

# **Transcripts of the interview with Viral Acharya (Starr Professor of Economics in the Department of Finance at New York University Stern School of Business) – November 2023**

## **Annette Becker:**

Hello everyone and welcome to the Sustainable Finance Research Forum, the SFRF, by the European Commission. I have the honour to continue the SFRF interview series with scholars working on sustainable finance. My name is Annette Becker. I work as an economist in the sustainable finance team at the Joint Research Centre and I take on the role of the interviewer for today's episode. And today, exactly one year after the launch event of the SFRF on October 27th in 2022, it gives me particular pleasure to host today's session with a highly decorated interviewee. Welcome, Viral!

## **Viral Acharya:**

Thank you so much, Annette. It's lovely to be here and do this interview with you for the Sustainable Finance Research Forum. And thank you to the Joint Research Commission of the European Commission.

## **A.B.:**

Thanks so much, Viral. I will give our audience a brief bio of Viral. Viral Acharya is the C. V. Starr Professor of Economics in the Department of Finance at the New York University Stern School of Business. And there are numerous affiliations of Viral to mention. To begin with, he is a Research Associate of the National Bureau of Economic Research in Corporate Finance, furthermore, research affiliate at the Center of Economic Policy Research and also research associate of the European Corporate Governance Institute. Another office Viral acts in has been that of academic advisor to several federal reserve banks, amongst them most recently at the Federal Reserve Bank of New York. And on top of many more mandates, Viral is a member of the Climate-related Financial Risk Advisory Committee of the Financial Stability Oversight Council for 2023-2026. So, Viral, thanks for accepting our invitation and let me come to today's topic. About your research agenda, one of your recent working papers pivots around climate risk and how heat stress affects the asset market. With your co-

authors, you look at how asset markets price climate risk and you account for different types of physical risk, namely heat stress, flood risk, and the like. Since you examine regional variation, the breakdown of your data is at US county level as well as firm asset location level. And also, you cover a series of multiple vintages. So, hearing about the granularity and breadth of your data, it shows that financial climate research is a demanding task from the very start onwards. My first question cluster would be on the data challenges and spatiality from both the research and investor side. **On the research side, which data challenges in particular regarding the spatial regional dimension did you face, which proved to be worthwhile? And, on the investor side, is their outlook for risk management to monitor a growing number of different metrics on physical risk as in heat, flood, or how granular or compound do investor measures on climate-related risk have to be in order to be both informative and reliable?**

**V.A.:**

That's a great question, Annette, and it's also quite timely. Just yesterday, I saw a post that Bloomberg is actually going to invest quite heavily in building a spatially oriented data set of physical risks for evaluating climate change, exposure of companies and so on. And it's good to think about it first from a climate change perspective, which is that when climate scientists models, global warming scenarios which they call as representative concentration pathways, you know how much emission per square meter, we are going to have. They have to pick a stress scenario and then they have to map that representative concentration pathway into a distribution of climate outcomes. Now you can imagine this is a pretty daunting exercise. And of course climate scientists have been building models to do this kind of spatial modelling going from a global warming stress scenario to a spatial mapping of what is likely to be the climate patterns for a particular county or a region. Now however, the climate science has advanced quite a bit because unlike finance and economics, they have been thinking about these issues for quite a while. And there are models out there to do this. And you know, they all will typically give you a distribution. So for example, if the planet is going to be 1.5 degree or 3.5 degrees Celsius warmer than today in 2085, what's going to be the histogram of temperature distributions in New York City? What's likely to be the risk of flooding? So you know, they have a range of models to do that. Now these models, of course, they all are imperfect in some sense because, you know, climate change modeling

involves very complex physical equations and interactions. Not all of them are considered in every single model that's out there. So the approach that we have used is to rely on this one scientific paper by Tseng et al. But roughly it averages about 44 different climate science models. And you can actually vary in the model what representative concentration pathway you want, what's the global warming scenario that you are looking at, is it 1.5 degree, 3.5 degrees warming or 5.5 degrees warming, you know, which would be very, very extreme. But you can model the – you can pick a scenario and then you would get a range of physical risk outcomes. Now, turning to capital markets, if you are really just thinking about understanding impact on the local county or understanding the cost of municipal borrowings, then that spatial mapping at the level of a county would be sufficient. But a lot of the climate finance and economics work is about companies. Is it affecting the cost of capital by investing in technologies that will help them adapt to minimizing losses or risk to employment, risk to sales at the time that these physical hazards materialize. But unfortunately, like municipalities, companies are not necessarily single location creatures. You know, they may have plants and establishments at various locations. Some plants may, of course, be more crucial than others. However, you know, you can think about, you know, say, employment-weighted exposure to physical climate risks based on various counties where a particular company is located. And when you think about multinationals, this problem is even more complicated because you have to actually model the climate change at all of their global locations.

So, currently, a big challenge for research, in my view, is to get this physical mapping of a company's plants and establishments. What's an economic unit of exposure to a particular location's physical risk? Should it be sales weighted? Should it be employment weighted, is one headquarter location or another location very central and critical? So it's disproportionately important to the value of the firm and its cost of capital compared to other locations. There are some industry methods to do this. There are black boxes, you know, they are all developing this data on their own and they sell a score for a company saying, okay, we have the underlying physical data, they have a black box of what the physical locations data is, and they will give you a ranking within an industry which firm is most exposed to heat risk, which firm is most exposed to hurricane risk, etc. But black boxes are not always very satisfactory. So, there are two options, at least in the United States, if you do not want to work with industries black boxes. One option is to use Dun & Bradstreet's

data, which has county-level plants and establishments. It will help you figure out if a plant is closed or if a new plant is being set up. It also gives you sales and employment weightings of the actual sales and employment at each of these plants. So then you can do a bottom-up construction of physical risk of exposure of a company. Another way to go is, of course, to use the US Census data, which is much harder to use, but you can, if you have access to the US Census, or you're willing to go and work at their labs, then you have a far more comprehensive coverage, including of single establishment firms, which typically may or may not have that much coverage in the other data sets. That would be the best way to do it, but it's a bit costly and time intensive. So long and short, I think the big challenge in modelling physical climate risk is to get the exposure of the companies to do that exactly as you said, one has to start spatially, but then one needs a mapping of the company's establishments, plants and economic value that or weight that one should attach to each of these plants and establishments. Now, of course, companies are themselves evolving as we speak, they may adapt, they may shut down an establishment, they may reduce employment in a certain establishment. So it's not even enough to have a snapshot at a given point of time because everything is evolving and ideally one would like to have this data at least updated annually or maybe at a minimum at least once every three or five years. So lots of interesting work to do. I would say it's almost ground zero in a way. You're going to build these data sets from scratch. That's what some of my co-authors and I, Tim Johnson from Urbana-Champaign, Tuomas Tomunen from Boston College, Suresh Sundaresan from Columbia University, Abhishek Bhardwaj from Tulane. We're all trying to do this using a variety of different data sets, but I'm sure someone else is doing it as well, probably doing it much better than we are using more granular data. As I said, going to U.S. Census would be the best way to do it. I do think, though, that the big challenge is multinational. And ultimately, to just give you a parallel to transition risk, Annette, we are realizing that measuring company-level exposures is not easy. See, even in emissions, we are thinking about scope one, scope two, scope three. You know, is it direct? Is it indirect? And so on. And the same way, even when we think hard about physical risk, once again, we are realizing that we need to standardize the measurement of physical risk exposures of companies. And in a way, that's a pretty important challenge to move the debate forward on this.

**A.B.:**

Thanks, Viral, for shedding a bit of light into that black box, which actually lays a solid foundation to kick-start our session. I would like to stay with the climate pricing and switch sides. So my second question cluster would be on the effect of climate risk rising on issues of, for instance, bonds. **So on the issuer side, how strong is the incentive from the rising cost of capital by, for instance, heat stress to invest in abatement technologies? And, also, how does this pricing pressure fare compared to financial instruments designed to redirect and support climate change mitigating activities as in green or sustainability linked bonds?**

**V.A.:**

Yes, so, you know, in our work, we do find that even though this data may not be available as granularly and as precisely as one might want, that markets do seem to be pricing at least the heat risk of companies which we have focused on, which is what's the likelihood that extreme temperatures beyond 100 degree Fahrenheit realize in the company's locations or the municipality's locations, because there will be economic damages associated with that. There could be worker fatalities, there could be worker injuries that could lead to lower productivity in hot days in many settings, and specifically in some certain exposed industries like mining, construction, agriculture, and farming. It could also lead to higher levels of energy expenditures, something that is not fully appreciated as to how costly it is, that even for non-exposed industries you would have to still incur significant air conditioning expenditures. And so, effectively, these are cash flow risks to the company, and they're going to, in some sense, get aggravated in times when there is global warming. So heating is a bit of an aggregate risk. You know, there are only so many pockets of the world that are not going to be affected by a global warming scenario. There are such pockets who would be beneficiaries of global warming, but if you took the overall GDP of the world or of market, it's going to be more affected on average by global warming than be a pure beneficiary of it. And so it's an aggregate risk, and so companies that are affected by this aggregate risk will then have a higher cost of capital. And then as you said, this does create incentives for them to adapt, mitigate the risk to employment, risk to their cash flows. And we find that companies are doing this. So in particular, we find that whenever heat shocks materialize in terms of actual hot days realizing in a county, sometimes they can be one-off, sometimes they could be in spells or very acute. Sometimes there are regions which are chronically exposed to heat

stress. So they get exposed to heat stress year after year. And both acute as well as chronic exposure, we find, leads to a stronger mitigation or adaptation response. And what do companies do? We basically find that they are simply shifting their weight of employment to locations which are not as exposed to heat risk. And in particular, they seem to respond more to realizations, and that's very typical of corporate behaviour, maybe until—you know, because we are all learning about climate change, and so only when heat incidents realize, if you have an actual worker fatality or injury, you know, one quarter's cost of energy expenditures becomes very high like this summer in Arizona or Texas, then, you know, the companies start rethinking, you know, okay, this is a real hit to my cash flows now. How do I stay nimble? How do I stay sustainable? How do I stay efficient, both in a financial as well as in an energy sense?

The second thing that's interesting, you mentioned about compounding of risk. It does seem that counties which are exposed to compound risks or corporations which are exposed to compound risks, so you know, multiple hazards happening at the same time, do actually by and large have a stronger adaptation response. And I think that makes a lot of good sense if you think about some of the unfortunate calamities that we have witnessed over the summer, especially in Hawaii. It was actually a compound climate event. You know, there was strong heat, hurricane style winds and then, you know, fires kind of took over. I think that the compound climate risks, especially in the physical space, have not been studied as much, but it seems companies are actually factoring in some of these risks.

One last point on this, Annette, which is very, very interesting and gives me a lot of thought every time I think about climate change is that, so I've been saying that companies are mitigating in some way around these physical risks. But of course, this is costly, you know, shutting down some of your establishments or operating them at lower capacity relative to the full capacity that you have built in, that's an operating cost. Relocating where your employment is means entering new labour markets and hiring new employees in those newer locations. And what we are finding is that smaller companies, especially few establishment companies, are not able to take this on. So unfortunately, they seem to be losing employees when physical risks materialize. And some of this movement of employees is within county to the larger firms in the affected location. What that means is that essentially, if you think about a concept of resilience, which is what is the climate resilience in the corporate sector, our work as well as some other work out there is finding that essentially small firms don't

seem as resilient. It's the large firms who are more resilient. And this has implications for industry concentration over time, which of course then feeds into pricing power and inflation and so on. There seems to be quite an important industrial consideration to keep in mind. Some thought needs to be given to what can be done to make it feasible for smaller businesses to adapt and mitigate. I'm not necessarily proposing that we simply adopt safety nets, but what I have in mind is, you know, what kind of sustainable finance, sustainable business practices, some support in maybe some of these relocations feasible might actually be quite effective. At least at a minimum, we should give it some thought.

**A.B.:**

That was a very clear message on hits to cash flow and firms' adaptation response, Viral. So, climate resilience affects industry concentration as a takeaway. My third question cluster now would be on the difference of asset classes with regard to climate risks. **That is, what differences do you observe in the asset classes like debt and equity securities in terms of reflecting factored in climate risk? And also with respect to asset classes, how does the market composition in the US diverge from that of the EU?**

**V.A.:**

So let me make two points, Annette, on this front. First, let me talk about debt versus equity. Now, clearly, as I said, physical risks like heat, for example, if they materialize, even other physical risks would have this impact. They would impact your cash flows, but they're also impacting your cost of capital, as I explained, because a global warming scenario is most likely going to be an aggregate risk scenario. So there'll be some sort of covariance-based extra pricing of the cash flow risk, which is linked to, say, heat, for example. So it should be priced in both debt and equity markets in a way. But of course, there's this natural implication that companies which are very safe to start with, which have very large pools of cash relative to the debt liabilities that they have, whose businesses have very stable cash flows, or whose growth options are very, very high, all that's equal, you know, they would have not much of an impact. And so that is what you find in data, that investment-grade firms as of now don't show a very strong pricing of physical climate risks. In contrast, weaker-rated firms, especially sub-investment-grade or junk-rated firms, and especially for their longer-term bonds, like 10-year or longer bonds, because that's the horizon at which physical risks are

likely to start accumulating into significant losses. We find that these are the instruments, lower rated bonds, longer term bonds in case of municipalities, they tend to be bonds which are just linked to cash flows of a particular utility rather than which are diversified for the municipality as a whole based on the full tax collection. These are the bonds where physical climate risk seems to be more priced. And our effects are not sort of giant-sized, but they are reasonable. We find an impact that if sort of you look at one standard deviation in the – standard deviation in the spatial sense of heat risk that leads to about extra 40 to 50 basis points in the cost of debt for these junk rated firms at longer majorities.

Now, junk rated bonds are not that different from equity because they are really sort of at the bottom of the capital structure in a priority sense. And so we find very similar effects in the expected return on equity, you know, we find again an effect of 40 to 50 basis points per annum. So effectively it says that, you know, for weakly rated firms, it's about 40 to 50 basis points per annum increase in their cost of capital. Now, is it large? Maybe it's not sort of earth shattering to start with. However, companies may worry about the immediate cash flow impact as well and not just on the cost of capital. So, cost of capital is something that is going to affect your investments, etc., going forward because the hurdle rates will rise. But they may worry about their default risk because, you know, management may be quite risk averse to, you know, losing their CEO style, lifestyle and salaries, et cetera. Boards may be concerned about the default risk as well. And indeed, if you look at the default frequencies of companies, we find that these risks like energy expenditures, worker productivity, worker fatalities and injuries, for smaller firms, loss of employment, all of these are already affecting in data the realized default frequencies of companies. You know, these are again not sort of giant-sized effects, but they are large enough to statistically observe them in the data. And so I would say that it seems to make a lot of good sense that safer firms, climate risk is not priced. For weaker firms and their equity instruments, for weaker bonds and equity instruments it is priced. It's more at longer maturities. It's more where the security of the cash flows is not too diversified. So revenue only bonds of municipalities rather than general obligation bonds are more exposed. I haven't seen a lot of analysis of physical climate risks in Europe, but I would imagine that the trust of these results is so, in some sense, so natural, and it meets such, it takes so many common sense boxes that I would imagine that the body of evidence that has now been gathered in the US would most likely carry over to Europe as well. But personally, I'm quite interested in carrying over this work to emerging markets as

well. For example, India is quite exposed to heat risk and I'm quite interested in studying whether heat risk is already priced in the cost of capital and default risk of companies in India, for example.

**A.B.:**

Indeed, the application to low and middle income countries might be quite interesting to shed light on. Let me get back to one thing that you said on the county-level migration of workforce, which connects to one of your working papers from this August on corporate mitigation of employment effects of heat stress. By linking the financial market and the real economy, you have studied how heat shocks affect the real economy by evidence from the US labour market. So I would like to ask these two questions: **How do climate events translate into the employment effects again and which are further transmission channels into the real economy? And you also analyse workforce reallocation and firm size by the financial constraint in the US. How can this insight inform the industrial landscape of the EU, where the economic backbone is mainly formed by small and medium-sized enterprises?**

**V.A.:**

Yeah, I think that's, as I told you, Annette, this is really the question that stays at the back of my mind about small and medium-sized businesses as to how to make it easier for them to be climate resilient. Because we are observing that, you know, for example, small businesses sometimes of a certain size don't even provide effective insurance coverage to their employees. You know, the employees are often left on their own to sort out their health insurances. So this would be one clear factor that deters employees from staying in small businesses. They would say, listen, you know, yeah, it's a slightly more flexible job, but, you know, I really don't have the safety net that I need, and I can get it if I'm in a large company. So you might see this kind of rotation of employment as a result of insurance. Another possibility is that, you know, over time, if the larger firms are more nimble about being able to move their employment and skew it towards less exposed regions, employees may think there's sort of overtime greater flexibility. Employees are not going to start leaving locations in a big way right away, but they might start seeing some insurance from just the fact that a large company has many locations and that opens up different areas that you could work

from. And in some sense, and we do find in data that financial constraints, which typically in the finance literature are a function of size and age. So we have been talking mostly about small and medium sized companies, but young firms are also typically financially constrained and young firms also generally, we find are not able to actually be resilient, make the transitions that are required. And I think, you know, it's costly operationally. You know, you have barely set up and you have to start shifting stuff around. It's going to be very, very costly. Very often young firms are, you know, running out of, you know, family backyards and things like that. So I think there are two or three things to think about. Maybe let me put three options on the table. One is whether we can think about better provision of insurance, more affordable insurance for smaller and younger firms. I've been thinking at a very conceptual level, not in a research sense, about whether there is a case to be made for an omnibus climate insurance contract. You know, we have like insurance for specific risks right now, you know, insurance against flooding risk, insurance against hurricane risk, heat risk.

But as we discussed earlier, many of these risks are of compound nature, and some of them may hit in a particular year, some others might hit in some other year. And I wonder if the overall aggregate provision of insurance may be cheaper if we actually sell omnibus climate insurance contracts of certain type. Maybe that needs to be explored in my view. Second, I would say availability of finance. So some work by Raghuram Rajan and Rodney Ramcharan on a historical drought in the United States in 1950s shows that areas that had access to bank branches, so availability of banking finance, these were the ones that were more resilient. They were able to adapt in terms of investing in newer types of feeds, newer types of irrigation technologies. And over time, actually, areas that had banking finance access, they leapfrogged in terms of technology, other areas which might have been even less exposed to climate change in the first place. So maybe access to finance would allow, would relax the financial constraints for these companies and maybe help them adapt and mitigate to the possible consequences. I think the third thing that perhaps can also be considered is simply whether, you know, for example, for large companies and I would say even medium-sized companies like private equity companies, which sometimes, you know, many companies are privately owned in that space of mid-size segment. You know, private equity companies are developing their own in-house expertise on how to give guidance on sustainable business practices. Very often, private equity firms will appoint their own board

member who has expertise in sustainable business strategies to help handhold the companies in this transition of adaptation and mitigation. Now, of course, they are not owning very young and small firms necessarily. So the question is, can somehow we create a platform or a possibility of providing this kind of sustainable business guidance to these smaller and younger firms? I think, again, that's something that we could give a thought to.

**A.B.:**

Thank you, Viral. I greatly appreciate the depth of all your replies. It certainly was a thought stimulating session on how the physical risk of climate change affects asset pricing and equally how it becomes tangible in the real economy, spilling over to the labour market and also to hear about ideas about novel mechanisms like an omnibus climate insurance for firms. Closing our interview, I am deeply grateful for the insights you shared in the last 30 minutes, dear Viral.

**V.A.:**

So thanks for that and for spending the session with me. Thank you so much, Annette. My pleasure. I encourage the audience to visit my website. Some of the work I've done on physical climate risks and climate stress testing is already up there. The work on mitigation and transition risk and compound – how to measure compound climate risks and what their impact is, it's still ongoing work. But if you are interested, please drop me an email and I'll share what we can.

**A.B.:**

Thank you so much. That is so nice. And with this, I say goodbye to our audience. Stay tuned for the next episode of the SFRF interview series upcoming this winter quarter. See you again on this channel!