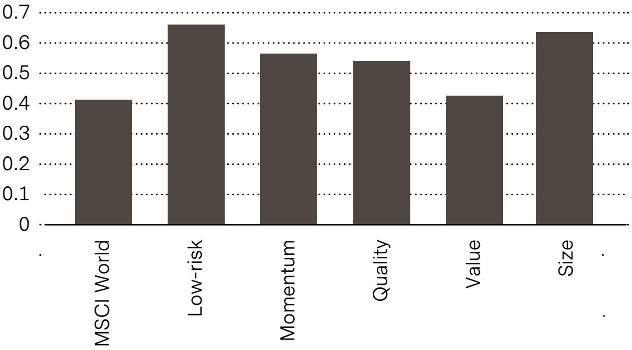
In sum, our current understanding of the systematic forces driving international equity markets has been shaped by the innumerable research efforts of the last four decades that have tried to grasp the variation of stock returns through the CAPM and its various multifactor extensions. Bottom-up approaches analyzing the cross-section of equity returns deliver comprehensive evidence that equity risk premia are indeed linked to fundamental company and stock price characteristics like size, value, quality (summarizing the profitability and investment factors), momentum and low risk. These five factors in addition to the traditional market factor define the playground of asset managers when it comes to designing equity investment strategies that are firmly rooted in empirical financial market research (see chart 1).

As factor investing is in essence strategic stock selection along the above factors, it implies taking exposure to sources of economic or behavioral risks in capital markets. Fundamental equity attributes like size (market cap), value (i.e. B/P ratio), profitability (i.e. profits-to-assets or book-to-equity ratios), and investment (i.e. annual change in total assets) determine a company's sensitivity to the business cycle, economic shocks and financial distress, as well as its general ability to capitalize on growth opportunities. Equity return characteristics like momentum and low-risk (i.e. low volatility) mirror a stock's sensitivity towards behavioral biases of market participants. The risk premia arising from these economic and behavioral sources have a systematic component but are also subject to conditional time-variability like the overall market risk premium.

CHART 1

Factor strategies achieve an attractive risk/return profile compared with the general market

Sharpe Ratio



The data are based on back tests on the following MSCI indices from 31.12.1998 to 31.12.2017: MSCI World Index Net TR USD Index, MSCI World Minimum Volatility Daily Net TR USD Index, MSCI World Momentum Net TR USD Index, MSCI World Quality Net TR USD Index, MSCI World Value Net TR USD Index, MSCI World Small Cap Net TR USD Index. Costs are not taken into account. Past performance is not a reliable indicator of current or future performance.

Source: Bloomberg/Vescore calculations

Although it seems that we are on solid ground in our understanding of systematic factors driving equity returns, a new zeitgeist has entered the current academic debate giving it a pinch of healthy criticism. After four decades of accumulating empirical research in hundreds of studies, the community has finally started to question the statistical methods used to extract factors from returns. The paper of Campbell Harvey, Yan Liu, and Heqing Zhu with the thought-provoking title "… and the Cross-Section of Expected Returns" published in 2016 is a prominent crystallization point in this emerging discussion. They address the general problems of data mining in financial economics and argue that the statistical hurdles that need to be overcome for a factor to be considered significant are too low. This debate is a healthy one with respect to future attempts to deepen our understanding of the equity risk premium.

Economic forces driving risk premia

The idea of rational asset pricing is compelling

Asset prices react to economic news. This is a fact. The theory that asset prices depend on their respective exposures to the state variables that describe the economy goes back to the intertemporal asset pricing model of Robert Merton of the early 1970s and the subsequent work of John Cox, Jonathan Ingersoll and Stephen Ross in the mid-1980s. An important contribution on the methodological side at that time is Ross's Arbitrage Pricing Theory (APT) relating asset returns to a set of abstract factors invoking arbitrage arguments to derive a pricing restriction including multiple risk premia. Contrary to the CAPM, which relies on a set of assumptions that gives rise to equilibrium conditions based on which investors can predict an asset's return for its given level of systematic risk, Ross's model is strictly speaking not backed by economic theory. Nevertheless, the APT is a widely used framework to analyze the influence of predetermined factors on asset prices and expected asset returns.

Rational asset pricing models assume that expected asset returns are related to an asset's sensitivity to changes in the state of the global economy. The CAPM measures this sensitivity by an asset's beta. Other models that use multidimensional factors to describe the economic environment rely on multiple beta coefficients. In a multifactor framework, like the APT, the exposure to relevant economic state variables is compensated for by multiple risk premia. Several academic studies in the 1980s suggest economic variables as proxies for the latent variables that determine asset returns. One of the most prominent studies in that field was contributed by Nai-Fu Chen, Richard Roll and Stephen Ross in 1986. They introduced macroeconomic variables such as the spread between long- and short-term interest rates, expected and unexpected inflation, high-grade and low-grade corporate bonds and industrial production, as sources of systematic risk priced into stock markets. In other words, an asset's exposure to these macroeconomic variables determines the degree to which an asset holder is able to participate in the payoff of systematic risk premia. Studies on economic factors driving asset prices are numerous, covering international stock and bond markets, yet the magnitude and significance of estimated risk premia is often rather small. Facing the ambiguous empirical results on priced factors researchers started to develop conditional asset pricing models to dive deeper into the dynamics of risk premia in capital markets.

Risk premia vary over time

The time-variability of risk premia became the focus of research efforts in the 1990s in the emerging field of conditional asset pricing which took a top-down view of the driving forces of asset returns. Eugene Fama and Kenneth French were among the first to link asset returns to business conditions. To model the business cycle, they applied variables like the aggregate dividend yield on the stock market as well as default and term spreads measured on bond markets. Their study of stock and bond markets, published in 1989, is considered ground-breaking as it documents that expected asset returns are lower in times of positive economic conditions and higher when the outlook deteriorates. This conclusion is intuitive for most financial market participants but contradicts classical valuation frameworks such as the CAPM or the APT, which rely on the assumption that the expected rewards for taking systematic risk in capital markets are constant.

Conditional asset pricing models are state-of-the-art in finance

Stimulated by the intuition on the time-variance of risk premia, researchers started to extent asset pricing models to include observable variables that capture business expectations and market sentiment. Wayne Ferson and Campbell Harvey are the pioneers in this research area with their seminal study on the variation of economic risk premia, published in 1991. They introduced a large variety of instrumental variables such as the spread between the returns of the three-month Treasury bill and the one-month bill, the yield spread between Baa- and Aaa-rated corporate bonds, and the dividend yield on the stock market. In a rational asset pricing model with multiple betas, linking expected asset returns to their sensitivities to changes in the state of the economy, their empirical findings indicated that changes in risk premia are captured by such variables, which are assumed to reflect information that market

The intuition on time-varying risk premia is quite simple: the willingness of market participants to take on systematic risk varies with their economic expectations. When the business outlook is positive, investors' risk appetite surges with an increasing demand for risky assets offering participation in economic growth. As a result, the prices of risky assets increase along with pressure on risk premia (discount factors) which decreases expected returns. When the outlook is bleak, the demand for risky assets declines, and this is accompanied by tumbling prices and increasing risk premia, which push up expected returns. So, expected asset returns fundamentally correspond to changing business conditions.

participants use in their investment decisions. In addition, Ferson and Harvey worked out that the conditional variation of risk premia is the primary source of predictability of asset returns at the portfolio level, rather than the time-series behavior of betas considered in other studies. Most importantly, that early work of Ferson and Harvey is one of the big cornerstones shaping our understanding that predictability in financial markets is consistent with the assumption of efficient markets.

The approach of Ferson and Harvey motivated academic researchers around the world to study asset prices in a conditional setup with cumulating evidence on priced sources of risk and instruments that capture the variation of risk premia. Conditional asset pricing models have become and are still state-of-the-art tools in finance. Over the last 20 years, the conditional modeling of risk premia to generate expected returns at the level of asset classes has evolved as a core competence in the investment practice for portfolio construction, tactical asset allocation and market risk management. One of the sweet spots for generating active returns in our mostly efficient capital markets is the predictable variation of risk premia. Fundamental valuation ratios observed on stock markets or interest rate spreads measured on bond markets can be used to predict a portion of the time-varying long-term drift in the prices of risky assets. Modern asset allocation processes exploit this predictability.

Bond market risk premia are driven by the same macroeconomic factors as equities

Our discussion so far has revolved around risk premia in equity returns because all knowledge development on the relationship between risk and return starts at some point with the CAPM's concept that systematic risk is reflected in the stock market. In a very strict sense, bonds do not belong to the universe of risky assets since global bond holdings sum up to zero. Hence, there is no aggregate representing systematic risk in bonds. Nevertheless, government and corporate bonds make up the largest "asset class" in institutional investment portfolios.

Comprehensive empirical research shows that the fluctuations of bond prices over their time to maturity are also related to the business cycle and driven by the same macroeconomic factors as equity markets. In 1995, Antti Ilmanen contributed a seminal study on time-varying expected returns in international bond markets. In this context, the term structure of interest rates plays a pivotal role in channeling the expected changes in business conditions into bond prices, in addition to the risk premia observable in credit markets. Therefore, on the asset allocation level, the same economic multifactor models can be applied to manage the risks of a balanced portfolio.

Pinning them down: How to harvest risk premia

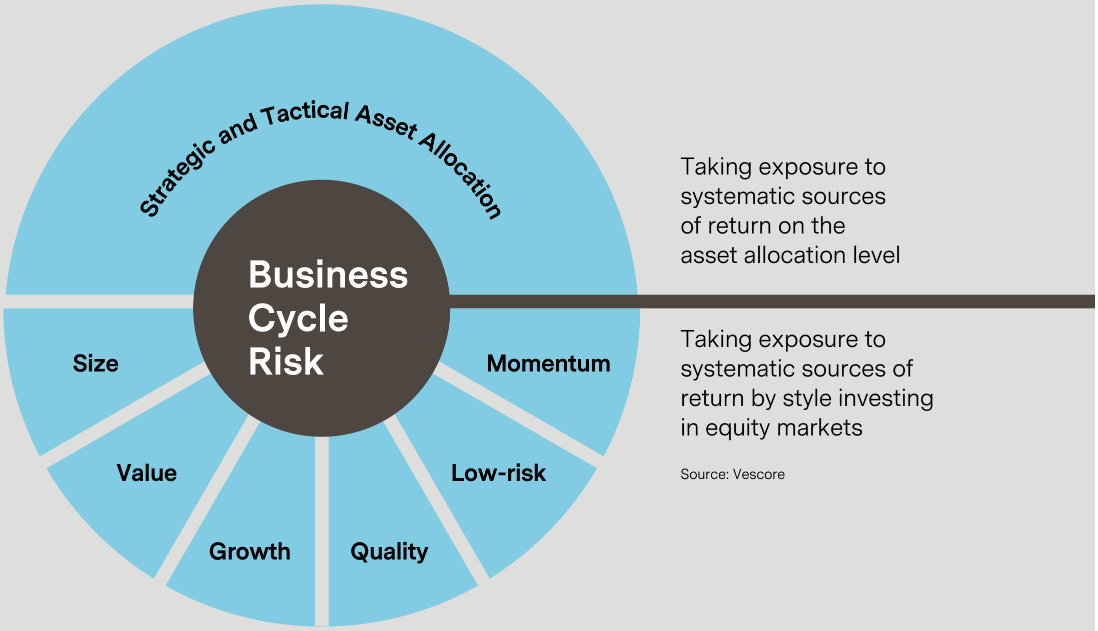
It’s all about managing global business cycle risk

Our knowledge on the forces driving asset returns, sources of systematic risk and the dynamics of risk premia has substantially increased over the last 30 years with hundreds of studies performed at leading universities around the world. It was in the early 1970s when academic researchers started to systematically explore the identity of the so-called latent state variables influencing the market participants’ pricing of assets. In sum, this vast collection of research boils down to the common understanding that systematic investment risk is more or less equal to global business cycle risk. We can rely on comprehensive empirical evidence which demonstrates that capital markets evaluate and price multiple sources of macroeconomic risk by means of risk premia that change over time depending on the investors’ risk appetite. Interest rates, inflation rates, output measures, exchange rates and certain commodity prices have been identified as suitable proxy variables for the prevailing economic environment. Fundamental equity valuation ratios as well as term and credit spreads seem to reflect the business outlook of investors and their overall sentiment governing their investment decisions.

In summary, state-of-the-art research in finance has brought about conditional asset pricing models and comprehensive empirical findings on forces driving returns and expected returns, which gives us a growing toolbox for value creation in asset management. Although certain behavioral biases are sometimes regarded as anchor points for investment strategies, harvesting risk premia preeminently means managing investment exposure towards global business cycle risk on the level of asset classes or by implementing a specific investment style or strategy (see chart 2).

CHART 2

Managing global business cycle risk is done by taking exposure to macrofactors in the asset allocation or via style investing in equity markets


Strategic and Tactical Asset Allocation
Business Cycle Risk
Size
Value
Growth
Quality
Low-risk
Momentum
Taking exposure to systematic sources of return on the asset allocation level
Taking exposure to systematic sources of return by style investing in equity markets

Source: Vescore

No matter if top-down or bottom-up, harvesting risk premia requires tactical maneuvers

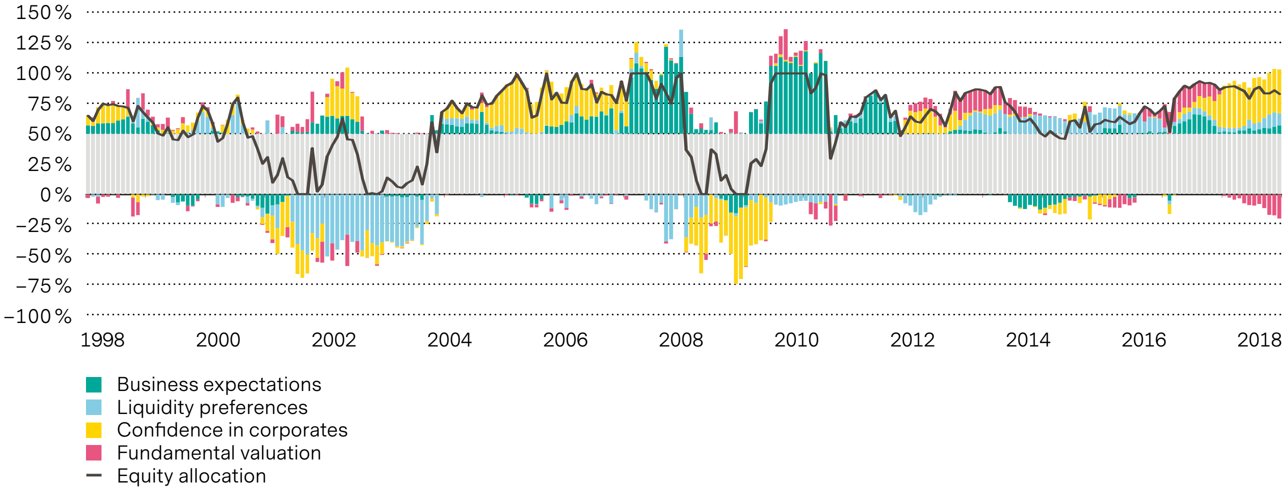
Strategic asset allocation determines an investor's long-term participation in global economic growth. Strategic decisions on the equity quota of a portfolio, the country and sector allocation in equity markets, the allocation to fixed-income assets, the duration and credit quality of bond investments and the currency allocation constitute the investor's playground for harvesting asset class premia linked to the long-term development of the global economy. It is common knowledge, however, that economic growth reveals cycles and frictions, resulting in risk premia varying considerably over time. If the investment horizon is long enough, let's say 30 years, this should not detract from the effectiveness of a strategic asset allocation in the long run. Yet, in many cases, investment horizons are much shorter, requiring tactical elements in an investment process to smooth the performance curve generated by investing in asset class premia. Conditional asset pricing models and accompanying empirical research allow for tactical asset allocation implementation procedures to support the timing of exposure in asset classes. Their goal is to stabilize the results of investment strategies that harvest risk premia in the market place.

Vescore's GLOCAP model is an example of a conditional asset pricing model that has been successfully applied in investment practice for 20 years to tactically manage the equity quota in a globally diversified portfolio. Chart 3 shows how the GLOCAP equity allocation has evolved over time in response to the fundamental economic variables that make up the respective market environment prevailing at the time.

While active portfolio management on the asset allocation level, with the purpose to control exposure to the business cycle, is a top-down approach to earning risk premia, the investment in a specific equity style or strategy is a bottom-up approach that takes exposure to the same sources of systematic risk and, hence, expected return. The style tilt of an equity portfolio towards scientifically approved factors like size, value, quality, momentum or low-risk determines its exposure to business cycle risk and corresponding premia. As we know that risk premia vary in accordance with market participants' economic expectations and appetite for investment strategies harvesting risk premia on the asset allocation level as well as in equity markets, these strategies must include tactical capabilities to smooth the performance over shorter investment horizons (see chart 4, page 14).

CHART 3

The GLOCAP equity quota tactically adapts over time in response to changing fundamental economic variables

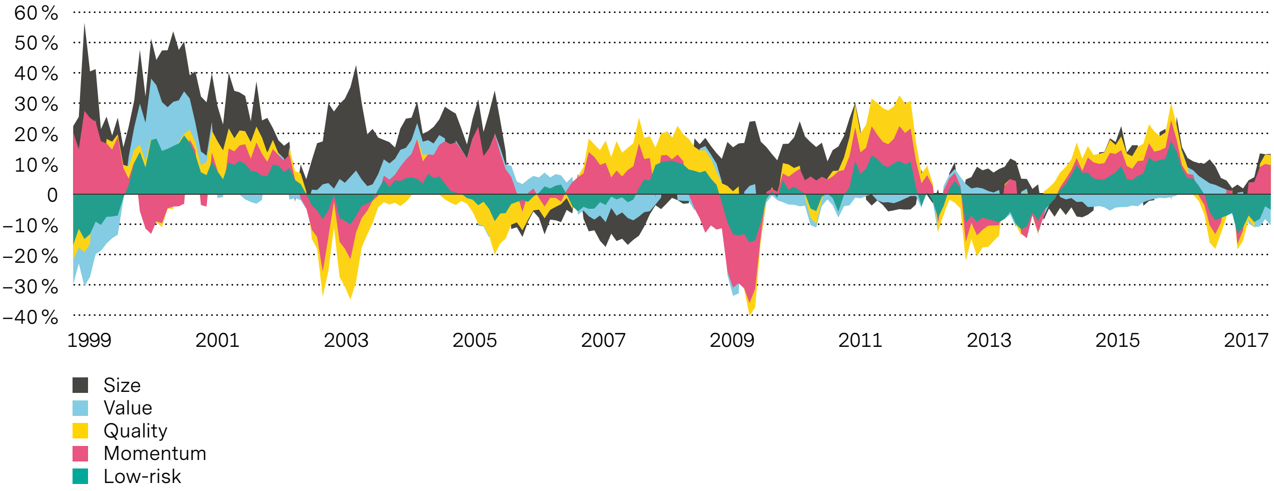


The chart shows the evolution of the tactical equity allocation determined by Vescore's GLOCAP model over a 20 year time horizon starting in January 1998. The tactical equity quota varies between 0 and 100% (grey line) and is derived from instrumental variables describing the market participants' business expectations (TERM spread), market-wide liquidity preferences (TED spread), investors' trust in corporations (credit spread) and the fundamental valuation of stocks (dividend yield). Starting with a neutral equity quota of 50% in a balanced portfolio these four instruments capture the changing market environment. Their individual attributions to the final equity quota can be positive or negative and may vary considerably in magnitude. In sum, GLOCAP adjusts the equity quota to the overall market sentiment on systematic risk.
Past performance is not a reliable indicator of current or future performance.

Source: Vescore

CHART 4

Factor premia vary over time



The chart shows the rolling 1-year return differences between the MSCI factor indices and the MSCI World Index from 31.12.1999 to 31.12.2017.
Past performance is not a reliable indicator for current or future performance.

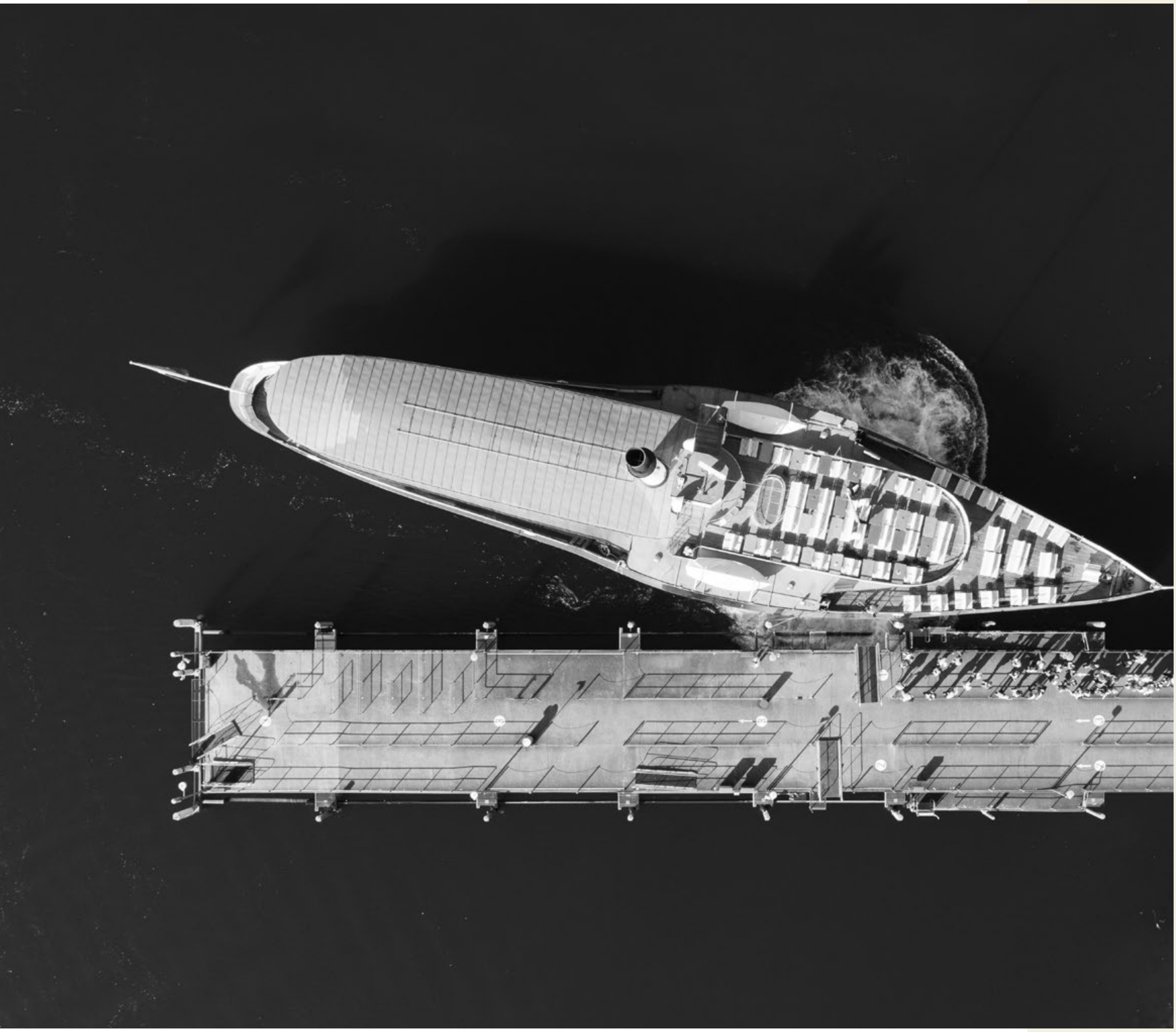
Source: Bloomberg/Vescore calculations

Capturing the sweet spots of disciplined investing

The evolution of academic knowledge on risk premia in capital markets has shaped the investment philosophy of Vescore for 20 years. We explore and harvest risk premia in equity, bond, currency, commodity futures and options markets by applying quantitative models to our investment decisions. We strongly believe that economically sound risk premia are the most reliable sources of return. At the same time, we know that risk premia vary over time corresponding to investors' expectations on the business cycle and overall market sentiment requiring conditional pricing and allocation frameworks that are capable of capturing and exploiting these dynamics.
Our playground for harvesting risk premia encompasses five market segments:

- ***Risk premia in equity markets:*** We harvest the global equity premium in a diversified portfolio by tactically managing the quota invested in international stock markets relative to fixed-income positions. The core of our allocation process is a conditional asset pricing model linking equity prices to macroeconomic state variables and instruments reflecting market participants' appetite for systematic risk. In equity markets, we make use of profound empirical evidence on priced fundamental factors in which we take tactical ("smart beta") exposures to smooth portfolio performance.
- ***Risk premia in bond markets:*** We harvest risk premia in bond markets related to unexpected changes in the term structure of interest rates driven by inflation and the market participants' preference for intertemporal consumption smoothing. Our investment process breaks down the yield curves in major currencies into fundamental value drivers including carry, mean-reversion and momentum in interest rates.
  The tactical positions in duration in international bond markets reflect these intrinsic driving forces currently at work. At the same time, they are conditioned on the measurable state of the global economy.
- ***Risk premia in commodity markets:*** We harvest risk premia in commodity futures markets by taking tactical positions in futures depending on the shape of the commodity term structure which can be in backwardation or contango. Our investment process results in a diversified portfolio of commodity futures that exhibit pronounced backwardation curves.
  By that means, we systematically take on the risk of unexpected changes in commodity prices from producers and consumers of commodities in the complex environment of scarcities, weather influences, economic cycles and technological change.
- ***Risk premia in options markets:*** We harvest risk premia in options markets that arise from the need of market participants to hedge the downside risks of their equity portfolios. Our investment process takes short positions in volatilities in major stock markets by means of variance swaps that trade future realized volatility against current implied volatility as well as relative positions in replicated variance swaps across stock markets. From an economic perspective, this investment strategy provides portfolio insurance, earning an insurance premium.
- ***Risk premia in currency markets:*** We harvest risk premia in currency markets resulting from divergent economic cycles in currency zones which are primarily reflected in the dynamics of interest rate differentials but also in deviations from purchasing power parities (PPP) and short-term momentum in exchange rates. Our investment process captures these systematic forces in currency markets by tactically allocating long and short positions to currencies in a zero-investment portfolio while strictly managing the volatility risks in currency markets.

Our strategies to harvest risk premia start with a rigorous examination of the sustainability of the respective return sources. In all cases we take on well-defined systematic capital market risks linked to economic forces and business cycles. As a rule, we model investment risks in a multidimensional framework assuming a conditional variation in risk premia. The latest discoveries of academic finance on risks priced in capital markets and the dynamics of the associated rewards form the foundation for the design of our investment strategies, which are configured to capitalize on the rapidly expanding possibilities of technologies. We guide our clients towards the economic sweet spots of disciplined investing in our largely efficient capital markets.



In a nutshell

1. Only systematic risk is priced in capital markets.

2. The higher the systematic risk of an asset, the higher the asset's expected return in the long run – this is the fundamental concept of the Capital Asset Pricing Model (CAPM).

3. The scientific exploration of return drivers in capital markets starts with the assumption that latent state variables exist that have a systematic impact on market participants' valuation of assets.

4. Rational valuation models claim that the systematic risk of an asset is captured by its sensitivity to changes in the state of the global economy. Put simply, systematic risk is equivalent to business cycle risk.

5. Multifactor asset pricing models in the spirit of the Arbitrage Pricing Theory (APT) describe the state of the global economy by observable variables like interest rates, inflation rates, output measures or commodity prices in addition to aggregate data on the valuation of assets in capital markets.

6. Risk premia vary over time corresponding to market participants' assessments of the state of the global economy and their respective appetite for risk.

7. Conditional asset pricing models capture at least a portion of the time-variation in risk premia by instruments describing market participants' risk attitude as reflected in interest rate spreads and aggregate fundamental valuation ratios.

8. Risk premia can be harvested top-down by taking exposure to business cycle risk on the asset allocation level or bottom-up by implementing specific investment styles like size, value, quality, momentum or low risk in equity markets – the fundamental sources of return are the same.

9. Any strategy to harvest risk premia must include tactical competences to smooth the performance over shorter investment horizons.

10. Since harvesting risk premia means taking investment exposure to global business cycle risk, it is consistent with the belief that asset prices in capital markets are informationally efficient to a large extent.

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