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**GARY GENSLER:** Welcome back. People can sit at that back table, or Rob you want to come up here? So I said you're to have a special--

**ROB GENSLER:** Focus on you during class. I'm his twin brother.

**GARY GENSLER:** Everybody can meet my twin brother Rob.

[APPLAUSE]

Rob's not your guest speaker. He's my guest. But he will speak a little later when we talk about Nouriel Roubini and Roubini's thoughts on blockchain economics. Rob worked at T. Rowe Price for 25 years, 24 years?

**ROB GENSLER:** 20 years, before that on Wall Street for 10, Salomon Brothers mostly.

**GARY GENSLER:** So he's from Salomon Brothers, Wall Street. He started his own hedge fund. And that didn't work out. So he closed that hedge fund.

He went to work for T. Rowe Price for 20 years. And he ran a global equity fund. But before that, he was doing telecom and investment. But I will ask Rob, as an asset manager around \$20 billion of money at one point in time and was successful at it, his thoughts about this cryptocurrency, crypto phase.

He has not-- as opposed to everybody in this class, he has not read the readings for today's class. But I know you all read the readings maybe. But that will be when we're talking a little bit about the blockchain minimalist.

So we're now turning into what I call act two. We've talked a lot about the economics of blockchain throughout talking about the technology. But now we're going to take today and Thursday really to dive a little bit more into the economics.

Now of course, we're talking about the economics the entire semester. But this is going to be just-- we're just going to stay right on that. And because my goal on this journey together is that we all get a little bit closer to the ground truth, separating the hype from the reality, I've tried to put in the readings, if you've chosen to sort of even do the skim read or look in, some of the blockchain minimalists, like the Nouriel Roubini piece that you had. And it doesn't get much more minimalist than Roubini's piece. But I think it's relevant to know where Paul Krugman or Nouriel Roubini or Joe Stiglitz or others are on this technology.

I don't happen to agree with them. But I'm not all the way over on the other side. I'm not with the Tim Drapers. And yesterday I had the honor to appear at a conference in New York City where Fidelity was rolling out their new blockchain digital asset business. And so I was the setup speaker, I guess.

But one of the other speakers there was Mike Novogratz, who started a company called Galaxy. I would put Mike and some others closer to the maximalist, or he cautioned me he's not a 10 on the 10 scale. He's probably an eight.

But I've tried to put into this readings and this course so that you can leave this course with critical reasoning skills really what are the economics. So let's go on that journey together today. And also, I say, think about some of what we're talking about today in light of your final projects, because you're going to be looking for some pain point in finance or with a little special discussion with me outside of finance and say what's a use case that all this crazy blockchain stuff can come together and actually work on it.

So the overview, of course, as always I'll talk a little bit about what our readings. I'll see if we'll do a little Socratic method. So we're going to talk about blockchain economics, a little bit about blockchain versus the internet.

That was Joi Ito's article that kind of set that up. And Joi wrote that several years ago. He might write it a little differently now. But I still think it's really relevant to get behind how do we think of blockchain versus the internet.

I call them the minimalists, whether it's Roubini or Krugman or Stiglitz, but-- or Gensler. You're going to hear from one back in-- that Gensler, who came three minutes after this Gensler. Well, he might have come before me, actually, because Rob, you lived in Botswana. And didn't they believe that the second delivered was the first conceived? But we're identical, so maybe it didn't happen that way.

And some costs-- I'm sorry. I mean, you know, I-- oh yes, we have to do the twins thing, you know? How many twins in this class? Yeah, yeah, all right. It might be just statistical. And you said you're Peruvian, identical twin?

**AUDIENCE:** I have an identical twin.

**GARY GENSLER:** Identical twin.

**AUDIENCE:** I had-- he's a medical doctor. He lives in Peru. And in Peru, by the way, they do say that the second is the--

**GARY GENSLER:** The second delivered is--

**AUDIENCE:** Kind of the older.

**GARY GENSLER:** So has the birthright.

**AUDIENCE:** I was the first, so I tend to disagree.

**GARY GENSLER:** Rob has the birthright in Peru. We'll talk about costs and trade-offs. We've done a little bit of this in the past. And then we'll wrap it up and a little fewer slides. I slimmed this out just so we can have a bit more discussion.

But the study questions-- how do decentralized blockchain applications affect the cost of verification and cost of networking? And anybody want to dive into that or we want to dive in when I do the little bit? I'll give my read about how blockchain changes verification and networking. Those are the two things.

That was in the Christian Catalini paper. I know you didn't love it that I assigned a 30-some page paper. But Christian's at the forefront of this. He's in the Sloan faculties. He's not here. He's sort of on a sabbatical semester.

But Christian's paper-- he's at the forefront of the economics around blockchain. You can't take a good blockchain course without reading Catalini's paper. And it's not just because he's a Sloanie. I think he's kind of got that.

And then the comparison to the internet. So it's sort of those two big items. And I know I-- as somebody said, there were too many readings. There was only five that were required.

Of course, Roubini's was just low-hanging fruit, because he gave it last Thursday. And it was-- how many people read the Roubini piece? It wasn't required, but-- so about a third or a half. Do you agree it was kind of a slap down? What'd do you think, Alene?

**AUDIENCE:** It was hilarious. I loved it.

**GARY GENSLER:** You loved it?

**AUDIENCE:** I couldn't really finish it. But it was hilarious.

**GARY GENSLER:** How many of you that read the Roubini piece found that you agreed with most of what he said? OK, so 2, 3, 4, 5-- oh, Alene-- 6. All right. Wow.

**AUDIENCE:** I don't know. Every time I read one, I'm like, yeah, they totally know what they're talking about. I'm on board. And I feel the same way with all the minimalists now.

**GARY GENSLER:** So you're identifying with the minimalists now? OK, OK, on Thursday you're going to read things like an open letter to Jamie Dimon that kind of goes-- it's not a maximalist. But it kind of goes the other way. And then the optional bits.

So let's start a little bit with blockchain economics and the first thing, verification. So what are you-- what are the costs, anybody who actually dived in or dove in to the longer Catalini piece? The cost of verification.

And these are things that I'm not just presenting because somebody wrote about it. I think Christian's right about this. I think that the blockchain can-- doesn't always, but can really lower the cost of verification. Beau, do you have a--

**AUDIENCE:** You talked about efficiently verifying auditing transactions that happen and the cost of audits lowering.

**GARY GENSLER:** So efficiently auditing and lowering the cost of auditing transactions. What else do he talk about? Kelley?

**AUDIENCE:** Part of that efficiency was the fact that currently there is quite a few third-party actors that are involved, separate between the input and output actors.

**GARY GENSLER:** Right. So you might have fewer people in the chain, fewer actors.

**AUDIENCE:** [INAUDIBLE]. They also mention the privacy policy and also censorship.

**GARY GENSLER:** OK, so let me-- you raised two-- privacy and censorship. Do you want to say, or somebody else, what is it about privacy? I mean, because these are really critical things that blockchain can do.

**AUDIENCE:** So with privacy, the addresses are synonymous. So there's no name attached to an address that you can interact with your peer without people knowing who you are necessarily.

**GARY GENSLER:** Right. But why does that matter? So--

**AUDIENCE:** Why would people pay more to be able to do that? So there's an understanding that there's a fundamental right to privacy. You don't want the world to know all of your doings.

**GARY GENSLER:** So some of it's about rights and values. James?

**AUDIENCE:** The key element was hacking. These are examples when people's information are so readily available that a third party can hack.

**GARY GENSLER:** Totally agree. But what's the big commercial thing that's going on right now in big data?

**AUDIENCE:** [INAUDIBLE] can profit from that information they're gathering as--

**GARY GENSLER:** I mean the dominant-- I'm sorry.

**AUDIENCE:** I think resale of the data as well as the-- [INAUDIBLE].

**GARY GENSLER:** So what Sean and Eric are saying, the dominant revenue model in tech today, whether it's big tech like Facebook and Google and so forth or any tech-- the dominant revenue model, not the only, is basically give me some of your data, let me analyze it and either advertise against it or somehow in these days use machine learning and AI to analyze it and really market other products back to you maybe. We all do it. We live in this. We give up our data, some more so than others, some less so. But it's a big piece.

Blockchain, Catalini raises, well maybe you can get a little bit more privacy if you wish it. It might be part of the revenue model. How about censorship? What was the point about censorship? Anybody?

So when you're dealing with a central authority, a commercial bank, they can decide whether to extend credit or not. That's a form of censorship. It's a form of allocating something.

But it can be as simple as to whether to even sell you the ticket to the movie theater or not in a sense. It doesn't happen to us often. But distributed decentralized platforms are more censorship resistant, I mean on a spectrum. Anything else from verification?

So let's see how we did. So this was how I sort of take it back, these six points. The direct costs-- there may be a cost trade-off that blockchain could have a lower cost of verification. That doesn't always, but a lot of verification in finance has multiple back offices trying to reconcile between the ledgers. We've talked a lot in this class about ledgers-- ledgers recording property rights.

So you can have one bank recording the property rights, another bank recording a property right. It could be the ownership of equities. It could be cash called payments. So there's a lot of direct costs that it can lower.

And I would say in the permissioned blockchain space, a lot of big banks are looking at that very first point. We just lower our direct costs of the back office. Stop there, straight and simple. We have a lot less reconciliation costs.

Privacy and data leakage costs. I call it both privacy, which sounds like Hugo and I want my personal privacy, or I just know Facebook is taking my data. I call that data leakage. I'm not terribly worried about it. But it's something. Alene.

**AUDIENCE:** So I'm very curious, is there a use case here? Because I really fail to see one. I could see privacy in the sense that you could transfer coins from anonymous spenders to anonymous receivers and you could even hide the amount. And that's useful for business, because businesses don't want other businesses knowing what they're up to. But what other use case is there?

**GARY GENSLER:** Oh, I think it's a very good question. Anybody have an answer for Alene? Because I do, but I just-- do others? Like a business use case where you might have users not giving up as much of their data and privacy. I'm going to use Uber. Oh, did you--

**AUDIENCE:** Yeah, I think an example I can think of is, for example, the hedge fund in--

**GARY GENSLER:** The which fund?

**AUDIENCE:** Hedge fund.

**GARY GENSLER:** Hedge fund.

**AUDIENCE:** In asset management, you don't want to know, because for example, also the hedge fund, they hide behind the brokers. They have certain swaps with the brokers so they don't have to review the acquisition they viewed. And also they try to do their position under the 5 percentage threshold. So in this way, because any action-- their action maybe can move the market over a certain stop.

**GARY GENSLER:** OK, so there is a commercial situation as an asset manager. I might not want others to know what trades I'm doing, what positions I'm taking. I was going to use a personal situation.

You could envision Uber having been created on a blockchain. It's not on a blockchain. But I'm saying you could have envisioned it-- riders, equipment owners called car owners, and drivers. It's like three communities-- who owns the car, who drives the car, who needs the cars-- coming together in a blockchain.

And maybe part of the reason I'm comfortable with a blockchain Uber-- maybe, maybe-- is I might have a few girlfriends. And I don't want anybody tracking that I'm visiting different girlfriends. This would be-- you would call it privacy, but perfectly-- I'm single. I'm single.

But I'm just saying that it's a perfectly legitimate thing. Do I want to share that data? We all share a tremendous amount of data if we use a credit card that-- particularly in today's world of machine learning and AI, that you can take somebody's spending patterns and really narrow it down.

Let's, for instance, say that I have a certain religious affiliation or a certain pro-guns or anti-guns or any orientation I might have. You get enough spending patterns, you can sort of piece together that's probably you. That's probably your religion. That's probably your sexual orientation. That's probably the country you're from, the ethnic group if you pull enough spending pattern coupled with machine learning and AI.

So use case is people are really talking about, well, maybe there's something that I can give a little privacy-preserving attribute. It won't be the dominant use case, but something. And this class today is just about economics. That's a legitimate economic thing that's going on here.

Was there a hand over here? Censorship risk. Basically that-- oh, I'm sorry.

**AUDIENCE:** Can I ask a related question? So in terms of the privacy, there is-- [INAUDIBLE] mentioned

those financial institutions, like before this, they can just keep their data inside and only maybe reveal that to regulators. But if we use the blockchain, they need to make all those transactions public. And it's kind of like the other-- it's like the opposite to keeping it private.

**GARY GENSLER:** So to the regulators you said?

**AUDIENCE:** Like, say one thing it keeps you anonymous. So that's kind of protection of privacy. On the other side, we need to make public all the information, which may otherwise just involve some certain institutions.

**GARY GENSLER:** Right. So you're abso-- remind me your first name.

**AUDIENCE:** Jennifer.

**GARY GENSLER:** Jennifer. Jennifer is right. There is a tension-- the traditional blockchains like Bitcoin have both. They have-- they mask a lot of data because of the pseudoanonymity.

But it's not truly completely masked, because you can use forensics and track things. And to verify a permission list blockchain, it's all public. So I agree with you. It sort of goes both ways.

There are technical ways, whether through zero knowledge proofs and other ways, to have more privacy. But I'm saying there's a legitimate economic cause. Paul Krugman's the last sentence in his op-ed was "tell me a use case." Tell me-- remember Krugman's-- he's a Nobel laureate. Paul is brilliant. And he writes eloquently for the New York Times.

But there are-- and Jennifer, you're right. It's not perfect yet. But there are privacy attributes that you can give to a system.

I do want to clarify, I only have one girlfriend. She lives in New York. I just want to make sure. It was a hypothetical about Uber. Realized we're on film.

**ROB GENSLER:** Now they'll just all think it's me.

[LAUGHTER]

**GARY GENSLER:** There you go. There you go. Thank you, Rob. There was a story-- no.

OK, settlement. We've talked about this. I think if you don't have some economics around settlement, that you don't need some immutable record of the movement of a right, particularly a property right, you might just as well just stay with a traditional database. I'm not sure I'm



entirely right about that. There might be some permissioned blockchain worthwhile.

But I'm kind of a view if you're not moving something that matters-- and settlement means something that's final. We talked briefly six or eight lectures ago about that old lawsuit in Scotland, the Crawford case, that if James steals \$1 from me but then hands the dollar to Andrew, I can't get it back from Andrew. I have no legal rights to get my dollar from Andrew.

I might have legal rights about James. But it's final. There's final settlement. It's Andrew's dollar.

So there's some things that you just want finality. One thing I would talk about is a lot of merchants in the US don't like paying 2 and 1/2 to 3% of all their sales to the payment system-- Visa, First Data, and so forth. A lot of that goes to the banks, not to Visa and First Data. And a lot of that is also for what's called chargebacks.

So I was the chief financial officer of the Hillary campaign. Now, it was really lousy that we lost for a lot of reasons beyond this discussion about blockchain. But I continued to be the CFO for the next six months, because we had to wind down a campaign. And we had to deal with what I called the computer and refrigerator graveyard. The hundreds of people we had working at headquarters left the equipment. And they left.

But the other thing I had to deal with for 60 days was chargebacks. Did you know that donors could go to Visa and say, no, I didn't really buy that donation, whether it was \$50-- low dollar-- or \$2,700. And so I have a personal sense of this whole chargeback thing. Now, donations to a political campaign are different than services you buy. But it's something merchants deal with a lot. Hugo.

**AUDIENCE:** Are merchants responsible then to pay Visa to refund the client? Or is it on Visa and First Data?

**GARY GENSLER:** We were in essence the merchant. And yes, we had to pay. The campaign-- and this happens in every losing campaign. It didn't have anything to do with--

**AUDIENCE:** What if you've already spent the money?

**GARY GENSLER:** That's a problem. That's a real problem. And what the payment processing companies-- in that case-- it's a matter of public record. We used a company called Stripe rather than First Data and so forth. I mean, the Stripes of this world are taking some counterparty risk.

Now, most merchants are not shutting down. We were shutting down. But yeah. So effectively it's on the merchant.

Cost of trust. In blockchain, there is a cost of trust. But it's trusting the code-- the computer code. You're trusting the Bitcoin core developer, so to speak, and the consensus protocol.

So when some people say it's trustless, it's not truly trustless. You still have to trust the code. You have to trust the consensus protocol versus the trust in the central intermediary. So it's sort of trade-off of-- yes, Aline.

**AUDIENCE:** You're also trusting the network in Bitcoin. Just a reminder.

**GARY GENSLER:** Yes, you're trusting the network in Bitcoin. It's a very good point. I think by and large we all trust the network even when we're dealing with Citibank as well. But you're right that right in the center of a blockchain solution, you're trusting the network for all its communications. But even at a central intermediary, there's some trust in a network.

**AUDIENCE:** Yeah, but not for correctness. So in Bitcoin, you can double spend if the network never messes up. But in a permissioned algorithm, you cannot double spend--

**GARY GENSLER:** There's different issues. I agree with that. You had a question?

**AUDIENCE:** I would go one step further and say you also trust the ISP, right? Not just Citibank, but you're trusting intermediary that gets you to Citibank's website. But then I--

**GARY GENSLER:** That's true.

**AUDIENCE:** --can put a fake website in between there. So there's layers of trust all throughout this.

**GARY GENSLER:** That's right. And I drive a car-- not when I'm in Boston. When I drive a car, I'm trusting the carburetor as well. And I don't really know how a carburetor works.

So there's all sorts of layers of trust. But I would say that the central trade-off with blockchain is you're moving away from trusting the central intermediary. And you're trusting code and consensus.

And then economic rents, and we've talked about this. I mean, it is not the reason why payment systems cost a half a percent to a percent of GDP around the globe. But some of that is economic rents.

And the financial sector in the US is a trillion and a half dollars or 7 and 1/2 percent of our economy. There's a fair degree of economic rents in there. So these are kind of the six or seven things not only that I think is worthwhile to discern out of Christian Catalini's paper, but it's also to Paul Krugman. There are legitimate things that you would say, well, we can maybe lower the cost of verification.

The second big piece in Catalini, he talked about networks. Now, these are my words, not his. But it's basically the value of networking, moving property rights. But again, because I'm thinking blockchain is about property rights-- I mean, we can talk differently-- but moving some property right or computer code that's going to trigger a smart contract that's going to be installed and move some property rights around. And does blockchain have an ability to lower the cost to develop or operate the network?

Basically, in Catalini's words, to jump start the network or get over the collective action challenges. And collective action challenges are always in business when you're trying to start a business. Some businesses it's really hard to get over the collective action issues.

I mean, I don't know that any of you would have read a business case on Federal Express. But when I first went to business school, they still had a case on Federal Express, because the gentleman-- I think it was Fred Smith-- who started this incredible idea, how do you do overnight delivery the first day. How do you make sure you have enough airplanes to fly all the packages, in his case to Memphis, Tennessee, and then fly the packages somewhere else where you have no customers and you have no employees and you have all these collective action issues within one company? Uber, Bitcoin itself had to get and jump over and build a network. Facebook built a network.

There's all sorts of study about how you build a network and how you sort of move towards a network and get the big pay day of a network. Blockchain can be part of that. I'm not saying it's the only way. But it is one thing. And Christian speaks about two things.

A token-- and yes, token economics might not have much to do with many things. But it might incentivize and help fund the network. So it's a new form of crowdfunding. And economically speaking, there's been crowdfunding for centuries. But I mean, it's a new form of crowdfunding, kind of building on what Kickstarter and others have done, to basically have a community of interest to pre-fund a project before it's functional.

Now we get into all sorts of public policy issues of whether it's a security or not. But the raw economics is it's a form-- it's a new form of crowdfunding before the theater is going to show its show. But it also might be an incentive mechanism during an operating phase.

That's one where I'm a little bit less sure of. I have to admit, I might be on the 1 to 10 scale kind of a two or a three. And I don't want my bias to infect you all, though, because there's some people that think there really are lots of token economics to help operate.

I think the first one-- it's a great way to crowdfund. I think that's already been shown. I think that's kind of been proven.

I'm less sure about the second one. Do we need tokens and token economics to run a platform? But let us not forget there are many gaming sites that effectively have tokens. They might be called hammers and swords.

How many of you are gamers? You don't want to admit it maybe? That's six or seven. So what do you have to pay a lot for? Is it shields, swords, or hammers these days?

**AUDIENCE:** Actually, I'm going to work for Activision Blizzard. But you have to-- one of the big ones is skins. It's like--

**GARY GENSLER:** Skins?

**AUDIENCE:** Yeah.

**GARY GENSLER:** Who figures? So there's a social community. There's a reward and incentive system in gaming that's very real and has been deeply studied. And it's a reward or an affinity or an identity.

I mean, some of you probably have affinity or identity points or air miles. Anybody collect air miles? Do you do it just for the travel that you can get, or do you feel a little cool when you get extra points? You don't have to admit that, Tom.

**AUDIENCE:** Hey, I'll take anything I can to be cool.

**GARY GENSLER:** Right. You remember that George Clooney movie, *Up in the Air*? How many people saw *Up in the Air*? And do you remember one of the later scenes when he finally-- he wins. He's like 10 million miles.

So there is a piece of human nature. And the people who are maximalist on the last point say

this is part of an incentive system like that scene in *Up in the Air*. I'm towards the minimalist end. But I have to respect that it might be I should be more neutral on that point.

Metcalf's law. Anybody know Metcalfe's law other than Alin? Brotish? Yeah, yeah, I figured.

Brodish, have you told the class, do you have a PhD too somewhere or something? No. No, no, no, no. I didn't know. That was a word going around.

**AUDIENCE:** [INAUDIBLE] the value of a network, and it is proportional to the [INAUDIBLE].

**GARY GENSLER:** Right. So it's an important concept that the value increases with the number of nodes. Idea, if I can only call Alfa and Alfa can call me, he doesn't find that very valuable to call me actually. But that's the bit. But if Alfa can now call five people, he doesn't view that as just five times more valuable. Maybe it's 5 squared, the number of nodes.

Now, further studies have sort of said that doesn't really work once you get probably past 100 or 150 nodes. Alfa doesn't really care. Once he can call his first 150 people, is it really going to keep going up? So there's a modified Metcalfe's law that talks about  $n \times \log n$ .

But whatever the actual value is, the concept is that it's non-linear. And that is part of the reason why Apple and Google and Amazon trade where they trade. Why are they worth \$500 billion to a trillion dollars? Rob will tell us why in the marketplace. But part of it is this Metcalfe's law, that it's non-linear with two billion, quote, "users" of Facebook.

And so part of token economics are around Metcalfe's law. And you'll hear people sort of say this. So I thought I'd make sure you have it. So back to Joi Ito. Tom.

**AUDIENCE:** Before we jump to this, as I was reading the Catalini paper, I kept thinking about the transaction costs and the cost of hashing, particularly for Bitcoin in a proof of work system and how those things-- I still just can't wrap my brain around the idea that Bitcoin becomes so diffuse, but yet transaction fees are small enough that that's possible.

**GARY GENSLER:** If you're worried that in Bitcoin's case that the proof of work and the electricity and the hashing function is just-- by design is going to be costly for a long time.

**AUDIENCE:** Right. I mean, we think back to last winter where there were too many transactions for a Bitcoin blockchain and transaction fees.

**GARY GENSLER:** So one of the big-- I'm going to hold this point for a bit, but you're going to see. One of the big

thing the minimalists, I call them-- the minimalists would say is by its very design and nature, blockchain is meant to be complex. It's meant to have some latencies because it's doesn't have a central authority. And the trade-off of having a central authority is some complexity. You called it the hashing, the proof of work, the other-- the network, Alene would say.

Well, you've got to propagate on a network. You have some latencies. In Bitcoin's case, blocks are added every 10 minutes. Whatever that bucket of complexity and design features, to not have a central authority that by its very nature the minimalists say will never take off in any scalable way.

Though I respect each piece of that argument, I think, one, we might move to other consensus formulas. Two, it doesn't have to take off in every use case. Question is whether in some use cases it will provide an alternative to a central intermediary.

**AUDIENCE:** Just think about--

**GARY GENSLER:** But if you're saying about Bitcoin how it's designed right now, I think Bitcoin-- it's very hard to get to very big scalable solutions.

**AUDIENCE:** Like the idea of using Bitcoin to buy a cup of coffee versus my Visa card when the required transaction cost is--

**GARY GENSLER:** It's probably too high right now. That's probably true. But we're going to hear on November 15-- we are going to have not just guests, but guest speakers when Jeff and Kelly-- Jeff Sprecher and Kelly Loeffler are coming. Jeff is the chief executive officer of Intercontinental Exchange.

And I hope you stick with the class or even if you don't stick with the class you come, because Jeff and Kelly-- Kelly is the CEO of their new startup Bakkt. Hold your question for Jeff and Kelly. Jeff's one of the great entrepreneurs in the US.

So the question that Ito raises in his write up is, is Bitcoin kind of the next layer? Did we go-- all these protocols of the internet-- and these are just the four big known. There's dozens of other protocols, sub-protocols and so forth. But is Bitcoin kind of that next protocol?

So what did you all take out of Joi's work? And again, it was about three years ago. But if Joi were here today, he's still-- this is his architecture. He started-- he runs the Media Lab. He started the first internet service provider in his bathroom in Tokyo at 23 years old. And he's

lived in.

Any thoughts from his piece? No? Same. Do I code call? Akira, did you read the--

**AUDIENCE:** Yeah. Interesting point for me is the email was the application for internet. And Bitcoin could be [INAUDIBLE].

**GARY GENSLER:** So what do you think? Do you agree with Ito or not?

**AUDIENCE:** Controversial [INAUDIBLE] Bitcoin, because as Dr. Roubini said, the concentration of the miners and association, et cetera.

**GARY GENSLER:** So blockchain versus the internet, some thoughts. Both are open protocols. I mean, they're a little bit different protocols. But broadly for this level, both are open protocols.

Both transport packets of data around a distributed network. Now, in the case of blockchain or certainly Bitcoin, those packets are packets of data representing some property right that then becomes known as value. Remember, when blockchain start-- when Bitcoin started, it wasn't worth anything. It was kind of an idea. But then all of a sudden, it was worth a penny of coin, so to speak.

And when those two pizzas were delivered May 22, 2010, it took a year and a half for anybody to transact 10,000 Bitcoin for two pizzas. So it started to have some value. But at first, it was just an electronic code, a property right, whereas the internet is content.

Both have apps built on top of a protocol level. So Facebook is really an app on top of a protocol level. And there's many other apps on top of a protocol level. And we studied smart contracts. So just for your thinking about this and if you're investing in it or if you're managing around this, is somebody pitching you on a protocol level like Ethereum, like Bitcoin, a new protocol level that other things are built on top of, or is it an app built on top of it, usually through a smart contract, not always.

Layer one is like Bitcoin and ether. Layer two is like the Lightning Network. And maybe there should be something that's interoperable.

And one of the reasons he thinks of Bitcoin as an app-- I don't use that vocab-- there's not settled vocab-- what you've highlighted there is not settled vocabulary. Like, this would be a heck of a class to give a vocabulary test in, because in fairness to students, there's not a

settled vocabulary, even on the word blockchain or permissioned systems blockchain or not. The purist would say no. I would say, well yes, it's blockchain. I might not be that pure around blockchain.

Just want to make sure. Is that right? No, Rob's not going to answer.

Both are said to be open network development. But I would contend really in both there's a lot of centralization. And Joi Ito writes about how a group around ICAN really does a lot of the centralized-- I'm talking about internet protocol, not the apps on top of it. And of course, the Bitcoin core developers or in Ethereum, if Vitalik Buterin sneezes, everybody wants to know which way did he sneeze.

So there's a lot of centralization around development. But it is open. It's on GitHub. It's open source. It's highly centralized kind of in both cases.

Interoperability, and this goes back to Joi's point. Bitcoin is not interoperable with ether, which is not interoperable with EOS, et cetera, et cetera. They all are kind of in their own space. They're not that ultimate base layer.

And so I think of it-- I might have the wrong word-- as almost like the era when it was a private intranet and it's not truly the internet-- Bitcoin. It's not communicating-- that word internet meant between networks. Alene will correct my words here.

**AUDIENCE:** What does it mean for Bitcoin to be interoperable with Ethereum? So for all intents and purposes, right now you could do this atomic cross-chain swaps where you could swap some Ethereum and some Bitcoin. So that's pretty amazing in itself. What more do you want?

**GARY GENSLER:** So Alene is saying whoa, whoa, wait a minute. Wait a minute. Slow down. You can move something of value from one ledger system, the Bitcoin ledger system, to the Ethereum ledger system through something called atomic swaps, which we talked about, which is a form of a layer, too.

And maybe I don't want anything more. Maybe that solves this problem. But there still is a problem that Bitcoin code, scripting code is different than the Ethereum scripting code. And you might say, so who cares.

But they are separate networks. You have to have this atomic swap to jump between Bitcoin and ether. And you'd have to have probably a different protocol to jump from ether to EOS.



**AUDIENCE:** Depends on what you mean by different. Same algorithm, but yeah. But they solve different problems. So that's why the script in Bitcoin is different than the EVM in Ethereum, for example. So by nature, they have to be different.

**GARY GENSLER:** I've said this to this class before. I think a lot of the interoperability challenges will get past that. But we're really at a different stage. The internet pre-1990s, before the world wide web in '91 or '92 and there were still more private networks-- this feels like we're still kind of closer to that stage of the internet. Alene's pointing out, well, maybe we're closer to the world wide web because the solution is atomic swaps and jumping--

**ROB GENSLER:** Sorry, I'm going to jump in here.

**GARY GENSLER:** Rob, speak up, because I can't hear you.

**ROB GENSLER:** Sorry if you can't hear me. But like euros and dollars and yen, you still have to worry about the currency exchange rate, no matter what you techies over here-- sorry-- can say. Oh, but I can do this in my sleep.

Yeah, but what's it worth to me? Because this price is going up and that price is going down. And the minute you get currency exchange and value questions in there, it's not seamless, OK? It's just not seamless. It might be seamless technologically. But--

**AUDIENCE:** But that was the whole point of starting Ethereum, starting Bitcoin, is that you were going to have two different currencies. So just make up your mind.

**GARY GENSLER:** So what Rob is raising-- what Rob-- this isn't debate. There's not one right or wrong. What Rob is raising is there's friction.

**ROB GENSLER:** Right. If there's so much value, what is my value relative to this other currency, this other [INAUDIBLE].

**AUDIENCE:** Just to clarify, I don't understand what people mean when they say interoperability. Like, I really don't know what they mean. I hear this a lot. And I don't know what they mean-- what they want. That's what I'm trying to say.

**GARY GENSLER:** OK, what I mean--

**AUDIENCE:** And I should understand what they mean, because I'm the technical person.

**GARY GENSLER:** Right, right, right. But you haven't gotten your PhD yet, right? You know? All right, all right.

**ROB GENSLER:** There's the money side interoperability. That's what I'm bringing up. Interoperability technically might be fine. But the money side is-- is one worth two or is one worth three?

**GARY GENSLER:** So what I mean by interoperability is that you, with the lowest amount of friction, one might even say seamlessly move across various ledgers in this space. I mean, interoperable can mean things differently elsewhere. But so it's like if I-- I'm a financial firm and I set up a blockchain system, can it speak to and move information and data and value with my Legacy databases to the blockchain? That's not going to be zero friction. There's going to be some friction moving stuff from the Legacy systems to this system. And if it's blockchain to blockchain, again, what I think of is can you with the lowest amount of friction cost-- whether the cost or what Rob's talking about, like the currency risk cost or just how you hook up the API or atomic swaps with the lowest amount of friction.

And so from a user interface, is it seamless? If I'm an institutional user, can I hop, skip, and a jump across these systems? Let me move on. But that would be my lay definition.

The incentives-- in blockchain and particularly Bitcoin, you have miners. But there are incentives even in the internet that you have registries and registrars that Joi talks about, but other incentives. You have somebody's got to be motivated to keep this thing alive and program as well.

And then I would lastly talk about the government. The internet kind of came out of the government. US Department of Defense and something called DARPA in the 19-- late '60s, '70s-- it kind of-- government ultimately by the 1990s took a light touch approach to the internet.

But it wasn't like the internet was birthed in a libertarian anti-government way. And Bitcoin and Satoshi Nakamoto and the papers all kind of came from the cypherpunk libertarian ethos and culture. So it's a little bit different cultural background. It doesn't mean the internet loves government. But it's just sort of a little bit different background. Alexis, was that-- or you're just thinking?

I should have said there's one other point, significant investment. The internet took 20 to 25 years before a lot of money got thrown. And an avalanche of money came into the internet by

the mid to late '90s. Amazon, eBay, and some others I think were started in 1995, Netscape and everything was going on. But by '98, '99, and 2000, you had that huge avalanche of money.

The avalanche of money into blockchain is not as big. But it came earlier. There was a good 15 to 20 years of quiet development on research labs like at MIT and the Defense Department before that avalanche of money came to the internet. And here we had it much faster. Those are my sense of some of the differences with it.

So now let's talk about the minimalists. They're kind of fun, as the paintings in the corner so suggest, minimalist. This was the one that I think was talked about before, Tom. So what else do the minimalists say? I'm going to have, like, 10 or 15 things.

Who is a minimalist? Alene is a minimalist. Who else kind of agrees with Roubini right now? Show of hands? Anybody?

All right, so I've got-- and you're still coming to class. That's good. That's good. What else is in the minimalist cap? Rob, get ready, because you're going to give your view.

**AUDIENCE:** So a class is one. Store of value is another one because a class is not--

**GARY GENSLER:** So you're saying it's not a good store of value. All right, not a good store of value. Let's just kind of roll. Tom.

**AUDIENCE:** I don't know if this is the same, but it has no intrinsic value.

**GARY GENSLER:** Has no intrinsic value. I'll take that. Sean.

**AUDIENCE:** The one thing that's really interesting is the Gini coefficient that you mentioned--

**GARY GENSLER:** Highly concentrated, the wealth concentration. Wealth concentration. Others? Remind me your first name.

**AUDIENCE:** Jack.

**GARY GENSLER:** Jack.

**AUDIENCE:** Similar point is that--

**GARY GENSLER:** So there's more than one Jack in the class.

**AUDIENCE:** Jack [INAUDIBLE], MBA 2019.

**GARY GENSLER:** Good move.

**AUDIENCE:** Is that it's not really centralized. So there was some stat that 99% of transactions go through centralized exchanges.

**GARY GENSLER:** Right. So I usually ask in talks how many people have owned Bitcoin. Yesterday, I am at a very high-end conference in New York with 150 to 200 what I call curated invitation list. And Fidelity is rolling out this big announcement. So the people in the room are kind of engaged. And Mike Novogratz, who made personally a half a billion dollars on betting on ether and Bitcoin-- it was more ether than Bitcoin, but on those two.

I asked how many people own Bitcoin. Two-thirds of the hands have traded or owned Bitcoin. Two-thirds of the hands go up, as you would think in a room like that.

How many had owned it directly on the blockchain, meaning they downloaded the software, they have the nodes-- of about 100 hands that went up that had owned it or traded, three hands went up in that pretty darn sophisticated high-touch area. So it's rather centralized because of crypto exchanges. Other issues?

**AUDIENCE:** 51% issue [INAUDIBLE].

**GARY GENSLER:** So it's subject to the 51% majority attack. And as Roubini points out, that's probably more true with regard to the small coins. If you start a coin and there's only a million dollars of value or even \$50 million of value and there's only a dozen or 100 nodes, it's far easier to overwhelm it than this thing like Bitcoin that's lived out there in the wild, one might say in the swamp for all these 10 years. But a state actor with a few probably single digit billions to mess around could do a 51% attack even on Bitcoin.

If the government of China or the government of North Korea really wanted to buy enough computing power and ASICs, or frankly maybe even the government of China would just take over those two big mining pools that are in China. I don't know, but-- or the government of Russia. There's a big mining pool. And they--

So 51% attacks. It's kind of an interesting thing. Other things? Jihee.

**AUDIENCE:** No killer app, so it's--

**GARY GENSLER:** No killer apps. So hey, where's the "there, there"?

**AUDIENCE:** There are a lot of bugs in their code.

**GARY GENSLER:** A lot of--

**AUDIENCE:** Bugs.

**GARY GENSLER:** Bugs. Bugs in the-- so there's still a lot to work out. So let me show you the list. And then Rob's going to tell us what he thinks.

There's many technical challenges. We've talked about this at an earlier lecture. We're not through the scalability performance end of this.

Again, I keep contending I think in single-digit years-- not months, but years-- we'll get through a lot of these scalability things. Maybe I'm too cockeyed optimist about the ability of technologists here at MIT and elsewhere. But I think we'll get through a lot.

We won't necessarily get through the governance. There's still a bunch of collective action issues. But I think maybe we're already through the interoperability. I think there's still stuff to do there.

They lack intrinsic value. That was said. You didn't say there's a lot of volatility. A lot of people raise that there's just a ton of volatility in these things. That's not a technical bug. But it's a feature of the crypto itself.

And we talked about limited adoption. Paul Krugman's piece says, hey, they're not accepted for taxes. They're not legal tender. Fiat currencies have an advantage, because over the last 300 or 400 years, nearly every society around the globe has said let's accept them for taxes and legal tender.

Good point to Paul Krugman. He's right. Can't get around that.

Having multiple currencies counter an economic history and logic. This is Roubini's point. But do we really need 20, 50, 100, 1,000 separate currencies? Maybe not, but on the other side, why is it-- what did you call it, skins?

**AUDIENCE:** Skins, yeah.

**GARY GENSLER:** Yeah, why is it that some people will value skins in the middle of a gaming site or affinity points? So I wouldn't necessarily discard it completely. It's like, I just-- I think that's too simplistic to completely discard it.

And then token monetary policy. We've talked about at Bitcoin, you can have the maximum of 21 million coins by the year 2140. It's put in the code. Do we want it to be the base currency-- it's not technically the monetary policy; it's the base monetary policy-- only in code, or do we want humans?

The minimalists would also tell you that blockchains tend towards centralization, whether it's crypto exchanges, whether it's development, the mining pools themselves, the holders, and even alternative consensus protocols. So right now you're thinking you're going to go to the door and get out of this blockchain class. But it's important to kind of know these things to think, all right, now where can it have a place?

Nobody raised the private key thing. You lose your private key, you're done. In most ledger systems, we have backdoor ways to correct that. If I lose my password, if a bank sometimes get-- somehow gets hacked, there's a way to backdoor and protect against the loss.

This is the other side of finality. If we truly want final settlement, this is the other side. Buterin's trilemma-- I'm not going to review that again. We talked about. And then people doubt the claims of token economics. I'm probably a little bit in that camp.

Oh, no killer app. The scams and frauds. All right, Rob, what do you think? Rob ran \$20 billion funds. And he's not read a single thing on the syllabus.

**ROB GENSLER:** No, I haven't even read a single thing on blockchain. In the '90s, I was a--

**GARY GENSLER:** Covert twins.

**ROB GENSLER:** Yes. In the '90s, I was a tech and telecom investor. And it's relevant to inform my biases, because I saw-- Google wasn't the first search engine that came public and came through our offices. It wasn't even the top five. It was the sixth or seventh, if I recall, search engine that came through.

And the first five didn't have a monetization case. And Google wound up figuring out the

puzzle. And I saw all the things in the '90s and the tech crash and all.

What intrigues me about this is-- and I'm not a minimalist as to blockchain has no economic basis. It actually probably does. And some will figure it out. And I'm very reminded-- I'm going to give you the bull side, and then I'll give you my real-- is when I first met, in the '80s actually, the head of Bell Labs-- if anyone doesn't know that, it was AT&T's labs and all.

He said-- and I asked him, all his years in research, what was the biggest lesson I could take away and learn in my tech investing. He says, when big change happens, it always takes longer than you think to happen. Always much longer. He says, but when it does, it happens much faster than you could ever imagine when it finally does.

And where that compares to all of technology evolution, even this-- this is what worries me. Maybe I'm wrong in my-- because I'm bearish, actually. But maybe I'm wrong. So I'm going to give why it could be--

Maybe we're in that first stage where all the hype is happening, because usually you have excitement, hype, disappointment, and then years later the use case, the broad use case actually happens, because right now I really feel strongly we're in that first excitement hype. I don't know whether the broad use case will ever happen. It might.

But what worries me about Bitcoin in particular-- I'm just a markets guy. That's all I am. I don't think much-- and I'm a practical guy, not a research guy.

And in markets, it's like, OK, Bitcoin comes along. And it's going up because the taxi driver's talking about it. And everybody is in it.

Why do they own Bitcoin? They own it because the greater fool theory. I'm going to find someone to pay me a higher price. And I'm going to miss out if I don't own it. And I got to be involved in it and all the rest. And then you see how many other coins are there if you--

**GARY GENSLER:** 1,600.

**ROB GENSLER:** --CoinMarketCap.com, and you're just like, oh my god, supply. You know, the last thing you want is interoperability. If you've got interoperability, then supply is infinite.

So the value of these-- now, they may still have an amazing use case as being a utility to provide this ease of transactions and all the positive things. But what I'm bearish on is the

value of Bitcoin, if you notice. I'm not bearish on blockchain having value. But if they're all interoperable, actually it would be great, or if the medical system all figured out a way to keep medical records in some better way that used blockchain, wow, wouldn't that be great? But would we be using Bitcoin as a very high-value thing?

And I'm also reminded, I think Bitcoin-- sorry, I'm real biased about this-- is a massive regulatory arbitrage. I don't want the governments, the officials anywhere in the world to know something. I want to create a system that's beyond governments. Have you found anything-- maybe in the history of humankind there is something-- where officially-- the official sector doesn't come back with a vengeance and get its fair share?

So I think blockchain can be very good as a utility to make a lot of other things. It's like, what are the killer apps that will come? And it was true with the internet. When the killer apps came, guess what. Amazon was a killer app and Apple was a killer app. Well, Apple's different, but Facebook, et cetera.

And oh by the way, all of them-- so because you were going to say, why would it say there weren't \$500 billion or a trillion of them. Remember, there was an installed base of value-- Amazon's case, 100% of global retail that they could disrupt. Wow, they have not even 5% yet. I don't know whether you should own Amazon stock or not. I'm not trying to say that.

But all of global advertising-- that's what's Google-- wow, and they're disruptive. So maybe Bitcoin becomes the utility that some app resides on top of and is-- and this becomes ubiquitous enough in 10 or 15 years. And I actually think something will happen that just will wow us all that we hadn't even considered.

But it's in the second phase, not in this first phase of hype, disappointment. And I don't think we're anywhere near the disappointment. The disappointment takes years. And then all the sudden, like the Phoenix from the ashes, it rises up again.

And it's once the distributed process is all out there and there's not nodes like the Bitcoin nodes, but nodes of users-- it's like guess what. These things in our phone, in our hands, distributed these. Until these were all there, you couldn't have a Facebook, right? Facebook needed this first in a weird sense, or they needed the desktop versions of this first.

And I still think we're very early days of this stuff. The real value will be made. And I'm telling you, major investment dollars somewhere 5 minimum years, maybe 10 or 15 years out. And



it'll be some sort of thing that's enabled because of this. But it's not going to be these first guys. There's too much supply.

**GARY GENSLER:** And here I had no idea what he was going to say. But that's been true for 60 years. So--

**ROB GENSLER:** Sorry, you had a question for him or me?

**AUDIENCE:** Both of you.

**GARY GENSLER:** And then I'm going to do a couple more slides. Sean, ask the question.

**AUDIENCE:** I think it's really interesting the way that you mentioned that, because Amazon has a TAM and Facebook has a TAM. And during the peak of its bubble last year, people were referring to TAM of--

**ROB GENSLER:** Total addressable market.

**AUDIENCE:** Total addressable market.

**ROB GENSLER:** Go ahead.

**AUDIENCE:** To let go to the market of gold. And what's your perception on that? And do you think that's a real-- to some degree a realistic assumption?

**ROB GENSLER:** I guess. But gold has 5,000 years or even longer of being the scarce resource that no one understands. I certainly don't. But it's the-- mining. And so it's got a lot of stability from that.

If Bitcoin truly was the only one-- but how many-- you said there's 160 of them. And you just said they're going to all be interoperable. So I don't know what the currency exchange is.

So is supply really constrained? I don't know. So I don't know. Maybe you know better answer, because I know that comparison--

**GARY GENSLER:** No, no. It's a real challenge. One of the things about valuing-- one of the things about valuing any crypto-- and I told you at the beginning, I'm just not going to run a class that tells you how to invest in or out of crypto. But here is just an observation. And feel free to ask more questions.

But that-- if any token-- I'm not just talking about Bitcoin-- any token-- it could be file sharing app like Filecoin-- has a really good, good use. And it's being used. You have to start to jump

to say, what is the velocity of the token? And any of you that have studied a little bit about macro economics and you know the velocity of money, it's how many times a piece of currency turns over. It's sort of the economy divided by the monetary base, whatever your measure is.

So how many times does a piece of currency turn over? In the digital age it can turn over faster. If it was just file storage and I'd get file storage from James and then James wants to get file storage from Hugo and along and along, and if there was high velocity, you need fewer coins, almost like the higher the velocity, the less value in the coin.

So you almost need some people to be holding on to the-- James wants to hold it because he thinks it's a good store of value and not use it for file storage, because if all you're doing is turning it over, whether it's file storage or anything else, it sort of lowers the value, higher velocity. And yet it's kind of counter to it. So I don't know. There's a mixture in the valuation mode of speculation, store value, usability, but not too much velocity.

**ROB GENSLER:** I'm going to say one last thing. I am convinced there is huge value that's going to be created. But it's in the things that are enabled to be able to be done by this.

It's not in the-- I don't know if you call them coins or tokens or whatever. They're the enablers. And if you've got a really expensive one, somebody else is going to have a cheaper one that will enable all this great potentiality. And somebody will-- and there will be huge value in that.

**GARY GENSLER:** Let me just-- I just want to cover. You can stay up, Rob. I just want to--

So we've already talked about this. But I just want to remind you of this. It's sort of like centralization versus decentralization when we're all thinking together about the economics.

And again, you could change the slopes. The cost of decentralization might come down-- the orange one. But as you know, I'm sort of a little bit closer to permission systems than permissionless systems.

And in terms of traditional databases, we've done this before. But again, the public blockchains versus the traditional databases-- and I don't mean every word you need to remember or anything like that. But if you don't need a ledger, if you don't fundamentally need something to move around property rights, I think you're probably in the traditional database side.

You can move over into the middle if you think that an invention of the early 1990s-- append-only databases, the blockchain, sprinkle a whole bunch of cryptography on top of it, the hash functions, and the digital signatures-- that's kind of your permissioned database systems. It can give you finality of settlement. It can give you an awful lot. But it's a club deal. And amongst the big commercial banks or amongst some systems, they're doing a lot there.

I think to get to the right-hand side, we'll need to get some of this performance behind us-- in some single-digit years, get the performance up to speed. But still, even after those three or five or six years, when we get the performance up to speed, I think you have to say one of two things. One is, is this a lower cost of verification? And it might be. And I say this for your final projects, too.

If you find a pain point that has high economic rents, this might be a lower cost. If you find a pain point around privacy, a pain point around censorship-- it depends on what the pain point is, or if you're just something that's not yet centralized-- I continue to believe that if you're trying to attack, if you all are trying to attack a centralized system with blockchain, you've got to basically go through the door of lower verification costs, lower economic rents, lower privacy, lower censorship, but lower some verification cost. If it's currently a decentralized thing, there's no centralized intermediary, it might be the token economics are a way to jump-start the consensus and the collective action.

But I remind you, even in medical records where there's no centralized thing, you still have to think, how is this going to jump start and get over this darn collective action problem that has existed for decades, or loan syndication is another example. Collective action-- it might-- it might-- and by the way, Goldman Sachs and Morgan Stanley and JP Morgan and Banque Nationale Paris-- BNP and others-- they trust each other only to an extent. So even the middle category-- these club deals are a little odd, too.

So I'm just repeating. This is going to be something you've seen. So can you lower verification costs? That's my core thing. Can you lower verification costs, whether it's direct costs, privacy, censorship, settlement and finality risks, and the cost of trust or economic rents?

If you can, this might be an alternative to the centralized databases, or does it jump start through some reward affinity. And I love the skins. Does it somehow help you jump-start something? I'm sorry.

**AUDIENCE:** Yeah, I was just thinking about what are your thoughts collectively on--

**ROB GENSLER:** Collectively?

**AUDIENCE:** Yeah, both.

**GARY GENSLER:** Double.

**AUDIENCE:** So Bitcoin is-- I mean, there's no necessarily intrinsic value, like direct peg where you can say, this is tied to this. But what about, like, tokenization of some assets, namely maybe real estate where if you sell a piece of real estate or new-- on a new-found token, you kind of understand where the market value of that piece of real estate is from sales comparables, et cetera. But the value potentially add from tokenizing the asset is lower transaction costs. So you can kind of directly peg a value to the real estate and also the value from the cost savings from not having to pay those transaction fees.

**GARY GENSLER:** So the real question is, is there an application of blockchain technology to using a token to digitize an otherwise either a liquid or liquid asset, because it could be. Dan used real estate. But you could just as well say, is there a role to have a blockchain token and underlying it is oil, or underlying it is gold, or maybe underlying it is a basket of equities or even Fiat currency.

I think yes. It's sort of a newer modern-day version of exchange traded funds, or it's a modern-day version of warehouse receipts. Paper money started exactly this way. Paper money was like, please, will you store my grain and give me a warehouse receipt.

And then it was gold. And I'll take a warehouse receipt. And it was easier to exchange the paper warehouse receipt than the gold or the wheat and so forth.

So I have to say, from an economic point of view, there's a long history. The answer has to be yes. However, caution is particularly when you get to illiquids, is it really going to create liquidity where there isn't liquidity?

Real estate is still very idiosyncratic. Gold is very fungible. Gold is something that doesn't degrade. It could be in a warehouse. Now, it might be that they start issuing too much paper.

But so I think that I have to say yes with a big footnote that I'm not as sure when you get to the illiquid end of the curve. But the highly liquid commodity end of the curve-- but even on the commodity end, you might say, well, why is this any better than an exchange traded fund? And particularly, by the time the securities regulators say yes to it and sprinkle holy water on it, it

might look like an exchange traded fund. Eric.

**AUDIENCE:**

Just going back from that point to lowering verification costs, there's a point I think Catalini makes that when you have the necessity of matching an offline asset to the digital version or representation, then you kind of don't gain the same lowering costs as you would do when you're dealing with a purely digital asset. So that could actually set the stage for some sort of collaboration with existing intermediaries that could kind of work on making sure that that offline and digital version matching can be--

**GARY GENSLER:**

So what I think Eric's talking in the Catalini paper is that a digital token tied to some other digital asset-- there might be higher benefits than tying it to something that's offline. I colloquially called them illiquids. But not everything offline is illiquid.

And his point is basically if it's digital-to-digital, it probably has more benefit and there's less costs embedded. And it could be with less friction. And that's one reason why it might have more applicability in the world of finance than it does to the world of diamonds or supply chain management.

But one of the reasons I think it might have a real benefit in supply chain management is supply chain management has not dealt with collective action issues in the past. So rather than verification, supply chain management and health care records are somewhere down in the network bag. Maybe this is a way to start to jump start or get some of the network effects in here.

Oops, starting or operating. I knew there was something else on this page. Did you have anything to add? No.

So we're going to do the same thing on Thursday. You don't have five readings and five optionals. I know it was a long list. I think it's only-- what is it-- four.

An open letter. Let's see. I know you're a bunch of business school students. The open letter to Jamie Dimon is kind of brief. And the Economist article's two pages and so forth.

So McKinsey's is so-so. I'm not going to say all of these McKinsey's and PWC and some of them that I put in-- they're general surveys. But I like to include them with the academic papers, because this is what the business community-- they skim. They look at these things. It's McKinsey-- some of you are going to go work for consulting, Tom. And so you know, it's

good to know what that vocabulary and that world's about.

The *Geneva Report*-- you've read some of that. That's, of course, Simon's and Neha's and Jonah and Michael's and mine. We came together. But we tried to sort lay out some of these economic issues in there as well.

Any other questions? Eilon? Any other questions for Rob who, like, actually knows something?

**AUDIENCE:**

That would be relevant, yes. Some of the questions-- some of the comments on the-- from the minimalist point of view were actually about money. They consider cryptocurrency a currency.

But if they are securities, so there's no need for medium of exchange or no need for monetary policies. There's need maybe for issuance of securities policy, but not monetary policies. So if it's not coins, I just disagree with-- if it's not currency, I disagree with some of the comments.

**GARY GENSLER:**

Let me just step back. I hope that many of you going on this journey and doing these readings don't need to agree with many of the things that are written, whether it's by the minimalist or the maximalist, whether it's by the tech folks or the McKinsey's that are doing big glossy business reviews. I hope you come to your own judgment and opinion, just like you have.

I will react to what you're saying. I think that whether it's a currency or a security is relevant for the regulatory situation. It might be relevant to the business cases. But I'm not with you on that. I'm probably not with you.

I don't really care if you call it a currency or call it a crypto asset. What I'm kind of interested in is, is blockchain technology and the permission or permissionless way something that can either disrupt the incumbents, do it cheaper, do verification cheaper, do databases, ledgers cheaper, or is it a neat, nifty way to jump-start a new network. And we're-- literally, if we did not have Uber today, I could see, wow, that would be an interesting use case. You could use something like this to connect a community of people that own cars, people that want to drive cars, people that want to rent cars.

**ROB GENSLER:**

And as someone that lived and lost a lot of money, made a lot of money for others in disruptors, think to yourself, because is Bitcoin and blockchain-- I put them together for this statement only. Is it going to be a disruptor to traditional stores of value, the monetary systems, dollars, euros, yen? You could be disrupting that, or is it a disruptor for medical records or Uber tech-- is it an enabler to disrupt some other industry?

I'm betting on the second case. I actually think this will someday be a disruptor to some industry just like, guess what, the internet. We didn't know it at the time. And was a disruptor to the taxi industry. Somehow it happened.

Nobody saw that coming in the '90s. But the taxi industry got disrupted, et cetera, et cetera, Airbnb and the hotel industry, et cetera, et cetera, all this stuff. So is-- and it might be a disruptor to the monetary system.

That's one bet I actually am negative-- I'm bearish on that bet. But I'm very bullish that it will be a disruptor on things that we aren't even talking about yet, haven't considered, or maybe you guys have. And I think that's the more interesting discussion is what's going to disrupt as an enabling platform.

**GARY GENSLER:** So I thank you. We're going to close with your question. But also, remember for Thursday, for those of you that feel that you wanted another way to participate in the class-- it's not required. It's not required. You can participate. We'll have a little bit of this discussion about whether it's minimalist, maximalist, blockchain economics this Thursday, not discussions of something that's not related to Thursday.