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PROFESSOR: So we're going to talk about crypto exchanges today, which very much relate to blockchain technology. But it's not directly an application of blockchain technology itself. But it is so much a part of the ecosystem of crypto finance, with well over 90% and in some cryptocurrencies 95% to 98% percent of the actual transactions happening on crypto exchanges. So I thought that no course in blockchain technology and money could really be complete without talking about crypto exchanges.

But I want to just dare say not to be looking throughout these talk today and even on Thursday when we'll also be talking about crypto exchanges with some outside guests, about, where are we lowering the cost of verification? Or where are we lowering the networking costs? This is about basically the secondary markets in this \$200 billion ecosystem.

And the first crypto exchanges came about actually in 2000, late in 2010, I think it was. But it may have been early '11, because just when there was one blockchain application, bitcoin, people wanted to move bitcoin. It was like, well, how can I do this? I can do it with another individual on a blockchain. But there was even, how do I find that other individual if I want to sell it or exchange it?

And so there was a business opportunity. Mt. Gox was one of the first three or four. I don't think it was literally the first one. But it was one of the first handful that started to take off. We'll talk about Mt. Gox that failed. Dozens, if not hundreds failed early on.

But they were trying to provide a user experience to trade initially just solely bitcoin. Bitcoin versus fiat was really what it was. And it was providing also a service to people that were not as technologically adept as some of the MIT students.

So I was going to ask again and by show of hands, how many in the room have ever owned a bit-- of cryptocurrency or something like that just to-- all right. So it's a third to a half. But you'll see it's going to be-- far fewer even in this MIT community have done that directly on a blockchain, as well. So is it Alin? Anybody else?

So of the 30 hands that went up, the other 29 basically have done it through a crypto exchange. So they provide a service right there. Now, there's a central irony that Satoshi Nakamoto's impetus, the motivation that we've talked about was how to do peer-to-peer movement of value on the internet without central authorities, this failed attempt throughout the '90s that finally he or she solved that riddle in 2008.

Here is a decentralized way to move value around the internet. And here, even at MIT, the 30 or so of you or the 40 of you that have owned a crypto asset, but one of you-- now, this is Sloan. And it's not computer science and AI class. But I suspect even over in the computer science class, it would be less than half actually have gone and downloaded the nodes, because there's a convenience factor. It's human nature.

And so that even started in 2010. So I wanted to talk a little about crypto exchanges, some of their challenges, and some of the opportunities. And it will set up also for Thursday's discussion, where we'll be talking about how a crypto exchange might be used for a payment solution and how an entrepreneur, like Jeff Sprecher really has looked at and said, no. This is where he can see value. You will hear Thursday somebody, who is true to his--

[LAUGHS]

--entrepreneurial skills is trying to find value in this whole blockchain technology bitcoin world and has chosen a kind of a mixture of a payment solution and a crypto exchange or both. Well, this might not be tied in. So I'll do it the old-fashioned way.

So we're going to talk, of course, the readings, crypto exchanges, a little bit of the public policy challenges, and then my thoughts on path forward. Where do I see the crypto exchange space moving forward in time? So Tom, you get to answer another question. How has--

[LAUGHS]

--crypto exchanges become critical gateways for--

AUDIENCE: Yeah, I mean, so obviously, the usability, the interface [INAUDIBLE] discuss about how many people have downloaded digital wallets and other versions of crypto exchanges. And this is still the--

PROFESSOR: Right. So let's go to the other side, because Alin was the one hand that went up that you've

downloaded nodes. Have you ever used a crypto exchange, if you're willing to share?

AUDIENCE: Well, yeah, so I used--

PROFESSOR: So you've done both.

AUDIENCE: Yeah, I used Coinbase. I bought some bitcoin. And then, I transferred some on my computer, because I was doing a research project. And I thought I was going to use it. But [INAUDIBLE] ended up deciding that it's too valuable to sort of use it--

[LAUGHTER]

[INAUDIBLE]

PROFESSOR: Right. Right. So if it were 2018 now and you were to transact in bitcoin, would you prefer to use a crypto exchange or the nodes that you've-- just bitcoin?

AUDIENCE: I guess it depends on the security goal. So if I'm [INAUDIBLE], I'll use the node. If I want to send money to my mom, I'll use [INAUDIBLE].

PROFESSOR: That's neat. Your mom uses bitcoin.

AUDIENCE: No, but surprisingly she's quite open to it.

PROFESSOR: She is quite open to it. OK. So even somebody who is computer literate and has both the nodes and the exchange is saying depends on how tired I am and what my goals-- security's goals. Maybe you didn't say tired. But and anybody want to hit the second question?

AUDIENCE: [INAUDIBLE] the amount of time, the amount of disputes that arise [INAUDIBLE] resolve these things [INAUDIBLE] that a regular exchange could not [INAUDIBLE]

PROFESSOR: Which type of disputes then?

AUDIENCE: Like, there was money [INAUDIBLE] triple debits from accounts or you know, [INAUDIBLE] money not taken out or too much and [INAUDIBLE].

PROFESSOR: Right. And how do these exchanges compare to traditional exchanges? So the New York Stock Exchange-- how does Coinbase compare to New York Stock Exchange?

AUDIENCE: You must add it to some kind of, like, user ready to buy some bitcoin beforehand. And then, [INAUDIBLE].

PROFESSOR: So you're saying they have reserves.

AUDIENCE: I mean, I don't know if it's a reserve. But like, we buy from Coinbase. We don't buy from another user.

PROFESSOR: So Coinbase itself-- so one change difference-- and I'm going to highlight three and see if we can get off from this discussion. One is the exchange itself might be on the other side of the transaction from you. Alexis called that that they had a reserve. Some might call that market making. I'm sorry.

AUDIENCE: Yeah, I [INAUDIBLE] crypto exchange [INAUDIBLE] as a broker. So they face the customers instead of facing [INAUDIBLE].

PROFESSOR: Right. So a corollary to what Alexis says that they might be a market maker-- remind me your first name again.

AUDIENCE: Zhongling

PROFESSOR: What?

AUDIENCE: Zhongling

PROFESSOR: Johnny-- is that they take on brokerage responsibilities-- in the world of finance or on trading platforms, trading platforms, by and large, early on did not allow the public to transact. The New York Stock Exchange, when it started in the late 18th century by an arrangement between members in the south of Manhattan, you know, near Wall Street-- the physical Wall Street literally-- it was a membership society or a membership club. And you had to be a member to transact.

Well, those membership and clubs, just like a golf club or a tennis club, had a set of rules well before governments got involved. And they would transact. That became, well, what is now known as intermediated access that I don't think any of you are members of the New York Stock Exchange, are you? I'm not either.

So we can't actually transact with the New York Stock Exchange. But we can use an app, like Robinhood and ask them to transact with the New York Stock Exchange or Goldman Sachs or Vanguard or you know, whom-- so that's called intermediated access.

So two things we've had is 1, is Coinbase might be the other side. 2, there's-- they don't-- they lack intermediated access. Eric?

AUDIENCE: They don't store the [INAUDIBLE] that's being [INAUDIBLE].

PROFESSOR: Right.

AUDIENCE: --in the [INAUDIBLE]. The Coinbase actually stores the currency.

PROFESSOR: Right. So Eric says the third big difference-- I mean, there are other differences. But the third big difference is crypto exchanges store the value. The New York Stock Exchange did not store the value. Your value is technically ultimately on a ledger at the Depository Trust Corp., DTCC.

And just like the payment system has the central bank and commercial banks, securities ledgers have a central ledger, which is DTCC in the US and in other countries, other similar clearing organizations. And underneath it are the brokers that hold things-- it's called in street name.

But whatever it's called, know that most exchanges, traditional securities markets-- those are the three big difference-- custody, intermediated access, and who's making markets against you. Please.

AUDIENCE: Maybe just a question I have is when I click the exchange, every transaction is backed by the [INAUDIBLE] right? So [INAUDIBLE] if I sell bitcoin, I must have owned the bitcoin before, whereas in the relative exchange you can just issue trade without owning [INAUDIBLE] or money, just a promise. So you can create the [INAUDIBLE].

PROFESSOR: Well, so you're raising a question of the difference between cash markets and derivative markets, which exist and have existed for a couple hundred years so that in a cash market, you're selling an ownership right and buying an ownership right in a stock and bond or even in bitcoin.

And then, in derivative markets, you're entering into a contract-- or sometimes people call them contract for differences, but a contract that's going to relate to a price-- a pricing mechanism from some of-- oracle it can be called. In computer science, they would call it an oracle but in the commodities market by some index provider or some pricing provider.

That's the difference is between cash and derivatives. But are you saying something even in addition to that?

AUDIENCE: Yeah, because I was going to get to the point that [INAUDIBLE] launched the bitcoin [INAUDIBLE].

PROFESSOR: Right.

AUDIENCE: And I had [INAUDIBLE] seems to always be the derivative in [INAUDIBLE] cash [INAUDIBLE].

PROFESSOR: Right. So I ask you all to go as deep as you can between now and Thursday, because you'll have the founder of ICE with us. But ICE is a one-day futures contract that literally you're buying a derivative of bitcoin. But it's a very unusual futures contract, because it has to be 100% collateralized.

So there's no margin. There's no ability to have leverage or debt or credit extension. And one day later, you get delivered the bitcoin. So one of the interesting questions for Thursday that you can press Jeff and Kelly on is, is this really a derivatives contract? Or is it a form of a cash contract that just starts as a derivative, and 24 hours later it becomes cash, because it's 100% collateralized.

And it settles one day later-- very unusual future contract. I'm not aware of any other one-day future 100% collateralized contract. It feels to me that this is, in essence, a cash contract by another name for one day that facilitates being regulated by an official regulator for derivatives. That's for that one. But I thought you were saying one other thing is, can you sell short bitcoin? Has anybody-- Sean? I don't know how, but I have shorted bitcoin before [INAUDIBLE].

PROFESSOR: Sean has shorted ether bitcoin and--

AUDIENCE: Bitcoin cash.

PROFESSOR: Bitcoin cash. So how did you do it?

AUDIENCE: Well, there is-- it's not organized, for instance [INAUDIBLE].

PROFESSOR: Shorting is selling something you don't own and taking the opposite price risk-- in essence, winning when a price goes down and losing when a price goes up. And it's existed for hundreds of years. It's not new. But it's-- to short something, in most markets, you need to be

able to borrow the underlying.

To sell a stock that you don't own, there's a whole market called stock borrow, where ultimately-- and we debated this one day. And there are experts in this room that have worked in stock borrow, where you borrow the security. And then, you sell it. Or you sell it. And within the two days that you have to deliver it, your broker borrows it for you. So I'm assuming, Sean, that when you shorted bitcoin, what was behind that app-- somebody borrowed it.

AUDIENCE: Yeah, [INAUDIBLE] borrowed it. And I think the market [INAUDIBLE].

PROFESSOR: Right. And so just to move to the third question-- so three big differences-- and we're going to dig into these-- custody, intermediated broke-- you know, basically, do you have an intermediary? Or are you direct? And is the exchange a market maker?

What are all the hacks and manipulation and so forth? Tell you about this state of security at these and the state of market integrity.

AUDIENCE: It makes the crypto exchange insecure and less [INAUDIBLE] and [INAUDIBLE] less customers see the financial institution or the mainstream financial institution.

PROFESSOR: Right. So in essence, that regardless of where you come out on pro-regulation or anti-regulation or pro-business or anti-business or pro-bitcoin or anti, it's a question of trust. When you're losing a lot of assets to theft-- and a hack is just another word for stealing-- or you're losing money to market manipulation, then that tends to have, you know, lower trust in these institutions.

I mean, we can debate what to do about it. I publicly have a point of view. And I'm going to share it with you as we go through this class today. But you don't need to share the second part, which is where I am on how to address that to recognize that the high level of custody issues and the high level of market manipulation issues probably is associated with lower trust in these institutions.

Even now, there's, you know, 30 million plus people that have used crypto exchanges and 30 or 40 people in this class. So there is a level of trust. I'm just saying that I think that's what's really at the middle of this. So let's have-- so we had a bunch of readings. I'll skip over that.

So crypto exchanges-- so this is what a centralized exchange does. There's about 200 of them. Probably in the history of bitcoin, there's 100 to 200 that have already opened and shut,

you know. So somewhere in the history, there's been 300 or 400. It's still pretty darn decentralized in terms of the number of them.

And I'll later say, I think one of the things that will happen is we'll see more consolidation. There's just so many of them. That's an unusual market structure. Markets usually coalesce around some central pricing function. You want to buy and sell your apples hundreds of years ago. You'd come into the center market if you wanted to get the best price discovery.

AUDIENCE: Is there a reason now, though, because you have [INAUDIBLE] in different areas alone. So [INAUDIBLE] same assets [INAUDIBLE].

PROFESSOR: So the question is, do we have so many crypto exchanges in part because of lots of different regulation? I think that contributes to it. I would say yes. But I don't think that's the only reason. Yeah.

AUDIENCE: I think another reason might be [INAUDIBLE].

PROFESSOR: So you're saying traditional exchanges-- there was the-- especially for physical goods, apples, there was a locational advantage of being in the central square. I agree with that. There was locational advantages to be in New York or London. Do you know in the 19th century the Philadelphia Stock Exchange was bigger than the New York Stock Exchange until about the 1840s or '50s?

Post-Civil War, New York took off compared to Philadelphia, but there is locational advantages. But in a digital age, there's less locational advantages. I agree with that. I also think it's a very early days in some regards. It doesn't take much. There's one software provider that provides the software for over 100 crypto exchanges.

They're not the biggest ones, because some of the biggest ones write their own software. But it's-- at least the CEO that told me this, who runs this software company said that it was over 20% and maybe 30% of the volume. So half of the crypto exchanges, of that, a quarter of the volume, all have the same software, meaning the software for the order book, for the custody, solutions, and things like that.

You, too, could start a crypto exchange. Please be compliant with securities law if you're going to operate here in the US-- well, actually if you're going to operate in any country, but particularly in the US. So it's not hard to start up. That's one other thing. It's not hard to start up a crypto exchange right now if you've got a software provider that can give you basically a

package. And you put a new name on it. And off you're going.

But they're matching agents, meaning they're matching buys and sells. They are also counterparties, which we talked about. And they're custodians. Traditional exchanges do the first. But they tend not to do the second and third. Decentralized exchanges-- decentralized exchanges are very small part of the market. We'll see some numbers later that estimate it's a little less than one half of 1% of the volume right now in October of 2018.

But they're a computer algorithm that allows you to trade peer to peer without a centralized. And there's a lot of variation in the decentralized space. And I'll take any questions on it. But it's an interesting piece, where it's saying, Kelly and I don't really need Coinbase to trade if there's some application that can find each of us. And we can find each other. Ross.

AUDIENCE: So it's really-- the decentralized exchange is-- I'm trying to understand what you're saying correctly-- centralized but only for the matching agent function.

PROFESSOR: Very good. Correct.

AUDIENCE: Right. And it just doesn't have the other two, because you can just trade--

PROFESSOR: Right.

AUDIENCE: --if you have a node.

PROFESSOR: So Ross has raised-- are decentralized really centralized for matching and don't have the other two? Let me answer it in reverse. Decentralized exchanges do not have any custody function-- no custody function, though I could envision that somehow they could set up a decentralized escrow function through some multisig. You could technologically even do that decentralized. But what I know now is none of them have a custody solution. And none of them are counterparties. That is accurate.

It's not clear that all of them are centralized. There's one developer. There's one set of computer technologists. But you can actually, if you wish, put that algorithm out and just say, that was a fun project. I'm a computer scientist at MIT. And just put it out there. And Kelly and I could find each other.

But usually, there's an economic model, where somebody is trying to make some money. And so then, there's some centralization of the software. And the SEC just brought their first legal

action last week against a decentralized exchange.

And it was, in essence, against the software developers. Now, there's the First Amendment. Don't get me wrong. There is clearly a freedom of speech and freedom of expression in this country. But you could be a software developer and still be complicit in some crime.

And both the SEC and CFTC have, in the past 12 months, brought in legal actions against software developers. And it's interesting that in the last week, the SEC-- they settled. It was sort of a thing where, EtherDelta had put a decentralized trading platform for-- what do you think the SEC is most interested in? What type of-- what's that--

AUDIENCE: ICOs.

PROFESSOR: --Catalina? ICOs-- yeah, so it was a decentralized platform to trade Ethereum-based, more specifically, ERC-20 tokens. Decentralized-- Eilon and I could trade our ERC-20 tokens. But they said, no, no, that's a Securities Exchange.

So and it's the first action the Securities and Exchange Commission has brought against any crypto exchange. Why they picked it decentralized to be their first? That's a story I don't know. But they did. So that's decentralized-- so less than 1/2% of the volume, but an interesting and tough, you know, new area. And it brings you back to maybe Nakamoto more vision decentralized.

So as I said, responsible, just like in this classroom for probably 95% percent of the bitcoin and ether transactions-- who do you think the biggest sellers are in bitcoin around the globe?

AUDIENCE: Miners.

PROFESSOR: What's that?

AUDIENCE: Miners.

PROFESSOR: Miners-- right-- miners. Who do you think the biggest sellers of ether-- ETH is?

AUDIENCE: [INAUDIBLE]

PROFESSOR: Anybody?

AUDIENCE: ICOs.

PROFESSOR: What's that? IC-- what'd you say?

AUDIENCE: ICOs.

PROFESSOR: ICOs, yes, because ICOs-- 80% of ICOs are done on Ethereum. And generally, in the early days, they were selling a token for bitcoin when Vitalik Buterin did his. And he sold ETH for bitcoin. But we've moved-- in the last 12 months, it's basically selling for ETH. So then, you want to sell it generally speaking. I mean, they might keep some.

Over 30 million direct members-- and as we talked about, they lack intermediated access and as we'll see, market integrity rules. So this is, you know, the market as it is. The most important part of this slide to me in this discussion is not the volatility, which we now.

And frankly, actually, recently, we haven't had much volatility for six months. But six months isn't enough statistical relevance to say what the next six years or 60 years will be. But 54% is bitcoin. Ethereum is, what, 16%. So between them, that's 70%.

So we already know in the US and in many other jurisdictions that 3/4 of the market are not ICOs or not what would be called securities, even in the US, Canada, and Taiwan, the three jurisdictions that follow something similar to the Howey Test that we've talked about. 3/4 of the market is non-securities. It's just a commodity, a cash crypto.

So you'll hear debates about initial coin offerings. And what's a security? And what's not a security? Relevant-- relevant and important debate, but for 3/4 of the market, it's not particularly relevant as a legal matter, as a regulatory matter. Brodish.

AUDIENCE: I have a question. So which bitcoins will become a stable value crypto currency? And what is the relevance of an exchange? If it is not an asset, what is [INAUDIBLE]?

PROFESSOR: So is-- Brodish, is your question that if there's limited volatility, what's the value of an exchange? The value is still is that some people will want to sell that asset or buy that asset. Some people might-- if it's a store of value, I might still want to sell that store of value so that I can buy a car or go to school or pay for my medical bills.

You don't think that's as exciting as a volatile asset. Is that what you're saying, Brodish?

AUDIENCE: Yeah.

PROFESSOR: Well, at Goldman Sachs, for years, it used to be that I was taught volatility is our friend. When

you're an investment banking business and making markets, a market maker likes volatility. So you might be thinking as a market maker or as an investment banker.

But I still think that if bitcoin or any of these became very stable stores of value, people would still want to trade in and out of it. But you're saying it's just less exciting. For you or for the market, you think?

AUDIENCE: For the market, maybe-- I don't have any bitcoin.

PROFESSOR: Oh, OK. I don't either. So here are the top crypto exchanges. I caution-- this was printed a week ago. It's only accurate to say that a web group, CryptoCompare, puts out a monthly report. And I grabbed the October report.

But I would-- there's no confidence that these numbers are accurate, except for I can tell you CryptoCompare has relationships with about 140 exchanges. And those 140 exchanges give their information to CryptoCompare. But here are the big ones.

What do you take from this slide when you look at either the average trade side, the trades in 24 hours, the volumes-- anything? I mean, has anybody traded on an exchange that's not listed there, if you're willing to say? Eilon has, huh?

AUDIENCE: In Coinbase.

AUDIENCE: Coinbase.

AUDIENCE: Coinbase.

PROFESSOR: Coinbase isn't listed in the top 14-- look at that-- for the month of October by CryptoCompare. Sabrina.

AUDIENCE: KuCoin.

PROFESSOR: What's that?

AUDIENCE: KuCoin.

PROFESSOR: True Coin?

AUDIENCE: KuCoin.

PROFESSOR: KuCoin. Oh, KuCoin.

AUDIENCE: I used Poloniex.

PROFESSOR: Poloniex which is definitely smaller than this [INAUDIBLE].

AUDIENCE: I was just going to say [INAUDIBLE] motivated on selling [INAUDIBLE] is do you know US-based exchanges?

PROFESSOR: So the US-based exchanges aren't up there. So we don't know if these numbers are accurate. They are what CryptoCompare collects from 140 exchanges. But it doesn't mean they are accurate. One way they can be inaccurate is an exchange can just outright lie.

And if there's no rule or law against it, they can do that. Another way they can do it is they can be honest about the numbers, but inflate the numbers through something called wash trades. Wash trades are banned in the US under securities laws and under Commodity Futures Trading Commission laws.

A wash trade is when I buy something and sell something at the same time basically to myself or my affiliate or my colleague. And if I have even-- if Alon and I are not even legally affiliated, but if I sell something to Alon and he buys it, and we have an agreement that we are just pumping the volume for some reason, that's a wash sale. Why would somebody do a wash sale between two unaffiliated parties?

Come on. Think devious. Think like, you know, a manipulator.

AUDIENCE: If you're starting a coin, you want to make other people think other people are using it.

PROFESSOR: Yeah, you wanted to make sure somebody else thought something was used. What's the-- that's use-- another reason?

AUDIENCE: It will show artificial liquidity [INAUDIBLE].

PROFESSOR: So artificial liquidity and one other thing that you might show-- an artificial--

AUDIENCE: Price.

AUDIENCE: Price.

PROFESSOR: Price-- thank you. So wash sales for a long time in markets was a good way for manipulators

to kind of, hey, look at this liquidity. Look at this price-- pricing signals. So that's why in the US Securities and Commodities markets-- we say no. It's one small core thing that's not allowed. But there's no ban on wash sales, though there's academic literature. There's some studies. Some competitors, some exchanges study other exchanges to say, they have a lot of wash sales over there. So we don't know how real these volume figures are.

The other thing that I find interesting is the average trade size-- \$200 to \$1,000, couple of them a couple thousand. I mean, these are not large transactions. Kelly.

AUDIENCE: So this isn't really [INAUDIBLE] itself. But some of the articles that we read compared exchanges to, say, like Scottrade and Fidelity and some other platforms like that for traditional securities. So I wonder-- and it basically was saying, like, look, you know, I think Coinbase or something has, like, 30 billion registered--

PROFESSOR: 20 million account.

AUDIENCE: 20 million-- so that's obviously pretty good. I wonder how the other metrics compare to--

PROFESSOR: So I went around trying to find a list of the membership. And I couldn't find it for others. And maybe it's kind of-- it's a little harder than pumping your numbers through wash trading. I mean, you could also lie about your membership. And even Coinbase's 20 million doesn't mean they're active members.

AUDIENCE: True.

AUDIENCE: [INAUDIBLE] security is [INAUDIBLE] Coinbase.

PROFESSOR: Coinbase-- so here is another way to look at-- it is by legal jurisdiction-- same database. You're going to have eight or 10 slides that are same database. Coinbase is in the US. And this would say that it was a little less than 140,000-- no, I can't quite see where that line comes. Maybe it's \$100 million a day. And this is just the month of October. So that's where-- Sean.

AUDIENCE: I was just curious. Why is that the Chinese crypto exchange [INAUDIBLE] listed up there? [INAUDIBLE] to me [INAUDIBLE] actually quite vague.

PROFESSOR: It's listed there in the Seychelles at 300 [INAUDIBLE] I'm not sure why it's not listed on this. It's the same database. It's not there. Yeah, there it is-- number 5-- number 5. So what would you

take around this about the great financial centers of the world? Yes.

AUDIENCE: [INAUDIBLE] one of the questions that I got to see in the previous slide was if you sum up all the trades that those [INAUDIBLE] are claiming that they are doing on a 24-hour basis, isn't that a lot larger than the capacity of the system itself? I can't remember-- what? It was like seven transactions per second that--

PROFESSOR: All right. So the question is, this looks like a lot more volume that's actually happening. And I'm going to agree with you. Why do you think that's possible-- two reasons?

AUDIENCE: Because they're just doing the exchanges internally. So they're not actually transacting on the blockchain, because they [INAUDIBLE].

PROFESSOR: Right. And remind me of your first name.

AUDIENCE: Jack.

PROFESSOR: Jack-- so Jack's point is, well, maybe not all of this is going to the blockchain. It's happening on a spreadsheet-- in some cases, an Excel spreadsheet. But I'm not aware of anybody storing it even on a blockchain within the Coinbase or Kraken or [INAUDIBLE] system. Second reason?

AUDIENCE: Like, I would say [INAUDIBLE] because it's [INAUDIBLE] the same second layer.

PROFESSOR: So it might be using a second layer solution or a lightning or second layer. That's quite possible, even though I'm not aware if there's a lot of activity. Third reason? There's a lot of currency crosses here. This is not just bitcoin. There's probably 2,000 to 3,000 different pairs that get traded on any day-- bitcoin-ether, bitcoin-dollar, bitcoin-tether. You can bitcoin bitcoin cash, but a lot of the crosses-- a cross in foreign currency land is two currencies. It's often called a currency pair. US dollar versus euro or US dollar versus yen, these were currency pairs. But now, if we can use the same terminology here, there's thousands of crosses or pairs, so it's not all Bitcoin.

But the first reason's the biggest one, what Jack said. Not all of these exchanges will settle to a blockchain immediately. In fact, it's costly, even for them. So they'll take some price risk, and if they have enough customers and their market making on the other side, they'll take some price risk. And they might settle to the blockchain multiple times a day but only settle when there have exposure.

And I don't know, their risk management might be, I'll settle when I'm long 10 Bitcoin or short 10 Bitcoin, but take some price exposure. That risk management, in essence, Coinbase or Cracken or Gemini or Huobi are basically saying, I'll take some price exposure and only settle to the ultimate settlement finality, the blockchain, several times a day which, of course, takes 10 to 60 minutes as well. So that's happened here. Good observation. Yes, Isabel.

AUDIENCE: [INAUDIBLE] talks a lot about how they key digital wallets off of the network for added security. So do other exchanges not do that?

PROFESSOR: So Isabel has raised that Coinbase promotes that they have a secure custody solution, and part of it is keeping your Bitcoin off of the network. The term is keeping it in cold wallets instead of a hot wallet. Anybody know what a hot wallet is? Eric?

AUDIENCE: Software-based wallet.

PROFESSOR: Software-based wallet that's connected, currently connected, as opposed to a wallet that's disconnected and not signed up. Let me hold that question, because I've got a slide on that, but yes, the answer is others also have cold storage. Mt. Gox five years ago didn't have much cold storage, but what other observation here about the great financial centers of the world? James?

AUDIENCE: They're all tax havens.

PROFESSOR: They're all tax havens. Malta, Binance, and OKX, now again, whether the Binance and OKX numbers are legit. You're Hong Kong, right? Yeah? You're Hong Kong.

Biggest tax haven of China.

Yeah, the British Virgin Islands, Seychelles, it's kind of-- so there's some regulatory arbitrage going on. And these are the countries where they're registered, not necessarily the country of the real operations. Some are-- Huobi is one that started in the People's Republic, but in Beijing, but they registered elsewhere.

AUDIENCE: [INAUDIBLE]

PROFESSOR: You mean you don't know them? Does anybody want to say? Priya?

AUDIENCE: Islands of the South Pacific right? French Polynesia or something.

PROFESSOR: There you go. I'm surprised that you haven't learned about this financial center. OK. James is this going to tell us more about it and how much it costs to go on Expedia during sip week. I think Sloan should benefit from a true trip.

OK. So this is a different way to measure it. This is not on volume. I'm going to take a second. This is just number of major exchanges, and there's the eight big ones in the US, starting with the biggest-- Coinbase, Bittrex, Poloniex, that we talked about, Cracken, Gemini, Itbit.

Those are the ones that are US-based, that some of you in the US might have. I think on this chart, if you don't find your exchange on this chart, I would be-- all right, all right, maybe, because it might have already failed, whatever exchange you have. But Eric, who are you looking for?

AUDIENCE: [INAUDIBLE]

PROFESSOR: All right. These slides will all be on Canvas. I'm sorry, Joe, you had a question?

AUDIENCE: [INAUDIBLE]

2 So what all of the exchanges did very early on-- this is starting right in late '10 and in '11-- they set up an account structure literally on Excel spreadsheets, but an account structure for all of their customers.

And let's say that you're buying Bitcoin, and Kelly is selling. Maybe I could do that transaction between you and Kelly right on-- this is going to be called the Gensler Exchange-- right on the Gensler Exchange.

So I don't need to move that to the blockchain, because-- oh, one really important thing. What happens when you open an account? I'm sorry. It's a good question, and now I realize I skipped over something. What happens when you open an account at a crypto exchange?
Alin.

AUDIENCE: KYC and AML.

GARY GENSLER: You might do KYC and AML, but that's not what we're looking for.

AUDIENCE: Would you be issued a key pair?

GARY GENSLER: What's that?

AUDIENCE: Would you be issue a key pair?

GARY GENSLER: What you-- you might be, but actually what I'm looking for is what happens to your-- I have Bitcoin, and I open an account, or I have US dollars and I open an account. I sign a user agreement with them that they're going to store any of my crypto in their name.

Coinbase, Kraken, Huobi-- they are not storing it in Alpha's name. I don't know if you have an account, but I'm just using you. If Alpha has an account, he signs a user agreement. He says, when I buy Bitcoin, it's in a-- at best, it's on this Excel-- well, it's probably better than an Excel spreadsheet, but it's in their database in Alpha's name. But on the Bitcoin blockchain, it's in a bunch of Bitcoin addresses that Coinbase controls or Kraken controls.

AUDIENCE: [INAUDIBLE]

GARY GENSLER: It has a name tag on a separate ledger. You have some legal rights against Kraken or Gemini. I mean, you do. I mean--

AUDIENCE: Yeah, but after, I mean, is it centralized?

GARY GENSLER: Correct. That's correct. And so because both of you, Kelly and you, have signed some agreement, they're moving Bitcoin to Kelly and Bitcoin to you-- or if you put US dollars in and you're buying Bitcoin. But it's because the market, the customers want it that way too.

So decentralized exchanges-- again, based on *CryptoCompare*, these are the top five in October by volume. But these are not the five you read about most. The article that you read talked about others.

So I don't have a deep confidence in these, but these are the numbers that *CryptoCompare* could pull together. And you can see, they're much smaller numbers. In aggregate, in the crypto database, it's only 0.4% of the volume.

AUDIENCE: [INAUDIBLE] Robinhood, it said that they waived the fees. In terms of competition, I didn't understand the business model-- how they're making revenue.

GARY GENSLER: So how many of you have Robinhood app on your phones? Yeah, about 10 of you. Do you pay any fees for securities transactions? Remind me your name.

AUDIENCE: Erin.

GARY GENSLER: Erin. No. Anybody pay any fees to Robinhood? No. Isn't that kind of neat?

AUDIENCE: I do.

GARY GENSLER: Whoa, you do. You pay some fees?

AUDIENCE: They sell your float. They sell your flow. They sell your data. [INAUDIBLE]

GARY GENSLER: OK, and your name is?

AUDIENCE: Isaac.

GARY GENSLER: Isaac, right. So Isaac's got it. They sell your data, and they sell your flow. What was the third thing you said?

AUDIENCE: Float. I don't know exactly how their custody of brokerage works, but I know that there's an advantage to actually having the securities at their brokerage [INAUDIBLE].

GARY GENSLER: OK, all right. So three things-- your data, your flow, and what Isaac called float, but I would call that they have the securities system to lend-- stock borrow or stock lend. And those are the three ways.

How does Facebook make money? They have your data. So we live in a time where platforms sell your data and use your data to sell advertisement.

AUDIENCE: I was going to say, with Robinhood, you can also pay a premium that's tiered to be [INAUDIBLE] margin. So instead of paying interest in the margin, you pay a flat fee. And then they also advance your settlements instead of taking three days. They'll do it immediately.

GARY GENSLER: All right. So there's a premium service where you maybe could get further. They sell your flow. What that means is there are parties that will pay brokerage houses payment for order flow.

Vanguard does it as well. It's not-- Fidelity probably does. I'm not certain. But many big brokerage firms, when we all work with them-- and my account at Vanguard, I have zero commissions, but I know they're selling my order flow.

AUDIENCE: But who would be interested in the data?

GARY GENSLER: So who would be interested in the data-- or who is interested in the flow?

AUDIENCE: So Facebook, I understand, would be marketing companies, so they were targeting, but in this case, is it federal agencies or--

GARY GENSLER: OK, no. Who is interested in the data or the actual order flow of financial transactions? Tom?

AUDIENCE: Hedge funds, trading entities.

GARY GENSLER: Hedge funds. What type of trading entities?

AUDIENCE: High-frequency traders.

GARY GENSLER: High-frequency traders. So I believe that Robinhood side contracts with initially, I think, three and then five high-frequency trading shops. And I've been told a number of those names. I don't know if they're public, so I'm not going to repeat them on the camera, but big-- a couple of them-- US-based, high-frequency trading shops. Why would a high-frequency trading shop pay for it? Daniel?

AUDIENCE: Go ahead. I had a question.

GARY GENSLER: Why would a high-frequency trading shop pay for it?

AUDIENCE: [INAUDIBLE]

GARY GENSLER: So they think there's some value. Isaac?

AUDIENCE: Or you can front run.

GARY GENSLER: Yeah, you can-- right, right, right. So anybody who's read, you know, some of the books on high-frequency trading-- you can front run, but there's also value-- to answer Rahim's question-- there's value in the order flow, because if you can see that the market's leaning just a little bit this way even for a few seconds, you can optimize your algorithms and make money off of that.

And the US equity markets-- well over 60% of the US equity markets are trading with high-frequency trading right now-- any daily volume. In the commodity markets when I was at the CFDC, some contracts we thought it could be as much as 90%.

The *S&P 500 Futures* contract or the interest rates contracts vary significantly. And they

provide a service. There's a market-making function those high-frequency traders do, and mostly, they do it legally.

But there's a value to that order flow. And so payment for order flow is a very critical part of financial markets all the way around the globe in any highly-liquid currency market, bond markets, equity markets, and, yes, Bitcoin. So Robinhood-- Erin, do you trade Bitcoin on there or do you trade regular equity?

AUDIENCE: Yeah, I actually don't use it that much, but it's on my phone.

GARY GENSLER: It's on your phone, all right. But the one or two times you used it, you had zero fee, because some trading house in Chicago has a contract with Robinhood to do that. And Jeff Sprecher, who you'll meet Thursday, will tell you Robinhood, with five million accounts now, that's a real threat to the brokerage model.

Why would people mostly of your generation-- or Millennials, because you're not-- some of you're Gen Xers, I think, but-- I'm a Baby Boomer. I know where I am. But Millennials, you get so many services for free. Robinhood saw an opportunity, and they've all of a sudden got five million customers. But that's how they-- it's a very good question. And so moving a little along just to give you--

So these are the main things from this *CryptoCompare* just in October to give you a sense. Two thirds of the volume they measure, spot in one third is derivatives. And we're not talking about the *Chicago Mercantile Exchange*. \$\$\$

The biggest derivatives exchange actually in crypto is BitMax that has a perpetual Bitcoin swap and a perpetual Eth that has no settlement date. Highly-leveraged-- you can put 1% margin down and 99% borrow.

And every 10 hours, it reprices, but it's a perpetual rolling 10-hour future. And that's why it's called a perpetual-- Ross, I saw you look quizzical. It's made perpetual, because it's rolling 10-hour pricing settlements. But you don't settle at 10 hours. You have to either post more margin or receive profit every 10 hours.

AUDIENCE: Why isn't it a 10-hour future?

GARY GENSLER: What's that?

AUDIENCE: Why isn't it just a 10-hour future?

GARY GENSLER: Because at 10-hour future might not have you or may continue in the contract, so they created a perpetual rolling--

AUDIENCE: If I don't post, I'm out 10 hours later.

GARY GENSLER: That's correct.

AUDIENCE: [INAUDIBLE]

GARY GENSLER: BitMax is the largest in this volume. They say they don't operate in the US, because if they did, it would definitely have to register its commodity futures trading commission. But whether they operate in the US or not is probably for some other people to figure out.

Crypto to crypto versus Fiat to crypto-- 70% of the volume is on crypto to crypto exchanges. Again, we don't know if the volume figures are accurate, but just based on these figures. So the ecosystem is still 2/3 crypto to crypto rather than switching out to some other--

Decentralized-- we already talk about this. Really important innovation. I think we're going to see more about decentralized, but right now we're still at the early days.

Bitcoin versus Fiat-- this is just the month of October, but 50% was versus US dollar, 21% yen, Korea-- who's from Korea here? Anybody, do we have anybody? So tell us a little bit about that figure. Why 16% Korea? Your views. I know there's no readings on it.

AUDIENCE: I am not actually sure why. But there were a lot of articles about how there are some people who just put all the money that they have invested over your lifetime to cryptocurrency [INAUDIBLE]. They didn't have any future like making money by working. I don't know like [INAUDIBLE]. So [INAUDIBLE].

PROFESSOR: Any other views? Are you--

AUDIENCE: I think psychologically a lot of the speculators thought that this was a very even thing to just sort of speculating on the stock market, where you needed to have some fundamental technical skill sets. Whereas, this is just a very pure--

PROFESSOR: Pure.

AUDIENCE: --even keel. Not here, but, you know, just that you didn't require any specific skill sets.

PROFESSOR: That's just pure, up or down.

AUDIENCE: Getting around capital controls.

PROFESSOR: Getting around curious to us capital controls? Yeah. There's a kimchi premium even that Bitcoin sells for a little bit more. And that's what it's called. I didn't make that term up. There's a little bit of a premium. And there's some academic studies on how that widens and narrows sometimes depending upon what the government's doing. It's measured in single digit percent. But you might pay 3% or 4% premium. Sometimes it's 1.5% premium. But there's a premium on the Korean exchanges.

But three years ago, what cross do you think was the largest, over 50% just three years ago? It's not even on that chart right now. Tom?

AUDIENCE: Rem NB.

PROFESSOR: Rem NB. In 2015 and 2016, over half the market was Rem NB Bitcoin. Kind of got the attention from the Chinese central bank. By 2017, that all changed. And the US dollar thing then kind of took that space. And a lot of folks that gets really US dollar to tether to Bitcoin or other ways. This fluctuates. These numbers aren't stable. There's some months that yen is the biggest number.

We talked about the country's wonderful financial centers. And then KYC, an interesting statistic. Now, this is about 140 exchanges that Crypto Compare has in their database. And they say only half of them, 47%, observe strict know your customer. 1/4 partial and 28% absolutely none, zero. No. That's just sort of the state of play of crypto. I hope none of those 28% are operating in the US. But they might be.

So what are the policy challenges? One is the markets are readily susceptible to fraud and manipulation. Any market-- it's human nature. I don't think we're going to take the human out of human. It's going to look for angles, look for ways to make opportunities, even the best meaning folks. If you hold the assets in custody and you might make the markets, because you're not settling to the blockchain, even for short whiles, this market model, this business model is to make markets maybe.

There's inherent conflicts of interest. There's conflicts of interest in pretty much all of finance. But then we try to manage. We either manage conflicts of interest by certain rules about

transparency or certain prohibitions about, in the custody world, banks hold custody as well. But we prohibit them from using your assets unless you permission them to use your assets, and things like that. So what we try to use usually is build some system of transparency and affirmative responsibilities or prohibitive actions, those three buckets, transparency, some affirmative responsibilities, and prohibited actions around conflicts.

But this space has the conflicts without much of those three things, transparency, either obligations or prohibitive actions. So inevitably, I think it's human nature. You're going to have some kind of games going on. The custodial arrangements we talked about, big challenge. We're going to see a little bit more about that. Complying with anti-money laundering, KYC, and implementing tax reporting. In the US, at least, in the US, brokers have to report to the government when you buy and sell something. This was not true 30 and 50 years ago. But we've come to a place where I think it was in the last 15 to 20 years, laws changed. Ross, maybe you know on your legal work.

But laws change where brokerage houses have to report. And those reports go into the US government and other countries. So the brokers say James sold this many shares of this and had a basis of that. And there's more tax compliance. Here, there's no broker. So it's hard to attach something. And some of the exchanges are rather slow when the IRS comes knocking. Coinbase and the IRS had a little kerfluffle, I'd call it, when the IRS asked for data on their then 13 million customers. And they settled, because the IRS was bringing an action against them when they wouldn't give them any information. And they settled and gave them information on their 10,000 or 20,000 most active accounts.

But for a while, right now, the coin basis can act like they're Swiss bank accounts. Is anybody from Switzerland? All right, then I can say it. But, you know, for decades-- wait. Who?

AUDIENCE: [INAUDIBLE] But I lived there.

PROFESSOR: You live there? Well, what did for decades, maybe centuries, Swiss bank accounts been known for?

AUDIENCE: Secrecy.

PROFESSOR: Secrecy. Secrecy. That was their-- they had a lot of other good things going on. But that was one of their marketing points, secrecy. It's a little harder now. But it's still relative to a German bank or a French bank, probably a little bit more secret, right?

AUDIENCE: Yes, it's less. A lot because of US pressure [INAUDIBLE].

PROFESSOR: Right. Right.

AUDIENCE: Still more secret than some of European [INAUDIBLE].

PROFESSOR: Yeah. But crypto exchanges are still thinking, oh, well, how can we give up secrecy? Because competitively, other exchanges aren't doing it. So I think Coinbase was trying to be good citizens, but also not give everything to the IRS the IRS wanted.

There's a big question of what's a security? What's a commodity? What's a derivative? And in every legal jurisdiction around the globe, securities exchanges are regulated pretty much in every jurisdiction. So what is a security and what's not a security does relate to what's currently regulated under current law. I've testified in the US Congress. And I'd say regardless of that, if it's even just a commodity, like Bitcoin under US law is considered a commodity, you probably want these exchanges regulated. And if it's a derivative, in most jurisdictions, it also is regulated.

So the first and the third in that list, securities and derivatives, exchanges are regulated. In most jurisdictions, commodity exchanges are not, but not all. So the definitional thing also relates to what comes in. So in the US, there are a number of exchanges that will, I would predict in the next 18 months, register with the Securities and Exchange Commission as broker-dealers under regulation alternative trading system Reg ATS. But I think that they will only do it if they're category one. They have a bunch of initial coin tokens that are so clearly securities, they register.

But what if you're only trading Bitcoin, only trading Bitcoin and Eth and so forth? Those might say, I don't want to have all those added costs. So question for Thursday is, why did the Intercontinental Exchange create a one day future, which appears to be like it was like walking into and saying, I want a regulated exchange? As a business proposition, that's what it feels like to me. That that was part of that decision set. But you can ask on Thursday.

Tracking beneficial ownership. We've tracked beneficial ownership in the securities markets for a long time, from the first joint stock companies. Because you track beneficial ownership to ensure that somebody gets their dividends. And if they're voting once a year on the board of directors and things like that. But somewhere in the last 30 or 40 years, law enforcement agencies said that's a good way to track against money laundering and track against other

things. So layered on top of securities laws, law enforcement agencies around the globe said, we want to know who owns what.

For the prior 50 to 100 years, it was just securities law that cared about tracking beneficial ownership. But there's some international treaty-- I can't remember the name of it-- that says all securities regulators have to do something extra and make sure that there's transfer agents. And there's this whole regime of keeping ledgers of who owns what. In addition to this anti-money laundering stuff, securities laws have this embedded in most jurisdictions,

This is a tough one for this space, not only because it comes from a libertarian basis. But it's also a tough one just technologically, just the technical solutions. The crypto exchanges, half of them have what Crypto Compare says is strict anti-money laundering. But 1/4 don't have any, which means they're not tracking beneficial ownership. I think that will slowly get ramped up. But if you see a lot of registered exchanges leaving one country for another, they're probably going to a place that has lower regulation.

Oh, and how do you remediate a noncompliant exchange? There's a bunch of exchanges here in the US that will register. Securities and Exchange Commission can do, look, we're not going to fine you. We're not going to give you penalties for the past. Can you just come into compliance in the next 12 to 18 months? That's probably what's going to happen.

But like the Ether Delta situation just last week, they come to some settlement. They say, you've been violating the law for the last X number of months. But how do you come into compliance? And so that will be an interesting sort of what level of regulatory forbearance will there be?

I think that at some point in time, there will be fines and penalties. But I think in the US context, they'll bring a half a dozen, or eight, or 10 into regulation. And then they'll bring down a heavier footprint, bring down the hammer, if you wish, in 2019 or 2020. I don't think that's going to be in 2018. Kelly?

AUDIENCE:

So maybe this is a question for Thursday, but what is the thought on the side of the exchanges? Do you think that there will be a huge cost to them to come into compliance? Or do they think that they're going to lose members or maybe even it would increase because it's [INAUDIBLE]?

PROFESSOR:

So a very good question. What does being compliant with some broad public policy norms do?

And I think there's probably different business models. If you're an incumbent, like NASDAQ-- and there was a brief article when Adena Friedman who runs NASDAQ said she wanted to be in this space. If you're NASDAQ, if you're CME, if you're Deutsche Borse in Germany, if you're ICE, you really already know how to be compliant. It's probably advantageous to be registered and for all those startups to be registered. In some ways, it creates a barrier to entry. But you want to do it.

If you're a startup, you could go one of two paths. So Gemini here in the US and Coinbase, at least publicly, are saying we want to be compliant. How do we get there? Coinbase may be, because now they're almost like an incumbent. And so they might want to keep the next round of startups out. But I think around the globe, there's no doubt that it would raise costs. The question is whether it would either secure your market share or flush out some competitors.

I would contend that it would increase the overall size of the market. Because more people would be interested. But some fear that it would shrink the market. Because if you had known beneficial ownership, if you tracked beneficial ownership for 100% of this market, some worry the market would shrink. That's from a commercial concept. Meaning, if you're tracking beneficial ownership. Question Riham?

AUDIENCE: [INAUDIBLE] the whole essence of Bitcoin, all of this is deregulation, being away from the government, and transaction between individuals without having regulations, this more libertarian view of exchanges [INAUDIBLE].

PROFESSOR: So the nature of your question is, isn't Bitcoin and crypto about some off the rails, libertarian, pro libertarian, peer to peer? I think it's genesis. Eric, you want to answer?

AUDIENCE: [INAUDIBLE] there's common theme in the reading about Coinbase where [INAUDIBLE] the fact that more and more people with that libertarian point of view are constantly reminded [INAUDIBLE] that it's kind of betraying that ideal. But you don't have to believe me. I mean, he's trying to make a business out of this. So being compliant with that is actually trying to broaden the base of customers and make the business more profitable and growth.

PROFESSOR: I think that to go from a \$200 billion market to \$2 trillion or \$10 trillion, it's got to come inside the public policy envelope. I just don't see particularly, lowering the risk of manipulation and fraud. Then you're going to have a broader societal acceptance. And investor protection matters. But there are others on the other side of that.

These are on the numbers. I'm not going to stay on it. But this is just to say one thing Crypto Compare does is average daily visitors versus their volume. Coinbase's average daily visitors is you can see that a highest read chart compared to their volume. They probably have legitimate use. The two, ZB and EXX, almost have no visitors. And they report a lot of volume. So it's just an interesting statistic to sort of say-- and it might well be that Binance's volume statistics are accurate. They're just a crypto to crypto exchange.

But they also, their ratio of visitors to volume is very different than Coinbase. Just to give you a little flavor for the craziness out there. Investor protection. I sort of said investor protection is critical. We're going to talk about this in a week or so about initial coin offerings. But it's further than consumer protection. And importantly, because we address. We know. We are honest. We're earnest about it. We say, yes, there are conflicts of interest. How can we address conflicts of interest? You don't ban conflicts of interest. But you sort of say, is there ways to manage it? How do we promote market integrity through transparency and rules of anti-manipulation?

So it's kind of those, you know, the realities of humanity. And we say, well, how can we sort of put some traffic lights and speed limits in the system to give people confidence that drive the roads? And by the way, Rahim, I can't tell you, because I wasn't there around the debates in the nineteen teens and the 1920s. But you can be assured there were debates in whether to put the first traffic light out. Literally, you know? Whether to put the first crosswalks. And do traffic lights and crosswalks restrict the use of automobiles? Absolutely. Absolutely.

But think about this. Did they promote the sales of automobiles? And I would contend they also promoted the sales of automobiles. That simple regulatory intervention meant that people could feel a little bit more safe having their neighbors drive. Because most people didn't drive. But having their neighbors come down pass there walking on the street, the pedestrians. Pedestrians felt safer.

So I think it's a bit of both. All right, I might be disclosing my point of view. I think investor protection bolsters investor confidence in capital markets. And that everybody benefits. But you've got to get the balance right. And I'd respect if half of you say, no, it should be less regulation, and have said more. I'm disclosing more where I am and at least the logic behind it.

You know what the Howey Test is. We'll come back to this in a week when we do initial coin

offerings. In the center of crypto exchanges, it's an important issue as to which crypto exchanges have an ICO token. Then they've got to kind of do a little bit more.

Hacks. These are the biggest hacks I could find. These are reported hacks. Who knows what's not been reported? Coincheck and Mount Gox each about a half a billion. A couple of 50 to 100, 200. And here's a bunch of tiny ones that I've put. I mean, they'll be on Canvas. But there's a bunch of basically, steal somebody else's coins, because they're [INAUDIBLE].

Earlier question, cold storage. This again, thanks to the friends at Crypto Compare. Isabella, that was your question earlier, right? So I can't really tell you why BitFlyer only has 80% in cold storage. And some of these others, like Bit for Nexus 96% or 97%. But I think that if you have a high volume and high flow, you could maybe keep more in cold storage. Or if your model is more about custody than transactions, you could have more in cold storage.

You do need something, you know, probably connected to give your customer base liquidity. And somewhat depends how long it takes you to move something from cold storage to hot storage.

AUDIENCE: [INAUDIBLE]

PROFESSOR: What's that?

AUDIENCE: At least they used their own capital [INAUDIBLE]?

PROFESSOR: So they self-insure. And Gemini announced that they just signed a contract with Aion one of the world's largest insurance companies, to insure against loss of that which they're having custody. But don't confuse it for 100% insurance. The insurance companies are charging significantly, somewhere around 1.5% a quarter. So there's some crypto exchanges, which will allow you to pay for the insurance. And Gemini says they've signed a contract with Aion. And I can't quite tell whether that's just because Gemini is going to pay for the insurance. Or they're going to allow you to pay for the insurance in that custody solution.

Let's see what else. Oh, we're almost wrapping. So here's what I think. Custody, I think the custody duties either have to be fixed or spun off. I think from a public policy perspective, they're better spun off. And that's because there's such an inherent conflict. I think if you're holding somebody's funds and also transacting, it's just too sweet a honeypot not just to be stolen, but for the operator to say, I want to use it in my own-- lend it, borrow it, transact around it. But that's my thought. Fix it or spin it off would be the custody.

Illicit activity, I think we're going to have to get to a place where if not 100%, close to 100% are actually complying. And if 1/4 of them aren't even doing AML and KYC, there's still a lot of-- there's some road ahead here. I know it might not fit, Rahim, with the libertarian soul of the genesis of all this. I won't say you maybe personally. I think that's going to be the path for our-- if we're still two and three years from now 1/4 of the market not doing it.

I think that the market integrity piece is the toughest one. And it's maybe where my own personal views shouldn't cloud my judgment. My own personal views is we need market integrity, anti-manipulation, no front running, things like that. But realistically, it's probably going to be done by individual exchanges or self-regulatory organizations. Gemini and others in the UK, there's some self-regulatory organizations. I don't think that's sufficient. It's a step really in the right direction.

But I think somewhere, if this gets bigger, it needs to be the official sector putting some traffic lights and stop signs in. Registration and remediation. First, to determine whether you have to register and then comply. And that's a multiple month or year period. In Japan, they started registering in late 2017. They started with 16 and another 16. Some had to shut down in Japan.

South Korea is registering. Now, some of those registration regimes are really just about custody and Bank Secrecy Act. They're not going as far as I would like to go, which is into market integrity. But I think you're going to see a bunch more jurisdictions, registration, remediation, some closing, and the like.

Margin and fee compression, I think that's inevitable, whether it comes from the Robin Hoods or the Intercontinental Exchange. But the juice is so much right now. I mean, some of these are charging 1% to 3%. You all transact. You know your fee structures better. But I think there'll be margin and fee compression. And I think there'll be some consolidation. There's not enough room here for 200 plus exchanges.

So those are my predictions. And I think the decentralized exchanges, once they have enhanced customer UI, there will be more adoption. But right now, not that easy to use for most regular people, the non-computer scientists. Two questions and then we might have to wrap.

AUDIENCE: Is there any indication that crypto exchanges are profitable?

PROFESSOR: Crypto exchanges, profitability, they're enormously profitable. Coinbase did a venture round at an \$8 billion valuation. One crypto exchange just sold itself for \$400 million. And Coincheck that lost the half a billion of Nam, the 27-year-old who ran that in Japan did not declare bankruptcy. Because he had already made over a half a billion dollars in the previous 12 months. They are enormously profitable.