

RESEARCH PRIMER:

Sounding the Alarm on a Looming Climate Financial Crisis

INTRODUCTION

The effects and risks of climate change are much discussed — stronger storms, wildfires, rising sea levels, extreme heat. Yet the effects of a changing planet are only starting to make their way into the valuation of companies, real estate or other assets.

Historical models from mainstream economists that analyze the macroeconomic or system-level consequences of climate change have long reported limited effects on the order of 1-3% loss of global GDP for every 1°C warming.

Climate science today tells a different — and extremely alarming — story. A range of new studies using various methodologies and authored by climate scholars from a wide array of universities and organizations predict the effects of climate change to be more than ten times larger than historical models, such that another 1°C warming is associated with more than a 10% reduction in global GDP with increasing effect sizes for each additional degree of warming.

And yet, current asset valuations — that have been taken at face value by the financial service industry — don't incorporate this looming shock to GDP.



The longer into the future the collision between climate science and the financial market occurs, the more likely it will be disorderly, dramatic and, potentially, pose systemic risks including a rapid and chaotic revaluation of a wide array of assets and asset classes — a true Minsky Moment, similar to the financial crisis of 2008.

Researchers, asset owners and managers, investors, and corporations have a shared interest in understanding the financial implications of climate risks sooner rather than later to avoid the looming cliff.

What is called for is an acknowledgment of the risks as reflected by an accurate and timely repricing of assets. That, in turn, will allow the market to reallocate capital to support a climate transition and avoid a sudden and disorderly climate financial crisis. In such a scenario, investors would begin to move their money towards more sustainable/adaptation-aligned investments sooner, not just from a moral imperative but because these generate better and/or less volatile returns.

“We’re racing towards an economic cliff and we either fall off or we shift course. All sorts of scenarios have been run, and they show that it's worse to wait to address this problem. And the longer we wait, the harder it's going to be to avoid that cliff.”

- Witold Henisz,
Vice Dean of the ESG Initiative

“Research by climate scientists implies that the impact of a 3°C increase (or even lower) could be catastrophic, that climate tipping points could be triggered even at 1°C of warming, and that changes to our climate which could trigger tipping points are too risky to bet against.”²

CLIMATE RISK AND THE GLOBAL ECONOMY

The Inaccuracies of Historical Models

The financial service industry and the consultants that advise it do seek insight from macroeconomic models that incorporate climate change. However, the models that they rely upon are dated, thereby creating a false sense of security in the minds of those deploying capital.

The reasons for this misrepresentation are complex and warrant exploration beyond the scope of this paper. In brief:

- For investors and fiduciaries the risk is that climate scenario models overestimate the cost of doing something today, while artificially lowering the cost of doing nothing on climate tomorrow – thus providing a crutch for hesitant investors wedded to business as usual investment practices and fearful of taking definitive action to decarbonize their portfolios and deliver on climate targets.¹
- Historic models relied on data on the historic impact of climate events which were smaller in magnitude, localized, and uncorrelated in comparison to more recent years. It is increasingly evident that the frequency, severity, and correlation of climate-related losses is increasing at an increasing rate. Newer models incorporate these shifts.

The Warnings from Emerging Research

Newer models examine data that present drastically different estimates to GDP loss due to climate change.

Digging into the data, researchers look at six main impact channels that affect GDP loss vis-a-vis warming temperatures: agricultural productivity (ie, more droughts), human health (morbidity and mortality), labour productivity (heat stress), sea level rise and the increased risk of flooding, tourism, and household demand for energy. Globally, models that consider the long-run effects of continued higher temperatures place GDP loss at 7–25% if warming exceeds the 1.5°C target set at the 2015 Paris Agreement by 1°C-1.5°C.

Other models examine how an immediate and aggressive response to climate change will impact GDP. Models that compare the up-front costs of such a response to the avoided losses estimate that GDP per capita would be 15-25% higher if we limit warming to 1.5°C as compared to a 2.5-3°C warming scenario.³

What is consistent in the research is that the economic damages caused by climate change are increasing in the level of future global warming and that damage is to both the future level of income and growth in incomes.

A gradual increase in global mean temperature that reaches another 2°C above 2024 temperatures, sees a precipitous decline in output of 46% by 2100. Capital shrinks by 37% and consumption drops by 37%. These magnitudes are comparable to the economic damage caused by the 1929 Great Depression, but experienced permanently.⁵

REGIONAL IMPACTS

New research also focuses on the impact to specific regions of the world and finds that economic losses are highly divergent across regions and countries. While much of Europe, the U.S., and Canada see GDP declines of 10–12%, China is at risk of losing nearly 24% of its GDP in a severe (3.2°C increase) scenario.⁴

Asset Prices do not Reflect Risk

According to the Centre for the Study of Financial Innovation survey, climate change was ranked in 2019 as the second-highest risk factor for reinsurance companies and the third for non-life insurance firms.⁶ Yet the overall literature does not find substantial pricing of climate risk reflected in the markets, and the pricing that is occurring is far less than what the models outlined above call for.

Why is this? As noted above, the economics of climate change is a constantly evolving topic, yet the financial industry has not kept pace with the newer research. The reliance on older, flawed models has leaked into financial markets, causing advisors to make recommendations on underestimated impacts.

CASE IN POINT: PENSION FUNDS

Following the advice of investment consultants, pension funds have informed their members that global warming of 2–4.3°C will have only a minimal impact on their portfolios. “Investing in a bright future” is the subtitle to the Australian superannuation firm Unisuper’s report, “Climate Risk and Our Investments.” It used a “worst case scenario” which implied a 4.3°C increase in global temperatures by 2100, and concluded that “the overall risk to our portfolio is acceptable.” The UK-based Shropshire County Pension Fund (Fund 2020) estimated that a trajectory that led to 2°C warming by 2100 would actually boost returns till 2030 by 0.05% per annum, while a trajectory leading to a 4°C increase by 2100 would only reduce annual returns to 2030 by 0.06% per annum.² These results fly in the face of a growing body of evidence regarding the macroeconomic consequences of global warming.

Another example is the inadequate risk assigned to the U.S. housing market. Among the natural hazards exacerbated by climate change, flooding is the deadliest, costliest and most widely experienced in the U.S. And yet, the risk is not adequately priced. This disconnect threatens the overall stability of the U.S. housing market.⁷

“

One of two things has to happen: we either fall off the cliff or we shift direction towards a climate transition. Whichever one of those happens, there are going to be changes in the valuation of a wide range of assets. And that's not priced today.”

- Witold Henisz,
Vice Dean of the ESG Initiative

Progress is Slow

There is some evidence that investors are beginning to price this risk,⁸ but mostly after a dramatic climate event. Stocks of firms with lower exposure to climate risk have higher returns during periods with negative news about the future path of climate change. Similarly, global stock market data finds that stocks of carbon-intensive firms underperform during times with abnormally warm weather, a period when climate is particularly salient.⁹ However these effects are not persistent and do not occur in response to developments in published climate research such as those outlined above.

It is also important to consider that these changes are most concentrated in the subset of firms facing a high transition risk — especially those that are also intense emitters of CO₂. While the effects — such as lower market-to-book ratios, carbon premiums, and higher costs of capital — are observable,¹⁰ their magnitude is not in line with the scale implied by the economic losses above.

While greater repricing of firms heavily exposed to climate risk is likely warranted, the effects extend far beyond just these firms. Initial financial shocks on asset prices (e.g., bankruptcies of exposed insurance companies or regional banks) will likely propagate across regional and national economies leading many firms and assets to have indirect exposure to a climate financial crisis not yet recognized.⁸

WHAT'S AT STAKE: AVOIDING THE MINSKY MOMENT

While there are some small rumblings of the market acting in a limited way, the current speed and course of action is not sufficient to avoid the looming cliff.

At all costs, the global economy needs to avoid a climate “Minsky Moment,” i.e., a sudden major collapse in asset values as market participants react to a series of dramatic climate events and finally recognize that their failure to incorporate climate risk into valuations has led to systematic overvaluations.¹¹ Such a recognition following the collapse of Lehman Brothers was a trigger for the global financial crisis.

“**This is in many ways similar to the financial crisis of 2008. There were murmurings of a potential problem a few years earlier, and a sense that things were out of balance. But no one acted, largely because of the flawed assumption that the entire U.S. housing market couldn't go down at once. It's never happened, so it can't happen. And then it did.**”

- Witold Henisz,
Vice Dean of the ESG Initiative

1. The Cost of Delayed Action

Recent research has begun to estimate the difference between the costs of investing to achieve a climate transition sooner rather than later. These estimates suggest a 40 to 50% increase in global abatement costs, mainly due to the buildup of capital stock dedicated to the carbon-intensive production patterns which become stranded once the transition is underway. Other risks of an abrupt transition include a sudden increase in the financial cost of carbon, increased costs of carbon-intensive goods, additional depreciation costs and R&D expenditures as companies rush to meet new climate standards, and sudden changes in revenue as carbon intensive goods become more expensive (leading to demand for such goods to plummet). Such rapid changes may test the capacity of governments to build effective and predictable policy responses leading to increased risk of error, policy instability and macroeconomic crises.¹²

2. Mitigation Costs Less than Inaction

While the long-run effects are disastrous, the costs of the economic transformation required to avoid the worst-case scenario cannot be discounted. Since the transition to a low-carbon economy is yet to happen, empirical evidence of the impact of transition costs on financial assets are scarce, but the examples available indicate that transition costs have already reduced equity returns and increased default probabilities for some firms.⁸ One estimate puts the cumulative capital spending on physical assets needed for the net-zero transition between 2021 and 2050 at \$275 trillion, or an annual increase of \$3.5 trillion from current levels.¹³

However, these short term costs generate substantial future benefit by reducing the likelihood of a potential Minsky Moment. Recent research by scholars at the German Central Bank concludes that proactive mitigation costs far less than delay with a lower likelihood of financial crisis or a lesser magnitude if one does occur and substantially higher levels of future output.¹⁴

3. Short Term Frictions

In addition to the up-front costs of a more aggressive climate mitigation and adaptation path, it is important to recognize that shifting the finance industry to accommodate this more ambitious adaptation path is likely to incur some short-term frictions that must be overcome.

Early adopters that re-value assets or re-weight portfolios are likely to see higher tracking errors, higher portfolio correlations, and potentially lower short-term returns compared to their laggard peers while the market corrects.¹ When considering the risk of outflows from these funds and/or managers, this is not an insignificant concern. While there are significant risks to being a laggard and being forced into writing off stranded assets or fire selling assets, those risks are discounted by their futurity.

Additionally, training and re-training investment professionals, creating new frameworks/methodologies, and acquiring new data is not without cost to firms. Bearing these extra costs, in a market cycle dominated by passive ETF strategies with slimmer margins, is particularly burdensome. Unlike subsidies or areas where government can assuage these pain points, the costs outlined here are likely to be borne solely by the financial services industry. Getting comfortable with these and moving in lockstep (as seen in AFTER a market crash) is key to success. The alternative is being forced to bear them later during a period of upheaval and market turmoil.

Adopting findings from climate research and adapting investment strategies across the industry may not only limit the magnitude of a financial crash but may be the difference between a firm surviving or following in the footsteps of companies like Lehman Brothers and Silicon Valley Bank.

WHAT'S NEXT?

New Developments and Opportunities

While research on climate finance is still in its infancy, there are already promising sources of information on the horizon. Firms can leverage new technologies and methods such as satellite imagery or NLP analysis on financial disclosures or discussion to improve their models. Over the coming years, increased disclosure by firms—whether mandated by regulators or demanded by large investors — will provide new opportunities to measure firms' exposure to various types of climate risks. And, in the absence of new data disclosed directly by firms, more creative use of data imputation can estimate corporate risk exposure thereby pressuring firms to disclose more if those estimates are known to be too pessimistic.⁹

A climate transition also provides real investment opportunities for firms operating in renewable energy, electric cars, carbon capture or energy storage. The unicorns (i.e., entrepreneurs who receive billion dollar valuations for their start-ups) of the next decade could include innovators in green steel, green cement, green agriculture, sustainable aviation and shipping fuel, sustainable computing, hydrogen, or carbon capture.

The Role of Business

Firms and investors need to pursue more aggressive adaptation strategies. This is important for companies across risk profiles, but specifically for high-exposure companies such as those located in high risk areas for flooding or those dependent upon carbon-intensive production processes.

While there are signs that these businesses and their investors are beginning to embrace this challenge and look to the future of a climate transition, there remains substantial divergence across and within industry and, even more so, geography, as to the extent to which companies are assessing and attempting to mitigate their risk — and what opportunities those companies are finding.

It is not surprising that firms facing the greatest exposure (utilities, construction, ski resorts, etc.) are more likely to engage with adaptation — yet those adaptations are still minute compared to the challenge. A recent study looked at 1,068 public companies headquartered in 43 countries across industries and their adaptation to five climate exposures: heat stress, water stress, sea-level rise, floods, and hurricanes/typhoons. The results show that firms are reporting adapting to only 23% of the relevant climate risks.¹⁵

The empirical results suggest that firms are sensitive to the nature and level of forecasted climate change exposures, adapting more often and more completely to those most salient to their business. Greater climate exposure leads to a higher perceived impact of climate change, thereby increasing firms' adaptation efforts. Furthermore, the positive relationship between firms' forecasted climate exposure and their adaptation is stronger for firms with greater ESG capabilities and over longer time horizons.¹⁵ Investor awareness of the balance between climate risks and opportunities can further accelerate or encourage necessary adaptation.

CONCLUSION

That climate change will dramatically impact the global economy is clear. It is also clear that the global economy has yet to adequately price the impact of a changing planet into assets. Because markets loathe chaos, avoiding a disorderly transition is in everyone's best interest. For investors and those in the financial services industry, this change has real financial incentives; adequately pricing climate risk can improve returns, reduce losses, and lower volatility across all asset classes, particularly those most exposed to climate and carbon.

To avoid a climate Minsky Moment and the devastation that would render, governments and businesses need to adopt a long-term perspective and coordinate action in a spirit of unity, resolve, and cooperation and, at the same time, take near-term actions to manage their own risks and capture opportunities.¹³ Additional high fidelity studies, quality data, and industry re-norming are all required to avoid the looming cliff of a climate Minsky Moment and achieve the long-term goals of stability, improved GDP, profits, and a healthier planet.



THE SCHOLAR: *WITOLD HENISZ*

Witold J. Henisz is the Vice Dean and Faculty Director, ESG Initiative and the Deloitte & Touche Professor of Management in Honor of Russell E. Palmer, former Managing Partner at the Wharton School of the University of Pennsylvania. His research examines the impact of political hazards as well as environmental, social, and governance factors more broadly on the strategy and valuation of global corporations. This work analyzes best practices in corporate diplomacy to win the hearts and minds of external stakeholders as well as the measurement thereof. He has been published in top-ranked journals in international business, management, international studies and sociology and he is the author of the book “Corporate Diplomacy: Building Reputations and Relationships with External Stakeholders.” Witold has won multiple teaching awards at the graduate and undergraduate levels and also teaches extensively on the topic of Corporate Diplomacy as well as ESG integration in open enrollment and custom executive education programs. He is currently a principal in the consultancy PRIMA LLC whose clients span multinational firms, asset managers, intergovernmental organizations and non-governmental organizations.

The Wharton ESG Initiative:

The Environmental, Social and Governance (ESG) Initiative conducts academically rigorous and practically relevant research that investigates gaps between the current pricing of ESG factors by investors and corporations and their long-term business and societal impacts. Informed by this research, we offer 30+ courses that MBA and undergraduate students can assemble into the ESG for Business major or concentration, over a dozen co-curricular experiences, four Executive certificate programs, and an expanding array of industry and policy convenings. We advance Wharton’s best-in-class education of current and future leaders, equipping them with the tools, skills, and perspectives needed to navigate a world in which ESG risks and opportunities are increasingly material. For more information, visit <https://esg.wharton.upenn.edu>.

REFERENCES

1. Keen, Steve, Mark Campanale, Joel Benjamin, Tim Lenton, and Jesse Abrams. "Challenging the Systemic Under-pricing of Climate Damages Within the Global Financial System." Presented at the Yale Institute of Sustainable Finance Annual Symposium, November 2024.
2. Carbon Tracker. Loading the DICE Against Pension Funds: Flawed Economic Thinking on Climate Has Put Your Pension at Risk. July 27, 2023. <https://carbontracker.org/reports/loading-the-dice-against-pensions/>.
3. Burke, Marshall, W. Matthew Davis, and Noah S. Diffenbaugh. "Large Potential Reduction in Economic Damages Under UN Mitigation Targets." *Nature* 557 (2018): 549–553. <https://doi.org/10.1038/s41586-018-0071-9>.
4. Swiss Re Institute. "World Economy Set to Lose up to 18% GDP from Climate Change if No Action Taken." April 22, 2021. <https://www.swissre.com/media/press-release/nr-20210422-economics-of-climate-change-risks.html>.
5. Bilal, Adrien, and Diego R. Känzig. "The Macroeconomic Impact of Climate Change: Global vs. Local Temperature." National Bureau of Economic Research, Working Paper 32450. <http://www.nber.org/papers/w32450>.
6. Venturini, Alessio. "Climate Change, Risk Factors, and Stock Returns: A Review of the Literature." *International Review of Financial Analysis* 79 (2022): 101934. <https://doi.org/10.1016/j.irfa.2021.101934>.
7. Gourevitch, Jonathan D., Carolyn Kousky, Yanjun Liao, et al. "Unpriced Climate Risk and the Potential Consequences of Overvaluation in US Housing Markets." *Nature Climate Change* 13 (2023): 250–257. <https://doi.org/10.1038/s41558-023-01594-8>.
8. Campiglio, Emanuele, Louis Daumas, Pascal Monnin, and Andreas von Jagow. "Climate-related Risks in Financial Assets." *Journal of Economic Surveys* 37 (2023): 950–992. <https://doi.org/10.1111/joes.12525>.
9. Giglio, Stefano, Bryan Kelly, and Johannes Stroebel. "Climate Finance." *Annual Review of Financial Economics* 13 (2021): 15–36. <https://doi.org/10.1146/annurev-financial-102620-103311>.
10. Li, Qing, Hongyu Shan, Yuehua Tang, and Vincent Yao. "Corporate Climate Risk: Measurements and Responses." *Review of Financial Studies* (Forthcoming). July 2, 2020. <https://ssrn.com/abstract=3508497> or <http://dx.doi.org/10.2139/ssrn.3508497>.
11. Corporate Finance Institute. "Minsky Moment." <https://corporatefinanceinstitute.com/resources/economics/minsky-moment/>.
12. Ralite, Soline, and Jakob Thomä. "Storm Ahead: A Proposal for a Climate Stress-Test Scenario." 2°Investing Initiative. <https://sustainablefinanceobservatory.org/resource/storm-ahead-a-proposal-for-a-climate-stress-test-scenario/>.
13. Krishnan, Mekala, Hamid Samandari, Jonathan Woetzel, Sven Smit, Daniel Pachod, Dickon Pinner, Tomas Nauclér, Humayun Tai, Annabel Farr, Weige Wu, and Danielle Imperato. *The Net-zero Transition: What It Would Cost, What It Could Bring*. McKinsey Report, January 2022.
14. Kaldorf, Matthias, and Matthias Rottner. "Climate Minsky Moments and Endogenous Financial Crises." Deutsche Bundesbank Discussion Paper No. 26/2024, June 21, 2024. <https://ssrn.com/abstract=4899092> or <http://dx.doi.org/10.2139/ssrn.4899092>.
15. Li, Xia. "Physical Climate Change Exposure and Firms' Adaptation Strategy." *Strategic Management Journal* (Forthcoming), September 9, 2024. <https://ssrn.com/abstract=4143981> or <http://dx.doi.org/10.2139/ssrn.4143981>.

RELATED WORKS

1. Kahn, Matthew E., Kamiar Mohaddes, Ryan N. C. Ng, M. Hashem Pesaran, Mehdi Raissi, and Jui-Chung Yang. "Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis." IMF Working Paper.
2. Kotz, Max, Anders Levermann, and Leonie Wenz. "The Economic Commitment of Climate Change." *Nature* 628 (2024): 551–557. <https://doi.org/10.1038/s41586-024-07219-0>.
3. Bolton, Patrick, Zach Halem, and Marcin Kacperczyk. "The Financial Cost of Carbon." *Journal of Applied Corporate Finance* 34, no. 1 (2022): 17–29. <https://doi.org/10.1111/jacf.12502>.
4. Bolton, Patrick, and Marcin Kacperczyk. "Do Investors Care About Carbon Risk?" *Journal of Financial Economics* 142, no. 2 (2021): 517–549. <https://doi.org/10.1016/j.jfineco.2021.05.008>.
5. Sautner, Zacharias, Laurence van Lent, Grigory Vilkov, and Ruishen Zhang. "Firm-Level Climate Change Exposure." *The Journal of Finance* 78, no. 3 (June 2023): 1449–1498. <https://doi.org/10.1111/jofi.13219>.
6. Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Edited by Hans-Otto Pörtner et al. Cambridge: Cambridge University Press, 2022. <https://doi.org/10.1017/9781009325844>.