Carbon Emissions Prices and Implications for SWF Benchmarks

Remarks prepared by Bob Litterman for the benchmarks panel at the conference "Sovereign Wealth Funds and Other Long-Term Investors: a New Form of Capitalism?" at Columbia University October 4 and 5, 2010

There is an appropriate price for carbon emissions today, and that appropriate price is not the current actual price, which throughout the world, with a few exceptions, is effectively zero.

In my remarks I will raise two questions: first, what is the appropriate price for greenhouse gas emissions, and second, what does the discrepancy between the actual and the appropriate price mean for the benchmarks of long-term investors?

I can't give you a precise answer to the first question; I can only indicate why I think the answer is that the appropriate price for emissions is far from the current price.

Because of this discrepancy benchmarks designed for long-term investors should tilt toward equities and other assets that will benefit from carbon being priced globally and away from those that will be hurt.

A rapid rise in the price of greenhouse gas emissions is a risk that I do not think is priced into the market.

Here is an example: Companies that make equipment used in carbon capture and sequestration are suffering today because they have no business. They are not making profits, they cannot attract capital. Yet if carbon were priced at a reasonable level coal fired power plants around the globe would be installing this equipment. Today there is no market simply because emissions are not being priced, and these companies that make carbon capture equipment are in trouble because the market is pricing in the belief that this situation will not change any time soon.

This is a disequilibrium situation. And when the market is not in equilibrium and is not expected to return to equilibrium quickly, then benchmarks should tilt away from the market portfolio.

The conventional wisdom expects carbon emission prices will increase slowly over a period of decades; at least that is the scenario that I believe is built into market prices. Moreover, I think that scenario is likely to be wrong. My conjecture is that the global effective emissions price will stay at essentially zero for several years, due to political realities, but that at some point emissions prices will jump to an appropriate level.

How high that appropriate level is depends on how long we keep the price at zero. As long as emissions prices are too low, society will emit too much carbon into the atmosphere and the underlying situation will get worse. The earth has a reservoir of unknown size to safely absorb greenhouse gases. When that reservoir is exhausted, if it is not already, the world could experience a climate catastrophe beyond imagination.

Had emissions been priced appropriately twenty years ago, the reservoir would have considerably more capacity than it does today, and the appropriate price today would be much lower than it currently is.

That dynamic creates a tension which means that a price somewhere between zero and the appropriate price is unlikely to last long. It wouldn't make sense. Once the risk of a climate catastrophe is recognized, there is every reason to price emissions at the then appropriate level.

Let me tell you why I think that when the price moves, it will move quickly. It is a simple story. Not pricing risk appropriately leads to disasters.

Start by thinking about what would be the appropriate price for carbon emissions today. What should the price reflect? The price should reflect the risk created by carbon emissions, clearly. But there is more to it than that.

The risk of a climate catastrophe is a systematic risk. It affects the entire world. Thus, not only should the price of emissions reflect the actuarially fair value of the discounted net economic impacts that are expected to be produced by the emissions, it should also reflect an additional risk premium. As I think we all understand, systematic risks should be priced with a risk premium.

My context for thinking about benchmarks is the vision that I learned from Fischer Black. He always asked what happens in equilibrium, and he often used the CAPM as his example. As is well known, the market portfolio is the natural candidate for a strategic benchmark because it is optimal in equilibrium. But with respect to the price of carbon emissions the world is not in equilibrium.

In the CAPM systematic risk is beta. But I want you to think beyond the CAPM. In the real world risk isn't simply a matter of statistical correlations, it is more fundamental.

Stocks require a risk premium because unfortunately they do poorly when times are bad, when global wealth is low and marginal utility is high. The future income streams created by equity investments are discounted at a higher rate than the pure discount rate embedded in government bonds because their payoffs are low when they are most needed.

Valuing investments in reducing carbon emissions also requires a risk premium – however, in this case the impacts of such investments are large in bad states of nature, when marginal utility is high. This flips the sign on the premium. This means the impacts should be discounted at a lower rate than the pure discount rate.

Because marginal utility is high when investments in emissions abatement pay off, it is appropriate to discount expected climate damages at a rate lower than the risk free rate. Thus, the implication of recognizing that climate risk is systematic and therefore deserves a risk premium, is that the appropriate emissions price is higher than the actuarially fair expected damages discounted at the risk free rate.

Yet the situation we have today with respect to carbon emissions, is that not only are emissions currently not reflecting a premium, they are not even reflecting the expected discounted damages.

How serious is it when a systematic risk is not priced appropriately? Recall that what caused the financial crisis was also a systematic risk that wasn't being priced. Systematic risk embedded in mortgages, particularly subprime mortgages, wasn't priced because insurance companies, ratings agencies, and investors, all treated mortgages as if their default risks were totally diversifiable. Of course it turned out that this wasn't the case. Mortgage defaults skyrocketed when housing prices started going down. But by then it was too late. Because the market had not priced the systematic risk, a huge supply of toxic mortgages was spread widely throughout the financial system.

Not pricing systematic risk leads to too much risk being taken, and such a situation will eventually lead to a high probability of a global catastrophe.

Let's focus on the sources of the risk premium that determine the appropriate price for carbon emissions. Consider one dimension of uncertainty first, the robustness or fragility of the earth's ecosystems. There is tremendous uncertainty about how this experiment with the earth's temperature will play out.

On one side are outcomes reflecting a robust planet. Imagine a world in which times are good; people are, by today's standards, wealthy. The earth has responded robustly relative to the burst of greenhouse gases and temperature rise to which it was exposed.

Imagine on the other side of this dimension is a world which, for reasons not necessarily foreseen, turns out to be too fragile to survive intact. Positive feedbacks and complex interactions cause collapses of ecosystems to build up quickly to a point where human ingenuity simply cannot cope. Such a world is very poor by today's standards.

And obviously there are other outcomes all along this spectrum. Think of the living standards of people at the positive end of the robustness/fragility dimension, and of

how their welfare changes as we move along this dimension. At some point we can expect nonlinearities to kick in and living standards start declining very quickly.

Consider another dimension: the level of greenhouse gases in the atmosphere. At the historical base level of CO_2, 280 parts per million, nature was very robust to climate all along the robustness, fragility spectrum. Nature was not stressed. The earth's reservoir of capacity to absorb emissions was large.

Today the level of CO_2 is about 380 ppm. Nature is being stressed, and it is responding to this experiment in real time as watch. We know very little about how fragile nature will turn out to be or how large its emissions absorption capacity is.

But what we do know is that the more greenhouse gas we emit, the higher the temperatures will be which will follow, and the more likely we are to run into a non-linear tipping point. A tipping point is a critical point at which a relatively small incremental change in a component of the Earth system has big – and potentially catastrophic -- impact.

Some tipping points pose more immediate threats than others. Consider the consequences of rising sea levels combined with more intense hurricanes for the states bordering the Gulf of Mexico and the Atlantic.

The World Wildlife Fund (WWF) and the insurer Allianz SE released a report last November warning that sea level rise could dramatically increase risks to buildings, transportation infrastructure and other assets exposed to severe storm surges in those coastal areas. The study estimates that current assets at risk to a 1-in-100-year storm surge amount to $1.4 trillion. A mid-century global sea level rise of 20 inches, with an additional projected 6 inches localized rise along the northeast U.S. coast, could jeopardize assets worth close to $7.4 trillion.

The report examined more closely the potential costs of a Category 4 hurricane landfall for New York City. In a comprehensive analysis that included more than just storm surge impacts, the authors estimated current assets at risk from a strong hurricane at $1 trillion. With sea-level rise and further development in the region, this could exceed $5 trillion by mid-century.

This is an example of how gradual increases in atmospheric greenhouse gas concentrations, followed by gradual changes in sea level and hurricane intensity can combine to dramatically increase the risks we face. Under those circumstances, a single strong storm right here in New York City would have catastrophic consequences far larger than those we face today.

But that is just by mid-century and from climate disruption that we will have largely committed ourselves to under even the most optimistic emissions scenarios. Far more worrisome are the longer term avoidable consequences we'll see if emissions continue at their current rate – or higher. These include tipping points where rising

temperatures *accelerate* the accumulation of greenhouse gases in the atmosphere, creating highly disruptive positive feedbacks. One such positive feedback is the release of massive amounts of carbon – including the powerful greenhouse gas methane – from thawing stocks of carbon in northern latitudes.

We could see a 7°C warming during this century. Researchers reported in August [Climatic Change, 21 Aug 2010] that as temperatures increase beyond 2.5°C above preindustrial levels we may see "the potential collapse of entire ecosystems."

In May, researchers reported in the *Proceedings of the National Academy of Sciences*, that if global mean temperatures increase beyond the end of this century, warming by 11-12°C above current levels within the next several centuries, the "majority of the human population as currently distributed" would live in areas where the combination of temperature and humidity would for the first time in human history exceed for extended periods the highest tolerable limits for humans and most mammals.

One of the authors, Matthew Huber, wrote, "When it comes to evaluating the risk of carbon emissions, such worst-case scenarios need to be taken into account. It's the difference between a game of roulette and playing Russian roulette with a pistol. Sometimes the stakes are too high, even if there is only a small chance of losing."

Deciding on the right price for carbon emissions is a difficult problem. It is sensitive to these tail events, to the small probabilities of truly catastrophic outcomes.

I want to give you an analogy which helps me to think about this problem. I like to cycle. When a cyclist rides down a steep mountain road there is a dynamic risk, return trade-off with plenty of uncertainty. And there are also non-linear risks with tipping points. You can get out of control, and of course the more you speed up the more you increase the risk of crashing.

Those who expect the price of carbon emissions to rise slowly over time have not yet internalized the risk that they are going too fast and that they may already be, or could very easily soon be, on a path that is out of control.

They are still behaving like a cyclist who has ridden down this route many times, who knows how tight the curves will be, and who plans to brake as needed before the next curve, which today seems to be a ways down the road.

At the point where you begin to realize that you may be out of control, you don't slowly increase the pressure on the brakes. You react immediately to regain control, and hopefully as the braking slows you down, you do regain control and you can let up on the brake.

The brake with respect to climate risk is the price of carbon emissions. But because of political realities in the US and elsewhere, the world has not yet put on the brake,

and my thesis is that the stock market has not yet priced in the likelihood that carbon will be priced realistically any time soon. In fact, given the disappointment in last year's Copenhagen conference, I suspect right now is an excellent time to dispose of assets that benefit from not pricing emissions.

But that time is certainly coming, and although it will probably take several years to happen, I suspect the price rise, when it occurs, will be faster than the market expects. At some point, governments will inevitably realize that the world's climate may be out of control, and they will have to slam on the brakes with respect to greenhouse gas emissions.

If this is true, then relative to market cap weights, long term investors should tilt their portfolio's benchmarks toward investments that will benefit from emissions being priced, and away from investments that will be adversely affected when carbon is priced.

Normally I would not advocate an activist role for sovereign funds, but in this context I think a certain type of investor activism does make sense. After these benchmark tilts are established, sovereign funds, who more than almost anyone else represent the interests of future generations, should promote a debate on what is the appropriate level for carbon emissions to be priced at. Having positioned themselves appropriately, long-term investors should try to do what they can to cause the emission price to rise as quickly as possible to this appropriate level.

Just as an example, one way to do this would be to encourage the construction of an index of carbon emission prices, disaggregated by country and by industry. Such an index could be used to focus global attention and political pressure on those areas where emissions are not priced appropriately.

Not only will long-term investors who take these steps be rewarded financially, but their actions will also work to make markets more efficient, they will help to move the world to a safer, more stable global equilibrium, and they will help to protect the wealth and welfare of future generations.