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WELCOME

DAVID WESSEL
Hutchins Center on Fiscal and Monetary Policy, Brookings

PAPER SESSION 1

MODERATOR: DANIEL BERGSTRESSER
Brandeis International Business School

AUTHOR: TIM JOHNSON
University of Illinois Urbana-Champaign

DISCUSSANT: Tom Doe
Municipal Market Analytics

AUTHOR: BAOLIAN WANG
University of Florida

DISCUSSANT: MONICA REID
Kestrel

AUTHOR: JUN KYUNG AUH
Yonsei University

DISCUSSANT: IVAN IVANOV
Federal Reserve Bank of Chicago

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WESSEL: [00:00:02] Good morning. I'm David Wessel, director of the Hutchins Center here at Brookings. On behalf of my our partners at the Brandeis International Business School, Rosenberg Institute of Global Finance, Dan Bergstresser, and Rich Ryffel from WashU in Saint Louis Olin Business School, and Justin Marlowe from the University of Chicago's Harris School of Public Policy, I want to welcome you to what's the 12th annual Municipal Finance Conference. Although it began before we got involved, we're very proud to be involved in it, and we're extremely happy to be back in person. Although anybody who wants to is watching online. So be careful what you say because it'll be you can become viral if you're not careful. And we have a great program. It's kind of crowded today and there's some logistical challenges. So I just want to go over them briefly. First of all, if you haven't found the restrooms, they're out straight that way and you all have nametags. And our security people asked me to ask you to wear them. And if you could try and remember to wear them, bring them home and wear them tomorrow. I've never succeeded in doing that in any two day conference, but maybe you'll be better than me. So we have one session in here this morning that I'll introduce in a moment, and then we'll break for lunch around noon. And we're building on something that worked well and we had the conference virtually, which is we're going to have informal discussions over lunch. We've got some topics. I'll explain them later. And there's going to be some signs for different things. There'll be a box lunch, you can take your lunch and those are not programed, although we do have one of our. Organizers of the conference will be in each room, but they're spread out throughout the building. And it's a little complicated because we have some construction. So I'll do that later and then we'll come back at 1:00, 1:00 we're going to have concurrent sessions, one on state and local tax issues and here and one on muni bond market issues on the second floor. I will direct you there and then we're coming back in here. It's going to be a challenging day to hear from David Schleifer of Yale Law School on his book and then to have some sessions in here. So my staff will be happy, the broker staff will be happy to guide you through that. And I want to call out the people who make this possible Holland Chen, Megan Waring and Stephanie Sims. So thank you. As as you all know, there's always a lot of logistical issues in arranging any conference. This one is no exception and I'm really proud of how well it's gone so far. Of course, we're only 5 minutes in, so so the first panel today is on climate change and municipal finance. Dan Bergstresser is going to moderate it. And I'll leave him to introduce the speakers and take it from here. So Dan, the floor is yours.

BERGSTRESSER: [00:03:06] There's a there's a note here. It says, Speak into the mike. Welcome. Can you can you hear me? Okay. I'll just remind everybody that this is being live streamed as well. So anything that you say, even in the back, might get picked up and carried over Zoom. So be be be aware of that. It's it's a delight to be back in person. The first session which I'm going to moderate is on climate change and municipal finance. We've got three papers. The way that we do the there'll be a certain amount of getting up and getting down, so we don't want to block the slides. So when somebody is presenting, only the presenter will be up here. Then for the Q&A, the presenter, the discussant and I as kind of the referee or ringleader, what have you sort of be up on the stage and then we'll go on to the next paper. We've got three great papers in this in this part of the program. The first paper is, is physical climate risk priced evidence from regional variation in exposure to heat stress. Tim Johnson of the University of Illinois is going to present that. And we've got Tom Doe, the founder of Municipal Market Analytics, who'll be the discussant. And then we will transition, you know, we will get off the stage and then we'll go directly to the second paper we're very excited about. It's the emerging green team. Baolian Wang of the University of Florida will present that paper and the discussant will be Monica Reid, the founder and CEO of Kestrel. Then we will get down again and we'll have the third paper of the of the session natural disasters and municipal bonds. You know, it's kind of as we think about all the stuff going on recently in the northeast, you know, elsewhere with natural disasters, we thought we'd start with this on the program. The presenter of that is Jun Kyung Auh of of Yonsei University who will present that paper. And then Ivan Ivanov of the Federal Reserve Bank of Chicago will be the discussant. So I will come back when it's time to moderate the the discussion between the the the

author and the discussant. But with that, I'm going to turn it over to Tim Johnson of the University of Illinois.

JOHNSON: [00:05:25] Okay. Thank you to the conference organizers for having this paper. And thanks to. As you can see, the title of the paper is is this paper is going to look at physical climate risk. And so be looking at actually three different asset classes, namely municipal bonds, corporate bonds and equities. In the interests of this audience of munis focus on the municipal bond results, the equity results. Besides just verifying the municipal findings, they're interesting for some other reasons in terms of getting at effects coming from cash flows, which is discount rates, but that's in the paper. So so you've got out for today. And the other thing to point out is that we're going to be focusing on heat stress in this paper. Now, a development in climate finance and climate economics in general is that recently researchers have started to decompose potential pardon me, potential damages due to various aspects of climate change into their components, things like hurricanes, sea level rise, floods, wildfires and direct effects of heat stress. Of course, all of these may be viewed as indirect effects of heat stress, but researchers have actually broken them down into, you know, direct versus these other things. And so that's one of the things we can do in this paper. We're going to look at specifically the direct effects of heat exposure. And that turns out to matter. It turns out that if you lump everything together, for example, you don't get the same results that you do if you disaggregate and look just at heat stress. So I know I don't need to work too hard to motivate a paper about the seriousness of heat stress at a conference in July in the district. But what ends up happening is that in terms of economic magnitudes, heat stress is a lot bigger in aggregate than the effects that are anticipated from, let's say, hurricanes. Why is that? Well, hurricanes are more localized, but to some degree, there's also the possibilities that that there's more mitigation measures available. Heat stress is very hard to mitigate against, as you all know, especially if you work outdoors, for example. Right. Or if you are directly dependent on energy expenditures. And those things are broken down into some different components there. And this is not from us. This is just from another paper in the literature that we're going to build on. And as I said, you know, it's just, you know, shockingly easy to come up with, you know, news stories emphasizing the significant nature of heat waves and their effect on their possible economic effects. You know, I could have just made these slides just from today's headlines, but these are from last winter. Did you know that nuclear plants are threatened by heat stress? That's a scary one, right? I didn't even know that. But so I'll skip with the examples here and just give you a brief preview of the results. So our question is, is physical climate risk priced and heat stressed does increase municipal and corporate bond spreads and conditional expected returns on equity. So that's sort of lumping all the three together just to focus on munis. Again, we get about a 15 basis point effect in credit spreads for particularly for long term bonds for, let's say, a county whose GDP is expected to be impacted by 1% per year. And I'll be more precise about what those measurements are in a moment as the other ones. Well, let's get number two, what we can do because of other researchers breaking down the different components of climate risk is we can actually look at the other ones in aggregate, the hurricanes, sea level risk and stuff. And I'll show you if I have time, we get nothing. Okay. So that's not to say it's not there, but certainly our empirical methods are not picking it up, so just leave it at that. Just graphically, what we're finding is actually a time series effect that somewhere around 2010, 2011, these effects went from negligible in the cross-section to significant, and these are basis points for one of our measures in the horizontal axis for kind of a one standard deviation exposed municipality or I should say county. Actually the data is on the issuer level, right? So the issue per month level. So what we have is we have these heat stress measures at the county level and then we can say, okay, we can locate municipal issuers to within a county which, you know, you can do with census data. And when we do the same things with corporates, it's a little more complicated. But again, I'm not going to talk about that today. These are the ones for corporates and I'll skip over that. So let me get into the measurement. There's a couple of there's two measurements, main measurement strategies in the paper. One comes with the so-called seagrass study that was published in Science by Chang at All At All in this case is about 15 authors. It's an extensive study based on if those of you in the climate sphere, no. RCP Well, there's all these climate models out there. They make projections under different scenarios about global policy responses. So the one that we call RCP 8.5 is one of these, not necessarily the worst case scenario, but it's a pretty bad case scenario. And then given

that scenario, there's like 44 different climate models run to give you a range of possible outcomes again at the county level. So what Chang It all did is they translated this into measures of lost productivity, increased energy expenses. We take it a step further and say, okay, well, can we then can we put that in terms of money? Terms in terms of GDP based on county level or state level, expenditures on labor, different types of labor and on energy expenses. So we do a little bit more just to translate the number into a fraction of county level GDP. We also another thing we do is we take a step back and say, look, if we don't want to overlay all these economic assumptions, can we just look at the projected number of hot days? So we have a kind of for you about a bunch of robust states where, again, at the county level we take all these forecasts and we say under this RCP 8.5 scenario, how many days over 100 degrees Fahrenheit will there be in 2080 or the end of the century versus baseline 2012? So that's the paper that's called Delta Hot Days. And we just do that in case, you know, you're worried about any of the economic assumptions that get overlaid on the basic climate assumptions that come from the sea glass projections, So let's say. So there are definitely some limitations to this. Let me just go to those. So these this measures actually only look at economic activity declines through labor productivity and energy expenditures. They don't include, for example, direct damages to infrastructure, which obviously going to affect economic growth. They don't affect, for example, energy output. Right. Energy transmission and output are both negatively affected by heat days as well. And they actually don't even include direct effects on human health. So those are some pretty big omissions would might suggest they understate. On the other hand, they don't do a great job of factoring in sophisticated measures of mitigation at the county level of various activities that might be undertaken. So overestimate, underestimate. Yeah, these are well-documented problems with this methodology in the literature. So we don't have very much to do about that except through, as I said, we do undo the economic projections and just fall back on the climate projections for a bunch of robustness tests. So the next thing we do is we say, okay, well, so this is just a picture of these climate projections and how we get Delta hot days. I think I could skip that one. So look, I just said that enough, okay? This other measure we have is from this company called for 27 that got by bought by Moody's in 2020. What they do is and this is principally for corporates, because they do it at the corporate level, they figure out, you know, based on the physical location of all of the corporations, you know, enterprises, what their exposures are in aggregate them up so that it enables us to, you know, make some mileage in the second part of the paper. But they do it from this valleys as well. And so, you know, their methodologies are black boxes proprietary. So we can't tell you exactly what they do or what they don't do. They assign every municipality score on a scale of 0 to 100. So what does that mean? You know, what's difference between a 50 and a 20? I don't know. I can't tell you. So all we can do is use that as it is. It's you know, it is an independent methodology. So it's good for robustness tests. And of course, the other thing that they provide is they do a breakdown of hurricane risk, wildfire risk, flood risk and direct heat risk as well. So which the sea glass effect did not do. So that's another reason to use it. I will say about both these methodologies that they they do suffer some limitations. For one thing, they are each just snapshots. We only have them once in time. So to the extent that counties exposure is being changed, for example, through mitigation investment, which, you know, we hope some of that's going on. But anyway, we don't know that these measures are going to pick that up. I don't remember the exact timing, but I think the 2427 measure was something like 2019 and the sea glass was something like 2012. Okay. So each of those is just a there's no time series creation. Those measures, just a straight cross county snapshot. Summary statistics for the risk measures, do I care about those now. I mean, yes, of course. But in the interest of time, let's see. Anything else I wanted to say about that? No, I think I'll skip that. Okay, so let's get into identification. Sorry. Five minutes, well, okay, skip identification. Basically, we're going to do two specifications. One is a regression specification with a lot of fixed effects. Okay. So the main fixed effects are we're going to be using our credits. Sorry, our rating by industry buckets. Okay. So to the extent that there are things that we need to control for at the county level, we're really kind of hoping that the rating agencies do a good job of picking this up. If they don't, we're also going to have county fixed effects, which means that anything that varies across counties that we don't that we might want to measure political affiliation or I don't know, or just latitude. Right. Just location. Right. That those in principle should be picked up by the county fixed effects. So first methodology is going to be a regression methodology with with the main independent variable being heat stress by year. Okay. So you saw that graphic showing you before

with different coefficients for each year. Those are just the coefficients from the regression. So that's the that's the first methodology. The second methodology is matching. And that was based on the suggestions from the. Paper of the mike. My colleagues are going to present the third in the session. And based on all we're doing there is we're taking each bond issuer. And if they're in the top 20% of exposed countries, matching them with a similar bond in the same month, in the same rating buckets from a county that's in the lower 50% of the exposure, then rerunning those regressions. Okay. So main results. Well, as we saw from the picture, we've got the heat damages. That's the one from the sea glass measure. And then we've got the heat score, which is the one from the 427 measure. We see a pattern of significant coefficients starting to emerge around 2012. We don't have strong priors or opinions about what happened in 2012 or what happened around then. You know, we can show you various anecdotal evidence about, you know, more concern with climate change from surveys and things like that. We can show you that more bad climate news came out around then, but we don't have any hard evidence to pin down like what really is driving the time trend in this. Okay. But the time trend is an important message, one that I definitely want to see as one of the takeaways from this paper. I want to skip to the matching results. There's a rematch on different things like coupon time to maturity and so on, and then county variables, and then we do the same regressions, strikingly similar patterns. I don't have really time to talk about it. The coefficients are a little bit bigger, but that's slightly. That's because, you know, first quintile versus bottom quintile is a little bit bigger spread and the independent variable. So there's not it's not really inconsistent and the pattern in coefficients is really strikingly consistent. Okay, So mechanisms we have subsample, so we break it down into long term short term bonds. Bonds with low credit rating, a high credit rating. I guess we do have time to just quickly look at those ratings. Well, as you might expect, we're getting almost nothing from high rated municipalities is a long term effects. Well, I should show you the long term ones, probably. First, because you might very well say, look, these climate risks, if they manifest in calculable cash flows, it's going to take a while, right? I mean, short term credit is not going to be affected. And that's exactly what this paper shows. And in fact, this paper shows that in terms of the long term bonds, the time series pattern is not really as robust as I said it was. Right. It starts even as far back as 2008. We were getting positive coefficients. So it's more that the aggregate you put the short term and long term together that you don't really start to see anything until until 2012. So that tells us that, you know, okay, so it's not necessarily we don't have to think of 2012 as a magic number in terms of when things started again in ratings. And this parallels what we're going to find in corporates, which are not going to have time to talk, talk about that. It shows up in low grade credits, not high grade credits. And in terms of revenue versus GEO, it well, it shows up in revenue bonds, not general obligation bonds. Again, revenues are directly impacted. They can't fall back on the general tax base. And so maybe that accords with with intuition as well. Let me just briefly show you the fact that other physical risks. Okay. So the caveats here, we may not have a lot of power to detect the other physical risks because, for example, like sea rise risk is limited to a small number of counties. Right. So when you put them in the giant cross-section of all the counties in the United States, it's a relatively small number of counties that's available that's affected, even though for them it's quite bad. It's we're just not see, when you see that sea level hurricane, school rainfall score, water score and heat score, well, the heat score is the one we're pointing to. The other ones are a bunch of zeros. Okay. So, you know, again, we don't have we don't want to say that they don't matter, but it's certainly harder to detect. And this shows you that a takeaway from this paper is it is important to disaggregate direct effects of the different types of perils that climate risk poses. So let me conclude in my last minute and 19, because I think there are some important takeaways from the paper on heat. Stress seems to be systematically priced source of risk across different asset classes. Again, we have robust results from the corporate bonds in the equity expected returns. Positive premiums suggest climate change have significant negative impact on aggregate economy, and there is, of course, implications for the discount rates used for the climate abatement investments and how risk exposure is measured is important. What I would say is my personal takeaway from this paper is that it's getting worse in terms of the price that you're going to have to pay if you're in an affected county, the mitigation costs, the capital cost, you are only going to go up from here. Of course, this is my speculation. This is not supported by the data, but it looks like the time trend is going in the wrong direction. So, of course, these are the counties that should

be investing in mitigation measures. Right. So this is actually an important lesson. Do it now. Okay. Do it now because it's not going to get any easier. Okay. Thank you.

DOE: [00:20:21] Good morning, everyone. Can you also can you hear me? All right? Yes. Good. Right. It's a pleasure to be here. And of course, this is a really important topic. We're all become incredibly sensitized to it. And it's a I think these types of papers that are coming out and studies are just incredibly important. And I'm a big believer that the medical industry has a great opportunity ahead. Adaptation projects are going to become a big part of the industry, is going to be a revenue opportunity from the banking side because how are we going to finance with the ways of protecting and stabilizing infrastructure going forward? Well, I've had the opportunity to work with the Center of Municipal Finance at University of Chicago. We had a climate conference last November out there, and it was what was exciting about that was the new generation of people that are students that are gravitating toward the municipal industry and public policy around the climate issue. So from that standpoint, you know, very, very excited. And so thank you for that. For Brookings and for academic institutions for hosting this conference. So when I was reading this paper and the first time, I was like, Wow, this is like contrary to anything I've I see on a daily basis in the market, I don't see it priced in to securities. And so I was reading it with great interest as to where is the disconnect from what I'm observing and from what the study presented. And I started to focus on that on the credit spread element, which was widened in 2010 to 2013, which is where we're seeing the big difference. Well, a key thing that was going on there is that right? The municipal bond insurers were many bonds that were insured, had lower credit ratings all of a sudden started trading to their lower to their underlying credit as opposed to being triple-A. So you had a tight spread compression in 0809, ten. And then when the credits lost their triple-A because of insurance, the spreads widened out dramatically. And you can see that specifically by just using generic credit measures of bond buyer index, for example, kind of an antiquated piece of data set. But nonetheless, it compares general obligation to revenue to give you that kind of picture. And there you see the widening. And the widening is kind of stabilized as as Tim's graph showed over the last few years. And during this time, you know, also in 2013, we had not only the taper tantrum from the Fed, but we also had the municipal industry adjusting to the problems in Puerto Rico. And we had mutual funds that were starting to divest or to hurt, to sell, reduce their exposure to the Puerto Rico credit. And that created a lot of turbulence in the marketplace as well. And that may have also had some impact on credit. Now, also during the low interest rate period, we also had a period where instead of having this, the industry went from being par coupon structure through about 2005 and then shifted to a 5% coupon. And then during the low rate environment, we had a lot of longer maturities, had two and 3% coupon structure. And then now we've come back to five. Well, what that's in fact doing is creating a lot of volatility in the longer maturities that may so there may be some structural volatility that may also be contributing to some of the the discord in the data. The other thing I struggled with, Tim, was that is that your choice of using bonds that and using trade data that was after the two or three months after original issuance, because we we know that bonds after they originally issued one is they do break to lower yields. We know that that's just the underwriting process that's in the municipal industry. But we also know that that's the most active time of trading. So as my colleague Matt Fabian likes to talk about, is that when we're talking about the municipal market, we're really comparing it to a flea market. I mean, that's really what the muni market is. Is this inconsistent over the counter, negotiate? You know what something's worth. And so the less kind of less trading, less activity, less price discovery, all of a sudden, these trades that you were utilizing as there was less trading, I just kind of felt like maybe there were some inconsistencies that were maybe showing up in the data, especially when you're kind of in the lower rated parts of the of the market. So but what I think I would you know, I get excited about office because I think it's critically important. And the more attention to the municipal market and the climate crisis that's before us is. We need to understand the data that we're utilizing, not just within the municipal market itself, but also the climate data and the various sources of it. And so now when I was very involved with the people at risk who are now owned by ICE for the last five years, they've now mentioned 4 to 7, which is some of the issue your data. And we have you know, FEMA is now out there. We have new resources. We have third party paid commercial sources of data and trying to discern what's the best data. And I think the problem we kind of run into going forward is that as is municipalities and and states and others start to address

this problem and start planning and designing projects is going to be what data do we use? And what I'm biggest concern is by spending a lot of time trying to discern what data is best, we're going to burn time off the clock and we're not going to be taking action That's so critically important. The other point that you made that I think was was was I was pleased to see is that the rating agencies aren't you don't see the credit changes as in response to climate risk. I would I think it's fair to say that there's been no credit downgrade that's attributed to climate issues that's occurred yet in the industry. And it's certainly heat, I think is is only in the last couple of years, I think has become a condition of sensitivity in the marketplace. And I think this is a broader issue that I think requires an examination, which is ratings are a 2 to 3 year outlook. We're looking at risks that have had will have impact over the next 10 to 30 years. And what does that mean to the investor? And I think that the the problem that we have looking historically is that individual investors, which are a bigger and bigger part of our our marketplace, always a big holder, but now they're more direct investment. Separate managed accounts have gone from 500 billion to nearly a trillion. Now. The mutual fund complex is now eroding. We have more direct involvement. So there could be more direct sensitivity, too, to this issue and how it's reflected, how it's communicated by the rating agencies. And my my concern with the rating side is that the individual looks at the rating as not being a risk of default over this 2 to 3 year period. But it's an assessment of whatever security they're buying. They're just ignorant to the or naive might be a better word to those long term to what the rating is communicating. And so that communication of risk is a failure within our industry right now. And I think that's what the data was was suggesting, is that that's that's an issue. And I, I look at how the insurance industry has shifted from looking back historian using historical data to now looking at model data and looking at some of the climate data that's out there now says, hey, all these different providers that give us a forward looking. And that's what the insurance industry has pivoted that way. The municipal industry needs to do that as well. And so papers like this, I think, are, you know, despite the comments I've made about some of the municipal data, which is quirky and hard to deal with and messy and, you know, it's not like equities and corporates and that's a challenge. But I think those are those are I think, you know, to be applauded that we're starting to take these steps toward investigation and the and the exposure or the understanding that these risks are out there. But they're but they're not quite, I think, fully priced in and the risk guys and Breckenridge, a large separate managed account has, you know 40 to 60 billion and municipals under management. They both have done studies in 2021 and 2022. In fact, Breckenridge Paper was presented last year at this conference and found that municipals weren't reflecting pricing in climate risk. So again, I think again and I didn't see that in the the appendix of a papers that were cited. So I guess there's just more and much more data to to take a look at and can you kind of to explore so you know, excited about the paper. Glad you're, glad it was presented. There's just more work to be done with a messy dataset called the Municipal Market. Thank you.

BERGSTRESSER: [00:29:51] Okay, so I'm going to arrange us up here. First thing I want to do. Can you hear me? Okay? Speaking at the microphone.

WESSEL: [00:30:13] There you go.

BERGSTRESSER: [00:30:13] All right. Can you hear me now? Is that better? So that when. When the. When it's red, you're audible. So the first thing I want to do, I want to give him the opportunity to respond to Tom's comments. So, Tim, do you have a short.

JOHNSON: [00:30:27] Yeah, let me let me just start with the rating agency at the end, because I didn't have time to talk about it, but we are actually using as one of part of our economics econometric strategy, the fact that the rating agencies did not historically reflect climate risk. Right. Because we're using that as an important control. And if they had been taking into account climate change and climate risks all along during the sample period, they'd absorb the effect we're looking for. So that's actually something that's oddly working in our favor. Now, the rating agencies have all put out white papers in the last couple of years talking about how they're now going to take it seriously. But at the same time, as Tom points out, they're saying, well, look, to the extent that these cash flows are going to happen in 20, 30, 40 years, we're not really going to be making very

many rating adjustments. And there've been only a handful of rating adjustments based on on climate that I know of. So that that agrees with Tom's observation in terms of looking at the the throwing out the first two or three months of trading data. I also have trouble with that. And here I just have to, you know, take the the cheap way out, which is to say we're following the literature. There's two or three other well cited papers in finance that do this, explain why they do it. And we don't want to get those guys as referees and said you do something. Nonstandard Right. So, you know, it's that's part of the game. But I mean, that doesn't mean that we couldn't redo the tests with that earlier data and just see what happens. Right? So that's a great comment. I want to learn more from Tom. I will follow up afterwards about, you know, what really happened with insurance providers in the 2010, 2012 period, because that's a kind of a gap in my own knowledge in terms like like what's in terms of what is going on in terms of the coupon choices. I will just point out that in our matching sample, which I didn't have time to go over in detail, would you match on coupon rate? So there we are comparing only 2% coupons to 2% coupons and and, you know, 5% to 5%. No. I have to also get from Tom afterwards that the reference to the Breckenridge in the risk papers because that those are missing from our sites. So. Thanks, Tom.

BERGSTRESSER: [00:32:20] Great. So I want to turn it to the audience to ask questions. So one thing that I'll say. We got folks running around with microphones. Before you ask your question, to let us know who you are, even if I know who you are. Yeah, I know who you are. Dan Oh, yeah. When you when you ask the question, say I'm Dan Garrett. And here's my question.

AUDIENCE MEMBER: [00:32:38] I'll try to start us off, Okay? I'm Dan Garrett from the Wharton School. I have a question. So you ended the talk, this is for Tim, with a quote saying it's getting worse. Capital costs are only going up, but that really isn't reflected in the estimates that you showed us. So instead, it does look like a really peak in 2016. They're coming down. So I thought of kind of three examples of what could be happening, which is, one, as the costs go up, counties could be changing what sort of projects they're investing in. So as you face a relatively higher credit spread, you can change the nature of your investments and that could be showing up. The second is that, of course, the credit rating agencies could be taking this into account, the credit rating controls that you're using so I'm wondering, maybe dropping this, the regressions could be a way of showing kind of what the longer term impact is happening. And also, it could be that the places that are impacted in 2012 actually adopt. And so they do kind of take these adaption sort of behaviors. And so I'm wondering if you can say something about that using the 2019 snapshot of risks that you all use as well.

JOHNSON: [00:33:28] Thanks, Dan, yeah. Those are great comments. And I will just repeat that. That was me speculating at the end is not supported by econometric evidence. That just it seems to me like I don't know, I guess it's just influenced by just picking up the paper every day to summarize. Oh, my God, it's, you know, it's a Vermont, it's Philadelphia, it's all of Italy, you know. So but no, I agree. I don't see a lot of evidence of adaptation investment going on. You know, I agree it could be going on and it's just a small effect. And but credit markets are sensitive to it. And I as a naive observer, I'm not. In terms of the rating agencies taking into account. That's absolutely right that that would that would give exactly the effect that caused things to plateau out.

DOE: [00:34:08] Just two quick comments to that. One is, in talking with sustainability officers, it is amazing to me. One, they have no knowledge of the capital markets, limited knowledge in terms of funding. They're always looking for grants, Right. They're not looking to the marketplace, don't even understand it. And then they go, Well, as long as our rating doesn't change, then I guess we're okay. So the ratings agencies, again, have this incredible power and influence that because of the way it's been structured historically, is that they're I don't think they're doing it well. I'll just leave it there. But the other thing we're encouraging because we don't see it being priced in to the end of the we don't see climate risk being priced in to the marketplace and by cusip at all. And we're encouraging issuers that come to market. Now to to Tim's final point, which was you're not being penalized if you need to have to protect your infrastructure, you should do so ASAP. And and there are banking entities that are now hearing that message and are engaging their clients to have those discussions.

BERGSTRESSER: [00:35:18] I see Mark Funkhouser over here.

AUDIENCE MEMBER: [00:35:25] Just a quick comment about the whole relationship between municipal governments and the rating agencies. It's astonishing to me that they make that argument that, well, we haven't seen the rating change. Mark Funkhouser of Funkhouser Associates, I when I was in Kansas City, I would hear that argument from officials after waiting for the ratings changes, like wait until your car hits a tree to tap the brakes. I mean, it's just as strange to me that we haven't explained to local government officials yet what it means. The rating happens after bad stuff happens.

AUDIENCE MEMBER: [00:36:08] Thank you, Mike A Greene with the law firm Steptoe and Johnson. This is all fascinating. And you talk about mitigation. Obviously, you know, a single locality or a county or even a state can mitigate, you know, the climate of the globe. But at this point, it takes a whole world to be willing to do that. But there's also mitigation. You could you could, you know, raise the you know, the the dunes on the beach to avoid flooding. You could do other things and in constructing evidence. But also one of the mitigation efforts. And really how do you reflect this in these studies is that if there is a problem, it may be called a natural disaster, but a forest fire or flood or drought or whatever which is caused by climate ultimately has FEMA or the federal government coming in in a big time way with funding, as we saw in Puerto Rico, California, Texas and Florida and Louisiana. How does that get factored in? Because if the risks are there, but they're ultimately covered by the federal government, how does that get factored into the credit exposure?

JOHNSON: [00:37:10] Well, I think one of the one of the unique things about heat waves is that it's very hard to write a contract on a heat wave. So there's there's very little insurance or mitigation efforts that can get be the subject of a grant, for example, that that you can say, well, okay, here is exactly the covered peril. That's just not the way insurers think about it. Right. You know, you can write a grant about hurricane damage. I mean, you can write a policy on hurricane damage. You can write a policy on flood damage. But we see very little. In fact, the state of California has covered has commissioned some explicit studies of how can the insurance actually help the insurance industry develop products that specifically, you know, fit in with their rubric of things that they cover. But it hasn't happened yet. And I think this may be one of the reasons why, you know, markets are more concerned with heat stress than with some of these other perils that we have trouble picking up effects for. I don't know if that addresses your question, but I think it's a it's an important aspect of what makes heat different.

DOE: [00:38:10] And Mike, remember that, you know, the municipal market has loved climate events and disasters, right? It's always a hurricane, comes in, knocks everything down, everyone gets nervous about it, what it's going to mean about the credit. And then there's a rebuilding process is funded by the federal government. The credit rebounds, performance occurs and everybody's happy again. And we go to the cycle over and over. Of course, FEMA's changing right. FEMA is now saying, look at you're you have infrastructure at risk. You now have data that can identify that risk. And if you're not doing adaptation and resilience type of projects, then guess what? We might not be there. And I think one of the great examples of of for thinking forward is what's happened in Battery Park with their efforts to protect their the citizens that live there in that community. But I think it's 26,000 or something like this. But they went to the capital markets almost had $1,000,000,000 issue too, for their project, almost took a decade to put the whole thing together. But they are they talked to FEMA while they were doing that so that if problems did occur is that FEMA would be there to support them.

BERGSTRESSER: [00:39:25] Okay. This has been fantastic. We now have to transition to the are we now get to transition to the second paper in the session. So join me in thanking Tom and Tim. We're, we are all going to sit down and Professor Wang from the University of Florida will come and present the paper. The emerging greenium and the discussant will be Monica Reid, the founder and CEO of Kestrel.

WANG: [00:40:08] It's better now. Okay. Okay. First of all, I want to thank the conference organizer for putting this paper on the programs and down for the moderating. I look forward to Monica, this discussion a little. So the title of the paper is The Emerging Greenium, and we study this clustering using the data from the municipal bond market. This is my first time looking into the municipal bond market. First, I'm studying city related issues. I know very little about like both. So I am very nervous when I'm presenting in front of 200 people, maybe another 300 online. Okay. Luckily, it's a very simple paper. Hopefully it's convincing, but it's very fundamental. Question So the motivation of the paper is you must be willing to pay a higher price for USD investment relative to known U.S. investment. Abusing terms a little bit here in this paper is basically easy. Basically, we only look at apart not as knotty. So the answer to this question is at the core of the discussion of how the financial market can contribute to like a dealing with ESG related issues. So one very important argument is that we got a lot of investor who are interested in ESG and they are willing to pay and they will lower the cost of capital green assets, whereas those of us that's the cost of capital as a asset will be lower and there will be more green investment. So that's the argument. So this is basically yes, yes, it's the whole area. My opinion is there's a lot of externality. But when we talk about financial markets, we want the private investment in private, partly to solve a social problem. Okay. But there may be a hope. Before I talk about data, very little theory. This is my opinion. So no doubt that most people have. Yes, you preference their like by their environment. Of course. Okay. But no doubt there are some people who are willing to pay. Okay. I'm not saying that everyone is willing to pay. Whenever I do a survey, I place 15 20% of my students tend to say, okay, I'm willing to pay maybe ten bases, one or 15 basis for an 80% or 90%. They are unwilling to pay. But we do know that some people are willing to pay. Okay. But does this translate to a surprisingly imperative place and some people are willing to pay? The argument is that some people are willing to pay others. I'm willing to pay. And you were appealing to increase the price of assets in order in as a result such a preference. If we are switched to other assets in equilibrium, there may not be a big impact. That's very basic as our presence here. In my opinion, it is very standard for you. Other problem. Okay. You are doing something. I like playschool. Okay, I'm going away. Enjoy my private benefit. Okay. So? So the theoretical prediction is actually very unclear. But what is a boring and grim or grim premium at the moment of a above venture, The yield on a grim bond and the lower than the otherwise identical conventional bond. So think about the difference between Green Bond was a conventional bond. The only difference is the use of precede. The green bond are supposed to precede the green bond, supposed to be used for environmentally friendly project. Everything else should be the same. Okay. There may be a yield difference if there is a yield difference. We call that green oak, green premium oak. I think you probably see a positive green and the yield on green bonds are lower than otherwise identical non-green bonds. And that's very clear evidence that investors are willing to pay. Okay. The question is whether they are willing to pay and if they are willing to pay and how much. The municipal bond market is very special, unique for this purpose. And at this audience, probably most of you are aware the municipal bond issue, where they actually issue many municipal bonds at the same time. So I'm showing you are why example on the left hand side, those are green bonds. On the right hand side, those are conventional bonds. You see around 15 green bonds. Maybe it's 13 conventional bonds with various maturities. And there are pieces that green bonds and a longer term bond, they have almost identical structure. The only difference, the why is a green, the other is non-current. And the one I highlight both of them with maturity in 2033 and identical maturity the same year were in there because they were all usually at the same day at in the same deal. In most of the cases. So this is a by design, the same issue or the same issuance stay, the same maturity, almost always the same credit risk. Importance and important characteristic differences between those bonds you can think of, they are almost always identical. Okay. The only difference at the issuance of all may differ a little bit. I winds up giving the others no ground. So you've got that label. Okay. So we do the exact match. So the same you should assume usual and status immaturity days and try the original SIM called eight. Some of the bonds are callable and we also match based on source optimize the revenue bond or yield on an 80%. The bonds are a deal bonds the result of very similar even just focus on the yield but are not federal taxable and they're often 80% though don't actually have the same coupon rate. Okay. We're going to look at them. I'm going to tell you, we got a one year, roughly 2 to 3 basis point when the market is not that large. If

you've got a tool bond, that differing coupon ready. And that difference in full power may actually lead to a difference in yield that's as large as was three basis four. So it's a very good that in this recession, almost all the bonds, 80% plus of the bonds, they have identical coupon. So even if you're worried about a structure that's not flat and that's not even a concern here. So a or a simple start in 2013 and in roughly March 2022, that's when we got the data. We got the roughly 1000 exact match hires, roughly 690 before 2018, and so 140 of there in 2018. You may wonder why I had that time split because there was no grand year before that and there's a grind them out there. Okay. I'm showing you other results by the two different sample periods. This is a committed distribution function. That's the great buy yield minus the yield of the exact match. Remember, they are almost identical winds that were in the others. Non grand, but. The lucre before 2018. The ride, the one it's after 2018. You start to see that after 2018 there are about 20% of the cases. They're either going to yield or growing by the lower. There may be a small number of that that go the other way. Okay. But before 2018, basically it's 10%, about 10% below, but now it's 20% below zero. Another interesting finding is Underwriter Discount is basically the commission charged by the underwriters. You'll see that before a 2018 underwriter that try to charge more if your usual green bond. But now they charge less. Okay. The ball for business from lower. Okay. It's probably easier to market Greenbaum now than a few years ago. If you put them together, that's roughly in total revenue for business. Of course, the underwriter discount, you should adjust that with the modified duration. So put them in the same comparator, make them comparable. Okay. But the emerging grunion, as we call that in the title of the paper, this. Yeah. Coincides with the increase in the attention or recognition of ESG. Okay. You say that these are the Google and find the blue line shows. Yes. The other two were different terms. Very similar. 13. There's no trend of other terms, but yet you see a cookie increase. If you put them together, you see a similar trend in 2018, 2019. I'm not calling you and you call the relationship, but you see that there's the correlation. Okay. Osama had the low numbers. Polls taken a great deal about roughly a 2.3 basis point yield of this or sample municipal bond, roughly 200 basis point, the credit spread relative to Treasury. That's roughly a two year basis. One. So you can form your own opinion whether 2.3 is a large enough okay, underwriter discount difference about 0.9 basis point and on average underwriters discount you, for example, or the around 50 basis point total issuance costs stay your usual green bond. That's roughly for business one. Okay, that's my month. And then the next funding is looking into the cross section. Since we have, I'm going to focus on the post 2018 sample because before that we don't really see any interesting cross-section of erosion. One interesting variation we are going to focus I mean, I'm going to talk about two. The first one is the use of Precede. There are actually green bonds. And their exact match is, if you look at the prospectus to say, okay, those bonds are going to fund the same project. Okay. Graham Bond and I were embargoed for the same project, of course. Select a different part of the building. My example is the. I see the second gentleman. Three authorities State New York, Columbia University writing about serious 2016 the Greenbaum 2016, a one year choral deconstruction of the Jerome Green Science Center. If we read, the second one is the same center, the same building, but the first one, I'm going to use that for some kind of green certification. The second one is the Romanian. Okay, My coauthor and I read all the prospectus. We figure out cases like this. We think the Columbia University want to think that the other does it, given the WINS agreement. The other one is not. Don't forget, the money is fungible, okay? It's a very simple money to fungible. But there are many cases that. The Gordon Bond, a name given by Yoda for different project. The University of Cincinnati case are used for two completely different buildings oak and many cases. One is higher education and the other round maybe for utility. A couple of different purposes. Okay, so we are you'll see a green. Yeah. Yeah. You only see green when the use of process are different. Yeah. The you're the person is identical. For the second example here at Columbia University, one you don't see any green. Yellow is almost always exactly zero. Underwriter discount, you'll see a very similar pattern. So that's a roughly half a sample is same. You're the person, you have the sample, different uses. And sensing the same use of Percy's subsample, you don't see any ground condition I don't use. Usually these are different. The to double. Okay. I think that's the entirety of the funding. It's the term structure of going in since we have exact matches. We can look into the term structure. And we see a downward slope, some structure. So for them, green bonds with maturity less than five years, scoring em is above five basis one. Between five and ten. That's slightly lower than two. Business one. And. 10 to 15, 15 to 20 of similar about 20 years. We don't see any growing yet.

Okay. We don't have this type of pattern for underwriter. This underwriter, it just kind of basically flat with with the risk that to a maturity. Okay. It's hard to find the interpretation. The one speculation I have is there may be some kind of liquidity premium. I want to invest into. Yes, I'm a good person, but I don't want to come here for too long. Okay. But that's my speculation. So. Okay. Let me conclude. So the headline finding of this paper is the average acronym for pounds three. This is from post 2018. But before that is as exactly a zero. Well, one thing I haven't mentioned is even after 2018, majority of cases, figuring out exactly zero is just a small number. You'll see. Yeah. Okay. So. So on average, the investors are very to pay, but in most cases, these are no pay. Okay. But conditional on they're willing to pay the magnitude is probably significant, higher than 2.3 basis. And also signs that you can structure a deal sometimes like a structured deal to make the green bond a non-green bond for different purposes to mitigate any kind of greenwashing concern. Maybe investors are more willing to pay. Okay. Okay, Let me stop here. I look forward to Monica's discussion.

REID: [00:55:28] Perfect. Thanks. Hi. Thank you very much for inviting me here today. I'm really happy to be here as my first experience with Brookings, and it's really been a pleasure to meet folks already, and I've learned a lot through this process. I'm Monica Reid. I'm the CEO and founder of Kestrel. So I have organized my remarks in a few ways. I just want to introduce my company and the role that we play in the U.S. municipal market, where a new entrant into the market. I want to talk a little bit about some of the factors that are related to greenness that might also be influencing results that the University of Florida team found out. They wanted to talk a little bit about the additional value that investors might also be receiving with green bonds other than the green team. And a few thoughts on the future of green bonds. And my message that I want to impart to you about green bonds is that the story is not so much about greenness as it is about investment in risk mitigation. So first, just a little bit about Kestrel. Kestrel is the market leader for green social and sustainability bond verification in the US municipal market. We have about 82% of the market share last quarter. So we are talking to a lot of people, a lot of issuers, a lot of deal teams and a lot of investors about green social and sustainability bonds. And our mission has been to try to bring some standardization to the process of issuing green bonds and help create more efficiency in the green bond market prior to us entering the market in 2018. It really was the Wild West. So there's this been a standardization. So we provide these. Our reports are called second party opinions. We have to do it. Climate bonds, certifications and other sort of form of green bond. We do reporting on those things and we also have an ESG data product. On municipal bonds, we score the primary market every day. And I'll tell you a little bit about that. So are a second party opinions. It's 46% of the total market, about 82% when you have a second party opinion involved. So that's a big distinction in green bonds in the U.S. municipal market, whether the green bond is self verified or whether they've hired an assurance provider like Castrol or Sustainalytics to go and provide an independent external review and comments on the on the greenness. We've done over 202nd party opinions, mostly in the municipal market. We've worked in 29 states, in Europe and in Canada, and we're known for our technical rigor. All of our analysts are environmental scientists are social scientists. They're not finance people. So this is really different than a credit rating. This is really talking about the risk mitigation and the sustainability that is inherent in the in the financed activities. So some other factors related to greenness that might possibly be contributing to the results. The first, as I mentioned, prior to 2018, there really, really was the Wild West. Everybody was saying there is no standard for green. There are there are no standards. And you had issuers that would make up their own standard for what was going to be a green bond. You had some issuers who would not mention any standard at all and just say this is a green bond. We have issuers who would say this is a green bond, as per the green bond principles, which is one international voluntary standard. And then you had a few that would do a green bond as per the climate bond standard, which is one of the most robust green bond standards in the world. And so there was that whole spectrum. But in the muni market, it was really tilted toward there are no standards. And since 2018 there's been this progressive increase in second party opinions in coalescing things or really coalescing green bonds are green as per the green bond principles or the climate bond standard. Generally, that's where most of them are. There's also, as I mentioned, this rise of external reviews, and 2022 was the first year that we had in two quarters. The green bonds issued with second party opinions outnumber the self verified ones. So I'd like to think that's

my team out there doing the outreach to try to do that. But it's great because it creates efficiency in the market. So why what what other things do investors receive if they are indeed paying Greenham, which I'm really excited to, to hear those results? Well, the first is risk mitigation. So people are talking about risk mitigation already, right? So the green bonds are financing these green assets, and the green assets incorporate the resilience that helps mitigate mitigate against the backdrop of climate change. They also get investors also receive some greater transparency. Investors are clamoring for transparency. They want to know what's happening. So having this external assurance on the green bond is it's increased information. And even if there isn't a second party opinion on the bond, more and more green bonds have a new section of the official statement where they're talking more about the green finance assets and the resilience and sustainability incorporated in those assets. There's a new world of compliance for investors. And the second party opinion on the Green bond helps to satisfy some internal and external compliance mandates for investors. So that's another thing it can get if it if it has its green bond and has a second party opinion on it, can kind of get through the review process more easily, save some a little bit of time, gives them a little bit of cover in a world of increasing regulation. And lastly, of course, it helps them meet consumer demand for climate aligned investment products. So Green Bond, Green Bond is an easy dunk. So what value do issuers get by issuing green bonds? Because the greening is not something we talk about a lot. We don't. In Castrol, we go around and we're trying to talk with issuers and their deal teams about issuing green bonds. We're not promising or greening them at all. We don't even talk about it. But we do have five cases of twin bonds where we've worked on the deal and the issuers, same issuers, same day, same coupon green, not green. And we have five cases where there's been a 1 to 5 basis point green team that we've seen in our work. But we debrief on every with every job, we debrief with every client to learn how the story ends, how did the sale go? And we also want to know about the process too. And we always ask investors how it would happen. And the vast majority say they had oversubscription, they had new investors to the credit, they had new ESG investors, and the ESG investors stayed in through the repricing. They were really sticky. So it allowed them to to do the repricing. They also municipal issuers, municipal governments. So complicated. They are moving on multiple fronts at the same time. So you might have a city that or an issuer that has made climate commitments where where we're going to be net zero by 2030 or 2040. And the Green bond helps advance that commitment as well as build the new water facility or water treatment facility. So the and the municipal issuers are advancing multiple objectives. They are often strengthening their internal communication. And they talk about this. We learned a lot issuing this bond. The sustainability folks and the finance folks don't always talk. And through the process of issuing a green bond, they have to. And last but not least, they often say, my board loved it, my stakeholders loved it, my city council loved it. They're going to talk about it in their annual sustainability report. I wanted to speculate a little bit about how green bonds might look in the future. So we have a new ESG impact data product. We produce a score, an ETF, SG and a total score and about 20 other data fields in Castrol. And our data's on Bloomberg today and we're measuring if there are risk mitigations incorporated in the bond finance activities. We're also evaluating if it's eligible to be a green bond or a social bond. And we're publishing that data in a data feed for investors now. So this might be the way that moves to the future. Today, we have about 11,000 series, over 100,000 CU ups and $1.47 trillion that we've run through this analysis. And today, about 7% of the bonds we see in the municipal market are eligible to be green but are not labeled. And another 17%, 17.4% are sustainability bonds. So those are green and social and not labeled. And then just lastly, another way things might change in the future is there's a new kind of certification that's available this year. It hasn't been used yet in the U.S. It's called climate aligned Issuers. It's a new standard from the Climate Bonds initiative. And it's possible we could have more climate aligned issuers who would be able to issue more green bonds more easily. So I really appreciate the source of the opportunity to be here today. And thanks.

BERGSTRESSER: [01:06:29] So thanks to both of you for a wonderful paper and discussion. What I want to start with is I want to start with a couple of minutes for Baolian to make any response he wants if you'd like to. Yeah, hit the button and it'll be red. Okay.

WANG: [01:06:44] Does it work? Okay. I just want to thank Monica for the fantastic discussion. She mentioned green bonds me actually, probably other utility others in satisfying people's non peculiar peculiarly preferences, including physical race and also regulation like transition. Risk regulation may actually change if you buy a green bond. The green as dummy, probably a hedge like a physical risk. Some of the green as I may also probably hedge for physical risk. And that's actually one thing we emphasize in the paper and this is in the results cannot be affected by physical race or regulation risk because the green bond and there are matches or have exactly the same cash flow regardless of what will happen in the future because they are I mean, single use the same issuers, same coupon, same maturity and same criteria as the both are your bonds. So the study, we couldn't identify physical risks or transmission risk. And that's also the advantage of this setting. And so we can speak more cleanly about green preference. I mean, this is not to say that the green label itself can create additional risk, but whether that's largely enough or not, I don't know. It's possible that. So just by putting a label there, there could be some additional risk. And as I said at the beginning of my presentation, know very little about this market. I'm learning a lot from Monika about verification and things like that, and also social bonds and sustainable bonds. They're not anywhere simple and that's going to be hopeful, is going to be in the next version of the paper. Thank you.

BERGSTRESSER: [01:08:46] Okay, I see. I see Mark Jaffe. And you should introduce yourself, Mark.

AUDIENCE MEMBER: [01:08:51] I'm Mark Jafee. So with that, from the point of view of the you know, municipal finance officer trying to minimize the cost of financing, the green, greenium has to be set against any costs associated with issuing green bond, for example, the fee paid to the climate bonds initiative or the feed paid to the validation or verify verification company. I was wondering if you know what those costs are and do you think that they are a significant factor relative to the green, greenium?

REID: [01:09:28] I'll start. I do know what the costs are. I mean, in most in most cases, it's less than it's a fraction of a basis point. So if it brings in we we say if it brings in one new investor, it's worth it. And it gets more efficient over time with multiple bonds. So it's it's not it's not expensive to do at all.

AUDIENCE MEMBER: [01:10:02] I am Jaewon Choi from the University of Illinois. So I have a question to Monica. So so when the bond is, say, the green bond issue, then it's going to carry the certification. I guess it'll also happen that the municipality doesn't really follow up with a green project or they do something else. So in that case, do you see cases where the bond actually loses the certification? And if so, is there any market reaction to that?

REID: [01:10:37] The municipal market issuers are all operating in a very sophisticated and well-defined legal and regulatory framework. And so by the time they are issuing a bond for a new. Wastewater treatment plant or new county buildings or whatever it is they're going to finance. They've made commitments about what they're going to finance outside of that green bond designation. For example, new wastewater treatment plant is got a two year run up permitting process where they have to make commitments about what they're going to build and how they're going to build it and what the outcomes are expected to be. And there's a there's a regulatory framework around that. Similarly, a city council in deciding to issue the bonds, is making a commitment. They passed a resolution. We're going to do this and in this way. And so those are just a few examples. But. But municipal issuers are very constrained. They're in design, build contracts that they can't get out of very easily. So you have some really good guardrails that will help ensure that they're going to build what they say they're going to build. Now, we also do surveillance on those bonds. If we verified the bonds, we come back in and provide a report that says they did what they said they were going to do. But in general, in the municipal market, you can have confidence that they're pretty locked in. And I would say the cases of greenwashing in that way should be pretty minimal.

BERGSTRESSER: [01:12:13] Janko.

AUDIENCE MEMBER: [01:12:20] I actually have some related question. So looking at your, you know, green label and stuff, right? It sounds to me like a bond covenant. Like, you know, if you issue a bond, then you promise to investors that, you know, your company is not going to sell some assets or do some certain things. Right. So what is the legal implication of sticking to the plan, as you say, to get the certification? So if the certification breaks at some point, Right. I understand that most of municipalities follow, you know, what they wanted to do. But at a margin, you know, we cannot build out any possibilities that, you know, things like that could happen. Right. So in that case, what is the legal implication to that? And what is investors point of view? What should they do about it? Thank you.

REID: [01:13:22] That's a great question. That's a great question. And I'm sure there are people in this room that are much more qualified to answer that question than I am. But I will say that part of the green bond process is there's there are sections to it, and one has to do with management of proceeds. Another one has to do with reporting. And you really do see issuers you see best in class issuers in the green bond market right now. If they're not best in class, they're trying to be best in class. And so the process of issuing the green bond with an external review, the external reviewer works through those things to to get to a reasonable level of assurance that these things are going to happen. And usually it's satisfied through the reporting. As for the covenant part of it, I can't speak to that at all.

BERGSTRESSER: [01:14:11] I'll say just a show of hands. Has anybody yet seen a lawsuit in the muni market or in the corporate market related to not living up to commitments made at the time of a green, like is this something anybody has seen? Have you. So, Steve, you've seen? Corporate?

AUDIENCE MEMBER: [01:14:31] Well. Oh, yeah.

BERGSTRESSER: [01:14:34] And you should introduce yourself. Just.

AUDIENCE MEMBER: [01:14:38] I'm Steve Winterstein, formerly with Alpha Ledger, now with SP Winterstein and Associates. The only thing that I can recall was the disclosure problems that we had back, I want to say 2018 with Oakland, Marin County. I think Santa Cruz and the city of San Francisco and I think I'm missing one. It might have been San Mateo where they there was an apparent contradiction of disclosure and versus a lawsuit against big oil. But that that, to me is probably the biggest landmark and it was thrown out.

BERGSTRESSER: [01:15:28] Okay. I think we have time for one more quick question. I saw --

AUDIENCE MEMBER: [01:15:35] Tim Keller, mayor of Albuquerque, New Mexico. We'll see you guys later tonight. I had a question, I think, on Kestrel, we're we're in the middle of this process right now and just appreciate also, the market need for these kinds of certifications is exactly the problem we're having. But, you know, my question is, there's so much variability in the estimates for like energy savings for, let's say, especially efficiency. So around, you know, the leakage from buildings and so forth on top of sort of the cost of solar panels, things like that. So, you know, the ranges we're getting for cost, you know, from a traditional bond perspective, they're just way too big. So how are you helping cities really sort of mitigate that factor? Are you adjusting durations or how do you recommend dealing with that? I think inherent volatility right now when you're trying to forecast energy savings.

REID: [01:16:32] Green bonds for green buildings. The green buildings need to be built too, but not necessarily certified, built to satisfy a national or regional green building strategy. Standard So you and just tell your engineers that you need it to meet our standard, our minimum standard as LEED silver. So you would tell your engineers you needed to be engineered to meet LEED Silver at a minimum. And it's just an engineering thing.

BERGSTRESSER: [01:17:03] Okay. Thank you very much. Thank you, Monica. Thank you, Baolian. Yes. So you all you guys go down now and we're going to transition to the next paper. So the next paper, the presenting author is going to be Jun Kyung Auh from Yonsei University. The paper is natural disasters in municipal bonds. We're going to continue with the climate focus and the discussant for that paper is Ivan Ivanov of the Federal Reserve Bank of Chicago.

AUH: [01:17:46] Good morning, everybody. And first of all, I think conference organizers to include our paper in this excellent conference. So the title of the paper that I want to present today is A Natural Disaster and Municipal Bond. And this is a joint work by Jaewon Choi, who is actually sitting right up there and Tatyana and Tim Park. Okay. So natural disaster, flood, wildfire disaster here, disaster there. Feel like I'm hearing all these words probably overly frequently these days. And actually data supports my feeling. Over the past three years, the number of disasters, emergency declarations in the U.S. has been growing at a rate of 7%, counting for over 11 million per affected county. So what we actually want to learn about from this paper is given this very frequent natural disaster and pretty economically significant physical impact in the county, what is the asset pricing implication of those events? So recent sort of survey and papers actually document that. Although the climate risk is ranked as a top climate risk over the next 30 years, it is actually underestimated in the asset pricing markets. So why is that? You know, a potential reason that we could give is that the detection of that. And the asset in that the risk in the asset market is actually not quite simple. For example, you know, if you look at stock prices, then you're going to have to deal with huge compounding factors that you have to control. And also most often the climate risks that what you know to a proxy or what measures the climate risk is actually very slowly moving and gives very little statistical power to detect anything. So what we want to do in this paper is that we are going to investigate natural disasters and municipal bond market reactions to it. And we believe that that gives us a little bit better understanding about acid market implication of climate, natural know, physical climate risk to physical risk and to asset markets. So what we to present, what we want to do is we focus on municipal bond returns as opposed to bond yield or credit ratings. And there is a reason to it. Using the return actually gives us a certain benefit, such as we can speak directly to the portfolio performance of the wealth of the bond investors, and that gives us some high frequency global. Pattern of investors response in terms of intensity and immediacy while allowing us to sort of compare returns of the same bond composition before and after the event. So using the high frequency return around this exhaustion, this event actually alleviates certain concern about immediate video problems. Certainly, it gives us a little better or clear. IDs. Okay. All right. You may think that the reaction of the bond market, your muni bond market regarding natural disaster might be obvious, but actually it is not. We actually do have a papers that document that they actually have a positive long run effect on the local economy. And also, moreover, the mechanism through which it affects the market, as in market, is actually pretty unclear. Is it, for example, expected cash flow or is it, you know, because of the discount rate or, you know, all sorts of behavioral as well as liquidity demands? So we don't know much about that. So what we want to do proceed in this paper is that we're going to split the sample in multiple dimensions that are correlated with a physical damage, but arguably uncorrelated with other factors. And we believe that that's going to shed some light about our understanding about the mechanism, how that physical risk affects asset market. All right. So we don't really have that much time here. So I'm not going to spend lots of time in our data. But at a very high level, we have three sets of information. One is the municipal bond data and our local economy data and also the information about the natural disaster. So we're going to combine all of this. And so that is basically the data set we're going to work with. All right. So the biggest empirical challenge to work with muni bond return is that muni bond you all may know trades extremely rarely. So on average, an average muni bond trades less less than three times per year. And that's going to make it impossible to perform a high frequency analysis with a raw data. So what do we actually do about it? So our solution is that we employed a repeat sales approach, which is motivated by real estate literature in which you face almost similar problems with housing market not being tried very actively. Right. And we're going to obtain a weekly bond return for U.S. counties, county level. Okay. So I'm going to actually, you know, move into a little bit deeper about what we do with a repeat sales. So we are going to estimate county level weekly returns. So. It doesn't work with the screen, but the little RTC, there is a county level weekly return, so we are going to regress to low

returns or log returns of the bond individual point I issue to by the same county and estimating. County Level Week will return. So basically we are regressing individual bond return on week year dummy variables, effectively estimating the time fixed effects of the bond issued by County C. Well, this sounds a little abstract, so I'm going to give you a little bit more spoon feeding. So suppose that there are three a municipal bond issued by Gomery County in Maryland where I used to live. And suppose that I respond A, B, C, right. And suppose also that there are three asynchronous trades from from these counties. So first, bond, for example, Trade Week one and week four giving us R1 and Bond C, for example, trade twice a week two and week four giving us R3, Right. Obviously there are no subsequent prices and therefore no weekly returns from the rule return. Right. However, what we want to do is rerun the following regression to apply to repeat sales. So basically what we want to estimate is are we two week, three week four in of the same county, basically estimating this system of regression equations. That's what we do. All right. So what is the benefit of that. So benefit if the theta coverage. So using the episode data actually gives us almost 35% of entire municipality that Abra issued a municipal bond as opposed to less than 4% coverage in the case of the return. So with that, we're going to conduct an event study where we construct weekly cumulative abnormal return of that. Disaster affected counties see against 20 benchmark counties in which benchmark counties are more than 500 miles away. You know, with, you know, sort of certain our matching conditions, you know, with relevant variables. All right. So this week, car or weekly cumulative abnormal return is going to be our main sort of depend on video. With that, we're going to investigate. All right. So how does it look like? So round the natural disaster, we actually do see that the price decline almost 31 basis point over ten weeks. Okay. So there are few things that we can learn from this baseline results. So first, this 31 basis point, given that our in sample weekly return average weekly return is 0.1, basis point is economically super huge, right? The decline, the magnitude of the decline is very significant. And also it takes a substantial time for asset market to reflect such damage induced by natural disaster. But this is with a all bond, all uninsured bond. We separately look at the revenue bond and then find that this impact is actually more pronounced in the revenue bond and arena bond cases. We actually see about 51 basis point price decline as opposed to two year bond, which actually do not find anything. We actually do some robustness check with our monthly cumulative average return instead of the weekly. And we actually, you know, we find something really similar. So all bond the 41 basis point and revenue bond -51 basis point and go bond we find nothing. So we actually you know interpret this result. The stark contrast between rap Bond and the geo Bond is that it is something related with revenue diversification. Right. So if the source of the revenue is on diversified, just like in a case of the bat bond, then it actually has more impact from this physical risk as opposed to the go bond. Just to reiterate, you know, with a real bond, a real returns, as you expect, we find nothing because we, you know, cannot really find any statistical power. So that reiterates the advantage of the sales approach that we have. How about short bond? So if the bond payoff is insured or protected by insurance policy, we actually find nothing that actually suggest that such a price impact is caused by a physical damage as opposed to liquidity reasons or liquidity demand or behavioral factors. Just to give you a little bit more direct evidence that physical damage actually matters, we actually split the sample into two. First, more severe damage, more severe disaster. That is I'm just going to say above median and below median, which is less than average, less the median severity in terms of the disaster severity. And if we find that in the relevant, the biggest impact actually comes from in a case where RAF one faces very severe or more severe disaster accounting for 61 basis point. You know, it basically gives us more support about physical damage actually matters in this market. And if we undo that damage by FEMA transfer, which is a federal disaster aid, then we see that, you know, we can basically undo all the fact, you know, when above median FEMA transfer is associated with very small or insignificant price impact. Right. You know, that also helps mitigate that, this negative shock. And what does it tells us is that the physical damage is actually the main drivers for all this actions. All right. So would then this ex post price reaction be priced in ex-ante to be able to see that we basically measure investor expectation by prior frequency of historical historical disaster? Okay. So if we actually look at the historical disaster, the below median historical disaster actually gives us much, much bigger magnitude and significance in terms of the price reaction. Meaning that, you know, if a bond from sort of, look, you know, Cowen is located in a disaster prone area, then all this price impact actually is somewhat you know in. Already implied in the price ex-ante. And finally,

just to give you a little bit more evidence about why the gold bond and bond are very different, we basically look at municipalities leverage and if, you know GEO, even the geo bond, you know, when it faces a high, severe, highly severe disaster and if that issuer is highly levered, then it you know, the issuer has basically less room to maneuver to make up, you know, or diversify away such a shock. So it lost it breaks the you know. So it's your bond actually becomes pretty sensitive as well. So, you know, we actually repeat this process with, you know, review to construct concentration directly and we find something very similar to. So I'm going to conclude. So we use the repeat sales methodology to study how natural disasters affect municipal bond returns and municipal bond market response negatively, but quite slowly, accounting for 9 million investment investor loss, which is actually quite significant given that average of physical damage is 19 million in sample. And overall, our findings basically show that the post-disaster reaction is consistent with investors, rational reaction rather than behavioral or any subjective perception changes. That is all. Thank you very much.

IVANOV: [01:34:12] Thank you. Okay, get started. It was really an honor to read this paper. It was great. I learned a lot. So I'm not going to go over this very much because I have already like like you saw the author doing a very nice talk. So just to summarize it very, very quickly, you have this large adverse effect. So on on bonds of about 31 basis points after like an extreme event. And these returns come mostly from revenue bonds, right? Like geo bonds are most not affected, but you still have some effect among some groups, right, That may be affected for various reasons that I'm going to talk in the rest of the slides and the authors touch a little bit on revenue stability, which is very important for these returns being smaller. And finally, I think what I find one of the most interesting parts of the paper is that it tends to like mitigate these effects. And then they have also this like really cool part in the paper about ex-ante, you know, mitigation. That also plays a role that I would like to see. It also played up a little bit more. Okay. So my comments are going to be around three areas first. The first one is the economic mechanism. So let me let me start with that. So I know the authors do like some of that in the paper right now, but I like splitting the same point to geo revenue bonds. But I would like to see more. Maybe one thing they could do is they can like flip things around and they could take the census like data and just like, show us a full picture of what what happens, like in terms of financial statement information like these entities. So like, what I would look at here is like try to measure revenue stability in terms of the significance of property taxes or transfers as a share of revenues. I think there is some work, recent work that shows that a lot of the cities, county governments and so on are relying more on fees, charges that are not as stable maybe. So I think that's what I would look at first and like explore other factors such as size and spending relative to revenues. I want to make a point here. Leverage ratios are important, but they're only like important if they imply higher costs of like raising money or like an ability to raise extra money. Right. And I think oftentimes in the space, what you see is higher leverage ratios mean that they can have a very large city which has raised lots of bonds, and they're able to raise lots of bonds going forward, too. And like last but not least here, I would look at risk, ex-ante risk of these entities, like in terms of agency ratings. I think it would be a good cut in as we saw in the first stock. These ratings are important, so I think we have to take them into account. So I have a few other points that maybe we can talk afterwards, because I want to get to the other points as well. Linkages, they're always important, but like we can handle them later. Okay. So my second point is about current level of aggregation. So my sense is that you like aggregate bonds to the current level. So of cities, special districts, school districts like counties themselves. And I think that's done for like reason since like trading in the secondary market this like sparse. So I think that makes sense. I do think that we could learn a little bit more if we just aggregate the data, like at least for some entities, you'll be able to find like information that's enough to estimate at least monthly returns. And I think that that should be like, okay. I think right now what I worry is that this aggregation that we have places too high of a weight on the large cities like relative to the other entities, because everything is also further weighted by Paramount's in the secondary market. So I think I would I would look into that. I think we can learn a lot more from this. I think it's a really great exercise. And then if we dig deeper, I think it would be interesting to see which entities are exactly affected here in the here. So yeah, so I would examine for the originator in terms of the types of entities and basically which types of like investors drive these returns. Obviously, like right now it seems institutional investors play more role, right? Because everything is rated by far. But I think it

would be interesting to see what happens to like retail to. Okay. So in terms of my last point here, I think I'm just trying to fit this within the economic mechanism. As the authors point out in the paper and in the slides, we have like lots of aid FEMA has done to alleviate disaster like effects in these areas that they're affected. And and there's this really nice fat paper right here that looks at positive effects. So it finds actually positive effects like after disasters, like in terms of all these factors like employment, wages, house prices, the house prices specifically would feed into most of the income these entities get like counties and like local entities. So I am wondering, like, why do you find this adverse effect? Right. And so I think if the longer run effect is likely to be positive because of this build better hypothesis, I think it would be interesting to see the exact entities that drive these results. And I think you show some of that in the paper. We basically show that these effects come from the areas that have low or No. Eight five, which is very cool, right? Because just like you have the setting these entities that they're affected but yet they don't get any eight. So so I think what I would like to alleviate here, this concern that some folks might have is that these are the areas that face less severe events. So so so I'd like you to do a little bit more on that and what the external validity of this may be. Right. Because, I mean, how can we apply this to a broad sample and like for, I think the majority of US counties. So I think I, I think I may have some ideas here. So you could look at maybe some discretions in the FEMA declarations. And I think you don't see much of those recently. But I, like you may be able to see more like going back in time. And you have a very large sample, which is pretty nice since oh five. And I think maybe there is some discretion, like in terms of like which areas the state picks, right? Like because the way I the way I thought this works is like the state would select the counties and then like FEMA would have to like, endorse them. But I think maybe the states have some discretion to not pick some counties and pick others for various reasons. So maybe this is something that you can do. So so that's all I have here. I really like the paper. I think it's an extremely important paper, you know, in the area that we need to know more about. My main comments here that I want to learn more about where these are coming from, and I think this would be an amazing paper that I would love to read again, like when you have another draft. Thank you very much.

BERGSTRESSER: [01:42:31] So I want to start by giving Jun Kyung a moment to respond to anything that Ivan said.

AUH: [01:42:39] Hit that there. Thank you, Ivan, for, you know, very encouraging comments and, you know, very helpful, very well thought out comments. So let me just I'm not going to be able to respond to all the comments that he has, but a couple things. So. The census idea actually is quite good. So I think what you're actually getting at is basically behind two of those count effect effects that we have. So we actually control everything by count effects defense. So if the revenue stability is somewhat time consistent, right, then it should be observed by time fixed effect. And then, you know, we actually have an look into what's behind of the kind of fixed effect. And there is a great suggestion. So we're going to definitely take a look at and in aggregation, is that so you're right about the weighting schemes that we have. So we actually do have, you know, not oil less, but WLS regression, you know, you know, in estimating this repeat sales, basically giving higher rates on more frequent or larger bond transactions. So the you know, reason behind of this is that we thought that, you know, it is more informative, right? So if, you know, bond is very thinly traded and if, you know, we're basically trying to give a bigger weight on larger traits and a more frequent trait and female transfer, we actually at least I actually haven't thought about discretionary in fact, over the FEMA decisions and and state designations and stuff and does something that you know, definitely we're going to take a look at and learn more about it. And I'm going to, you know, ask him about some technical issues probably outside of this this conference room. Thank you.

BERGSTRESSER: [01:44:45] So I I'm going to ask my own question now, and I'll preface it with, you know, my first job out of college was working the very, very the the very most junior employee at the Federal Reserve in the entire system. And one one of the things I had to do was collected on onion prices. And we were trying. So we were trying to make an index of onion prices. But there are a million different kinds of onions. You got Vidalia and you've got like imagine. And just there's a cycle of the onion market where one, you know, for a few weeks you'll have Vidalia onions. And so we tried to create a repeat sales. Onion price because we want a long horizon index of onion

prices. And one thing that matters for that is that, you know, there is a life cycle of the onion, like the the Vidalia onion comes in the market and there's sort of a tendency for the price to kind of follow life cycle. And one of the things that I'm thinking, I mean, what you're doing here has the potential to be really transformative because a lot of researchers, a lot of, you know, we really want a measure of Long Horizon county, you know, unit level municipal bond performance. But if there is something where there is kind of a life cycle of a municipal bond where it's issued and there tends to be the sort of, you know, it's placed and then it's seasons. And one thing that I think the power of this potential methodology means that we need to kick the tires a lot. And when you use this and then you say, if I change the change, change, change, do I end up with something that looks like a price that makes any sense at all? That's my question.

AUH: [01:46:26] Yeah. Okay. I actually didn't know that you know, people at the Federal Reserve. Spending this much time to, you know, come up with something really good with their own home prices? Probably. Why not for corn prices or oil prices or whatnot. Right. So basically what we're trying to build up here is that okay, so you can actually apply this methodology to many different illiquid assets. Right. But, you know, you know, when it's applied in the bond market, you know, essentially what we can have is an index of muni bond per county level or at city level or any municipality level. Right. So I believe that, you know, like indexing something basically gives us a lot of application and many different layers, I guess. Right. So, for example, you know, you can, I don't know, come up with just being very creative here, right? So, you know, come up with some ETF of Montgomery County Muni bond index or something like that. Right. So you are actually able to translate something really illiquid into something very liquid asset basically capturing on those aspects. And yeah, so we're we're very excited to see, you know, any other application do we can we can build up on here. Thank you.

AUDIENCE MEMBER: [01:47:58] Hi. Tracy Gordon, Tax Policy Center. When I had a job slightly less glamorous than Dan's as a research assistant in graduate school, I spent a lot of time thinking about housing and housing price indexes. And I guess the comparable concern here about sort of repeat sales is the starter home which transacts very frequently. And from what I gather from our friends at this conference, it's the 5% coupon bond that transacts very frequently because institutional buyers like it. So I guess you're saying you you want to capture that increased activity, but it's clearly not representative of the whole market. So what we used to do in real estate, in this real estate context, my advisor was John Quigley. He pioneered this idea of a hybrid approach that also used hedonic regression to try to get at the systematic differences between the properties that you see transacting very frequently and the rest of the sample. So it's kind of getting the best of both worlds. At a minimum, I would love to see just a summary table showing the statistics for the highly transacting bonds and the rest of the sample.

AUH: [01:49:03] Absolutely. I'll keep it in mind. And please expect your next revision for Ted. Summarize that.

AUDIENCE MEMBER: [01:49:12] Hi, this is Adam Bloomfield, economist at the FDIC. Previously CC one just sort of framing question about the non behavioral angle, the idea that the insensitivity of insured bonds. Right. Rules out the behavioral effect. I'm not to me I'm not as convinced versus if you were to look at that something more hard like default rates like the change in expectation in relation to actual defaults or risk ratings, which is what if said to me, I think there still is a way to frame this as a behavioral phenomenon. Even if you seen a differential in sensitivity. So that's one comment. The second is just a quick clarifier about geographic I.D. I know when wrestling with these kinds of data years ago, something that was hard was that from the Q sip derived geography that, you know, these bonds are often issued by some sort of central conduit that are quite distant from the actual location of the beneficial owner. And how do you deal with that? I apologize if I didn't catch it in the paper, but I it's something I'd be interested for you to mention.

AUH: [01:50:39] Yeah, that's very a very nice question. So let me just answer. So you ask him to take two questions, so I'm just going to answer in a separate fashion. So first of all, the insured versus uninsured is not the only evidence that we have about behavioral factor. It's not the main

driver. For example, take a, you know, wrap bond and go bond. Right. For, you know, if you are just for whatever reason, you're just really nervous about, you know, anything about. Or uncertainty about the future of the county. Or if you face some liquidity problem that you're going to have to sell your bonds immediately because your property in that region is destroyed by hurricane or flood, whatever. Right. So then, you know, we don't actually expect to see the price impact is only concentrated in RAF bond instead of your bond rate. So we do actually have a series of evidence that actually tells us, you know, certain consistent way that. The muni bond market is actually quite rational. Then we might expect that's basically kind of things that we want to deliver here. Okay. All right. A second one is you're quite right about the location. So location is actually very hard to actually. Yes. To to collect. So basically what we did is, you know, instead of going to to see a global cruise ship owner location. So we actually use the Moody's data. So we actually scraped entire Moody's data that actually gives us a little bit more color and a taste about the location of who actually who's actually the issuer of those bonds. Yes. I hope that it classifies your question. Thanks.

BERGSTRESSER: [01:52:48] That's great. We've hit the end of our time. I hope you'll join me in thanking Jun Kyung and Ivan.