The Climate is Ripe for Change

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"How can asset owners and managers work together to drive rapid decarbonisation that averts the long-term wealth destruction implicit in 3C+ climate change?"

The Problem

In order to move the world to carbon neutrality trillions of dollars need to be invested worldwide in 1.) renewable energy generation, 2.) electricity transmission systems and 3.) energy efficiency.

ESG activities, while accelerating markedly, only impact at the margin the cost of capital of companies, favourably or unfavourably. The reality is that they have not had much real-world impact on society or the environment. They do not channel fresh money at scale to make the investments needed. Further, today's best practice model for long-term pools of capital, based around strategic asset allocation and market benchmarks, inhibits the ability of asset managers to make the investments needed, principally because of misaligned incentives. Returns are judged relative to a market benchmark thereby requiring managers to think as much about what they

don't own as about what they do own. The focus is on tracking error risk, not the much more important absolute risk to the institution of meeting its liabilities.

Risk management is focussed on returns relative to the strategic benchmark (these risks are small), rather than on returns relative to the liabilities (these risks are large). Volatility is the preferred measure of risk, whether through VaR measures, or through the volatility of returns relative to a market benchmark. VaR as a risk measure can by itself create systemic risk. If volatility increases, VaR limits may be exceeded, not just for one investor but for many. In aggregate, reducing VaR exposures means reducing the size of the balance sheet exposure. Investors become sellers for choice with few, if any, buyers. These are the conditions that create gap risk.

Regulatory regimes, while well intended, encourage asset owners to act in a pro-cyclical manner. With multiple powerful vested interests, governments struggle to provide the incentives necessary to turn the economic ship in time. Yet we have already gone through at least two global energy transitions in the past, from wood to coal, and from coal to oil, gas, nuclear and electricity. We also know that transitions can happen quickly, recently and most notably in the area of technology. Only twenty years ago, it would have been close to impossible to have imagined how technology has changed almost every aspect of our lives. Our teenage children simply cannot imagine a world without smart devices!

The world will transition to renewable energy and carbon neutrality. The question is can this be done in time? What needs to be put in place to make the necessary changes happen at pace?

The Solution

We believe that there are four elements to a solution and they all need to be brought together at the same time:

1. Fundamental changes to the best practice model for long-term pools of capital.

   This approach, sometimes called a Total Portfolio Approach (TPA), has been adopted by some major funds in some cases for more than a decade. So far, though it is largely major funds with their own investment resources, along with funds which have gone down the fiduciary management route who have adopted a TPA. To many smaller pools of capital the Strategic Asset Allocation model is seen as simpler.

2. A rethink of what we mean by risk.
3. A supportive regulatory regime.
4. National and international government bodies coming together to provide the right incentives to encourage change at pace.

The Approach

(Not so) Modern Portfolio Theory

To understand the changes we need to make to the industry's best practice model, we first need to understand its flaws. Only then can we truly understand how an alternative approach can satisfy the twin needs of our fiduciary responsibilities, and the need for the world to drive rapid decarbonisation.

Harry Markowitz won the 1990 Nobel Prize for Economics for his pioneering work in Modern Portfolio Theory (MPT) first published in 1952 (Portfolio Selection). It was his work which introduced the concept of mean variance efficient portfolios where risk was defined as the volatility (standard deviation) of returns. An efficient portfolio was one which gave the highest return for a given level of risk. All this was well and good in theory but it was impossible to implement at the time as we simply did not have the computing power to handle the large scale matrices of returns, volatilities and correlations involved.

Roll the clock forward and Bill Sharpe, who also won a Nobel Prize for Economics in 1990, published his seminal paper describing the Capital Asset Pricing Model (CAPM) in 1964. The ideas set out finally made the concepts of Markowitz's work tractable. Sharpe made the entirely plausible assumption that return and risk were linearly correlated. After all why would an investor accept higher volatility if it was not compensated by higher return? This simple idea allowed Sharpe to introduce a single risk measure, Beta, the volatility of an asset relative to the market. In so doing the computational limitations of the Markowitz model were overcome. Falling out of this work were two other conclusions. Returns should be IID (Independent and Identically Distributed) or follow a normal distribution. And crucially the market portfolio provided the highest possible return to risk ratio. It is hard to overstate the significance of this. It led to the start of the index, passive fund business when Wells Fargo launched the first fund in 1975. Since then trillions of dollars have been invested on this basis through passive funds and of course more recently through Exchange Traded Funds (ETFs).

What is important to remember is that almost all models are in some way approximations, or abstractions from reality. When Isaac Newton explained in one set of equations the movements of billiard balls and planets, in fact everything that was observable at the time, he had the humility in Principia Mathematica to acknowledge that if masses were too big or too small, or speeds too fast, his set of equations might not stand up. That was pure genius! Move on to the 20th century and Albert Einstein developed the general theory of relativity for which he was awarded the Nobel Prize for Physics in 1921. It was also Einstein who said "we should always make things as simple as possible, but no simpler …". More on that later.

Gordon E. Moore, founder of Intel, in a 1965 paper predicted that computing capabilities would double approximately every two years. At the time, he was referring to the number of transistors on a chip. More generally, it is now interpreted as meaning that speeds and memory will double every two years while prices will halve. This has really stood the test of time well.

As Moore's law rolled forward not only did computing power grow exponentially but so did the data we had on stock prices and markets, so allowing us to test Bill Sharpe's assumptions. What we found was that:

- Returns and volatility were not linearly correlated
- Returns were not independent and distributions were not normal; they were leptokurtotic (fat tailed, high peaked).

Both of Bill Sharpe's key assumptions were wrong. That does not mean that the market portfolio is easy to beat. It isn't. We still have the truism that the return to all investors is the market return minus costs. Investors as a whole must earn less than the market.

The fact that returns are not normally distributed, but are instead fat tailed, means that we should expect outlier returns, tail events, to be far more common than we would expect from an efficient market as described by Markowitz and Sharpe, and that is exactly what we have experienced to our cost.

We also observe that returns are far more episodic than we might expect. Taking the longest data set I can find of US equity returns going back to 1802 we find that secular bull and bear phases lasting between 8 and 20 years are the norm. This in itself creates very serious problems for investors trying to build assets to meet, for example, their retirement needs.

The growth in computing power and data is seductive. In 1974 the challenge was to get information. In 2020 the challenge is how to make sense of all the data we are bombarded with. Today the talk is all about Big Data. We are encouraged to believe that it holds the key to the universe. The reality is that too many of us misuse and abuse our computing power. If I measure the temperature in the room, and then repeat the measurement 1,000 times in the next minute, I am not likely to learn anything useful. More data is not necessarily more information. Too many of us are seduced by the apparent sophistication of our models with the result that we put far too much reliance on them and their ability to give us precise answers. As a physicist I was always taught never to display answers to more significant figures than were significant! That is a lesson those of us working in investments would do well to bear in mind.

What do I mean when I say the industry is badly organised to deliver? I point to a piece of legislation in the United States passed in 1974, ERISA, the Employee Retirement Income Security Act. It was this Act that spawned the investment consultancy business and led to the benchmark based best practice model that was pretty much standard up to the end of the last century. Many pools of capital still follow the model today, albeit there is increasing recognition that the model is flawed. While practice varies country by country in line with local practice and legislation, the essence of the model is broadly the same.

What is it about the model I so dislike? It is essentially a five stage process:

- Conduct an asset/liability study to determine a strategic, market based benchmark
- Construct an implementation plan around that benchmark – typically combining a mix of specialist managers in both active and passive strategies
- Conduct a manager search to fulfil the implementation plan
- Fund and monitor the managers
- Repeat every three to five years

If you will accept that as a short hand description of what we typically do today, how could anyone find fault with something so apparently reasonable? Unfortunately, it is riddled with problems.

The 80:20 rule

The model devotes most of its effort to controlling the risks from the portfolio of managers to the benchmark that came out of the asset/liability study. Only every three to five years do we manage the risks from the benchmark to the liabilities. Yet surely the lesson of the last twenty years is that the risks from the actual portfolio relative to the strategic benchmark are small, sometimes trivially small, whereas the risks from the strategic benchmark to the liabilities are large, sometimes very large.

In short, we have the 80:20 rule completely back-to-front. By spending most of our time worrying about market benchmark relative returns, we are missing the point that you cannot pay pensions out of relative returns; we need to be much more focused on the benchmark that really matters, and that is the liabilities. Not doing so has cost us dearly. As interest rates have declined over the last forty years, pension liabilities have grown dramatically. By holding fixed income assets of much shorter duration, in line with the market benchmark, we have missed out on a compensating increase in asset values.

Our risk appetite never changes!

But it's worse than that, much worse. Implicit in a relatively static strategic benchmark is that our risk appetite remains unchanged even as our wealth (funding ratio for a pension plan) changes or as forward-looking risk premia (return expectations) change. This makes no sense at all. Surely we can all agree that our risk appetite should respond to changing return prospects, and surely most of us will acknowledge that our risk appetite does in fact change as our wealth rises or falls, even if the manner in which it changes will be different for different investors.

Asset/Liability modelling (A/L)

There is more. The great risk with modelling is that it is all too easy to get caught up in the apparent sophistication of the model and the precision of the numbers that emerge. Yet the 'GIGO' principle holds, 'Garbage In Garbage Out'. The return assumptions used, are of course, critical. Typically, an A/L model will use something close to the current redemption yield as the forecast for bond returns. For equities the model will use something similar to a Gordon Growth Model. The Gordon Model simply says that the long-run real return from equities will equal the current dividend yield plus the long-run growth rate. Essentially the idea is that in the very long-run, returns are dominated by income, dwarfing changes in valuation. The current dividend yield is observable, and the long-run growth is usually derived from looking at long-run historical growth rates in earnings or GDP.

The problem is that, in every decade since the 1970s and quite likely before, a Gordon model forecast would have been way away from reality. In the last decade and in the 1970s, the forecast would have been far too high, and in the 1980s and 1990s, far too low.

Gordon growth model versus reality

Annualised Real returns on the S&P 500	Strategic Forecast (Gordon Model)	Actual
1970s	7.2%	-0.1%
1980s	7.6%	12.6%
1990s	5.1%	14.8%
2000s	2.7%	-2.1%
1970s to 2010	7.2%	6.5%

Source: Strategic Forecast data from Robert Shiller, Used in "Irrational Exuberance" Princeton University Press, 2000, 2005, updated. Actual data from Global Financial Data, Thomson Datastream, Schroders, February 2012, for illustration only.

For most, if not all of us, being way off target for periods as long as ten years is simply unacceptable.

Component Part Suppliers

The asset management industry has been reduced to being component part suppliers. What do I mean and why does it matter? Clients in the main come to a manager to ask them to manage a segment of their portfolio, perhaps UK equities. We are not often asked to help with the holistic problem of delivering the return that will allow the fund to pay its pensions. As a fund manager we are asked to either match, if we are passive, or outperform, if we are active, a market based benchmark. First, this is a negative sum game in that the return to all investors in a market place is the return of the index less costs. So, while any individual may succeed in beating their benchmark, the odds are stacked against the industry as a whole. We have created a target that is unachievable in the aggregate. I would also argue that this is a chronic under-use of manager skills. Asset allocation is recognised as the most important determinant of returns, and yet it is largely left unmanaged in between asset/liability modelling every 3 to 5 years!

Second, as already noted, by focussing on broad market benchmarks, managers are incentivised to worry as much about what they don't own, as they do about the assets they do own. This is a major impediment to putting ESG goals at the heart of the investment process.

Risk

In strategic asset allocation work volatility (standard deviations) and correlations are key variables. Yet, as already noted, investment returns are not normally distributed, nor are correlations and volatility stable.

Fundamentally, risk is the inability to pay the liabilities that a fund is set up to meet. Volatility doesn't only present risks (which can be managed), volatility can also present opportunity.

In the next section I will outline a different best practice model, one better suited to managing risk, and one which at the same time is potentially better able to play a leading role in decarbonisation.

To realise that potential two other elements need to be brought to the table, a supportive regulatory regime, and national and international governmental bodies coming together to provide the incentives.

A Brave New World

A better best practice model

So what am I advocating?

I am not advocating abolishing all benchmarks; certainly not. I am advocating replacing market based benchmarks with real world benchmarks directly linked to a fund's purpose. So for a pension fund that might be its funding ratio and the funding ratio's volatility. For an endowment it might simply be a real rate of return goal after all fees and charges.

To be clear, this does not mean eliminating market benchmarks entirely; it just means relegating them to a secondary, much more minor role where they belong. So after you have looked to see if you have met your funding ratio goal, it is entirely reasonable to then go on and ask the question "did I make the most of the opportunities the market presented"? Was this an environment when, say, equities were performing well and how did my holdings do against the opportunity set out there? For that you will want to keep an eye on market benchmarks, but this is absolutely secondary to understanding first the evolution of the funding ratio.

There is another very important benefit that comes from adopting a real-world benchmark in place of the strategic benchmark. It frees up asset allocation, allowing it to be more dynamic and to really work for the fund. To be clear, I am not talking about some high turnover, Tactical Asset Allocation programme. I am talking about responding to the extreme over- and under-valuations that occur far more regularly than the Efficient Market Hypothesis (EMH) would suggest (Remember those fat tailed distributions).

Let's remember that the idea of efficient markets and CAPM lay very much at the heart of the asset/liability model that lies behind the whole idea of strategic asset allocation studies. Yet nobody today believes that the EMH represents anything other than an abstraction of reality.

Think back to the main valuation outliers we have experienced in the last 30 years. I can think of four of them.

First, there was the Japan equity bubble of the late eighties. This is the last time I can remember the industry actually responding in a timely fashion to a bubble. By the way, the credit goes to the asset owners, not the asset managers. Here, I am thinking of US pension funds. They simply could not believe that Japan represented 45% of the world or something like 85% of the World ex US. They used every device under the sun to reduce the weight of Japan in their portfolios. They moved to regional weightings, GDP weightings or equal weightings. The goal was always the same, to reduce the weight of Japan in their portfolios. What a good decision that was.

Then when we had the TMT bubble at the end of the '90s, most funds just rode the bubble up and down.

When the fantastic opportunity came in Investment Grade credit at the end of 2008 and into 2009, how many funds really took advantage?

How many have responded or are going to respond to the bubble in developed government debt which has taken government bond yields down to close to zero in nominal terms and negative in real terms? In doing so, the "reverse yield gap" (Equities yielding less than Government Bonds) has convincingly reversed again. How many believe that is sustainable in the long-term and what are the implications if the "reverse yield gap" were to reappear?

Plan Ahead

I would be the first to acknowledge that what I am suggesting is not easy. First, any change in allocation away from the comfort zone of the "Strategic Asset Allocation" solution will potentially take a fund away from the consensus, never an easy choice to make. Going down this path has significant skills and governance implications for fund boards. Dynamic asset allocation necessarily means doing something different to other funds, the consensus. That is an inherently uncomfortable act for many. It is also inevitable that in doing something different to the typical fund there will be periods when headline returns will be worse. The governance structure

needs to be able to withstand that pressure. A robust, sustainable governance structure will need to have the following three elements:

- A highly skilled investment committee. Key investment decisions are going to have to be made jointly. For all parties to the decision to be comfortable, everyone at the table will need to be able to contribute.
- Representation by all key stakeholders. Everyone with a material interest needs to be at the table, the sponsor, the Trustees (or their Investment Committee), the fund's consultant, and the fund's lead asset allocation manager/adviser. In order to be able to withstand the pressures of being on the wrong side of the median fund from time to time, it is important that key decisions have been collective so that they are a shared responsibility.
- Detailed records. Memories can be fickle and 20:20 hindsight is a wonderful thing. It is important that detailed records are maintained of the reasons behind key decisions. When those decisions are questioned later on, it is important to be able objectively to judge whether the assumptions behind them have turned out to be false (in which case the strategy must change), or whether they remain valid (in which case it will probably be right to tough it out and wait for the strategy to come good).

This kind of an interaction between stakeholders, particularly the collective nature of decision making, is very different to, and rather more complex than the typical modus operandi for most funds today. The prize, if we do this properly, is a strategy which responds to the highly cyclical returns from markets and is genuinely tailor-made to the circumstances and risk appetite of the individual fund: Better funding ratios, better outcomes.

Risk

If volatility is not an effective measure of risk what is? Cash flow. Predictable cash flows of all forms (dividends, coupons, maturities …) large enough to meet expected liabilities for the next several years minimises the risk of having to sell assets at depressed prices during down markets. It can also provide the potential to act as a long-term investor and benefit from volatility by acquiring (not selling) assets at depressed prices.

However, managing risk from market cycles is not the only risk we have to contend with. There are a myriad of other risks: Credit, Counterparty, Liquidity, Operational … and Climate Change.

Fiduciary Risk

In the past many asset owners argued that it was not possible to take ESG factors into account because of their fiduciary responsibility to maximise risk adjusted returns. The exact position varies country by country. However, at least in the UK, it was always possible to take ESG factors into account as long as 1.) it did not fundamentally alter the risk return profile of the fund and 2.) Trustees could reasonably assume that the majority of their beneficiaries would be supportive.

So, if for example, a fund wanted to exclude Tobacco stocks, they could do so if they felt that the beneficiaries would be supportive. Excluding a handful of stocks is not going to fundamentally change the risk and return profile of the fund. Almost every other decision Trustees will take will have more impact, for example the degree of LDI hedging.

Moreover, it is perfectly reasonable to argue that ultimately Tobacco companies will pay for the negative externalities they create, through regulation and taxation. At some indeterminate time in the future, Tobacco companies will likely go out of business. Excluding them now can reasonably be regarded as prudent risk management for a long-term investor.

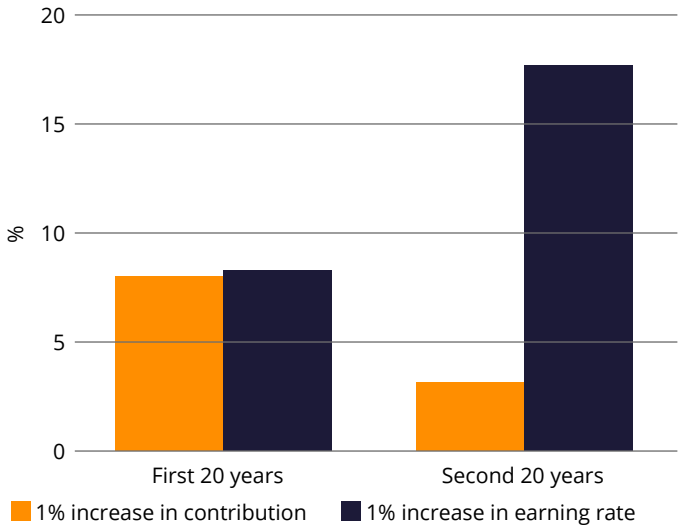
Finally, it is reasonable to assume that Trustees of most funds could safely assume that the majority of their beneficiaries would be supportive of a tobacco exclusion, or at the very least neutral to the idea. For those Trustees that don't find that assumption safe, the polling of members on their wishes has become a new avenue to pursue.

Money versus Time-weighted returns

Another example of where we make things too simple is in our use of time-weighted returns. The asset management industry spends almost all of its time thinking about time-weighted returns (where the return in each period is given equal weight) as opposed to money-weighted returns where each return is weighted by the amount of money it acts on. Time-weighted returns are simple and convenient, but it is money-weighted returns that matter to an individual and the difference can be dramatic.

Given some plausible investment and savings assumptions, it turns out that in the first 20 years of a savers life a 1% change in contributions has about the same impact as a 1% change in investment returns. But in the second 20 years, when the returns are acting on a much larger pot of money, a 1% change in investment returns has about six times the impact of a 1% change in contributions.

% increase in end benefit

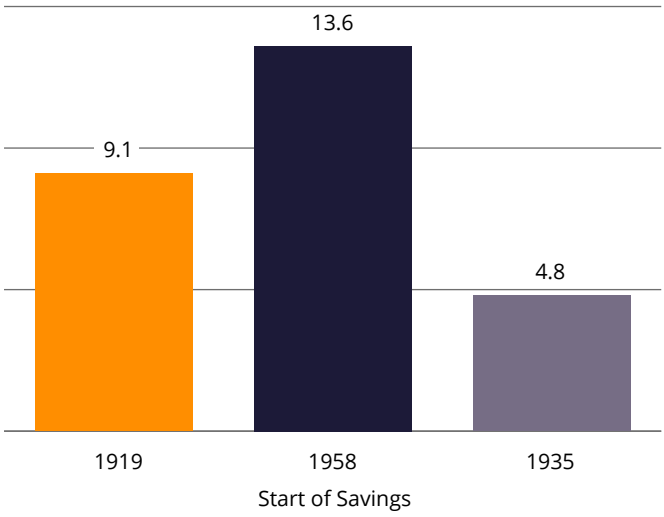


Source: Schroders. 40 Year contributions at base contribution rate of 9% of salary, indexed at 3% p.a. Annualised earning base rate 8%p.a.

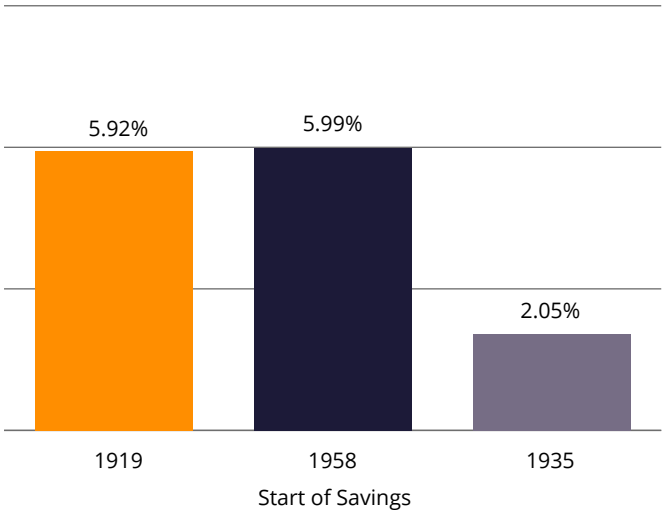
This immediately highlights a very difficult problem. For an individual targeting a real level of assets to retire on, it will be extremely difficult to manage the outcome by varying contribution rates alone as changes in investment returns in the final years will overwhelm, for better or worse, the effect of any changes in contributions. This is, of course, the key reason behind lifestyle type savings plans which migrate a saver's asset allocation to less "risky" structures in the final years before retirement. Such programmes do however, come with their own costs, particularly when government bond yields are extraordinarily low, or negative in real terms, as they are today in many developed markets. The problem is worse than that. It clearly matters a great deal as to the level of real returns experienced during a saver's life, but the order of returns matters also. There were two forty year periods (starting in 1919 and 1958) in Australia where a saver would have experienced nearly 6% real returns, but the outcome can still vary enormously. In one instance the final savings pot would have been 13.6X final salary, in the other only 9.1X. In the first instance, the higher returns were experienced later in the saver's life and so acted on a larger pot of money. There is of course no way for an individual to know the saving's environment they are going to experience, either in terms of the level of returns or their order.

There were also periods when real returns were much lower at around 2% and then the final savings pot would have been only about 4.8X final salary.

End benefit as a multiple of salary



40 year average rate of return



Source: Schroders

There are no easy answers to this. However, as more and more individuals have to take responsibility for their own savings and bear the investment risk, we need to educate them as to the realities they face and we need to try as hard as possible to build strategies which, while unlikely to eliminate the problem, will at least help to mitigate it. This will not be easy. If the first 20 years of a saver's experience happen to coincide with poor investment returns, it will be challenging indeed to try and persuade them that this could be the best possible outcome if the next 20 years turn out to be a secular bull market! All the evidence is that this is a chronic problem. As we showed earlier, secular bull and bear markets are the norm.

Predictions!

What I conclude from this is that going forward successful asset owners and asset managers are going to listen to Einstein and stop making things too simple. They will acknowledge:

- That tail events are much more likely than a normally distributed world would suggest, and will not be surprised by them.
- That naïve use of volatility as a risk measure serves little purpose, either in strategic asset allocation studies or in day to day management. Plain vanilla mean variance optimisation will become a thing of the past. We will use the power that Moore's law has given us to move our models closer to reality which means:
  - Moving from time- to money-weighted returns
  - Recognising that valuation risk is investor specific
- That there are risks and opportunities that no backward-looking statistical measure will ever capture. However, we will be foolish in the extreme if we do not try to take into account in our portfolios things that we really should expect to happen. What will be our excuse for having ignored climate change when disruptive technologies make large parts of our portfolios obsolete? To do this we really will have to think and act as long-term investors.
- Our behavioural biases. Admitting that such biases exist is the first and most important step to being able to overcome them.

If our regulators allow us, the smart part of the industry will start to act in a counter-cyclical fashion. That after all is how you buy low and sell dear. To do that asset owners and asset managers will need to reorganise themselves and adopt a different governance model. Market related benchmarks will become secondary. Real world outcome benchmarks will take their place centre stage. That should be welcomed by asset owners and asset managers alike.

Climate Change

The great majority of us now accept that global warming is happening due to human activity and the effects of carbon in the atmosphere. It seems inevitable that we will move to a carbon neutral global economy. Whether we do so in time to avoid the worst effects of global warming is another matter, but the fact that the transition will eventually take place already has significant investment implications. If we are focussing on our liabilities, rather than on a market benchmark we have the freedom, some might say the responsibility, to factor climate change into our decision making. In fact the UK Pensions Regulator requires Trustees to consider climate change when determining their investment strategy and incorporate this in their Statement of Investment Principles.

We need to recognise that some sectors of our economies will eventually cease to exist, coal for example. We may not know the timing, but asset owners might want to consider whether they want to continue to own investments in companies which are in the departure lounge.

More positively, recognising the scale of investment that will be required to transform the global economy, Trustees may want to have exposure to what will be the fast-flowing part of the economic river, renewables, transmission and energy efficiency. Returns could well be attractive particularly given a supportive regulatory environment and national and international cooperation.

Regulation

There are three elements required for a supportive regulatory environment. The first I have already mentioned and, at least in the UK, it has already happened. The requirement for pension fund Trustees to have to consider and report on climate change as a risk factor in their investment strategy puts climate change firmly on the agenda.

The second step is more challenging, particularly as regulators for perfectly understandable reasons don't like to dictate investment strategy. However, they can be a catalyst to driving best practice forward. They can do this in two ways. The Governor of the Bank of England's eyebrows used to carry considerable weight! While regulation today is more rules based, that is not to the exclusion of principles. Asset management firms see this today with the FCA's (Financial Conduct Authority) focus on culture. Trustee Boards which fall well below best practice in their consideration of climate change should similarly be challenged. This is also where peer pressure can play an important role in making free riders increasingly uncomfortable, and at every level, country, company, individual and Trustees of pools of capital.

Third, they will need to be supportive in the way they consider and value financial assets, both from a market value perspective, and in terms of credit and liquidity risk. The scale of funding required is so large that it is unlikely to be met purely by conventional equity and debt. Infrastructure debt will likely play a large part and it will be important that the regulator's actions allow infrastructure finance to be an eligible asset for pension funds, insurance companies, in fact all institutional investors. Defined Benefit pension funds are becoming increasingly mature and infrastructure

debt, if properly structured, can have a more predictable internal rate of return (compared to equity) and therefore could potentially play an important role in asset allocation. Again, focussing on the funding ratio and the volatility of the funding ratio as the prime benchmark should facilitate this.

Finally, there is one more area of regulation that will be critical, and this lies outside the area of financial regulation. Governments around the world need to provide the conditions which will attract the level of investment needed. They have done this in the area of solar energy. Now this needs to be repeated on a much larger scale across the three areas of 1.) all forms of renewable energy, 2.) transmission and 3.) energy efficiency.

National and International Cooperation

Governments essentially have three policy levers at their disposal to help us get to carbon neutral, carbon pricing, taxation and regulation. They can all play an important part, but carbon pricing and taxation have particular issues around their implementation, which leaves me to believe that the most effective lever will be regulation.

Carbon pricing, at least as we have seen it so far, has been so politicised that the volume of carbon credits issued has been so large that it has not been effective at changing behaviours. Perhaps though, more fundamentally, the price of carbon to change behaviour in a low or middle income country is completely different to the price needed to change behaviour in say, the United States. If we are not to have a single global price for carbon, then carbon intensive activities are likely to migrate to the cheaper parts of the globe. Of course, for climate change, it makes no difference whether the ton of CO2 is emitted in China or in Europe.

Taxation can play a part in levelling the playing field and encouraging behaviour change, but again it has its problems. It is quite likely that the lower demand for gas guzzlers in Europe compared to the United States is partly driven by the much higher level of gasoline taxes in Europe, and that's good. However, if say in the UK we impose higher taxes on carbon intensive activities, we put our manufacturing industry at a competitive disadvantage and those activities may migrate to lower tax regimes. Any attempt at using taxation in the form of tariffs to stop that migration and to level the playing field would likely run fair and square up against GATT (General Agreement on Tariffs and Trade) rules. Changing GATT rules is highly problematic and is a decade long task. We don't have the luxury of time to do that.

Regulation is not so constrained. Countries are at liberty to set their own standards for say, building insulation. If a country wishes to mandate that all new vehicles must be electrically powered after a certain date, they are free to do so. These decisions are not without consequences, but they can be game changing, particularly if they are implemented in a large economic bloc such as the United States or EU. We already have the example of the car industry in the United States in the 1970's. The government of the day implemented regulations that required car manufacturers to fit catalytic converters which allowed for the introduction of lead-free petrol. The industry lobbied hard against this saying that it would make American car manufacturers uncompetitive against the rest of the world. Instead, within a matter of a few years the rest of the world had followed the United States.

What I believe should be clear is that effective regulation, and national and international cooperation are necessary preconditions for unleashing the volume of capital required to make this technological change at scale and at pace. Failure to do so will come at a very high price indeed with potentially unimaginable implications for human and planetary health.

Next Steps

There is something ironical about the fact that it has taken the committed actions of a 16 year old, Greta Thunberg, to lift climate change up the political agenda when serious scientists have been making the arguments for over thirty years. Yet how important it is that she has managed to do so.

If you believe in the arguments that I have made here, then I think it is beholden on each and every one of us to take this story to our politicians, our employers, our industry associations and to the media that influence opinion in each of our countries. It is no exaggeration to say that this will be the defining issue of our generation.

An Addendum

17 Sustainable Development Goals (SDGs) were adopted by all United Nations Member States in 2015. However, progress against these goals is very limited. They sit low on government agendas. The way we measure our economy, GDP (Gross Domestic Product), is positively Victorian and contributes to this lack of attention to the SDGs. We capitalise plant and equipment and write it off over a number of years but, in what is supposed to be a knowledge based economy, we think nothing of education. More importantly, we measure our gross production (it is in the name!), not our net production after accounting for the negative externalities we create, CO2 emissions for example. We should replace GDP as our measure for the economy with NDP (Net Domestic Product) by deducting from our gross production the economic value of the negative externalities we create for each of the 17 SDGs. Doing so would do much to raise the SDGs up the political agenda, something we should all be in favour of.

About the author
Alan Brown is a member of the 300 Club, a former Chairman of CDP (a climate change NGO), and a former CIO of Schroders.
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The 300 Club

The 300 Club is a group of leading investment professionals from across the globe who have joined together to respond to an urgent need to raise uncomfortable and fundamental questions about the very foundations of the investment industry and investing. The mission of the 300 Club is to raise awareness about the potential impact of current market thinking and behaviours, and to call for immediate action.

Current economic and investment trends will change the investing landscape over the next two decades and we are at a crisis point which presents huge risks to investors, according to the 300 Club. Moreover, the 300 Club believes that current financial and investment theory and practice run the risk of failing investors at their time of greatest need.

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