2025 Financial Stability Conference, Financial Stability in a Time of Rapid Economic and Technological Change

Paper Session: Technology

Host:
Peter Zimmerman, Federal Reserve Bank of Cleveland

Presenters:
Artem Streltsov, SUNY Buffalo
Rashad Ahmed, Andersen Institute for Finance and Economics

Discussants:
Russell Wong, Federal Reserve Bank of Richmond
Ariel Zetlin-Jones, Carnegie Mellon University, Tepper School of Business

Peter Zimmerman:

Okay everybody, it's 10 o'clock, so we are ready to start the next session. If you could take your seats. Our first presenter is Artem Streltsov from the State University of New York at Buffalo, with the paper Inflation Expectations in Cryptocurrency Investment. And that will be followed by a discussion from Russell Wong from the Federal Reserve Bank of Richmond.

Artem Streltsov:

All right. Should probably be closer. Thank you so much for including our paper into the session. First, let's start with the motivation in what we're looking at exactly here. So the fundamental question in cryptocurrency research, where is the demand coming from? Understanding this helps us reveal how cryptocurrencies accrue value. And there are a lot of possible explanations that have been proposed so far in the literature. It's finance and illicit activities, it's developments of platforms, it's bypassing capital controls and ensuring financial freedom. But one advocated use of cryptocurrencies is that of cryptocurrencies being used as an inflation hedge. And unfortunately, so far, the theoretical and empirical evidence is lacking in this respect. Why is that? Sorry, the clicker is... There you go. Why is that? So the biggest challenge is data availability. You really need granular investor-level data on cryptocurrency investment.

If you look at its off-chain cryptocurrency transactions, then the exchange data is proprietary so it's not available to the public. On-chain, on the other hand, you will not be able to see fiat fund flows. So that's a challenge. And if you just naively regress, let's say, or compute correlations between returns in cryptocurrency space and inflation expectations, then the results will be mixed. And even the ex-ante theory is quite ambiguous. You have precautionary savings and also substitution effect that may drive some of the results. So you need direct evidence to study this question, whether inflation expectations drive cryptocurrency investment. And some question that you may answer if you have data on the sort is, to what extent do inflation expectations drive cryptocurrency investment? What cryptocurrencies are being used specifically to hedge inflation? How do those results differ across demographies, across geographies, and so on?

And how we address this challenge is we were lucky enough to have access to a very granular dataset. It's a proprietary dataset from the largest cryptocurrency exchange in India. And we matched this

dataset with household surveys conducted by the Reserve Bank of India. And here's a summary of the main findings. We find that the one percentage point increase in inflation expectations be it three months ahead, one year ahead inflation expectations, on average is associated with 1,000 rupees more in net buying activity in the following period. So this is the result on the intensive margin, but we also demonstrate an effect on the extensive margin, whereas we have more new cryptocurrency investors, I should say, joining cryptocurrency exchanges in response to their inflation expectations. In fact, we estimate that on average one percentage point increase in inflation expectations predicts 10 new cryptocurrency investors per pincode. pincode is like a zip code in India.

In the regressions that we use, all the data that we have, we have 1,065 pincodes. So that essentially predicts more than 10,000 new investors in response to one percentage point increase. But the truth is that there are 19,000 pincodes in India. So if you scale it, because we have a sub-sample, if you scale it to the whole of India, then you should expect nearly 200,000 new investors in response to one percentage point increase in inflation expectations. What about heterogeneity? We find that the effect is heterogeneous across actual cryptocurrencies. The effect is only significant for Tether and Bitcoin. And it's not significant for other cryptocurrencies, which makes sense because for Tether, for instance, it's a stablecoin one of the largest ones in fact. It's back to US dollar. Sounds like a good way to hedge inflation. Bitcoin, on the other hand, it's the first largest cryptocurrency, the best known cryptocurrency, but most importantly it has a fixed supply, unlike Ethereum. So that's why you might expect the result to be there for Bitcoin, but non Ethereum.

So the effect is also heterogeneous across geographies and time. For instance, we demonstrate that the result is really driven by urban areas where fintechs are located, where investors are more sophisticated, and so on. There's no significant difference across demography. On the other hand, most investors, 84% are male. They have lower inflation expectations than women. Also, we find that, as you might expect, younger population has lower inflation expectations than older populations. To address endogeneity, in this slide deck I will be following our approach of following Michael Weber's paper and the coauthors from 2023, whereas we use current inflation expectation as IV for future inflation expectations. We also have other IVs in the works as well.

So why India? Well, first of all, India is a major player in the cryptocurrency space these days. They have been ranked number one by Chainanalysis in their Global Crypto Adoption Index since 2023. India is also the most populous country. It's number one in terms of population with a median age of 28. And 28 sounds like a very crypto-curious age, I would say. Also India has been plagued by inflation historically. In the last decade the average inflation rate is 6.3%, which is non-trivial. It peaked at 11% in 2013 and bottomed at 3.6% in 2017. And it is somewhat challenging in India to hedge inflation using fiat currencies due to strict capital controls under the FEMA, which is the Foreign Exchange Management Act managed by the Reserve Bank. One way to demonstrate this inflation is to just look at the dollar exchange rates. This is not reflecting the whole picture, but this is a major component. As you can see since 1995, if you look at the exchange rate of US dollar against Indian rupee, it depreciated by over 160%, which is quite significant.

All right. So what is the data that we use in this paper that is so powerful? As I mentioned, we have access to the largest Indian cryptocurrency exchange proprietary trading data. It covers from January 2018 to June 2022. In fact, for each trading pair at the investor level, over time, we have their data on at what price and how much they purchased the sold. And for each investor, we know their gender, we know their age, we know when they became an investor, or open their account I should say. We also know their geographic location among other things. Also, we have access to this inflation expectation survey of households, which is run bimonthly since November of 2006 by the Reserve Bank of India. And

essentially at the pincode, age group, gender level, essentially it provides inflation expectations, on current perceived inflation, on inflation three months, and one year ahead. We match those by pincode and period, and we calculate average inflation in each bracket, average inflation expectation I should say. And also at the investor level, we know their trading activities, so we are able to calculate their net buying activity in rupees or Tether in the following period.

So in terms of cryptocurrency data, investor demographics, the median age is 31 years. 31 years. The gender composition, as I mentioned, 84% are male. And some are undisclosed, interestingly enough. On the right you can see a map of how representative those data points are. You can clearly see some blank spots. As I mentioned, 19,000 pincodes, we have 1,000, but the coverage is genuinely quite representative of India. Average inflation expectation is 14%. As you remember I mentioned earlier, the actual inflation in India was 6.3%. Inflation expectations are much higher than actual inflation. So what is the main empirical specification? We leverage Fama-MacBeth regressions, whereas we regress net buying activity in the following period, on current inflation expectations of investor and their gender and age. So this way we cross-sectionally extract the relationship between inflation expectations and their cryptocurrency investment.

Why should you use Fama-MacBeth regression? Well, first of all, it gives you time-varying coefficients, which is good. But also, as you might imagine, retail traders not necessarily trade that frequently. But if you were to approach this as a panel data question, if you were to balance by or create a balanced panel data, you really lose a lot of data in the end. And yet when we actually check the results are still significant in the fixed effects and regressions and stuff. And we established causality using, in this slide deck, sorry, using perceived current inflation as an IV for inflation expectations following Michael Weber's paper and coauthors from 2023.

So here's the baseline table with results. Here we regress in the Fama-MacBeth session of sense, Fama-MacBeth sense. We regress future trading activity in cryptocurrency against rupee, by the way, this is important to specify, on controls, which is gender and age, but also inflation expectations. The four different columns specify the different horizons of expectations. You have three months, you have one year inflation expectations, but also you have instrumental variable estimates of three months and one year ahead. So the result is that on average one percentage point higher inflation expectation predicts or is associated with 1,000 more investment in rupees in cryptocurrency space, at the investor level.

A placebo test. This is why I mentioned that rupee is important, that it was against rupee. A placebo test could be a trading in pairs against Tether. So trading against Tether, there's no way that's a good hedge for rupee inflation, so you should not be observing a result. And indeed we find that there's no statistical significant effect. It's a placebo test. So that was the intensive margin. What about the extensive margin? What about new customers that may or may not be joining the cryptocurrency exchange in response to inflation expectations? We indeed find that on average in response to one percentage point higher inflation expectations, on average 10 new investors join this cryptocurrency exchange per pincode. And again, as I mentioned earlier, in our data we have 1,065 pincodes. So there's over 10,000 new investors per one percentage point in inflation expectations. If you scale it up to all of India, that's almost 200,000 new investors in the following period per one percentage point increase in inflation expectations, which is really not that trivial because one percentage point you have an average of 14%.

So it's really not that inconceivable that inflation expectations might go up or down by one percentage point, I should say. Oh, and the controls here, by the way, I should just briefly mention it. The controls essentially the number of survey respondents. This is at pincode level. The previous regression was at the invest level. This is at pincode, zip code level. So here we control for a number of survey respondents, which is essentially a proxy for population over time. And also proportion of self-

employed. Essentially how risk-averse or not risk-averse that pincode is. Anyway, if you please. What about heterogeneity across cryptocurrencies? What cryptocurrencies specifically are being used to hedge inflation? So first on the right, as you can see against Tether, there's no economically significant effect for any token pair. On the left, you only have economically significant effect for Tether and Bitcoin. And as I mentioned, this makes sense because Tether is one of the largest stablecoins out there, while Bitcoin is a large well-established cryptocurrency with a fixed supply. So that's where this activity is concentrated.

So what about geographic heterogeneity? For each pincode we know if that pincode is primarily urban, primarily semi-urban or rural. So what we do is we just add a dummy. We add an urban dummy and then we also add an interaction between inflation expectations and the urban dummy. And so, notice that once you do that, actually the solo inflation expectations term is no longer significant, so the effect is really absorbed by this interaction between urban and inflation expectations. And it's also amplified by that. So what that hints at is that the effect is really concentrated in the urban areas, which also makes sense because this is where fintech areas are. This is where investors are more sophisticated, they're more knowledgeable about cryptocurrency investments. You might ask, "Well, those urban areas might also, maybe it's a wealth effect, maybe they're also more well-off, so you're capturing the fact that they're just more able to invest rather than other areas. Or the old are more sophisticated, which means maybe they might want to speculate, trade cryptocurrencies, so to speak, for profit or try to." Maybe that's what you're capturing. Maybe that's the true effect.

So in fact, we actually were able to collect an additional survey. The exchange actually collected it. And this survey, there were 15 questions in that survey. The cryptocurrency exchange asked its investors those questions. And two of the questions that we included in this regression were: what is your annual income? So we have brackets for the annual income to capture the wealth effect. But also what is your expected return in the following month in the cryptocurrency space? So that also captures the second component that I just talked about. So if you add those two components, otherwise the regression is the same. As you can see, the effect is not going anywhere. It's even got a little bigger. And as you would expect, higher expectations in the cryptocurrency return space predicts higher buying activities. So that also makes sense. And I finished three minutes early.

Russell Wong:

All right. So thanks for having me in this crypto section. It's always happy to come back to [inaudible 00:17:37]. So I think Artem come around with a very nice data set about how or why people using crypto. So in this morning we have some question about what is actually the use case of cryptocurrency. So they are paying nothing, might be a lot of scam in this space. So here is a new motivation for why people using cryptocurrency. So I want to present a main result in the paper. So Artem have way more than that, but I think it is maybe something to capture the key finding in this paper. So people may say it might be about speculation or maybe it just look cool to have crypto. But here is another relatively new argument about why people want to hold crypto, in particular in the less financially developed country like India.

So the argument will be to hash inflation. So the result I want you to highlight will be the red rectangle. So the regression they are running will be the long rectangle at the bottom, so you can check in the paper. So the key finding will be when people expect higher inflation in India. Then using the investment level data in India. Then you can find when people expecting higher inflation they actually buy more cryptocurrency. And then the amount are 1,000 rupee, it's actually not a small number. It's corresponding to four or 5% of the GDP per capita in India. So they are actually using significant of their

income try to buy the cryptocurrency. And the result disappear when we are regressing on people trading in crypto but settle in stablecoin. So most of the events actually come from people using the rupee to buy crypto, rather than using stablecoin to buy crypto.

In the second regression all [inaudible 00:19:37] disappear. So then it say, okay, it something really special about rupee rather than just the crypto trading per se. So that is the main message from the paper. So let me quickly go through the comment. It is very nice paper. And my entire career working in search models, so my discussion will be more focused on the theory side, but I will say something about the regression as well down the road. So the first thing is about hedging. So when we talk about hedging, it's about hedging some risk. But expected inflation is not inflation risk. So inflation risk will be something like I have some uncertainty about the next three months or a year ahead, inflation may go up or down. Then I want to hedge again this with upside or downside. So that's what unique hedging.

But in the survey it actually measuring something, the expected inflation, rather than the inflation risk. So to put together the evidence for this story, it might be nice maybe to come back to the survey to see if there any more direct measure about the inflation risk. And then we run a regression and see whether the story going on. And actually it is reasonable to merging, so the expected inflation and invasion risk, they coincide with each other. So when people expecting high inflation, it's also more likely the inflation risk increase. So that's why the two thing are not totally independent. And they do in other literature, like in the oil price literature. So I want you pinpoint you to the work by Lutz Kilian in Dallas Fed. So he had entire career working on disentangling the impact of oil price and all the oil price uncertainties. So we don't need to reinventing the wheel to how to disentangle the two elements. So maybe we can borrow some trick from him. So that is the first comment.

So the second comment might be about the mechanism. So why crypto? So why we want to hedging something even riskier? But the answer, it could be. I don't know anyone in the audience working in asset pricing. So let's see, what is the Euler equation for the crypto, which is standard. So I don't want to bore you about the math, but it is standard PhD level macro, so you will see in the first class. So what is that? Okay. Why you want to price something with no dividend? So then on the right-hand side will be, are you expecting the correlation with the stochastic discount factor Mt+1 and also future price. So there's no dividend, that's why you have no extra term. So what make crypto could be good hedge to inflation, will be like, okay, when inflation going up, there's a risky component, so my stochastic discount factor going up as well. So what is the usual story in the typical macro, will be like the inflation is high, my purchasing power of cash is going down, I consume less. Then my marginal-

Russell Wong:

... of cash is going down, I consume less. Then my marginal utility consumption going up. So that's why the stochastic discount better in the future going up as well.

So why are assets like crypto, although paying no dividend, could be a good hedge? Because, when the time you need to consume, your stochastic discount is high, the price of crypto is also high. That provide insurance to the persuasion power of cash.

So that's why although it is very watertight, it is very risky. But as long as the correlation between the stochastic discount factor Mt+1 and the future price in crypto is positive that it is a good hedge, although the crypto price per se can be watertight. So that's why, okay, in theory, it's not that crazy. So as long as the correlation between inflation and crypto pie measure in rupee. So that's why we have taken into account the exchange rate dynamics. We have not just the crypto price in US dollar. As long as they are positive and significant, so that it is a good hedge although the per se volatility can be huge.

So my suggestion will be, can we see it in the data? So I think it's easy to chat even from the macro time series to see, okay, maybe in some developing country like India. So it could be a good hedge, but maybe not for US, might not be Europe, but maybe India is special. Going back to the second slide of autumn.

So then, if that's the case, then the next question is how people using crypto in hedging the inflation rate. In particular, what is the effect of the correlation? If we can measure it in the investment level definitions. So that will be a very, very direct evidence coming from the standard order equation to the measurement in the data. Okay?

And so my third comment about the theory, so I admire the list of other in this paper. So I think they have a theory in mind, but it's just not that clear in the favor. So then, let me come up with my own take. So what is the typical asset pricing regression usually look like? Will be, we are regressing stock return, excessive return on the right-hand side. And on the left-hand side will be a bunch of different factor.

So you can come up with CAPM or different Pharma French, that kind of the regression. But here is something different. So on the left-hand side is not the sum stock return, it is actually the quantity. So we are not regressing P, we are regressing Q here. Which is something nice because now Q is something that actual action is, right? But it is something different from the typical asset pricing, that kind of regression. And then go into the area of the demand system asset pricing, right?

So like John and Yogo, the JPE. So what they're doing is they are really regressing on Q. So what is the methodology will be like? It's very similar. So what they see will be a bunch of the investor level data. So I see might be hash fund, maybe insurance company, their total portfolio, right? So how much stock they're holding, how many treasury they're holding. And then they can use the information or the investor level of the portfolio to estimate the asset pricing. So it is very similar in the spirit what Adam is doing. On the left-hand side will be about the quantity of the crypto they are buying. On the right-hand side will be a bunch of the venture they try to explain for this one.

But there's a buzz. So it's also a huge debate about the micro foundation in the demand system asset pricing. For example, Charakota, [inaudible 00:27:05]. It is a very fun debate to watch, so I highly encourage everyone to pay attention to this one. So then this means, okay, what is the message I want to say? So the micro foundation is really, really matters. So what they try to make the point will be, "Okay, we come up with different micro foundation. So the demand system asset pricing equation can be totally something very different. So I think it will be super nice, we can divide the micro foundation on the queue about the regress on the left-hand side, and then put it to the data. So then that will become very nicely to the excess pricing literature as well. So we build upon some micro foundation of why people using cash and crypto, right? And then divide the system and see what happened because now you have the investment, investor level information.

So here is my take for what kind of a very simple toy model it can be. So it build on my previous work, myself and [inaudible 00:28:12] and PA will live here. So think about a very simple economy, maybe too simple, but just as a starting point, continuous time, two assets. Like [inaudible 00:28:23] and long stop RFS, but in money in crypto. But what make money special will be like money can be useful to buying something. And that's something maybe you can come up with some simple CRA utility, but only occasionally. That's why people have to hold their money in pocket in order to prepare some occasional purchase. But there's a new element in the toy model. Money is suggested to the infection risk. If by holding money, so the money purchasing power can depreciate. And people have expectation of this inflation risk. Then the model can tie to the inflation risk to the actual trading strategy in terms of how much they're holding in money and also crypto.

And then you can bake in the metric bonding motion for the crypto price. Then you can divide, okay, how watertight the crypto price is translate into the portfolio holding in crypto. And again, it's a closed form solution, you can divide all the testable implication and check with data. So that I think will be something nice to see. So here is my last minor comment. So maybe I start from the last one because it may be the minor. So I'm not so sure whether we can call it Pharma French. So what is the pharma [inaudible 00:29:42] that kind of [inaudible 00:29:44] kind of the regression look like would be like. It's not just a regressing stock return on better. It is the first stage. And the second stage will be regressing stock return on the better loading. In terms of the language will be not just regressing on inflation expectation, it's regressing actually on the beta of inflation expectations. So it may be something different from what it's currently doing.

And another comment will be, okay, if crypto is not just the only inflation hash you can think of, right? So traditionally people are thinking gold as inflation has. So it might be good to see what make crypto special than gold, right? So maybe you are easier to asset than gold. So you don't need a middleman to buy gold, right? So crypto is 24/7 Without intermediation, no storage costs, no need to think about the custodian. If you buy huge gold, you think about how to store it. So it's also more liquid. You can sell it easily, unlike gold, you have to find a middle man. Maybe good to highlight these features to compare with gold. So another thing which makes India interesting is because in 2016, they're the huge Indian demonetized station exercise, right?

So which is documented by total rise QGE. So what they find is also having the India location data, and then they find... So the exercise will be, back then in 2016, Indian government tried to retire all the cash in the economy. So all the cash in your pocket will no longer value, in 2016. But you need to return your cash and get a new one. And then the money velocity, it actually vary a lot by location. In some area, you get the new money quicker than the other. And then in the QGE, they show it have a huge impact because of this change in money velocity in unemployment, in output measure, in the late nights, that kind of the measurement. So maybe we can check this out cost because I remember in the regression. So most of the variation from the crypto trading actually come from location, right? Whether you are in urban or not. So maybe the location is driven by different in the money velocity can also explain, okay, why people want to hold more crypto because the money velocity in terms of cash is also very different.

So my last point is about, okay, in the data, actually people net trading is negative. So then this means during the period, people expecting high inflation. The raw data is saying that actually people are selling crypto on average. So then it seems to me, "Okay, it is also the period the crypto price increasing by a lot, especially after COVID. They maybe try to realize the capital gain. So maybe good to see what is the main driving force in the regression, driving people to sell the crypto, although maybe they are selling less because they want to hash the inflation expectation. But in order to expect, "Okay, what is the most driving factor for people trading crypto?

Maybe we need something else to control for. Okay. So that's all I have. So it is a super fun paper, interesting data and lots of follow up. Thank you.

Peter Zimmerman:

Artem, would you like to take a minute or two to respond to Russell's comments? Sure.

Artem Streltsov:

All right. Very good discussion. Thank you so much. Let's see. See if I can make out my handwriting. All right, so the first question or comment was essentially whether there's a difference between actual

inflation risk and inflation expectations. What we are looking at is inflation expectations, and to me, that probably is more important when it comes to people actually trading because this is their own perceived inflation expectation, and they're trading based on their perceived understanding of where they stand rather than what the true inflation risk is, which they may or may not even fathom. And in fact, the data shows that they don't because average inflation expectation is 14% while true inflation is 6%. So something definitely is not adding up there in terms of understanding of people, how inflation will evolve.

Next, the second comment was ... I'm actually, I only wrote down the answer, so I don't remember what the actual comment was. Yeah. I was just wondering if we can even find that thing in the slides. But the message that I wrote down essentially is that... No, I think it's my slide deck, so it's not coming up. So what I wrote down is that the goal is not to answer whether crypto is a good inflation hedge. It also touches on the gold, right? Gold is a good alternative, but the goal of this paper is not to show that crypto is better than gold or worse than gold. The goal of the paper is to demonstrate that crypto is being used as a hedge. It is an alternative that is being used to hedge inflation. Whether it's better or worse than gold is a separate discussion.

Right. Your third comment was on deriving hedging demand, and then actually using our data to fit the theoretical model. That sounds really cool and we haven't done that, but I think they might really [inaudible 00:35:56]. Thank you. Yeah, so Thoma McBath, you mentioned that usually you need returns or like a tradable portfolio. So to me, and probably some other finance academics, Thoma McBath is more of a methodology. So it's a methodology of every specific methodology to estimate premier, essentially, right? The demonetization effect from 2016 is something that we did not think about. I don't think we have data, unfortunately, because our data starts in 2018, but maybe something similar we can come up with, we can use, but this is definitely good comment.

On a negative net trade, it's negative overall, right? So you have trade in activity overall. Yes, it does seem like the net trade activity on average is slightly negative, but first of all, what we really are interested in is how this responds to inflation expectations and the result is there. And the fact that it's negative could be just driven by market conditions because crypto winter, let's say, right? The second period of that was definitely crypto winter. Maybe people were just losing faith in cryptocurrencies for Hespel and that drove the results. I mean, the fact that the unconditional average is negative, but conditional on inflation expectations is positive. And that's what the paper is about.

Peter Zimmerman:

Okay. Just any questions from the audience?

Artem Streltsov:

Yes.

Speaker 2:

So to me, your paper raises a puzzle because my prior would have been that Tether would be the preferred hedge because it's, in some sense, less volatile, right? So I can think of two reasons why that might not be the case. One is that there might also be concern about inflation in US dollar terms. And if Bitcoin is also hedging US dollar inflation, then you get to hedge out all kinds of inflation. You're not going to be able to find perfect data, as you said in your introduction, to test that, but any kind of rough indicator might be helpful to convey the message of why Bitcoin is being chosen. And then the other

reason I can think of is that those who want to hedge rupee inflation don't like dollar rupee exchange rate volatility, right? And if they hedge with Tether, then they're going to be subject to that exchange rate volatility as well.

So if you could find some kind of measure of expected exchange rate volatility or expected exchange rate change as a control variable, that might be helpful.

Artem Streltsov:

Yeah, that's a really good comment. But actually we do find that Tether is being used more than Bitcoin to hedge.

Speaker 2:

I thought you said that the results...

Artem Streltsov:

No, no, no. What I meant is, so you have token pairs against some base, right? The base can be Rupee or the base can be a Tether, for instance, right? Among others, there are other bases as well. But those are the two bases that we look at. So Tether against Rupee is a pair that is being used most aggressively to hedge inflation. This is what this table is saying.

Speaker 2:

Okay.

Artem Streltsov:

While let's say using Bitcoin against Tether doesn't make any sense.

Speaker 2:

Right. Okay.

Artem Streltsov:

And that's exactly what we show.

Speaker 2:

Okay.

Artem Streltsov:

Yeah. But I think we'll try to still make some use of your comments otherwise. Yeah. Thank you. Interesting.

Speaker 3:

Yeah. Could I just ask, so this might just be my lack of understanding of kind of how you were talking about your results, but did you want us to take away that this was a causal channel, that this was my inflation expectations go up, that leads me to seek inflation hedge by buying Bitcoin? Because I can imagine, I mean, let's take a really pessimistic story, like imagine it's just that, and I work a lot with

survey expectations, the people who have higher inflation expectations are just the less sophisticated people in the economy who aren't paying attention and, "I like the fad, I like to buy Bitcoin," and that's all that's going on here. So I didn't really understand how you could take away this kind of like, "I have higher inflation expectations that's leading me to buy this Bitcoin to hedge my inflation risk."

Artem Streltsov:

Right. Yeah. I mean, in variable bias is definitely something to keep in mind, but the way we try to get at that is twofold. First of all, we have some instrument variables, right? We already have one that I demonstrated here. It follows a published publication, published paper by Michael Weber and such, but we also have other instrumental variables that we are in the process of adding to the paper. So that could get us closer to truth in a way. But also in the last table here, as you can see here, we have an even more expanded survey whereas we control for wealth effects at the investor level. So investors' wealth. We control investors expectations in respect to returns on [inaudible 00:42:10] currency space. So that kind of speaks to some of what you just said. I can see that there's still maybe some other immediate variables out there, but they always are.

Speaker 3:

I mean, personally, I don't buy the Weber instrument identification, but that's just me.

Artem Streltsov:

Right. Yes.

Speaker 4:

I guess related or following on the same vein, I was wondering, do you have any longitudinal dimension that you can compare for somebody that changed its inflation expectation, whether it changed your behavior about the portfolio of holding Bitcoins and other crypto assets?

Artem Streltsov:

I'm sorry, could you repeat the question? I'm not sure I caught that.

Speaker 4:

So do you have a panel dimension in your survey? Do you see people that you ask them twice about their inflation expectations and then you can use basically fixed effects at the individual level to try to remove all this potential variation that Lina was actually referring to.

Artem Streltsov:

Yeah, it is a time series, right? It is a panel, right? What we have is a panel. It is not a balanced panel, but it is a panel. We have 26 survey periods, I believe.

Speaker 4:

But do you see the same respondent two times in the panel? Can you do like-

Artem Streltsov:

Yes, yes. Well, there's a reason why I call it imbalanced panel. Imbalanced means that you do not observe that, but if you balance the panel, whereas you only look at the observations where people respond several times or have entries at all times, right? You will have a much smaller panel, obviously, but the effects still exist. We do have fixed effects tests. The results are still significant, but they are smaller in magnitude.

Speaker 4:

Because that could be a way to address data concern.

Artem Streltsov:

Yes. Yes. But it's a much smaller panel, as you might expect.

Peter Zimmerman:

Okay. Thank you, Artem and Russell. Our next presenter is Rashad Ahmed from the Anderson Institute for Finance and Economics, and that'll be followed by a discussion from Ariels Edlin Jones, from the type of school of business at Carnegie Mellon University.

Rashad Ahmed:

Thanks everybody for having me. My name is Rashad Ahmed. I'm an economist at the Anderson Institute, and this is joint work with Inaki Aldasoro at the BIS. And in this paper, we're trying to present or we're trying to test for measurable effects of a price impact of stablecoin flows on treasury bill yields at a relatively early stage of the stablecoin market. Oops, sorry.

Now, estimating price effects or the impact of flows on yields, this is a very hard problem. Price impact isn't observed. You have to estimate it. There's a ton of endogeneity. So it's a difficult problem, but what's a little bit easier to assess is looking at the quantity data to get a sense of where the stablecoin industry stands in terms of their role and their importance in treasury markets. So I wanted to share some of this data first. So what I'm showing you here are holdings and purchases of T-bill securities for major foreign countries. The stablecoin sector, which is in dark blue, and a couple of the largest US government money market funds, which is in light blue.

Rashad Ahmed:

... largest U.S. government money market funds, which is in light blue. So these are T-bill holdings, so no notes, no bonds. Left-hand side are holdings at the end of 2024, beginning of 2025, the stablecoin sector, which was more or less circle and tether, the two largest issuers, they held about $115 billion worth of bills. So this put them on par with some of the largest foreign country investors in T-bills. And it also put them in the same ballpark as some of the largest government money market funds ran by JPMorgan and Fidelity. Now to give you a sense of the growth of the stablecoin sector in the market, let's move to the right-hand panel, which is showing you flows. So these are purchases of bills in 2024. Stablecoin issuers as a sector purchased about 35 billion and that put them ahead of most foreign countries in terms of T-bill purchases, but not ahead of China, which purchased quite a bit more. But still in the same ballpark and also in the same ballpark of purchases as some of the largest individual U.S. government money market funds.

So at 200, 300 billion market cap, the stablecoin sector is not huge, right? It's not like 7 trillion like its money market fund cousins. But that said, it no longer seems tiny and its importance does seem to be

growing. Now in this paper, we're trying to do something a little bit more ambitious. We're trying to see if there's any early evidence, measurable evidence of stablecoin flows having an effect on the pricing of T-bill yields. So the way we do this is we estimate local projection regressions of stablecoin flows on three-month T-bill yields. We like the three-month maturity because it tends to be the preferred habitat of stablecoin issuers. The GENIUS Act basically put the line in the sand at three months in terms of what are eligible maturities that stablecoin issuers can purchase. But even in this setting, it's a very hard problem to estimate and you have a lot of endogeneity problems.

Both omitted variable bias and simultaneity are big issues. You have several third factors that can jointly drive variation in stablecoin flows and T-bill yields. And also simultaneity bias is arguably in my opinion, an even bigger issue because we are interested in the directional effect of stablecoin flows on treasury bill yields. But at the same time, treasury bill yields can causally affect stablecoin flows because stablecoins are like non-interest-bearing money-like tokens. So as interest rates rise, the opportunity cost of holding stablecoins goes up as well. So this is going to bias our estimate in absolute terms to become even bigger if it's not properly addressed or confronted. And we show this in the paper with naive local projections, just simply regressing forward changes in T-bill yields on measures of stablecoin flows and you get a really, really big price impact. You get that, a two-standard deviation flow, which is about $4 billion, reduces three-bill yields by 25 basis points, which is just implausibly large, right?

It's the size of a Fed cut coming from $4 billion of flows. It's just unrealistic, completely unrealistic. And that's what a naive regression would get you. We still think it's valuable to run that naive regression because it gives you a sense of the scope of the bias that this problem is faced with and it gives us a benchmark to start at. So from there, we start thinking about how to address these endogeneity concerns. So first, we carefully select controls to try to deal with the omitted variable bias. For example, we want to control for the forward evolution of non-treated bill yields like the six-month yield and the one-year yield, which are going to be highly correlated with movements in the three-month yield, but they fall outside the perimeter or the preferred habitat of stablecoin issuers. We also want to control for the rest of the term structure to capture macro and financial conditions.

We want to control for T-bill supply, we want to control for crypto market conditions. So we're going to consider all of those issues. And when we do, we see that the effect of stablecoin flows on T-bill yields attenuates quite significantly. We find that that same two-standard deviation flow is going to affect T-bill yields by about 2.5 to five basis points. So much smaller, but anybody that's familiar with the QE literature, any sort of price impact literature is aware that this is still a pretty sizable effect. And we also try to explicitly confront the simultaneity problem. So to do this, we use an instrumental variable. And what it is, is a daily version of idiosyncratic crypto shocks from Iñaki, my co-author's, other paper. And once we augment the local projections with this IV, we get a little bit more attenuation. And our final plausibly causal effect that we get is that this two-standard deviation flow affects three-month T-bill yields to the tune of 2 to 2.5 basis points.

So much, much smaller than the naive estimates, but still quite sizable. A final exercise that we do in the paper is we try to decompose these average effects into issuer-specific contributions and we find that Tether's flows contribute about 70% of the price impact, Circle's flows contribute about 19% and then other dollar-backed stablecoins contribute the rest. This is very much consistent with the relative size of these different issuers and also the portfolio compositions of these issuers. Tether is not only the biggest, they also hold by far the most T-bills in terms of dollar value and share of their reserve portfolio. So this is an empirical paper. We are a little bit constrained on the time period of data we can use given that stablecoins are a relatively new technology. So we're looking at the period from 2021 to 2025, so four to five years of data.

We try to boost our sample size by using daily frequency data and to construct our measure of stablecoin flows, we're going to look at six dollar-backed stablecoins. We're going to look at their market capitalizations, we're going to aggregate them and compute five-day flows as the five-day change in their market caps. We have an alternative measure of flows as well. We take from the blockchains explicit mint and burn data for each of these stablecoins so we can calculate flows based on changes in the outstanding stablecoins in circulation. As a secondary measure of flows, it's correlated about... It has a 0.99 correlation with our market cap-based measure. So both measures check out. We gather data on crypto prices like Bitcoin and Ether on the treasury yield curve. We get T-bill supply data from auctions and we get data on our IV, which is a daily version of a crypto shock series proposed in one of Iñaki's other papers.

And what this is, is it's the unforecastable component of the Bloomberg Galaxy Crypto Index, which is a market value weighted price index of cryptocurrencies excluding stablecoins. And what we do is we run it through a penalized regression and we condition it on its own lags and on several market indicators like the VIX index, the Citi Economic Surprise Index, equity markets, interest rates, commodity prices like gold and oil exchange rates and whatnot. And then we recover the residual. That's our idiosyncratic crypto market shock. You can think of it as like an abnormal return and then we accumulate it. So we have this cumulative return. I'll show you pictures of this later. It's pretty well-behaved. It's mean reverting, but you get to see these persistent booms and busts, idiosyncratic booms and busts in crypto markets. And that's going to be our instrument because this demand for trading crypto is what's going to drive stablecoin demand up and down.

So here's just to give you a sense of the data, left-hand side is the market capitalization of these $6 back stablecoins. Our sample period ends in March of 2025. Market capital is about 200 billion at the time. It's closer to 300 billion now. And you could see that the space is very, very concentrated, right? The two largest issuers completely dominate stablecoins in circulation. The right-hand side is just a time series of the yield curve over the sample period. Even though it's a pretty short sample period, at least we do benefit from a lot of variation in interest rates. We had non-parallel, parallel movements. We had inversions, we have a flat yield curve to the end of the sample. We have a period of low rates, a period of high rates, a period of rising rates, a period of falling rates. And here is our measure of stablecoin flows.

Just to give you a sense of what it looks like. The left-hand side is the aggregated measure, five-day flows. Right-hand side are issuer-specific decompositions of the same thing. And you can see that on average, stablecoin flows over this period have been positive, which is very much consistent with a growing stablecoin market, but you do have quite a bit of variation. You have some persistent periods of outflows from stablecoins as well. Now before we jump into the local projections, I wanted to share some descriptive analysis. So we wanted to do some event studies to see if there's any sort of observable evidence of what we're trying to measure. So we identified these four events, right? These are four events that were stablecoin flow-inducing and we wanted to trace the outcomes, the average outcome before and after these events 15 days before and after. So if you're studying crypto or stablecoins, these are not new events.

You have the Terra Luna crash in 2022. You have the FTX collapse also in 2022. These both induced outflows from stablecoins. And then we have the presidential election November 6th where Trump won and he obviously ran on a decidedly pro-crypto agenda that triggered significant inflows. And then also we had the surprise launch of Trump's meme coin on January 17th, three days before the inauguration. And it's really interesting if you look at the data, this induced significant inflows into stablecoins. These stablecoins were done used to buy the meme coin. So we normalized all of these flows to inflows and

then we were just plotting here the averages before and after. So to start, let's look at the middle figure. So the middle figure are stablecoin flows before and after these four events averaged. And there's not a lot of events. So again, this is just descriptive, okay? But you can see that following these events, you've had significant inflows into stablecoins.

Now the right-hand side figure, let's look at that next. That's showing you the evolution of the three-month T-bill yield as a spread to the six-month yield starting 15 days before these events and then 15 days after. And what we thought was pretty cool is you can actually see... You can observe a little bit of a reduction in the three-month yield relative to the six-month yield here, looking across these events. And then all the way on the left-hand side is a similar plot, but we're using our crypto shock measure, our cumulative crypto shocks. And what it shows is that our crypto shocks really jump around these events. So these events do actually seem to be interpreted as crypto market shocks. And I think at least from a descriptive sense, it gives us a sense that this mechanism may actually be at play even at an early stage like today.

So then we jump into the local projections. I know there's a lot of equations on this slide, so forgive me, but we'll walk through it. The first row at the very top, you can think of that as just the naive local projection, right? You have changes in three-month bill yields regressed on five-day flows. And then we add to that our controls. So we have to carefully think about the controls, we want to control for the forward evolution of non-treated bill yields. So we're going to condition on changes in the six-month yield and the one-year yield. That way we can better isolate the excess impact of stablecoin flows on the three-month yield. And then we also control for the rest of the yield curve changes in longer-term yields can capture macro financial conditions. We also want to condition on crypto market prices to control for crypto market conditions.

And then we introduced the IV. So on the left-hand side is the measure of crypto shocks, daily crypto shocks, and on the right-hand side is the cumulated version. So you can really see that it's pretty well-behaved, but you do get these persistent booms and busts, which we argue are going to be conducive for driving crypto demand... Not crypto demand, sorry, stablecoin demand. So here's the first-stage regression just to check relevance of our instrument. And we find that these crypto shocks are highly correlated and positively correlated with aggregate stablecoin flows, but also issuer-specific flows. So the relevance condition checks out. And then for the exogeneity condition to be satisfied, the assumption that needs to hold for our estimates to be causal is that these crypto shocks, these idiosyncratic crypto shocks can only affect T-bill yields through this stablecoin channel, right? There's a boom in crypto markets, it's idiosyncratic boom.

This is going to raise demand for holding stablecoin balances because stablecoins are primarily used today for trading crypto and facilitating leverage in crypto markets. So then these stablecoin issuers turn around, they get this inflow of dollars, they turn around and they buy reserve assets, which include T-bill yields... T-bills, sorry. So that's the mechanism that needs to be in play. All the other mechanisms needs to be shut down. We think that being an idiosyncratic measure of crypto shocks, we're able to shut down all those other channels like general financial market conditions that can jointly affect the demand for stablecoins and the demand for treasuries. So here are the results. Left-hand side is once we add controls to the local projection, right-hand side is with the IV. So what it's showing you is the impulse response function following a two-standard deviation or 3.5 billion-dollar inflow into stablecoins. And what we find is the three-month bill yield falls by about 2 to 2.5 basis points once you instrument the specification.

But as you can see from the right-hand side, the confidence spans are quite wide, but still there's pretty clear that there's a deciding.... We were finding a pretty clear downward impact on bill yields from

inflows. So then we go and control for T-bill supply and we get very similar results, but you can see that the results get estimated a little bit more precisely. And the right-hand side, our IV specification, the effect size gets a little bit bigger too. We're looking at about a three basis point impact now. And then we also check for spillovers to other tenures, and we really don't find any. We do find that stablecoin flows put downward pressure on one-month yields, which makes sense, that falls within the preferred habitat of stablecoin issuers. That's the upper left figure. But then across to the top row we see that there's basically no effect on other bills, other bills of the six-month and one-year maturity.

In the bottom row, those are effects on the two-year, five-year and 10-year yields. So notes and bonds. And generally we don't find any significant effect on those longer-term maturities. There's a little bit of an effect towards the end of the horizon for the 10-year yield. But by and large, what these results tell us is that the effects of stablecoin inflows are very much concentrated in the short end of the term structure where stablecoin issuers are directly buying treasuries and we don't really see much of an effect further out on the term structure. We do find that the effects have gotten stronger since 2024. So in 2024, we did see a pivot in stablecoin growth and since then it's been growing very rapidly. The right-hand side is showing you the impulse responses in the post-2024 period.

The left-hand side is showing you for everything before that. And since January 2024, it looks like the effect has gotten stronger to the tune of about five basis points. And we also find that the effects are asymmetric. So inflows into stablecoins seem to put downward pressure on T-bill yields of about three to four basis points. But outflows from stablecoin issuers raise T-bill yields by 7 to 10 basis points. So these are very large effects that we're finding, but they also have pretty wide confidence intervals. So keep that in mind. But we thought a little bit about it. There could be different reasons for this, but I think our leading hypothesis is that stablecoin issuers reserve management, really depends... It differs if they're facing inflows or outflows, right? If a stablecoin issuer faces inflows, that's automatically going to be logged as deposits at first. And then the portfolio manager has the luxury and the time to reallocate those deposits across other reserve assets like reverse repos and T-bills.

So they can do that in a more efficient way, a cost-effective way that potentially minimizes price impact, at least relative to outflows. So when a stablecoin issuer is facing outflows, they either... They may have to fire sale T-bills and if they're going to do that, they're probably not going to get an optimal price. They're going to have a larger price impact. But even if they didn't have to sell treasury bills, they would have to stop buying treasury bills abruptly and they wouldn't be able to time that decision. That would obviously also have larger price impact. That's our leading hypothesis for this result. And these are the issuer-specific contributions we were talking about earlier. So we just picked the 15-day impact out of our local projection, out of our baseline local projection. That's what I'm showing you in the big gray bar. So that was about a 2.2 basis point impact.

And then next to that is the contribution of Tether's flows. So it's about 70% or 1.7 basis points of the 2.2 basis points. And then you can see that USDC or circle, they contribute about 19% and the rest contribute 11%. So again, very much consistent with their relative sizes and their relative participation in T-bill markets. And that's pretty much what we have so far. We're still working on the paper, so we're actually revising and doing some new analysis as we speak. Hopefully we'll be able to share those publicly at some point. But we end the paper with a discussion. So we're at 300 billion today. There are projections of a multi-trillion-dollar market very soon by the end of the decade. We don't know if that's going to happen, but if it does, we take that T-back estimate from standard charter of 2 trillion and we do a back-of-the-envelope calculation.

What kind of price impact would these flows have under a 2 trillion-dollar market? And we find that the effects would probably increase to the tune of six to eight basis points, but that's also keeping

everything fixed, right? I think something more elaborate would take into account the possible endogenous response of the treasury if they wanted a tilt issuance towards the short end. And also it's going to depend on where the flows into stablecoins come from, right? If it's like a pure increase in treasury demand resulting from an increase in new foreign demand for US dollar stablecoins, that's one thing. But if it's flows going into stablecoins from say, money market funds, which also hold about 50% of their portfolios in T-bills, you might have a much more moderated effect. So there's a lot of different things that are going to going to drive these results in a more realistic setting.

One policy implication that I think is interesting for everybody here is the potential impact on monetary policy transmission to overnight rates and short-term rates. So obviously it suggests that there could be a risk of weaker control for short-term rates. And this is a little bit analogous to the Greenspan conundrum. If you go back to the early 2000s, you had foreign central banks buying a lot of treasuries at the long end, and there was a lot of discussion about whether this is holding down the long end at a time when the Fed was trying to raise rates. So there's a scenario that rhymes with that.

But the action would really be concentrated in the short end of the term structure. For regulators and supervisors, reserve transparency. We really would like to know where the pockets of concentration lie within the stablecoin sector and across issuers. And of course, financial stability, there will be interesting questions that we'll need to think about related to fire sales. And also as the stablecoin market grows, so long as it continues to facilitate crypto activities, how the lines between crypto markets and traditional financial markets will blur. And yeah, that's all I have for you. Thank you so much. Looking forward to the discussion.

Ariel:

Well, thank you, Joe and Peter for inviting me to this conference to discuss this interesting paper. For a conference on financial stability, trying to understand in the crypto side of things the way crypto is spilling over to traditional financial markets seems a very important question. I think Rashad did an amazing job persuading us of this interesting evidence that there's a potential connection between, in particular the stablecoin market and treasury debt markets. I'm not an empiricist, but so I thought it might be helpful to zoom out a bit and help you understand my reactions to this paper. Again, I find it compelling. I just want to dig in a little bit more. And to do that, I typically find it helpful when talking about cryptocurrencies to start with some definitions to make sure we're on the same page. And so when talking about stablecoins, maybe a definition, here's one you might think of, which is stablecoins are units of account on distributed ledgers that are at least intended to be redeem...

Ariel:

... on distributed ledgers that are at least intended to be redeemable one-for-one with USD. And I'm bringing this up for a moment because we're thinking deeply about why stablecoin markets move, and so we should know what they are. I think about them as deposits. What makes them unique is they transact on different communication platforms.

So if we're going to understand why people are acquiring stablecoins, we need to know what are the transactions I can engage in by moving my deposits on, say, the Ethereum blockchain or the Solana blockchain as opposed to with a paper check or on the Visa network or on the Stripe network. What makes stablecoins, quote, unquote, "unique," is they are transmitted on different communications networks. And so then we can ask like, "What are the drivers of demand for this that might then be spilling over, say, to treasury markets?

Now, not all stablecoins are the same. It's helpful to think about they are, broadly speaking, today two approaches to generating these units of account and fixing their exchange rates One-for-one with US dollars. There's the quote, unquote, "narrow banking approach," which the GENIUS Act is sort of nudging us all towards, which is that for every stablecoin outstanding, the issuer is supposed to hold the dollar of some risk-free asset in reserve, okay?

I hope, to the banking people in the room, you see why I'm using the narrow banking analogy. This is exactly what we would impose on a Diamond-Dybvig bank if we wanted to eliminate runs without deposit insurance. So we're eliminating the liquidity transformation, risk transformation aspects of creating deposits when we do it this way.

I guess there's another approach. You could do a fractional reserve stablecoin if you wanted. We had some early research showing how this might work. Terra Luna also had some early research on showing how this might not work.

But the idea here... And there's still some of the other that I think Rashad showed us. There are stablecoins that don't use any reserve assets in terms of the treasury market. They use Ethereum as a reserve asset. We call them over-collateralized stablecoins. But, conceptually, what these have in common is that the issuer holds less than a dollar of safe assets in reserve, or they might hold risky assets that at least in some states might be worth less than a dollar.

And so we can ask these different types of stablecoins or different ways of creating deposits on these ledgers, "What are the risks? Are they good or bad?" Again, what are we trying to achieve by issuing these coins? You might have to take a stand on that.

And for a conference at a policy institution, I think it's important, as someone like Rashad contributing to this growing agenda, trying to understand how to implement stablecoins and their implications for regulation, I have a deep concern, which is, are we putting the cart before the horse? If we don't know what stablecoins are for, how do we know how to regulate them? How do we know what kinds we should be implementing? We might ask, "Is demand going to be $2 trillion or is it going to be tiny?" We have to really know what they're for.

Should stablecoins be run as narrow banking systems or not depends on whether we think they're being used for things like liquidity insurance or not. So we have to take a stand on the upside of them, they're value-added, before we know what we can do.

And so I'm giving you this background. This is my perspective when I come to this paper. I'm trying to understand what are the determinants of stablecoin issuances that I can see in the paper and then the subsequent implications on treasury markets, which I very much believe. And so that's my framing that I'm going to try to ask as I read this paper.

One thing Rashad, I think, left out, though, for those of you who are not deep into stablecoin markets, is the basic mechanism of the transmission from stablecoin issuance to treasury markets that he has in mind. And so for this, I'll use my language. Assume we're thinking about Tether or Circle. They're following this narrow banking idea. And so what does that mean? They're holding a dollar and some reserve asset for every stablecoin they issue.

So when Tether says we're going to mint a hundred new Tethers, presumably in the background, they're supposed to also be, when they sell those, acquiring a hundred dollars worth of safe assets. And if those safe assets are, say, treasuries, this is now a shock to demand in the treasury market. That should push up treasury prices, therefore push yields down. It's a very simple mechanism. Again, it's hard to quibble with that.

I hope, whether you're a monetary policymaker or a fiscal policymaker or someone who participates in debt markets, you see the relevance of this question. We have a new source of shocks to demand in treasury markets. What are therefore the opportunities? I put fiscal policy here because I'm thinking more about medium to long-run effects. If we see big stablecoin growth, will this kind of enable treasuries to be more valuable? They're able to be transmitted on newer platforms. Maybe there's a fiscal opportunity to issue more debt at lower rates in the long run. I think these are the kinds of questions Rashad's really going after. I find it interesting and compelling.

And so what do I want to focus on in my time? I want to just briefly reframe some of the empirical findings, maybe simplify them a bit, at least in language of what Rashad is showing, and then use it to highlight what I think is super interesting in Rashad's paper, which I think he's uncovering something deep about stablecoin value-added that I think is kind of a buried lead in their paper. And I think there's a lot of opportunity for further thought on this issue.

So let's dive in. This is one way to represent the goal of a paper or the raw correlations Rashad showed us. They're going to try to regress changes in, say, three-month treasury yields on changes in stablecoin market cap Q. And so if stablecoin market cap, because every token's worth a dollar, goes up, it means they're issuing. So delta Q is effectively net issuances of stablecoins.

I want to know when stablecoin issuance goes up, do yields go down? And the answer is yes, and to quite a large effect, that roughly three and a half billion dollars rise in stablecoin issuance causes or is associated with a 25 basis point drop in the three-month yield over the next 30 days. And I'm glad Rashad even said it in his talk. This is implausibly large. They find this implausibly large, and so we, of course, should not believe this.

Average 30-day yield change in three-month T-bills is about five basis points. So this is just massive. There's a huge order of magnitude. In fact, we shouldn't really believe. And so there's an obvious deep concern here, which is safe asset demand is correlated with treasury yields. It's unsurprising that these things might be moving simultaneously or there's some omitted variables, some simultaneity issues. They want to try to unpack that.

So how does Rashad do it? He says, "Well, I'm going to come up with some estimate of crypto price shocks." This is what I'm calling p-hat. I apologize. I said I'm not an empiricist. I should have different coefficients in this regression. They're not meant to be the same beta versus alpha.

But what they're going to ask is, if I see some unpredictable movement in, say, the Bitcoin price, that might impact stable coin demand. And I'm going to take that predicted component of this regression to then see what's the effect in treasury yields. This is their development of an instrument. What's the raw result? Rashad explained this, I think, quite well. Effectively, a 1% increase in this unpredicted cumulative crypto price causes about a $3 billion increase in stable coin issuance. Stable coin demand, stable coin issuance supply seems to be responding to unexpected shocks to crypto prices.

It's a strong instrument. I think it's a pretty reasonable justification for an exclusion restriction. I'll let the empiricists fight. I'm not Rashad's referee over whether they believe the specification. As a macro person, I'm pretty convinced. I think this is interesting. And the IV estimate gives you their answer. Instead of a 25 basis point decline in yields, about two and a half. That's the paper in a nutshell.

What do I learn from this? I think this regression is really the key. I think understanding what is driving the change in the quantities of stable coins and that it's responding to prices is key. In other words, I'm going to ask, is the fact that they find this coefficient beta one is positive, is this the horse we should put ahead of the cart?

Crypto prices go up, and people rush into stable coins. This was not my instinct. Unexplained shocks to crypto prices, and I'm like, "Yes. I need Tethers." I don't get it. And what do I mean I don't get it? I'm trying to understand why is this type of money demand rising so aggressively in response to a change in prices?

I can think like a monetarist. What do I mean by that? A rise in asset prices traditionally... Well, there's a wealth effect. Maybe I want to buy more stuff. If I want to buy more stuff and I need a medium of exchange, I go out and get more currency. Think about that as like a Baumol-Tobin effect.

I'm wealthier. I need more checking balances, so I got to go get those. There might be a more Friedman-like effect of a substitution. Crypto prices rise. I think they might keep rising. There's an opportunity cost of holding this cash. I better not be buying cash. I would expect this effect to be somewhat ambiguous, but the result here is quite strong.

But I'm confused by this wealth effect. Because we know, at least today, people aren't using crypto, even stable coins, to buy goods and services. It's hard even to use Tethers to go to a Bitcoin conference. They still want cash for your attendance fee. Crypto is just not a medium of exchange today. That doesn't mean it couldn't be, but it's not today.

And so I don't quite understand this big Baumol-Tobin effect that says when prices rise, suddenly we're rushing into stablecoin currency. I'm a bit confused by that. I'm going to try to think about that a little more. In other words, I want to know who or what institutions are significantly rushing into stablecoins because crypto prices are rising. I think this is what I want to understand. And I mean this not as a critique of the paper. I mean this as I think there's something interesting in this data fact that might be suggestive of why people are buying stablecoins.

What do I think are challenges? Again, I think about theory about this from traditional knowledge. Well, crypto price rises are sort of paper gains, and we know crypto's enormously volatile, so it's not even like a permanent wealth effect. This is a very temporary shock to your wealth. And so it's not like when the S&P 500 goes up and I'm likely getting wage increases, now I have more money to buy stuff. This is like the Bitcoin price happens to go up. How am I possibly going to use that to buy more stuff? I've got to be selling off some of my crypto. I've got to be substituting into these other riskier assets.

And so I'm trying to understand who's rushing into these stablecoins. Well, one challenge is there are a bunch of enthusiasts who are self-custying their coins. Not your keys, not your crypto. Those enthusiasts all have their coins. But once they're in your wallet, it's kind of a pain to trade them. You have to get out your ledger, your hardware wallet. You got to push a bunch of buttons to try to sign off your keys to actually transact. That's not very mobile at high frequency. And self-custody crypto is sort of stuck. It's pretty illiquid.

I guess on the other hand, there's a lot of crypto sitting on exchanges. We know the majority of crypto spot trading today takes place on centralized exchanges like Binance or Coinbase. The problem there is even if you want to substitute out of Bitcoin, why would you be going into stablecoins? In other words, if I have a big Bitcoin account at Coinbase and I want to sell some of it because the price went up, I can just keep it in a cash account at Coinbase. Why do I have to buy stablecoins?

Which hearkens back to one of my earlier messages. Like, what can I do with units of account on a crypto ledger that I can't do with dollars? I'm not really persuaded by some of the discussion we heard yesterday, which is, "I can buy a lot of illicit materials." I don't think that's really compelling. It's really easy to track crypto addresses. Even the criminals understand how traceable they are today.

I think one thing I do see as value here perhaps that explains why is there a big movement into stablecoins at high frequency, actually paying tax is a big deal. I think tax avoidance is probably the illicit

activity stablecoins are most useful for. That if you're moving in and out of crypto and realizing capital gains, people likely want to try to avoid declaring that to the IRS. And if I put it in my cash account at Coinbase, Coinbase is going to report those capital gains. But if I'm trading on Binance where I can't have a cash account as an American, because I'm trading through some VPN in some foreign country, what I can park it in is Tether in the short run. So I can realize capital gains and engage in tax avoidance.

I'm hinting at this as one plausible explanation because it says, "When we look to the future, when the IRS catches up and understands how to measure all of this correctly, will this channel for stablecoin demand go away? Plausibly. So it's a source of risk for long-run demand.

It also hints at something different. When I talk to practitioners in this space and institutions that are trading kind of... I'm actually going to have a similar comment that Russell had in the last one, which is I think a lot about hedging demand, that there are movements in crypto volatility. And as I move in and out of crypto, it's easier to go in and out of Bitcoin and Tethers than Bitcoin and dollars. And so what I worry or think could be driving some of these big increases in demand is movements in second-order moments, volatility in the crypto space rather than first-order moments, unexplained variation in prices.

So I think one question we could ask, and I know Rashad knows some of this spaces, we might ask when we see this big increase in demand according to price movements, do we see similar flows in, say, futures markets where you can also directly hedge movements in crypto prices as a way to correlate your big shocks to demand?

Maybe a separate question I'd like to see the authors explore a bit... So I'm going to show you some data to motivate this. I'm looking at measures of volatility in the crypto space versus the traditional equities market. So I'm looking at daily volatility of returns on, say, Bitcoin, and I'm trying to compass the volatility in daily returns of Bitcoin against the S&P 500.

And so I've smoothed this over 180-day window just to have it not wiggle around so much. The first thing you should observe in blue, Bitcoin daily return volatility is much, much higher than a risky asset like the S&P 500. Second, what I want you to see is volatility in these markets is very distinct. The volatility cycle, if you will, in crypto is not the same as the VIX. It's not the same as what we see is fluctuations in traditional asset markets.

And so that suggests there might be some value in trying to ask like, "What if I use the second moment of Bitcoin prices and unexplained shocks to the second moment which would directly drive demand for safer assets in this space?" There's a very plausible mechanism from shocks to volatility to demand for safe assets or substitution from risky to safe assets. Would I get similar bang for my buck when looking at your regressions then asking, "Does that transmit over to the treasury market?" And so I think that's a way. I think there's room for additional understanding of what's really driving crypto demand, particularly in the stablecoin space.

So let me wrap up. I think the paper gives really clean, really strong evidence of transmission from stablecoin markets to treasury markets in a causal sense. I think there's some, to me, surprising implications for how changes in crypto prices are driving changes in stable coin demand. I think I'd like to see that explored a bit better, maybe in ways that align more with what I view as straightforward theory to understand stable coin demand. And by doing that, I think they can explore some competing hypotheses on what's driving them. All right. Thank you very much.

Rashad Ahmed:

Thanks, Ariel. I mean that was a fantastic discussion. Sorry. You got me to think about things that I haven't really thought about yet. Honestly, I don't have too many things that I want to bring up. I think

the point on understanding on a deeper level what about crypto market price movements are driving demand in stable coins is a very interesting and deep question.

Me myself, also spending some time in the space, I can give you my opinion. And Ariel has alluded to some of these mechanisms. Clearly, one of them is portfolio rebalancing by the investors in this space. So as the value of their crypto goes up, they're most likely, at least to some extent, rebalancing their portfolio into a larger share of stablecoins.

There's also this momentum factor. It's probably going to be very difficult to measure. But, of course, when there's momentum in the crypto market, you have more and more people that want to trade crypto. How do you trade crypto? Of course you have centralized exchanges where sometimes you can trade them for dollars. But most cryptocurrency pairs are traded vis-a-vis stable coins. So you're going to need stable coins.

For example, Trump coin. How did you trade Trump coin when it launched early on? You need a stable coin. So there's this intimate link between stable coin demand and crypto demand.

But I thought what was really interesting about Ariel's discussion is some of the mechanisms that I haven't carefully thought about, tax avoidance mechanism that he brought up, especially if you're operating on an offshore exchange. It's going to be harder on an onshore exchange. Now you're going to... It's a taxable event, even if you convert from a crypto to another crypto. But on an offshore exchange, it's still plausible. I thought that was a really interesting mechanism to think about.

And also, in volatility perhaps playing a role in possibly strengthening our identification, I thought that was a great idea. It makes a lot of sense to me intuitively, the second moment being an important mechanism. So those are things that I think we will definitely look into.

And then, also, the other comment that Ariel made that resonated with me is to see if we can find consistent evidence in similar markets like futures markets or perpetuals. Maybe if we see some relationship between funding rate shocks, which can also be a proxy for crypto market demand, that could help strengthen our identification.

Something that we haven't shared today, but we are working on now based on other feedback, is looking at whether... As sort of like a placebo test, we find that our crypto shocks are strongly correlated with stable coin demand. Well, are they correlated with money market fund demand? We find that it's not, which is encouraging for us that we're actually getting some clean crypto-specific shock measurement. But, of course, it's still a work in progress, so very much looking forward to additional feedback and suggestion from everybody. And thanks again, Ariel, for the comments.

Peter Zimmerman:

We've perhaps got time for one question. [inaudible 01:27:59].

Speaker 4:

I think this a great work and it's great that you are exploring this, but I have a hard time understanding your specification with my prior understanding of treasury markets. What I would think happen in the three months maturity space is that it's basically mostly determined by expectations of monetary policy. So what I would expect is deviations from futures to be transitory and to be explained by strong demand. And the buyer is not going to be just mechanically buying. They can delay their purchases. They can buy across the maturity spectrum. They can also lend in repo markets, which Circle does. So it will be interesting also to understand the portfolio composition of these stable coin issuers to understand the direct impact in the cash market as you're trying to estimate.

And the other wrinkle of the crypto market is that the providers of these stable coins can mint the stable coin while they keep it on the treasurer account and they haven't actually deployed the stable coin or buy the treasuries. And I was wondering... The description, it wasn't clear if you're controlling for that or not.

Rashad Ahmed:

Thanks for the question. So I'll start with the end of it. What the gentleman was referring to is when stable coin issuers like Tether preemptively mint stable coins but do not release them into circulation in anticipation of demand in the future... Obviously, these are things that do happen. It's tricky how to perfectly address it, but one of the ways we try to address it is by using not daily changes in stablecoin circulation, but we use something more like a five-day change.

We also are trying to look at gradual changes in T-bill yield over longer horizons to try and address some of these issues. But to be totally frank, these are difficult issues to try and address in an empirical setting where data is already quite limited, and in some cases transparency is limited, like in the case of Tether. We would love to use more granular data on reserve portfolios. Unfortunately, the variation in transparency is huge, even between the two largest.

You have QCIP-level data on treasury bills reported by Circle, which I'm sure a lot of economists here, after hearing that, it's like, "Ooh. That's going to be really nice to do some granular analysis." Well, Tether, the largest issuer, they don't report that. So you're quite constrained, and we have to make assumptions to even get as far as we did. But I think your points are very well taken. I just want to remind everybody, this is a really hard problem to try and econometrically estimate anything in this space as far as price impacts go.

I think your first point is also well taken. The short end of the term... This is a paper about a causal effect. It's not a paper about what drives the most variation in three-month T-bill yields. What drives the most variation? Of course monetary policy expectations. That's going to drive overwhelmingly most of the variation in short-term rates, overnight rates. This isn't about that. This is about whether stablecoin flows have any sort of measurable effect. It doesn't have to explain most of the variation in interest rates. I'll just leave it there.