COMILLAS
UNIVERSIDAD PONTIFICIA

Speech for the Investiture Ceremony as Doctor Honoris Causa of Dr. Robert F. Engle and Dr. Eduardo Schwartz

FORMAL SPEECH

THE IMPACT OF CLIMATE RISK ON FINANCIAL MARKETS

Dr. Robert F. Engle

Investiture Ceremony as Doctor Honoris Causa

May 8, 2024

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DISTINGUISHED AUTHORITIES,
PROFESSORS,
STUDENTS,
LADIES AND GENTLEMEN.

I. SCIENCE

Science knows that if the energy coming to the earth is greater than the energy escaping from the earth, its temperature will rise. The layer of greenhouse gasses around the earth is trapping heat that in the last million years would have been emitted back into space. The rapid increase in CO2 and other greenhouse gasses is due to the rate at which we humans burn fossil fuels. These fuels were created over countless millennia by plants which converted the sun's energy into organic molecules which have been stored in the earth and sea. By burning these fuels, we release the energy and the carbon that has been lying dormant.

As the planet warms, glaciers melt, the sea rises, weather patterns change and droughts and floods occur in different locations and intensities. These changes are unprecedented since humans inhabited this earth, but they have occurred through other causes in the millions of years before. We can see it in the fossil records where species became extinct, water covered much of the land we now live on and temperatures were much higher than today. The planet will probably survive what we are doing to it, but we may not.

II. SOLUTIONS

We should adapt as much as possible to a warmer world. This is called "adaptation." Adaptation requires changing many things

in our economy from increased air conditioning and building insulation to moving our cities to higher land or building enormous sea walls and dikes to protect existing city locations.These costs can be considered relative to the alternatives using conventional cost benefit analysis. The people paying the cost are also the beficiaries.

We should also slow the pace of climate change by reducing our emissions of GHG. We call this "mitigation." Decarbonizing the global economy is also very costly, however the beneficiaries are not the ones paying the cost. The beneficiaries are all the people of earth including the unborn generations.

Economists have been trying to do cost benefit on this problem. What are the damages we expect in the distant future and what will it cost us today to reduce them. Conceptually there is a Social Cost of Carbon (SCC) which is measured in dollars (or Euros) per ton of greenhouse gas emissions that summarizes the present discounted value of all future damages to the whole planet from an additional ton of emissions. If anyone who emits CO2 was asked to pay the SCC, then only emissions that occur would be those where the benefits to the emitter exceed the costs to the rest of the world.

If a carbon tax on all emissions were introduced, there would be enormous changes in our economies. Many industries would have to raise their prices dramatically to pay for their emissions, and demand might go to zero. There would be a scramble to purchase solar panels and wind turbines and maybe nuclear reactors to generate power more inexpensively than from fossil fuels. The winners would be deluged with capital from investors and the losers would see their stock prices head toward zero. This is an example of transition - it is clearly a risk for some companies and an opportunity for others. The risk of transition affects asset prices today as equity of fossil energy companies trades at prices which are low relative to their earnings.

Another approach to mitigation came out of Paris. Almost 10 years ago most nations of the world signed an agreement in Paris that committed them to make their economies emit no net emissions by 2050. Commitments to netzero emissions means that negative emission strategies can be used to offset positive emissions. The agreement is not binding except as public pressure can enforce it. Countries can choose their own approach to reach netzero. It is a landmark departure from using the price of carbon as a target to using quantity of emissions as a target. Scientific research finds that if the planet is entirely netzero by 2050 we will avoid the worst damages of global warming.

III. POLICY CHOICES

There are four classes of policies that can be used by governments to bring their economies to netzero.

TAX CARBON EMISSIONS

SUBSIDIZE RENEWABLE ENERGY

REGULATE EMISSIONS

HOPE

The hope policy is based on hoping that consumers, employees, investors and corporations will voluntarily adopt greener behavior! This relies on the goodness of each of these people to do the right thing to help the planet. Economists are skeptical that people can be convinced to do this because of the “free rider” problem. Anyone who decides not to participate, receives the benefits of those that do without having to give up things that are polluting. Hope is the main policy that governments are relying on while they debate the alternatives.

Today, the EU is primarily taxing carbon with the Emission Trading System. The US is primarily subsidizing renewable energy with the IRA, Inflation Reduction Act. China is primarily regulating by forcing fossil energy companies to reduce emissions and putting government resources into designing and implementing green technologies which are subsidies to renewable energy. All of us are relying on HOPE to make these more effective. Coordination and collaboration are essential if we are to achieve the Paris Accord outcome.

IV. RESEARCH AT VRI

The Volatility and Risk Institute at NYU Stern that I Co-direct is carrying out research to answer these difficult questions from a financial perspective. Financial markets are forward looking and therefore are quite sensitive to the risks of climate change. Asset prices today reflect investor expectations about future events and these include both physical and transition risks. In our research at the VRI we have constructed some climate sensitive portfolios which are designed to appreciate when climate risk goes up and depreciate when it goes down. We call these CLIMATE HEDGE PORTFOLIOS.

Some of these are simply short fossil energy producers, others are emission weighted returns or green minus brown returns. Others are developed statistically by looking at the performance when there is climate news. A new index based on property and casualty insurers is designed to hedge physical risk. And we have some new ones in progress.

What can we do with these hedge portfolios?

- We can invest in them directly
- We can invest in stocks that have a high beta on these hedges

- We can invest in publicly available "sustainable" funds that have a high climate beta.
- We can assess the risks to the financial sector by examining the climate beta of banks, insurers and other financial companies.
- Here are some results from VLAB.STERN.NYU.EDU

Table 1 gives performance metrics for over 200 funds that are publicly available. Some are mutual funds and are ETFs. Over the last 5 years the return, volatility and Sharpe ratio are given for each fund. Then the table reports correlations with two measures of climate news. The last three columns present measures from modern finance. The CAPM alpha is the intercept in a regression on the Market return. The climate betas are the coefficients on either the Stranded Assets (SA) Portfolio or the Climate Efficient Factor Mimicking Portfolio (CEP) in a regression with the Market, three FF factors, Oil returns and both climate hedge portfolios.

5 YEAR PERFORMANCE: TWO FLAVORS OF GREEN

Security	Return	Volatility	Sharpe Ratio	Correlation: Cos Sim	Correlation: Tag Index	Climate Efficient Factor Mimicking Portfolio: α_{CAPM}	β_{SA}	β_{CEP}
Invesco Solar ETF	15.79%	43.76%	0.27	-0.042	0.052	5.13 (0.30)	-0.21 (-3.51)	0.39 (2.80)
SPDR S&P Kensho Clean Power ETF	15.94%	36.55%	0.33	-0.080	0.058	3.46 (0.26)	-0.08 (-1.84)	0.35 (3.03)
Invesco WilderHill Clean Energy ETF	2.03%	44.92%	-0.05	-0.054	0.002	-9.88 (-0.60)	-0.16 (-3.77)	0.30 (2.83)
iShares Global Clean Energy ETF	10.00%	32.23%	0.18	-0.083	0.061	-1.48 (-0.12)	-0.13 (-3.11)	0.29 (2.96)
Global X Lithium & Battery Tech ETF	10.84%	34.13%	0.20	-0.055	-0.057	-0.63 (-0.05)	-0.39 (-8.11)	0.28 (4.21)
KraneShares MSCI China Clean Technology Index ETF Fund	3.52%	35.07%	-0.02	-0.051	-0.062	-2.49 (-0.17)	-0.42 (-5.48)	0.27 (2.94)
First Trust NASDAQ Clean Edge Green Energy Index Fund	14.23%	40.63%	0.25	-0.070	0.018	0.58 (0.04)	-0.13 (-3.34)	0.27 (2.98)
Invesco Global Clean Energy ETF	6.19%	32.38%	0.07	-0.058	0.031	-6.23 (-0.54)	-0.21 (-6.88)	0.26 (3.73)
VanEck Low Carbon Energy ETF Fund	11.24%	30.70%	0.23	-0.079	0.021	-1.35 (-0.14)	-0.15 (-4.28)	0.25 (3.87)
ALPS Clean Energy ETF	5.85%	38.01%	0.05	-0.060	0.039	-7.14 (-0.51)	-0.08 (-1.82)	0.22 (2.31)

Table 1

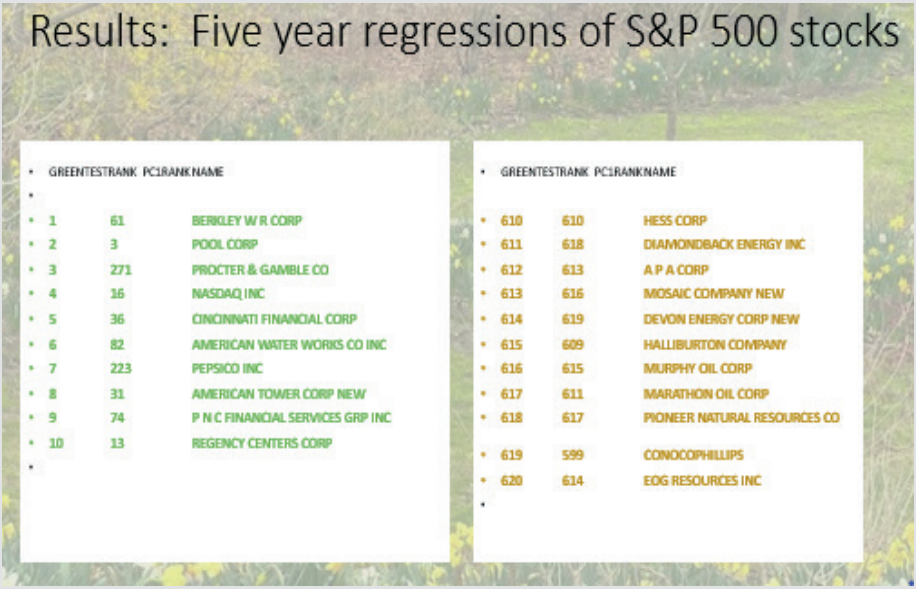


Table 2

Regressions of stock returns of SP500 companies on standard risk factors and 4 climate hedge portfolios. Top 10 and bottom 10 rankings based upon either the t-statistic of the average beta or the t-statistic on the first principle component of the hedge portfolios.

V. IMPACT ON FINANCIAL INSTITUTIONS

Banks and insurers lend to many institutions. If these institutions are exposed to climate risk, the financial company should face climate risk.

- CLIMATE BETA measures the exposure to movements in climate hedge portfolios. These tables show results for transition risk.

- CRISK, (Climate Risk) measures the capital adequacy of the institution after a climate stress event. It is based on the beta and the financial health of the company. It is an estimate of how much capital the institution would need to raise in order to continue to function normally after the stress event. Some banks are undercapitalized even before the climate event and therefore CRISK does not reflect just climate risk.

Figure 1 ***Climate Beta of Citigroup***

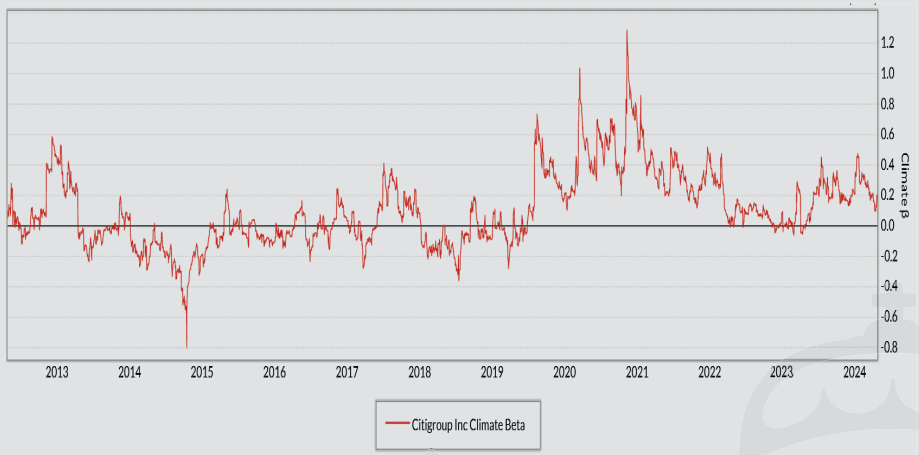


Figure 2 ***Total CRISK of US Financials***

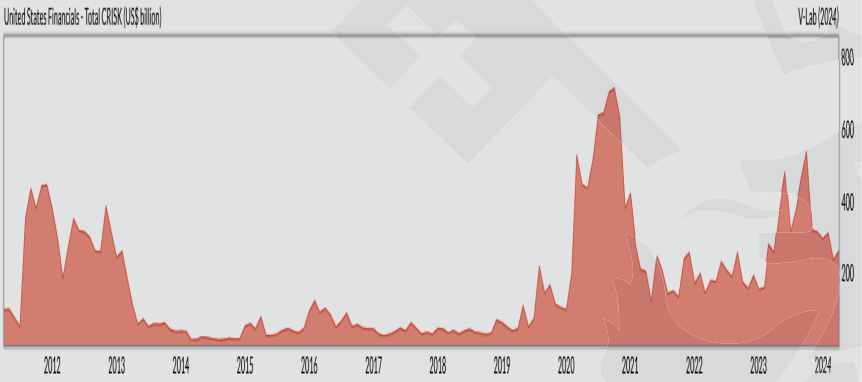


Figure 3 ***Climate Beta of Banco Santander***

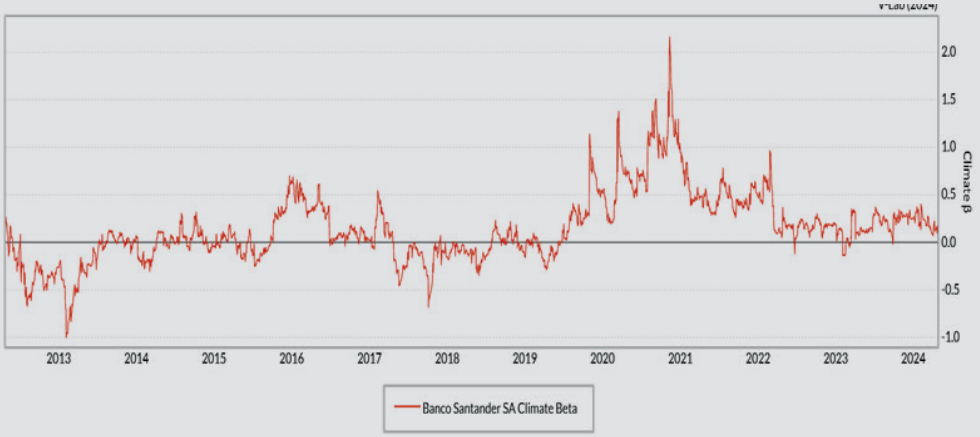


Figure 4 ***Total CRISK OF SPAIN***

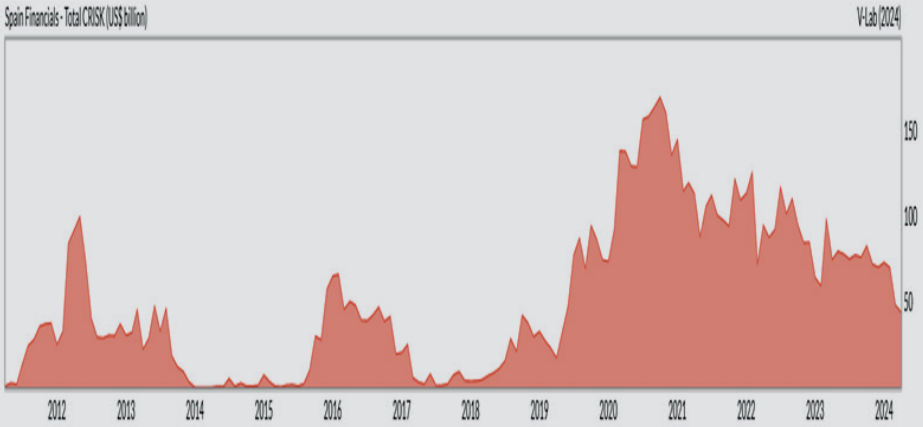


Figure 5 ***Total CHINA CRISK***

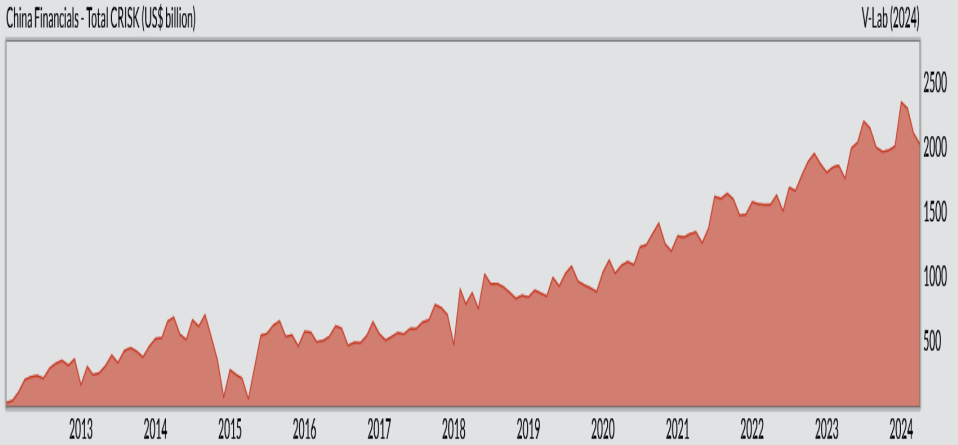
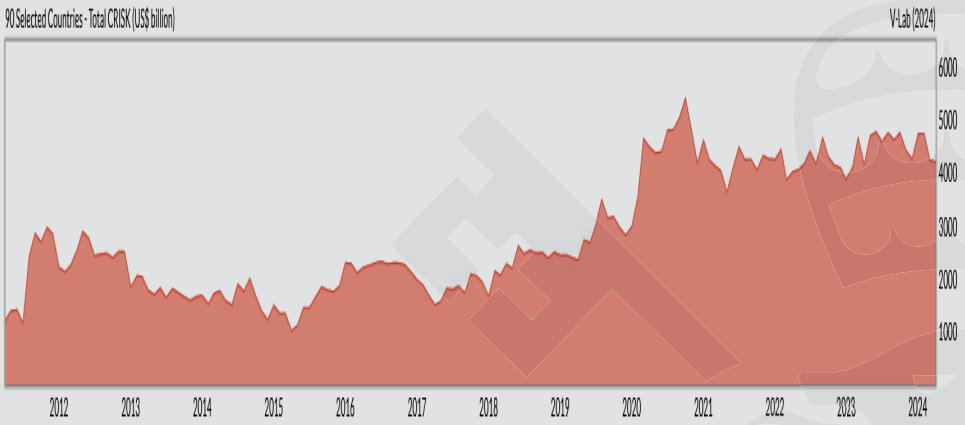


Figure 6 ***Total WORLD CRISK***



VII. CONCLUSIONS

- The risk of climate change impacts asset prices today.
- These risks include both physical risks and transition risks
- We see this for stocks, for portfolios and for financial institutions
- To reduce the expected damages from climate change, we must transition to a lower carbon economy. This costly transition will be amply funded by private capital if it appears profitable. Public policy through subsidies, taxes, and regulation can create the needed conditions. Political leaders must be willing to carry out the required policies. Only then can we be confident that our children and their children will have a healthy planet to live on.

Figure 7 **THREE OF MY GRANDSONS WONDERING WHAT KIND OF WORLD WILL THEY INHERIT**

Figure 8 **IF WE CAN TELL THEM THAT WE HAVE A PLAN....**

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