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1. Executive summary

The advent of what might be called sustainable factor investing has positive implications for the sphere of investment and beyond. It meets two compelling exigencies that have emerged over the course of several decades and in recent years in particular: the appetite for evidence-based investing and the desire for a better world.

We explain how two of the most fascinating stories in the annals of finance have brought us to this point. The first starts with the birth of “modern finance” before charting the gradual erosion of conventional wisdom regarding risk, reward and stock selection. The second chronicles the rise of responsible investing and the ever-growing consideration of environmental, social and governance issues in portfolio construction.

In a world increasingly averse to risk and ever more rightly intolerant of injustice and inequality, sustainable factor investing has become a core component of our philosophy of long-term asset management. We demonstrate both the importance and the effectiveness of such an investment ethos.

2. Introduction

There was a time when the most elegant and revered models in finance were rooted in a firm belief in the efficiency of markets and the rationality of human beings. There was also a time when those same markets and human beings showed comparatively little interest in concerns such as diversity, employee relations or even the future of the planet. Thankfully, times change.

The realisation that even the finest theoretical equations might not always hold true in the real world - particularly when that world is inhabited by creatures perilously susceptible to cognitive error - has paved the way for new and more sophisticated investment strategies. Meanwhile, the wider recognition that our shared destiny depends in no small part on a collective desire to work for the greater good has led to a much richer appreciation of the importance of sustainability.

These shifts, which have occurred over the course of several decades and are still developing today, have brought with them two key corollaries: the rise of factor investing and the emergence of environmental, social and governance (ESG) considerations in assessing an organisation's practices, function and broader impact. Now the two are increasingly converging, and the result is what we might call sustainable factor investing - a phenomenon whose implications for the sphere of investment and beyond are potentially far-reaching.

In this white paper we examine how this synergy has come about, what it means today and where it might lead. We begin by investigating the histories of factors and ESG respectively; we explore how their stories have more recently become entwined; and we demonstrate the benefits of an investment philosophy that takes proper and rigorous account of both.

In doing so we draw on a range of empirical research and analyse the contributions of some of the most influential figures in the annals of finance. We also look to the academic arena for an external perspective. Finally, we explain how sustainable factor investing has become central to our own ideas about long-term asset management, underpinning an investment ethos that thrives on dialogue and transparency and prizes ownership over speculation.

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3. Factor investing: from “modern finance” to present day

3.1. The one and only: the market as a single factor

When Harry Markowitz presented his dissertation on portfolio allocation to his doctoral adviser - none other than future Nobel Prize winner Milton Friedman - he was warned it was so radical, so focused on algorithms and so far beyond the scope of conventional thinking that it might not qualify for a PhD in economics.¹

Not long afterwards, despite Friedman’s concerns, Markowitz received his degree.² Forty years later, in 1990, he, too, received a Nobel Prize.

Irrespective of whether it fell within the established remit of economics at the time, Markowitz’s work fundamentally transformed the sphere of investment. Almost at a stroke, the longstanding emphasis on selecting high-yielding single stocks without the slightest contemplation of their possible effect on portfolios was made to look archaic. By demonstrating the influence of risk, correlation and diversification, Markowitz propelled portfolio construction into the “modern” era; and thus Modern Portfolio Theory (MPT) was born.

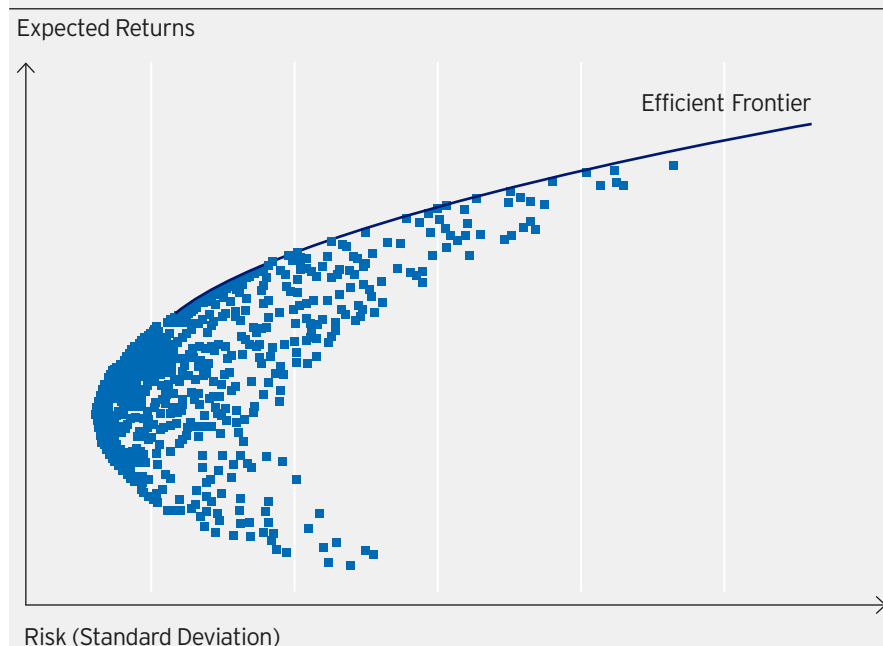
Markowitz’s model showed how to quantify both the risk and the return of an individual asset or a portfolio of assets. In doing so it gave rise to one of the most enduring tenets of investing, which is that the sole means of generating higher returns is to accept higher risk. Crucially, the model presupposed the existence of a phenomenon that has since come to be regarded as vaguely absurd: the efficient market.

The cause of “modern finance”, as it became known more generally, was duly furthered by the creation of the Capital Asset Pricing Model (CAPM), which built on MPT to develop a technique for measuring systematic risk. Like MPT, the CAPM relied on the efficiency of the market and the rationality of investors. Unveiled in the 1960s, it was this advance that essentially gave us the very first factor: market risk, the element of a security’s overall risk or volatility due to correlation with a capitalisation-weighted benchmark.

Throughout the 1950s and 1960s, then, the prevailing wisdom was that markets should work perfectly, that human beings should be machine-like in their grasp of logic and that the number of factors worthy of consideration in constructing portfolios, roughly speaking, could be boiled down to a grand total of one. Although each of these conceits nowadays seems faintly ridiculous, it would be several years before such a worldview would face a meaningful challenge.

Figure 1

The idea of the efficient frontier - a line representing the optimal combination of risk and return - is central to Modern Portfolio Theory. Here each point on the graph represents a portfolio, with those nearest to the efficient frontier having the potential to produce the greatest return for the lowest risk.



Source: Markowitz, H: Portfolio Selection, 1952.

¹ Accepting his own Nobel Prize, Markowitz recalled Friedman’s scepticism. “I assume he was only half-serious,” he said, “since they did award me the degree without long debate. As to the merits of his arguments, at this point I am quite willing to concede that portfolio theory was not part of economics at the time I defended my dissertation - but now it is.”

² One of Markowitz’s radical points that many overlook even today is that variance or standard deviation as “risk” measures consider (extremely) high returns undesirable: “Analyses based on semi-variance tend to produce better portfolios than those based on variance. Variance considers extremely high and extremely low returns equally undesirable... Semi-variance, on the other hand, concentrates on reducing losses.”

3.2. And then there were three

The CAPM may have been commendably clear about what it deemed the sole source of investment risk – the market itself – yet it could not provide a practical means by which that risk might be measured. The next major asset-pricing model to appear sought to address this quandary, but it also posed an altogether different problem.

Arbitrage Pricing Theory (APT) was first presented by Stephen A Ross in 1976. Ross, a student of physics before obtaining his doctorate in economics, recognised that several different risk factors might combine to affect returns. The factors involved were certainly broad – they included macroeconomic issues such as inflation, interest rates and business activity – but at least there were more of them.

APT introduced the notion of using a series of beta coefficients to measure a security's sensitivity to risk. In contrast to the CAPM, it assumed each investor would hold a portfolio with a unique array of betas rather than an identical market portfolio. As the first multi-factor model, it represented a landmark innovation. However, it dealt only in the likely characteristics of factors, as suggested by numerous a priori guidelines: the precise number and nature of those factors could not be defined.

Enter Professors Eugene Fama and Kenneth French, of the University of Chicago Booth School of Business, and their groundbreaking three-factor model. Noting the historic outperformance of (a) stocks with a low price-to-book ratio over growth stocks and (b) small-cap stocks over large-cap stocks, Fama and French added two new variables – value and growth – to the CAPM's long-solitary market risk. Typically, the CAPM could explain more than 70% of diversified portfolio returns: the Fama-French approach substantially improved on this figure.

Fama and French's seminal paper, *Common Risk Factors in the Returns of Stocks and Bonds*, was published in the *Journal of Financial Economics* in 1993. By precisely defining the number and nature of factors for the first time, it laid many of the foundations for subsequent interest in two vital strands of research – the first centred on the importance of non-traditional beta, the second on the possibility that ostensibly uncorrelated asset classes might in reality have exposure to the same underlying drivers of returns. Finally, more than four decades after Markowitz had crossed intellectual swords with Friedman, the era of factor investing had begun in earnest.

3.3. And then there were even more

William F Sharpe, one of the architects of the CAPM and later the creator of the Sharpe Ratio, shared the 1990 Nobel Prize in Economic Sciences with Markowitz. In his Nobel Lecture he referenced a prescient article from six years earlier, *Factor Models, CAPMs and the APT*, in which he wrote: “We need not completely abandon a valuable framework within which we can approach investment decisions methodically. We have developed a useful set of tools and should certainly continue to use them.”

Echoing this sentiment, especially in the wake of Fama and French's breakthrough, the refinement of factor models proceeded at pace. As is the way with progress in any field, what had once been cutting-edge and apparently all but irrefutable was superseded. In due course the likes of MPT and the CAPM started to show their age.

Central to the incipient shift was the debunking of MPT's most cherished precept. In short, it turned out that higher returns did not invariably require higher risk. First uncovered by American economists Robert Haugen and James Heins in a 1972 paper that for decades was condemned to the realms of heterodoxy, evidence of the low-volatility anomaly – manifested in the empirical outperformance of low-volatility equities in comparison to their higher-volatility peers or the benchmark – eventually became too persuasive to ignore. The cause of factor investing was in no small part aided by the belated realisation that diversification solely by asset class might disguise risk concentrations and that strategies based on anomalies could also serve as the building blocks for portfolio construction.

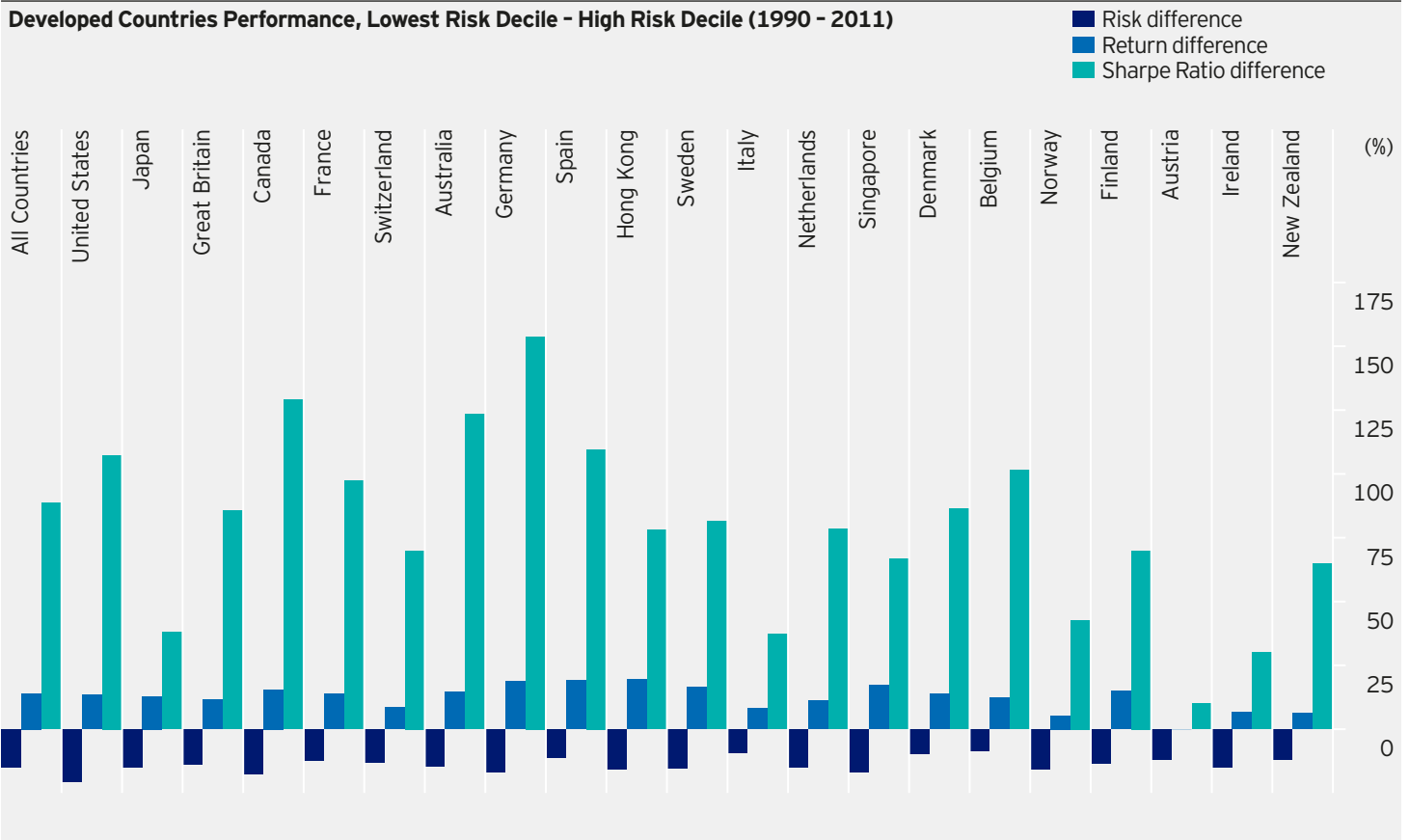
In tandem, an enhanced understanding of other areas of finance was reshaping the landscape perhaps even more dramatically. Behavioural scientists, foremost among them Nobel Prize winners Daniel Kahneman and Amos Tversky, produced a wealth of evidence to uproot another entrenched cornerstone of economic thought: the ideal of the rational investor. Novel concepts such as loss aversion, representativeness and the conjunction fallacy exploded the myth at the heart of MPT and the CAPM. As the investment world now concedes, human beings are anything but calculating, infallible, supra-cogent automatons; and the likes of MPT and the CAPM cannot account for the consequent mass predilection for cognitive error, because the models on which they are based do not cater for irrationality or even non-monetary utility.

Against this background of evolution and even revolution, factor investing's value in the search for an effective risk-return balance grew increasingly obvious. With factor-based approaches finding ever-greater favour as either a complement or an alternative to asset-class-based allocation, it seemed the most pressing question might be not whether factors were useful but how many still remained to be discovered.

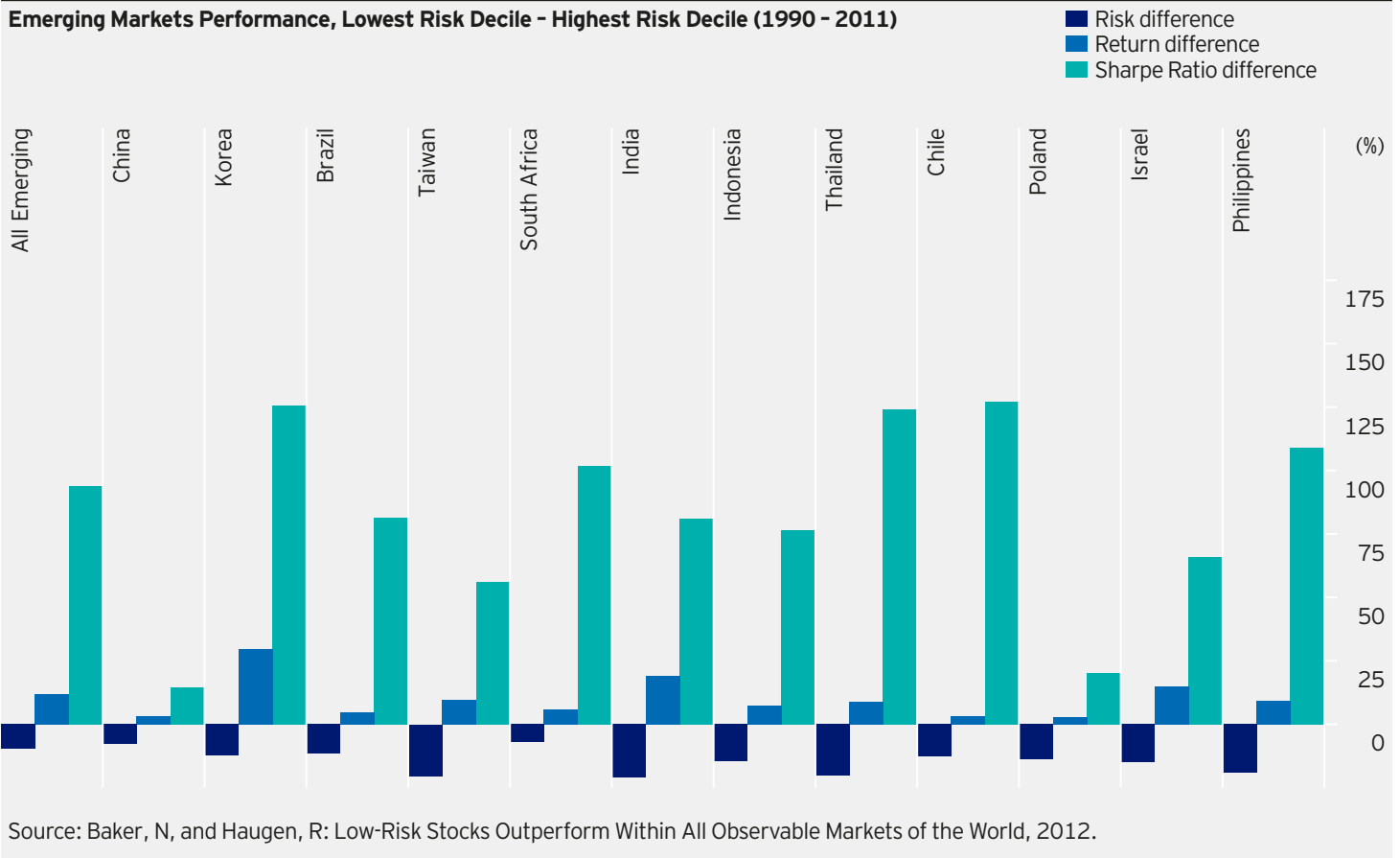
Figures 2 and 3

Robert Haugen is nowadays commonly referred to as “the father of low-volatility investing”. His final paper on the subject, published four decades after his first, demonstrated the persistence and comprehensiveness of the phenomenon in the equity markets of 33 countries over a 21-year period.

Developed Countries Performance, Lowest Risk Decile - High Risk Decile (1990 - 2011)



Emerging Markets Performance, Lowest Risk Decile - Highest Risk Decile (1990 - 2011)



Source: Baker, N, and Haugen, R: Low-Risk Stocks Outperform Within All Observable Markets of the World, 2012.

3.4. Factors today

The global financial crisis further underlined the damage that asset-class correlations might cause in times of market stress. It was the performance of the Norwegian Government Pension Fund at the height of the turmoil that prompted one of the most influential studies into the role of factors.

The fund reported a loss of 23.3% during 2008, yet during the same period its equity/fixed-income benchmark was down “only” 19.9%. Commissioned by the Norwegian Ministry of Finance to investigate this disparity, academics from Columbia Business School, Yale School of Management and London Business School concluded that 70% of all the fund’s active returns from 1998 to 2008 could be attributed to exposure to systematic factors - among them not just value and growth, as proposed by Fama and French years earlier, but credit spreads, duration and foreign exchange.³

Other research has since drawn attention to the impact of factors such as quality, momentum and volatility, to name but a few. Moreover, having once been confined to the dominion of equities, factor investing is today routinely applied to the likes of commodities and fixed income. As a 2015 S&P Dow Jones Indices paper remarked: “It is likely that the potential advantages of factor-based products... will mean practitioners continue to utilise and develop them.”

This much is doubtless true, although amid the rush to add to an ever-distending array it is becoming more and more important to distinguish between a factor that can genuinely be discerned from empirical data and a factor that is merely implied by quirk or coincidence. Generally speaking, authentic factors are differentiated from their ersatz counterparts principally by their persistence and comprehensiveness - per, for instance, the low-volatility anomaly as described in Haugen’s final study. As we will discuss in more detail later, strict criteria and rigorous screening processes are essential in sorting the wheat from the chaff.

As is now widely appreciated, it is these “real” factors that make a critical and ever-present contribution to overall investment performance. In doing so they topple the once-unshakable conviction that returns are derived purely from a simple combination of beta, as represented by market risk, and alpha, as represented by adept active management. Ultimately, quite how many factors there are or might be is open to debate, if not imponderable; but it is safe to say - not least for our purposes here - that some of the most compelling and significant to emerge revolve around ESG.

Figure 4

A landmark study of the performance of the Norwegian Government Pension Fund used the following factors to explain variations in returns between 1998 and 2008.

TERM	Difference between long- and short-maturity U.S. Treasury bond returns
CREDITAa	Difference between Aa and Treasury bond returns
CREDITBaa	Difference between Baa and Aa bond returns
CREDITHY	Difference between high yield and Baa bond returns
FXCARRY	Captures the carry trade of investing in currencies with high interest rates and shorting currencies with low interest rates
LIQUIDITY	Reflects periods of high and low liquidity
VALGRTH	Difference in returns between "value" stocks and "growth" stocks
SMLG	Difference in returns between small and large stocks
MOM	Captures the momentum effect of going long U.S. stocks with past high returns and short stocks with past low returns
VOL	Captures differences between implied and realised volatility

Source: Ang, A, Goetzmann, W, and Schaefer, S: Evaluation of Active Management of the Norwegian Government Pension Fund - Global, 2009.

“Factors topple the once-unshakable conviction that returns are derived purely from a simple combination of beta, as represented by market risk, and alpha, as represented by adept active management.”

³ As the largest sovereign wealth fund in the world, the Norwegian Government Pension Fund has also played a notable role in the history of ESG investing. In 2015 Norway’s parliament agreed to pull the fund out of mining and energy companies deriving more than 30% of their sales or activities from the coal business, and the following year more than 50 such firms were excluded. The fund’s stance on environmental issues has been widely hailed as evidence of the growing influence investors wield in addressing the issue of climate change.

4. ESG investing: the rise of responsibility

4.1. From Pigou to PRI

According to the Global Sustainable Investment Alliance, a collaboration of the world's biggest sustainable investment organisations, more than half of all professionally managed assets in Europe now qualify as "socially responsible investments"; in North America and Australia the proportion is lower but rising quickly.⁴ There can be no doubt that both the scale and sophistication of investments that give thought to environmental, social and governance issues are nowadays unprecedented. Yet it is important to note that the basic phenomenon itself is by no means new.

British economist Arthur Cecil Pigou first outlined the concept of "negative externalities" in *The Economics of Welfare*, published in 1920. Building on the work of celebrated neo-classicist Alfred Marshall, who preceded him as Professor of Political Economy at Cambridge, Pigou contended that the undesirable impacts of business - for example, pollution - should be punished by government intervention through taxation; by contrast, he said, "positive externalities" should be subsidised.

It is not difficult to find historical evidence of investors imposing their own "punishments" on the producers of negative externalities. Faith-based charities have long shunned sectors such as alcohol, armaments, gambling and tobacco. The political stances of some countries have prompted mass disinvestment - as witnessed, for instance, during the apartheid era in South Africa⁵ - and even today major index providers decline to recognise around half of the world's stock markets. In recent years the notion of complicity - that is, that the owners of stocks or bonds ineluctably share responsibility for the actions of the companies in which they invest - has become key to many investment decisions, with concerns ranging from committee structures to child labour, from bribery to climate change, helping to shape portfolios around the globe.

The success of the Principles for Responsible Investment (PRI), an initiative backed by the United Nations, underscores the ever-strengthening awareness of ESG. Assets under management in 2006, the year after PRI's launch, stood at US\$6 trillion; by 2015 that figure had increased almost tenfold. As signatories, institutional investors have a duty to act in the long-term interests of their beneficiaries and to align investments with the broader objectives of society.

It is tempting to surmise that during the past few decades, on balance, investment philosophies have thus moved a little nearer to the likes of Pigou and a little farther from the likes of Friedman - who, his appetite for intellectual confrontation undiminished after his skirmish with Markovitz, famously railed against the idea of philanthropy and corporate social responsibility in a 1970 *New York Times* article.⁶ Yet every investor retains some kind of Friedman-like focus on the bottom line: after all, nobody invests to lose money. As we will examine in the next section, a crucial question that has traditionally accompanied ESG investing is whether acting with the well-being of the wider world in mind brings due reward or whether, contrary to all our best and just intentions, it actually "pays to be bad".

⁴ A detailed breakdown can be found in the Global Sustainable Investment Alliance's 2016 Global Sustainable Investment Review.

⁵ The role of major banks in applying decisive pressure to the apartheid regime should be recognised. Chase Manhattan and Citibank denied South Africa their customary rollover credit facilities in the mid-1980s, setting the tone for more than a hundred US companies to pull out of the country between 1985 and 1987; other nations duly followed suit. The episode is recounted in detail in Russell Sparkes' *The Ethical Investor*.

⁶ Criticising those who championed the cause of corporate social responsibility, Friedman warned: "This may gain them kudos in the short run. But it helps to strengthen the already too prevalent view that the pursuit of profits is wicked and immoral and must be curbed and controlled by external forces."

Figure 5, 6 and 7

The Global Sustainable Investment Alliance's 2016 Global Sustainable Investment Review highlights the extent of sustainable investing's recent rise.

Growth of SRI assets by region, 2014-2016

Region	2014 (\$)	2016 (\$)	Growth over period (%)	Compound Annual Growth Rate (%)
Europe	10,775	12,040	11.7	5.7
United States	6,572	8,723	32.7	15.2
Canada	729	1,086	49.0	22.0
Australia/New Zealand	148	516	247.5	86.4
Asia ex Japan	45	52	15.7	7.6
Japan	7	474	6689.6	724.0
Total	18,276	22,890	25.2	11.9

Note: Asset values are expressed in billions.

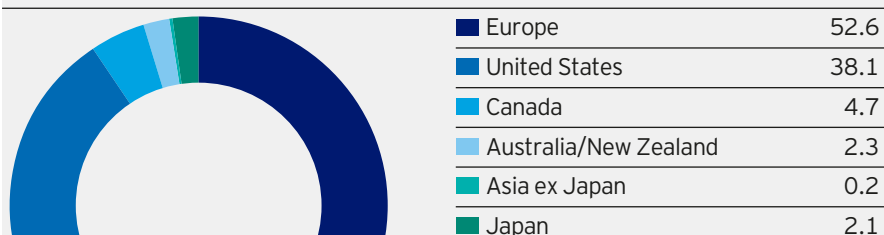
Asia ex Japan 2014 assets are represented in US dollars based on the exchange rates at year-end 2013. All other 2014 assets, as well as all 2016 assets, are converted to US dollars based on exchange rates at year-end 2015.

Proportion of SRI assets relative to total managed assets, 2014-2016

Region	2014 (%)	2016 (%)
Europe	58.8	52.6
United States	17.9	21.6
Canada	31.3	37.8
Australia/New Zealand	16.6	50.6
Asia	0.8	0.8
Japan	-	3.4
Global	30.2	26.3

Note: Asia figure includes Japan in 2014, but excludes Japan in 2016. Eurosif used a narrower definition of SRI in 2016 than in 2014.

Proportion of global SRI assets by region, 2016 (%)



Source: Global Sustainable Investment Alliance: 2016 Global Sustainable Investment Review, 2017.

4.2. Vice in the academic literature

So-called "sin" or "vice" stocks began to attract considerable academic attention in the mid-2000s. One of the first arguments to emerge from the earliest studies was that the likes of pension funds should deem it their fiduciary duty to invest in assets such as alcohol and tobacco, regardless of the wider implications of these products, if the expected returns could be classed as abnormally high.

This claim duly earned support from numerous analyses, maybe the most high-profile of which was *The Price of Sin*. Published in 2009 and afforded generous media coverage, including in the *Financial Times* and the *Wall Street Journal*, *The Price of Sin* concluded that "sin" stocks perform better than their more virtuous counterparts and that institutions subject to social norms should expect to pay a financial cost for abstaining from investing in them.

Importantly, however, many studies of this sort examined only the performance of hypothetical investment portfolios. They did not analyse actual funds investing in "sin" stocks. This meant researchers enjoyed the benefit of hindsight when selecting securities – a luxury that investment managers are not afforded. A more accurate picture could be developed only by exploring the performance of a real-world fund.

Perhaps tellingly, there was only one: the Vice Fund. It still operates today and still pursues the same investment philosophy, which is essentially to penalise rather than reward responsible corporations. Using controls for exposure both to small stocks and to tobacco stocks' excess legal risk, a landmark 2013 study, *Fiduciary Duty and Sin Stocks: Is Vice Really Nice?*, found no evidence of the Vice Fund significantly outperforming its conventional benchmark; it also suggested that the pro-"sin" results of previous studies were merely artefacts of the simplistic approaches used.

Further research has since reinforced this contention. Notable additions to the pro-ESG literature include *The 'Price of Sin' Aversion: Ivory Tower Illusion or Real Investable Alpha?*, which also exposes earlier studies' lack of real-world relevance, and the University of Hamburg's *ESG and Financial Performance: Aggregated Performance From More Than 2,000 Empirical Studies*, which concludes: "We clearly find evidence for the business case for ESG investing... ESG outperformance opportunities exist in many areas of the market." In addition, studies such as *ESG Shareholder Engagement and Downside Risk*, published in 2016, have underlined the power of active ownership in encouraging better corporate governance and, by extension, improved long-term performance – a notion that chimes with our own belief in an investment ethos that prizes ownership over speculation.

4.3. Approaches to ESG investing

The Global Sustainable Investment Alliance (GSIA) has set out seven approaches that together satisfy broad definitions such as “ESG investing”, “socially responsible investing” and “impact investing”. Here it may be helpful to take a closer look at two that encompass issues we have already mentioned in this white paper.

The first is corporate engagement and shareholder action. Although negative screening is the most popular sustainable investment strategy globally, it should not be forgotten that there are many options beyond simple exclusion. Ownership entails rights, and one of them is the right to effect - or at least to try to effect - meaningful change. As illustrated by the research referenced above, win-win scenarios are eminently feasible if a company is willing to listen.

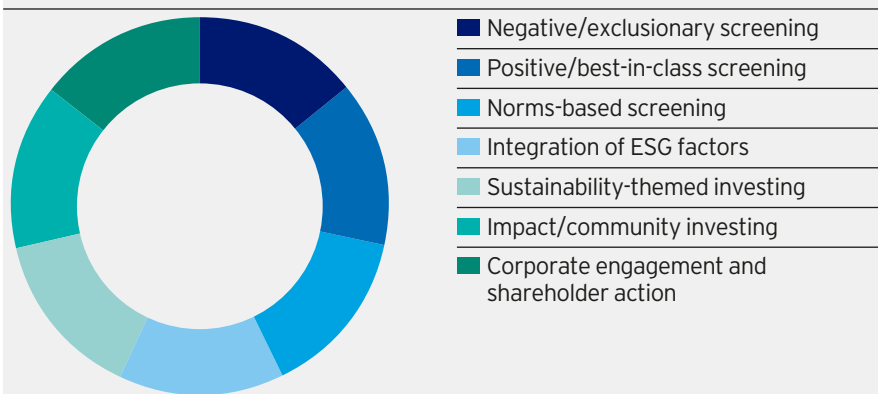
Some investors favour conspicuous and confrontational measures when attempting to reform policies and practices. Others employ more discreet tactics. Regardless of whether pressure is applied publicly or behind the scenes, transparency and dialogue are usually pivotal to success. Routes might include conferring with a firm's representatives, seeking a seat on a board, filing complaints or voting at shareholder meetings.

The second approach notably pertinent here is the integration of ESG factors. This might be succinctly defined as the systematic and explicit inclusion of ESG risks and opportunities in investment analysis. According to the GSIA's 2016 Global Sustainable Investment Review, this strategy is second only to negative screening in terms of popularity worldwide; in the US it is pre-eminent.

This brings us to where our two stories combine. Whether we choose to trace a path from the formative brilliance of Markowitz or the fearless contrarianism of Haugen, from the prescience of Pigou or the fury of Friedman, we have reached the point at which we can state with confidence that factors and ESG are strongly entwined. The result is a form of investment thinking whose reach and significance are today all but indisputable and whose methods are becoming ever more sophisticated, scientific and sensitive.

Figure 8

As detailed in its 2016 Global Sustainable Investment Review, the GSIA has distilled various socially responsible investment techniques into seven specific categories. They are as follows:



Source: Global Sustainable Investment Alliance: 2016 Global Sustainable Investment Review, 2017.

4.4. Asset management in the evidence-based age:

Q&A with Professor Andreas Hoepner

Andreas Hoepner is a Visiting Professor of Finance at Henley Business School's ICMA Centre and a co-founder of Sociovestix Labs, an academic-led social enterprise that advises on the generation of dynamic ESG strategies. In 2011 he co-authored one of the first studies to advocate incorporating ESG criteria into investment decisions, demonstrating the role of corporate environmental responsibility ratings in reducing downside volatility. The co-author of this white paper, he has served as the chair of the Financial Data Science Association and as an Academic Fellow with the UN-backed Principles for Responsible Investment initiative.

This white paper has charted the rise of ESG investing over a number of decades. How significantly do you think the cause has advanced during recent years in particular?

It has certainly gained a lot of momentum during the past decade or so. Speaking as a researcher in this field, I must say that studies into ESG investing were very much in their infancy even just 10 years ago and that the gap between academic research and mainstream finance was quite substantial. Today the notion that ESG considerations can be incorporated into investment decisions to enhance returns and reduce risk is acknowledged by researchers, practitioners and investors alike.

You were among the first researchers to identify and demonstrate some of the key advantages of ESG investing and the growing role of factors. How do you see ESG investing developing in the years to come?

To answer that question we first need to understand the nature of successful long-term asset management and, in tandem, how ESG investing relates to it. Then we need to consider how the wider world is changing and how the sphere of investment might itself change as a result.

First of all, then, I would say successful long-term asset management is about identifying structural trends earlier than others. Essentially, fund managers need to be able to discern corporate strengths or weaknesses well ahead of time. For this to happen it's necessary to have detailed information that can provide a competitive edge. As we now know, ESG-related data can be the source of a powerful advantage in this regard.

At the same time - and this is also increasingly important - ESG data can help meet the ever-growing demand for transparency in financial markets. This is especially desirable in an era when, in large part thanks to the internet, more and more people believe it should be possible to know pretty much everything about anything. So on the one hand we have a need for information, and on the other hand we have an appetite for information.

Now let's try to put the broader issue of information into perspective. We can do this very easily by reflecting on the amount of information we consume on a daily basis. Studies have suggested the average individual was involved in two newspaper pages' worth of information exchange per day in 1986 and six entire newspapers' worth per day by 2007. Today the amount of information we share and absorb has become so large that it's measured by the minute. We're living in the age of "big data", and this has major implications for asset management.

Why is that?

Big data sets have a subtle and democratising impact on investment research. They enable researchers to gather evidence on questions that were previously dominated by the assumptions of a select few "experts" whose authority remained unchallenged in the face of insufficient information. Given that asset owners have a fiduciary duty to take into account any relevant considerations that can be assessed with reasonable means, big data is lending itself to a much more evidence-based approach to asset management.

By way of illustration, we might usefully learn a lesson from the world of medical science, where any patient would expect a doctor to rely not only on personal assumptions and clinical judgment but on a wealth of evidence from laboratory tests and so forth. In financial markets this kind of thinking is still comparatively nascent - but this is changing as the potential power of an evidence-based philosophy becomes more apparent.

So is big data likely to play an ever-greater role in shaping ESG investing and the integration of factors?

In my view, the next chapter in ESG investing will draw heavily on bigger and deeper data to prioritise ESG issues across industries, countries and time.⁷ I also think this trend will continue to gain momentum as more and more millennials enter the workforce and increase their share in pension fund inflows, since it's millennials who show the greatest appetite for information and transparency and who most commonly express a desire to "make a difference".

"The big data 'stockpile' swells by the second. Crucially, financial data scientists can track all of this information, all of this behaviour, to measure how much attention a given aspect of ESG receives."

And in what ways do you see ESG investing drawing on big data?

All of us are constantly generating more and more data. We might do so by voicing our preferences through social media, by conducting a Google search or by clicking on certain topics on certain websites. The big data "stockpile", as it were, swells by the second.

Crucially, financial data scientists can track all of this information, all of this behaviour, to measure how much attention a given aspect of ESG receives. They can gauge activity and attitudes with regard to a particular industry, a particular country and a particular time period. In short, they can develop a full and dynamic picture of the "why", "where" and "when". For analysts this can serve as a useful guide in the form of efficient heuristics, and the resulting ability to prioritise ESG might even be more directly integrated into corporate ESG assessments.

How would that integration work?

It's worth noting that some ESG ratings can be a little static, as the considerations from which they're derived - board diversity, employee relations, environmental policies and the like - might not change very frequently. By contrast, society's attitudes towards the same issues might vary significantly during the same time period.

So if these existing and rather static assessments could be combined with the much more fast-moving picture that big data can provide - in other words, if ESG ratings could be rendered altogether more dynamic - then skilled portfolio managers should be able to extract more accurate signals to exploit upside opportunities and avoid downside risks. I believe that in the years ahead a select group of investment managers with outstanding experience in this more evidence-based and dynamic approach will come to dominate the market for ESG investing.

⁷ The Deep Data Delivery Standards initiative aims to promote excellence in this regard. Visit www.deepdata.ai for more information.

5. Sustainable factor investing: where factors and ESG meet

5.1. Evidence and ethics

The forces of globalisation have made investing easier in some ways and harder in others. It has become easier because all-round levels of interconnectedness, in tandem with the demands of fair disclosure, have rendered the sharing of analysis and insight both simple and instant. It has become harder because everyone has access to much the same vast universe of opportunities and much the same wealth of facts and figures - a situation that presents new challenges in terms of achieving comparative advantage and delivering outperformance.

One potential response for investment managers keen to set themselves apart is to obtain and exploit knowledge that goes beyond that which is near-effortlessly available to all. This might prove markedly valuable in the field of long-term asset management, where the ability to identify structural trends early and position oneself accordingly is often vital to ensuring clients' investments earn suitable reward over time. In the age of "big data", when an unparalleled capacity to access and explore information can enhance all manner of professional decision-making processes, the scope for looking further and digging deeper is unprecedented.

As we have already seen, factors have played a huge role in encouraging a move towards a more evidence-based approach to investment. They have certainly brought the spheres of finance and academic research closer together, as acknowledged in a 2013 MSCI paper, Foundations of Factor Investing, whose opening lines credited "a large body of academic literature" with factors' emergence. Not least in an era when asset owners have a fiduciary duty to consider any relevant information that can be assessed with reasonable means, factors have come to offer exactly the sort of resource-effectiveness, flexibility and empiricism that portfolio managers need to better serve their clients' interests.

In the case of ESG factors, however, it is not only clients' interests that count: the interests of society as a whole must also enter the reckoning. This is why the rise of such factors has been fuelled not just by an enthusiasm for evidence but by an appetite for ethics.

Demographic shifts have strengthened the general trend towards sustainability, accountability and legitimacy. The growth of the millennial generation has been particularly instrumental in this regard, with concerns such as climate change promoted to the top of news and corporate agendas alike as those born between the early 1980s and late 1990s make their voices heard both in public forums and in boardrooms. Studies have shown more than 80% of millennials believe they can make the world a better place, and ESG factors constitute a powerful tool in enabling investments to reflect this conviction.

5.2. Sustainability as a factor

With sustainability developing into a major investment theme, the evaluation of a company's ESG performance has become an industry in itself. The likes of Bloomberg, Thomson Reuters and MSCI, all of which established or acquired in-house ESG capabilities in the late 2000s, have led the journey from the margins to the mainstream.

Several procedures are used. Some, such as the straightforward surveys customarily conducted in the 1990s, are nowadays perceived as rather outmoded; others, such as the big-data-and-media-driven techniques gaining ground today, are in many ways cutting-edge in their design and implementation. We believe the external due diligence practised by EIRIS, MSCI and others tends to facilitate the highest degree of customisation; in addition, because it is independent of corporate self-reporting, this method is usually less susceptible to "greenwashing".

Although we remarked at the end of chapter 3 that the question of how many factors there are or might be is nigh on imponderable, a breakdown of the measures EIRIS uses to construct its corporate sustainability ratings provides a basic idea of some of the ESG-related factors currently taken into account (see panel 1). As can be seen, these range from environmental risk management to board-level diversity, from water scarcity to human rights, from supply-chain labour standards to employee relations. Even this, however, is only a partial snapshot: EIRIS can give weightings to more than 250 different criteria before arriving at an overall score.

Drawing on all of the above, we might usefully make a case for treating sustainability as an "inverse of risk". While conceding the temptation to search for a select array of "winners", we would argue that there may be greater merit in steering clear of the hundreds of "losers" in ESG data.

Such an approach is liable to involve much less competition, as most portfolio managers are assessed against the same benchmarks. Moreover, given that we are living in risk-averse times, it may well pay to remember that there are always more would-be losers to crash than there are would-be winners to rally. Under-weighting firms with poor ESG assessments vis-à-vis their benchmarks should avoid the many smaller drawdowns that a benchmark, with its thousands of stocks, will regularly incur. In other words, it is the insufficient sustainability of the benchmark itself that gives rise to ESG opportunities.

Figure 9

The range of factors outlined below offers a partial snapshot of the full array that can be used by EIRIS, a leading provider of external due diligence, to assess ESG performance.

Selected ESG factors

Environment	Social	Governance
<ul style="list-style-type: none"> - Environment impact and risk management - Environment performance - Environment solution companies - Climate-change impact and risk management - Biodiversity impact and risk management - Water scarcity and risk management - Sector-specific issues, e.g. chemicals, timber, tar sands - Allegations of environmental pollution or damage to biodiversity 	<ul style="list-style-type: none"> - Human rights - Supply-chain labour standards - Relations with customers and suppliers - Relations with employees - Stakeholder engagement - Community involvement - Sector-specific issues, e.g. access to medicines - Allegations of breaches of human rights norms and labour standards 	<ul style="list-style-type: none"> - Board practice and structure - Anti-bribery practices - Codes of ethics - ESG risk management - Board-level responsibility for stakeholders - Board-level gender diversity - Allegations of bribery

Source: EIRIS global sustainability ratings, as at 17 May 2017.

5.3. Sustainable factor investing in action

Although past performance is not a guide to future performance, the uncomfortable reality for compliance officers everywhere is that history is the sole source of empiricism⁸. This being the case, it may at least be illuminating to discover how ESG factors have contributed to a specific portfolio's returns over the course of a number of years.

Building on the notion of sustainability as an "inverse of risk", we studied the decade-long performance of a real-life portfolio customised to meet the preferences of a faith-based investor. We analysed more than 500 time-series observations of equity returns over the period from April 2005 to December 2015, using weekly observation intervals to enhance statistical power while minimising the intra-weekly stock-price noise generated by higher-frequency traders.⁹

Employing a highly sophisticated multi-factor approach and various controls, including for exposure to negative returns and drawdown, our model was able to explain 88.77% of all returns. The portfolio was found to have a beta of 1.17 and a value tilt of 0.39 - both statistically significant at the 1% level.

Most importantly for our purposes here, sustainable investment was calculated to have been responsible for alpha of 180 basis points per annum. This represented healthy outperformance against the benchmark universe.¹⁰ Since alpha was also estimated at the 1% significance level, the chances of the portfolio not outperforming its benchmark were less than one in a hundred. This suggests evidence-based, sustainable investing does not only allow for customisation towards specific asset-owner preferences: it also has strong alpha potential, as proved by the sample portfolio over the span of a decade.

There is, of course, another key inference: sustainable, evidence-based investing has clearly and substantially enriched portfolio managers' understanding of which assets are most affected by ESG factors. In the next section we will briefly examine further how this understanding has helped redefine the eternal quest to reduce risk.

5.4. Sustainable factors and the reduction of risk

Research indicates that a desire to manage risk is the principal driver of the industry's burgeoning zeal for integrating ESG factors into investment decisions. It was by far the most prolific motive cited in a 2015 CFA Institute survey of more than 1,300 portfolio managers and research analysts, with investors' own demand for ESG a distant second (see panel 2).

Some might think it surprising that other reasons did not figure more prominently. Reputational benefit and regulation, for example, polled just 30% and 11% respectively. As we have stressed throughout this white paper, though, ours is a risk-averse age - one in which the search for reliable, meaningful returns has in many ways become tougher and investors' confidence has been shaken by the global financial crisis and other shocks.

Since fixed-income products hold comparatively little appeal in an economic environment characterised by low growth and limited yield, most investors recognise that equities represent one of the likeliest routes to recovery for portfolios that may have suffered from the dwindling appeal of bonds. What these investors want, all things being equal, is a combination of decent performance and reduced risk - an investment journey that is devoid of dizzying peaks and troughs yet nonetheless rewarding. The role of factors of all kinds in achieving this aim is becoming ever more manifest.

With this in mind, it is interesting - to put it politely - to note the thinking of the 27% of CFA Institute survey respondents who said they did not integrate ESG factors into their investment decisions. Most ascribed their disinclination to a lack of demand from clients and investors, perceptions of immateriality or a dearth of data; a small percentage - bizarrely, we would say - even claimed including ESG factors in their analyses would force them to "focus on short-term performance". Some 57% said they would start to consider ESG issues in light of sufficient client demand.

It is easy for institutions to administer blandishments about embracing ESG. What is far more difficult is to justify all the boasts and fulfil all the promises. We believe intelligent procedures and an authentic commitment to responsible investing are required not only to surmount many of the inherent and longstanding hurdles but to give more and more investors what they so obviously want.

Figure 10

A recent CFA Institute survey asked portfolio managers and research analysts worldwide if, why and how they considered ESG issues. Carried out in May and June 2015, the survey invited 44,131 CFA Institute members to take part. Its findings were based on 1,325 valid responses.

Why do investment managers consider ESG issues?

Survey response	Respondents (%)
To help manage investment risks	63
Clients/investors demand it	44
ESG performance is a proxy for management quality	38
It's my fiduciary duty	37
To help identify investment opportunities	37
My firm derives reputational benefit	30
Regulation requires it	7
Other	5

Source: CFA Institute: Environmental, Social and Governance (ESG) Survey, 2015.

⁸ Nonetheless, we shall say it again: past performance is not a guide to future performance.

⁹ 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.

¹⁰ The MSCI World Index.

6. Conclusion

All great scientists recognise their own work is likely to serve only as a stepping-stone to something better. So it has proved in the case of sustainable factor investing, a concept that has resulted from the combined wisdom – some of it still relevant, some of it long since refuted – of several of the very finest thinkers in the annals of finance and economics.

We hope that in assembling this white paper, on balance, we have cast their shared achievement in a suitably impressive light. Moreover, having reflected on all that has brought us this far, we look forward to sustainable factor investing's continued refinement and to whatever additional benefits may consequently be enjoyed in the sphere of institutional investment and beyond.

There are certainly grounds for optimism in the latter regard, because what seems increasingly obvious today is that sustainable factor investing represents an investment ethos uncannily in keeping with the zeitgeist. With millennials in particular driving substantial moves towards sustainability, accountability and legitimacy, it echoes the widespread conviction that everyone can and should play a role in making the world a better place.

For this to happen, of course, it must pay to be good. As we have seen, the rise of sustainable investing in general has long been accompanied by debate over the impact of incorporating environmental, social and governance considerations into investment decisions. For whatever reason, those studies that suggest it pays to be bad tend to earn more column inches than those that argue the opposite; and yet the most comprehensive research clearly indicates that ESG-led investing neither compromises corporate financial performance nor has a significant adverse effect on long-term reward or risk.

In this paper we have added our own small contribution to the growing body of evidence in support of sustainable factor investing, demonstrating that such an approach not only allows for customisation towards specific asset-owner preferences but also offers strong alpha potential. In doing so we have shown that sustainable factor investing has become an important and effective component of our philosophy of long-term asset management in a world that is both increasingly averse to risk and ever more rightly intolerant of injustice and inequality.

“What seems increasingly obvious today is that sustainable factor investing represents an investment ethos uncannily in keeping with the zeitgeist.”

7. Appendices

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7.2. ESG investing: the Invesco approach

Invesco has been involved in ESG investing for more than 15 years. It is a signatory to the Principles for Responsible Investment and has its own Responsible Investment team. It currently manages more than US\$550 billion in sustainable investments across 17 different strategies, using a variety of approaches to ESG integration.

Two of these approaches, each of which is used by the Invesco Quantitative Strategies (IQS) Group, are especially germane here. You will recognise both from the official list of strategies/activities compiled by the Global Sustainable Investment Alliance, as reproduced in section 4.4. The first is positive screening; the second is the integration of ESG factors (see panel). In both instances IQS's proprietary stock-selection model, which itself benefits from the application of factors (see panel 5), also features.

The strong ESG focus manifest in these processes supports an investment philosophy that respects the concept of business ownership and rejects the negative elements of mere speculation. So, too, does Invesco's status as a Tier 1 signatory to the Stewardship Code of the Financial Reporting Council, which stresses the merits of constructive engagement between investors and the companies in which they invest.

This aspect of ESG investing is also very much to the fore in Invesco's proprietary voting platform, which helps fund managers make well-informed, thoughtful and independent proxy investment decisions. The only one of its kind in the industry, the platform allows Invesco to build an institutional knowledge base on corporate issuers, to streamline the delivery of research and to foster dialogue and transparency. The advantages and unique aspects of this system are covered extensively in a companion white paper, Proxy Voting: The Hallmark of Active Ownership.

IQS approaches to ESG investing

The IQS Group has more than US\$2 billion in ESG assets under management (as at 30 November 2016). It uses two main approaches to choosing the ESG assets in which it invests.

- Positive screening

This approach uses the Dow Jones Sustainability Global Index (DJSGI) family as a benchmark and as the investable stock universe. The companies in the DJSGI are selected according to the best-in-class principle.

The underlying universe is the Dow Jones Global Index, which contains the 2,500 largest-capitalised companies in the world. From this, the best 10% of each industrial group is calculated using industry-specific sustainability analyses before being pooled with the DJSGI, which contains 319 companies from 26 countries and 57 industry groups. A strategy based on the DJSGI thus invests in best-in-class firms whose sustainability is carefully assessed by the index provider.

- Integration of ESG factors

This approach uses the Portfolio Manager service from EIRIS, a leading provider of external due diligence, in cooperation with a global network of partners.

More than 250 criteria can be used to analyse 3,500 companies worldwide, including almost all the constituents of the MSCI World Index. Individual clients decide which criteria should be employed to meet their particular portfolio requirements. Broad exclusion/inclusion guidelines can be set, as can specific measures and conditions.

Figure 11

Both of the main approaches used by the IQS Group to select ESG assets in which to invest feature IQS's proprietary stock-selection model, which has a proven real-time track record of more than 30 years.

The IQS stock-selection model

ESG stock selection model				Concepts
Earnings expectations	Market sentiment	Management and quality	Value	
How are expectations changing? ✓	What is market sentiment telling us? ✓	What is management doing? ✓	How attractive are valuations? ✓	Factors ¹ Quantifiable Predictive Complementary
- Earnings momentum - Earnings revisions - Cash flow surprise - Revisions against trend	- Price momentum - Long-term reversal - Short term reversal - Short interest	- Net external financing - Net asset growth - Capital efficiency - Fundamental health score - Liability payback horizon	- Cash flow yield - Gross profit yield - Earnings yield - Dividend yield	
Stock return forecast				

Source: Invesco. For illustrative purposes only. As of 17 May 2017.

¹ Not all factors are used in all regions and sub-models. Additional factors are used in specific sub-models and definitions may vary across regions.

Important information

All data provided by Invesco as at 30 April 2017, unless otherwise stated.

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