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HAVE CAPITAL MARKETS FORGOTTEN ABOUT SUSTAINABILITY?

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Transcript of a talk presented at the Spring JOIM Conference honoring Harry M. Markowitz on March 24–26, 2024, at the Rady School of Management, UCSD.

We are celebrating the remarkable career of Harry Markowitz. Amazingly almost all current portfolio research begins with Markowitz's basic insight. He showed us that finance is about risk as well as return, and that has turned out to be the way we all think about it now. It was revolutionary at the time and now we call his invention modern portfolio theory. It was published in 1952 so it's not actually that modern but I suppose in the context of modern art and classical music, and so forth, it's in the right range. I'm going to focus on climate risk which was not a topic that he addressed in his original paper but it is an application of many of the ideas. I will discuss a notion of Long Run Risk for climate models and then I will introduce a type of long run risk called *termination risk*[1] that seems appropriate in understanding the economic behavior of firms exposed to severe climate risks.

Markowitz recognized that when we use estimated parameters of the means and the covariance matrix, portfolios do not have the desired performance. The solutions to this are myriad. There are things to do such as using super long samples or restricting your models so you don't have so many parameters. A particular dilemma for the Markowitz framework that interests me, is that as we discover or recognize that volatilities are predictable, a natural question is: how does that help you in a Markowitz framework? How do you optimize risk and return? I can tell you both from my own work and from many comments from others, that if you use high frequency data to measure the risk and low frequency data to measure the returns and you plug it in, it doesn't work. Because expected returns move at the same time as volatilities move, you are using the wrong expected returns in this case, and you get very unsatisfactory performance. So we end up saying that we've got notions of expected returns which come from long run data sets and notions of risk which come from high frequency data and there is an art in managing these.

I'm especially interested in the question of what happens when risk changes. Markowitz does not

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really answer this question dynamically in the sense that the risk goes from one level to another level. So what happens when risk increases? Well, when the risk rises the asset is typically less desirable. So you expect the price to fall a little bit. As the price falls, the expected return goes up, assuming that the cash flows are not impacted too much, and ultimately the price falls enough that the expected return induces economic agents to hold all of this asset. Thus there is a risk premium that rises for the individual asset. And that is the response to the higher risk. This drama gets played out every day. It might take minutes for it to happen and might take less. but it's very common, and we see it all the time when there's a change in risk. Even if the risk is far in the future, we think that this shows up in current data, and that's the theme here. Long run risk can be revealed in current prices, because the market is forward looking. If you don't think this is true, look at what's happened to Nvidia and Tesla. These are two stocks that had sky high evaluations. They're both based on optimism about the future. But the optimism about Tesla is a little less than it used to be, and Tesla is down 27% this year, whereas Nvidia today is up almost 100% since January. So you can see that changes in risk are reflected in today's prices.

So if we want to implement Markowitz in the context of climate change, then what risk measures should we use? Should we use historical risk measures or forward looking risk measures? Well, the answer is, of course, we should use forward looking risk measures at least as well as we can. And so how do we do that? Well, Bob Merton gave us the roadmap something like 50 years ago. Okay, so we know sort of how to do this. Investors may think that the future is going to be different from the present. They may want to hedge these changes by constructing hedge portfolios that adjust for this. And so it's a natural thing. Okay, what do hedge portfolios look like in the climate context? And how do we assess whether they work?

A climate hedge portfolio basically wants to be overweight assets which are not exposed to climate risk and underweight assets that are. This simple description is not sufficient to clearly answer the question of what you put in this portfolio, but this is certainly what your goal is for the hedge portfolio. And in that case, if climate risk goes up, this portfolio should appreciate today. if climate risk goes down, it should underperform the market today. And if climate risk doesn't change, we think that this is a risk reducing portfolio, and therefore it ought to have a negative risk premium, just like an insurance contract should have So investors who want to hedge this actually have to pay a little price. But they will be rewarded if, in fact, climate risk increases in the future relative to what is expected in the market.

Termination Risk

Next I want to discuss how businesses and ultimately other economic agents should manage long run risk. And I want to introduce this with an example. Suppose you are an owner of a beachfront luxury hotel, such as you see in La Jolla. You also see them all over the world. You see them in Miami, Mozambique, and the Maldives. These beach front luxury hotels have a lot of long run risks, but among these is sea level rise. If sea level rise happens, this hotel is going to be destroyed. And so there is some life expectancy to this hotel which is uncertain. We call this a physical risk. This hotel is likely to become what we call a stranded asset. That is, it's value is going to go to zero at some uncertain point in the future. What is the implication of this? Well, a pretty simple implication of this is that if you're considering a remodel or upgrade to this hotel, you might not do it if the payback period is long compared to the life expectancy of the hotel. So you might expect that

this hotel owner would, under-spend on investment and maintenance. As a consequence, the same revenue would actually be more profitable because the expenses are down. So, you might expect to actually see improvement in cash flows from this hotel. Secondly. If there are other hotels on the same beach, and they're all doing the same thing, then the aggregate supply is shifted inward, and you expect prices to go up. There's a little bit of monopoly power there, and so profits would go up temporarily.

Would investors be interested owning shares in this hotel? What is their value? This hotel is going to be destroyed, but it has cash flow now, so it has value, and this value is something like the present discounted value of expected future cash flows according to our normal finance theory. Because the termination date is uncertain and cash flows are uncertain, there's probably a risk premium associated with owning this stock. Nevertheless, you would expect this to have some value, even though ultimately, it's going to go to zero. I'm going to call this kind of risk *termination risk*. And the idea of calling it termination risk is, there's an endpoint that is uncertain. It is uncertain when it will end or even whether it's going to end. But if you think there's a possibility that this is correct and will be the end of your business, you need to plan with that risk in mind.

There are several other features of termination risk that should be mentioned. If the demand for beach vacations rises, you would expect the revenue and profits of this hotel to rise and also its stock price. However you might also expect some supply increase; however if termination is imminent the supply response should be quite limited.

Two major sources of fluctuations in stock prices are changes in demand and changes in termination date. Stocks should appreciate when demand increases or when the termination date moves further into the future.

Another possible strategy for the hotel owner would be diversification. He might consider starting an electric vehicle plant with the cash flow that is arriving. However, unless the owner has specific skills in building EVs, investors would be unhappy with this expenditure as they would most likely prefer to select their favorite EV brand. Diversification would lead therefore to lower stock prices and valuation of the combined company. This was illustrated dramatically in the tobacco industry where extravagant diversification strategies were tried but eventually abandoned as the value of the components was greater the value of the whole.

Finally if there are small numbers of firms or hotels, this reduction in supply, which produces some monopoly rents. is actually not necessarily going to happen. There is competition between these hotel owners and if one reduces price to increase market share, then the rest don't get as much monopoly rent. So there will be pressure to consolidate these hotels. There might be economies of scale but also a coordinated management would be more able to manage the decline and extract monopoly rents.

I am describing termination risk in this presentation because I think it looks a lot like the fossil energy sector. And that's the connection I am going to try to make. Over the years we have seen many businesses terminate. Think for example of Kodak, Blockbuster, RCA Victor, and tobacco. We do not make shoes or televisions any more. There are many reasons these businesses have terminated but they include technology, competition and public policy.

I think in the energy context. We often expect that these fossil energy companies are going to turn green. but I don't think it's an easy thing for them to do. Their business is drilling holes in the ground and feeding pipelines. This is different from putting wind farms in the mountains and

on the ocean, and solar panels in the desert or in shopping malls. The electricity flows into the grid, not pipelines. There is not any clear reason why fossil energy has expertise in renewable energy. Possibly they will start fully owned subsidiaries in green areas and then spin them off. I think we've seen that, and that would be a logical thing to do. But as long as investors are not interested in investing in fossil energy when it's brown. they're going to be pretty hesitant to invest in it when it's brown with a little green.

So is termination risk really a plausible explanation for fossil energy companies? Consider the International Energy Association model for what the transition from now to 2050 is supposed to look like. There are a lot of steps along the way, but this picture, in Figure 1, which has coal and gas and oil in it used for electricity generation is quite suggestive. We're at the peak right now. And all of this is going to decline. But when we see pictures like this that show that we are at a turning point, you do wonder whether you really believe that it can happen. On the other hand, think about the fact that we have made commitments to get to net 0 by 2050. If there's any truth to that, then there is a risk that these energy companies are going to be out of business in 25 years. The other

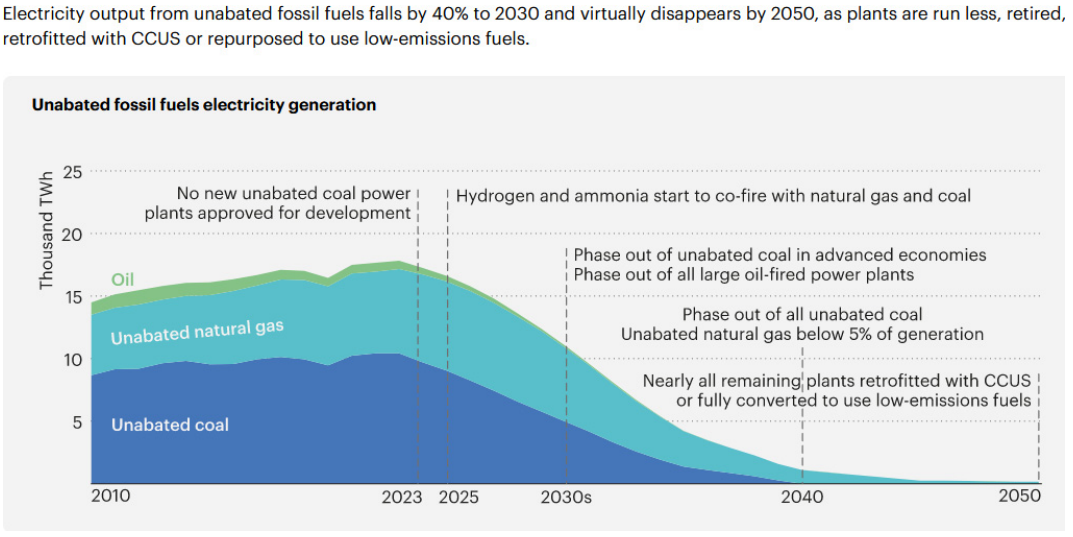

Figure 1 Unabated fossil fuels in electricity generation.

(a) (b)

Figure 2 (a) Average P/E ratio by sector (FY 2020–2021) and (b) S&P 500: Average P/B ratio by sector (FY 2020–2021).

Table 1 Sector performance measures (January 24, 2024).

Name	Market Ca	P/E	Fwd P/E	PEG	P/S	P/B	P/C	P/FCF	EPS past 5Y	EPS next 5Y	Sales past 5Y	Change	Volume
Energy	3350.22B	8.38	9.84	7.07	0.93	1.74	9.45	8.02	26.11%	1.19%	21.15%	1.40%	425.09M
Financial	9674.51B	13.56	12.97	1.38	1.86	1.66	11.67	10.31	9.84%	9.81%	13.23%	0.40%	728.43M
Basic Materials	1934.20B	16.43	14.14	3.28	1.58	2.05	11.23	19	16.92%	5.01%	13.52%	0.43%	297.17M
Utilities	1234.17B	17.23	15.11	2.46	1.76	1.66	18.91	71.51	3.43%	7.00%	8.75%	1.46%	111.37M
Consumer Defensive	3616.44B	21.47	18.32	2.64	1.25	4.18	19.67	23.05	8.27%	8.14%	6.74%	0.76%	206.34M
Consumer Cyclical	6818.30B	23.11	18.79	1.98	1.53	4.26	8.74	29.19	16.21%	11.66%	36.34%	−0.82%	1.03B
Industrials	5137.29B	23.25	18.11	2.16	1.87	4.25	15.74	25.05	13.22%	10.75%	7.89%	0.68%	765.69M
Communication Services	7153.56B	26.19	19.2	1.27	3.24	3.92	12.66	20.21	21.13%	20.62%	361.04%	1.35%	515.80M
Health care	7600.43B	32.12	19.1	3.55	1.96	4.3	13.78	23.26	16.25%	9.06%	78.79%	−0.29%	1.12B
Real Estate	1473.90B	37.07	30.28	4.85	4.18	2.14	18.66	18.17	10.18%	7.65%	48.79%	0.92%	201.64M
Technology	16870.25B	38.62	25.51	3.1	5.77	8.68	19.74	36.36	18.41%	12.45%	16.90%	0.25%	1.35B
Thermal Coal	11.04B	4.31	6.62	—	0.94	1.42	6.75	3.22	29.15%	−4.75%	11.90%	−1.20%	3.60M
Oil & Gas Refining & Marketing	225.80B	6.41	10.83	—	0.32	1.9	5.4	5.43	25.37%	−8.84%	22.29%	2.07%	23.49M
Oil & Gas Integrated	1525.16B	7.52	8.44	—	0.8	1.49	6.53	6.66	29.76%	−6.15%	16.69%	2.12%	85.92M
Oil & Gas E & P	730.00B	8.13	10.73	1.07	2.17	1.91	22.76	10.77	36.51%	7.57%	39.10%	1.76%	155.41M
Oil & Gas Midstream	578.60B	11.33	12.53	1.98	1.31	2.24	28.77	9.89	9.00%	5.71%	17.45%	0.90%	85.18M
Oil & Gas Drilling	27.32B	12.57	12.29	0.35	1.42	0.96	8.76	19.38	36.45%	35.68%	6.44%	0.69%	25.75M
Oil & Gas Equipment & Services	229.72B	14.58	11.43	0.62	1.4	2.42	11.94	14.6	17.87%	23.49%	5.92%	1.10%	70.95M
Uranium	31.89B	81.31	49.03	1.69	14.43	4.56	11.37	99.74	5.09%	48.13%	12.15%	−3.13%	37.57M

side of this is, we've got to raise all this capital for renewables, and it's not clear if that's happening either.

So is there any empirical evidence for this notion of termination risk? Well, stock prices as we said, should reflect the discounted values of expected earnings, and so price earnings ratios should be low if there are not many years of earnings still to go. So when termination risk gets close, we expect to see low PE ratios and we might expect low price to book ratios, too, because a lot of the assets of fossil energy companies are likely to be the stranded assets, and they may not be marked down on the books as much as the market value. So what do we see if we look at earnings ratios in 2020 and 2021?

In Figure 2 you see that energy sectors are all the way on the right in both years. In fact, it's got negative earnings in 2020 which is the pandemic year. If you look at price to book ratios, it's the same story. So these 2 years are consistent with this idea.

"More recently on January 24, 2024, Table 1 from finviz shows the same thing. These are again sorted by price earnings ratio, which is the second column here. And you see again, energy is the lowest price/earnings ratio that's at 8 compared to technology with 38 past earnings per share increase 26% over the last 5 years, and are expected to increase 1% over the next 5 years. Within the energy sector you see that thermal coal is the lowest P/E and oil gas equipment is the highest, except for uranium, which has a P/E of 81. I don't know exactly where that's coming from, but in any case, uranium may have a longer termination point.

What's happening with energy use data? Figure 3 shows 70 years of data on energy consumption. You see that renewables are increasing in green and nuclear energy is red. Coal is decreasing, and it really looks a lot like the IEA energy sector. And so, if anything, coal looks like it's on a termination trajectory. However, oil and gas don't and so you might wonder whether anybody looking at this expects the curves to be turning over and coming down. We may be skeptical about commitments to get to net-zero by 2050 but there still is a risk that all fossil energy will terminate in another 25 years.

To evaluate this risk, we might consider the policies that are available to bring countries and the world to net-zero. The Paris Agreement allowed each country to make its own decision as to how

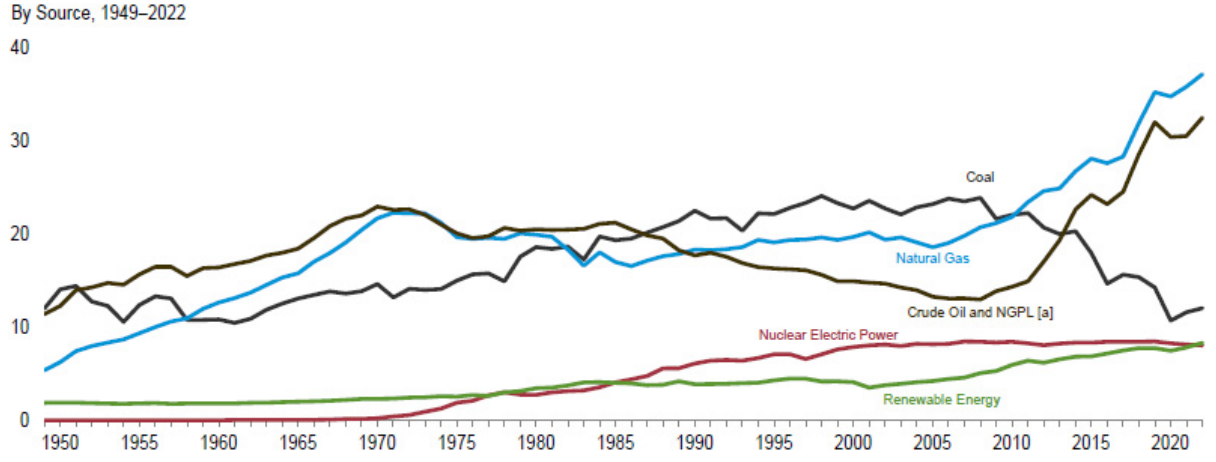

Figure 3 US energy consumption by source.

it wants to manage this. Different countries have different solutions. What are the types of solutions? For economists the first choice is always to *tax* carbon emissions. The second choice is to *subsidize* renewable energy. A third choice is to *regulate*. That's a system that we use a lot. We regulate emissions, cars, and electric utilities, and so forth. In other economies which are more planned, it can be an even more powerful way of reducing emissions. And then the last one I call *hope*. I could call it do nothing. This policy hopes that the private sector is really motivated to be greener, and that consumers, employees, corporations and investors will voluntarily adopt greener behavior. Consumers will buy greener products, employees will work for greener companies and investors and corporations will voluntarily adopt decarbonization objectives. Clearly some of that is happening. From an economist's point of view, it is a lot to expect, because we know about free riders and worry that free riders are likely to undermine this effort. Hope has no clear definition of how much is enough. We can see whether the direction is helping to mitigate climate change but not whether it will be sufficient to reach climate goals. It is asking a lot of the private sector to voluntarily do this, especially if it's hurts the bottom line.

Because all of these agents are forward looking, they will base decisions not only on the policies that are in place today, but on policies that are likely to be implemented in the future. If climate disasters continue to occur, it may be that the electorate will choose politicians with sensible climate policies. If they wait until the urgency is great, these policies may be much more costly than if they were implemented in a carefully planned way.

Climate Hedge Portfolios

What are the implications for investors? Well, investors, I'm going to suppose, want to do something like hedging the climate risk.[2] They may not want to be exposed to climate risk themselves as much as they would if they held the market portfolio. So how do we construct these kinds of portfolios? There are really 2 general strategies. We are going to sort all the assets into buckets that are not very exposed to climate risk and buckets that are super exposed to climate risk. And we might do this with a lot of characteristics such as balance sheet data, sector data and location data. These are the kind of data that financial markets know a lot about. But they might also want to use data on ESG which stands for environmental, social, governance data. This is a controversial set of data because, first of all, it's not totally clear what you want. Second of all, it's typically voluntarily supplied and it's interpolated by vendors to try to cover the bigger universe, and it's easy to say some of these things are more useful than others, and so forth. There are efforts being made to increase disclosure. But in fact, even with mandatory disclosures, the data is not sufficient to answer the question of which assets go in which buckets.

There is a second approach, which is statistical. When there is evidence that climate risk is increasing, which stocks go up and which stocks go down? This is basically asking for the market view about the greenness or not of stocks. And the market view may not be the same as what ESG or any of these emissions data look like. A hedge portfolio should be overweight those that rise on climate risk news and underweight those that fall on the news.

At the Volatility and Risk Institute (VRI), we have developed a series of climate hedge portfolios. We post their performance daily on our web site VLAB which stands for volatility laboratory. The address is VLAB which can easily be found by googling "vlab at nyu". We're going to focus on a portfolio we call the Stranded Asset Portfolio (SA), which is a very simple portfolio

proposed by Bob Litterman. It's long the S&P500 ETF(SPY), short, 70% of a coal ETF(KOL) and 30% of the broad energy ETF(XLE). This is a portfolio which will appreciate when fossil energy stocks go down. It is based entirely on the sector in which a company is classified. A more statistical portfolio is the climate efficient factor mimicking portfolio (CEP) which basically is trying to form a fund of funds. It is a portfolio of sustainable funds from our database of about 200 such funds. We want to form a portfolio of these. The criteria are: long only, minimum variance, and maximum correlation with climate news conditional on standard risk factors, oil returns, and the stranded asset portfolio. We do this once a month and then hold it for a month. These are both eminently investable portfolios. And hopefully they're good hedge portfolios.

Lets examine their performance over the long and short run. Table 2 shows with SPY, ACWI, SA, CEP, and a hedge portfolio that does not distinguish coal. These are all out of sample returns. You can see that over the long run these portfolios are comparable to the broad market portfolios. Whether they are better or worse, depends on whether we've had a lot of climate news or not, so we don't know really what the right answer is supposed to be here. Stranded Asset has the highest Sharpe ratio followed by SPY and then CEP. Probably the last 25 years has seen rising climate risk so the hedge portfolios could be expected to outperform the broad market.

Over shorter time periods, the performance is more variable. Looking at the one year returns ending on 3/24/24 and 3/24/23 we see big changes in Table 4.

The market returns during 2022 were negative but the hedge portfolios were far more negative and had higher volatility. This was the year of rising interest rates as the central banks fought inflation. It was also the year after the worst of the pandemic. The next chart plots these series over the last decade.

The stranded asset portfolio in green performed extremely well before and during the pandemic rising dramatically from Jan 2019 to the end of 2020. It then declined until Jan 2023 but has recovered since then. CEP in orange rose sharply from Mar 2020 to Jan 2022, declined in 2022 and has recovered in 2023.

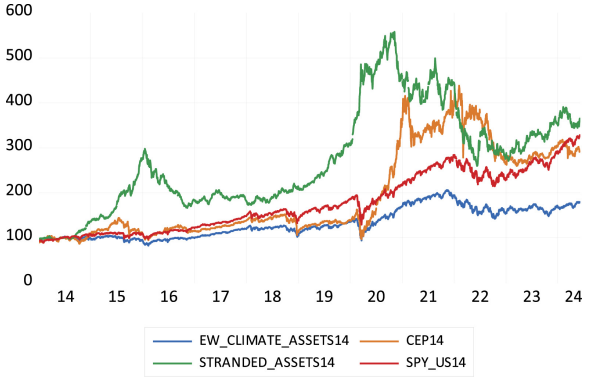

Figure 5

Table 2 Long term performance of benchmark portfolios.

Benchmark		Return	Volatility	Sharpe Ratio
iShares MSCI ACWI ETF	15.98 Years	7.06%	20.81%	0.13
SPDR S&P 500ETF Trust	31.13 years	10.26%	18.74%	0.31
Stranded Assets	25.25 years	7.74%	22.56%	0.34
SPY:US-XLE:US	25.25 Years	−5.01%	21.75%	−0.23
Climate Efficient Factor Mimicking Portfolio	22.72% years	10.38%	24.48%	0.24

Table 3 One year performance of benchmark portfolios — Year ending 3/24/23.

Benchmark	Return	Volatility	Sharpe Ratio
iShare MSCI ACWI ETF	−8.07%	22.67%	−0.56
SPDR S&P 500ETF Trust	−8.18%	24.18%	−0.53
Stranded Assets	−25.63%	27.08%	−0.95
SPY:US-XLE:US	−40.64%	32.24%	−1.26
Climate Efficient Factor Mimicking Portfolio	−23.75%	37.99%	−0.75

Table 4 One year performance of benchmark portfolios — Year ending 3/24/24.

Benchmark	Return	Volatility	Sharpe Ratio
iShares MSCI ACWI ETF	27.73%	11.36%	2.00
SPDR S&P 500ETF Trust	34.44%	11.53%	2.55
Stranded Assets	20.04%	16.52%	1.21
SPY:US-XLE:US	7.13%	19.75%	0.36
Climate Efficient Factor Mimicking Portfolio	14.27%	13.57%	0.68

Performance of Sustainable Funds

Why did they do badly in 2022 but did well in 2020 and in 2023/4? We have examined two benchmark climate hedge portfolios which show similar patterns but with important differences. If we look at the more than 200 sustainable funds over the same sample period in VLAB, the correlations are pretty high but there is significant divergence across funds. The equal weighted average of all the funds uniformly underperforms the SPY and has many of the same features. The average shows strong performance during the pandemic followed by weak performance in '22 which then becomes strong in '23 and the first half of '24. Within the collection of sustainable funds are many with far superior performance at least for parts of the period.

The reason sustainable funds have underperformed is simply that they are underweight fossil energy and oil and gas outperformed. The question is, why did oil and gas outperform? The hypothesis is that this is a natural response to termination risk. Termination risk would encourage firms to reduce their investment and thereby increase cash flow. And if your cash flow goes up by a lot, those stock prices go up. Furthermore, if there's a demand shock, then that will also push these up again. Furthermore, it is very likely that termination risk looked more severe in 2020 during the pandemic than it did in the next

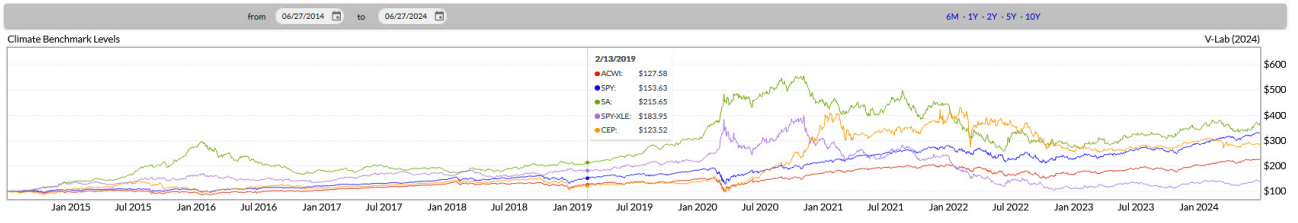

Figure 4 One decade of climate benchmark portfolios.

few years. Remember that during the pandemic we stopped driving, did not commute to work or school, flew much less and drove the price of oil so low that at one point oil futures went negative. In this setting, termination risk must look highly plausible and expensive. So as the pandemic subsided, oil prices rose and termination risk presumably retreated leading to still higher stock prices.

This effect is magnified by the fact that we do not have a comprehensive emissions tax. As prices and profits rose, the rewards went to stockholders rather than tax collectors. A carbon tax would have reduced the profitability of fossil energy and provided resources for other government policies or tax reductions.

Countries also face termination risk. The risk for a country is that its major industry will terminate. If you think about the Middle East you see that they are grappling with this daily. They are trying to take their enormous cash flows and use them to diversify their economies. We see it through building tourism and sports and travel, education, arts, and all sorts of things in which they are heavily investing, so that when their energy revenues go away they will have alternative businesses. Furthermore, OPEC has reduced output over the last couple of years just as predicted from termination risk.

What about Russia? Russia has also reduced the supply of fossil energy. They cut off gas supplies to Europe including the pipeline through Ukraine, they reduced reserves in Europe, and the sanctions reduced it even further. They decided, I believe, that to diversify the economy the best thing to do was to invade Ukraine, as Ukraine would provide them with a lot more export capabilities and natural resources. I think they made a miscalculation about how easy or hard this would be. But I do think that the termination risk issue in Russia is very serious; that Russia in a decade is not going to be financially as strong as it was two years ago when they started, and that Europe will have a lot more green energy, and therefore will not be so vulnerable to Russia's gas restrictions. This is not the only explanation for this invasion, but I think this is part of the incentive. This argument implies that climate change is making war more likely.

Finally, let me mention Iran which also has its major industry facing termination risk. They also have lots of cash flow but they are using it to disrupt the Middle East. It is not clear how this is expected to diversify Iran's economy but again, climate change is fostering war.

As climate advocates, should we be dismayed at what is happening? Even though, our sustainable investments performed badly last year, energy prices were high, and, from a climate mitigation point of view, high fossil energy prices are good. High energy prices discourage people from buying goods that are produced with a lot of emissions. I don't think any economist would be surprised that effective climate mitigation includes raising the price of goods that have a lot of emissions. When people say you go to the gas station in your SUV, and it's so expensive, what am I supposed to do? That's the answer. You're supposed to drive less, or buy a Tesla or at least a fuel efficient car. And we know that this disproportionally falls on the shoulders of poor people. We need to deal with that, but that is a separate problem. So high energy prices are not a problem for climate mitigation.

Does this mean that that we should no longer invest in these hedge portfolios? Assuming we are still trying to hedge climate risk, changes in termination risk will move a hedge portfolio in the right direction. If termination risk increases so that the date is closer, oil and gas stocks are going to fall, and will head toward zero. That's exactly what you want to have happen to your

portfolio so you should still short firms exposed to termination risk.

We see that Putin has accelerated decarbonization, the Biden climate bill has accelerated decarbonization, and so has the EU green deal. So these geopolitical events are really moving us in a climate friendly direction.

We could also ask about termination risk for the human species. We have a strategy for a firm facing termination and a strategy for a country facing termination but what is the strategy for the human race? We can't diversify. We can't reduce our investment. Those are not good options. The only thing we can reduce is the probability. We need to reduce the probability of termination. Paris provides a road map. Science says that if the world can become net-zero by 2050, we will avoid the worst consequences of climate change. We cannot enforce these commitments except through diplomacy and public opinion. Hence the best way to reduce termination risk is to have the major emitters collaborate, cooperate and work together. If the four biggest emitters can reach net zero then smaller countries will come along. They will have access to new technologies and strong moral pressure. Hopefully if there are free rider countries, they will be small. The biggest emitters are

China, US, Europe and India. Europe is working actively on decarbonization, the US has started a climate policy, China has invested heavily in green technology but is faced with rapidly rising emissions anyway, and India has a lot of work to do. I feel like the key is that the US and China need to work together. There are many ways to do this and the future for all of us depends upon the success.

Here is a picture of three of my grandsons looking out at this calm lake, wondering what it's going to be like for their families. What kind of world are they going to inherit? In 2050 they will still be younger than most of us are today. It is not surprising that they are worried. If we can tell them we have it solved, they'll be a lot happier about it.

Endnotes

[1] Engle (2023).

[2] Engle, Giglio, Kelly, Lee, Stroebel (2022), DeNard Engle and Kelly (2024), Jung, Engle and Berner (2023).

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