

## GENERAL DISCUSSION

THOMAS LAUBACH: This is fascinating stuff, and I have one suggestion and one question. So the question is, I think the general notion of providing the public with affordable access to a reliable payment system is important, and we know that even in the United States there are a bunch of unbanked people. But why do you think the central bank has to be the direct provider of access to that service?

My suggestion would be to take a look at what's been going on in India, which is a very interesting case: hundreds of millions of unbanked people, and the government is extremely active in developing technology to provide these people with a payment system that they can access but that does not necessarily involve accounts at the central bank.

ROBERT HODRICK: I'm a little worried about the negative interest rates on these digital currencies, because if multiple central banks have these nice, stable monies, it would seem relatively costless to change from dollars into euros. Accessing the foreign exchange market would be simple, and once you say you're going to start charging me 1 percent per annum, I'm going to start going into the euros. I'd like to hear what you think about that.

JOHN COCHRANE: Laurie, doesn't the blockchain get longer and longer and longer? One advantage of money is that it doesn't carry its history with it. Jesús, I know that digital currencies are currently just fiat monies, but why aren't they backed? The natural thing would be to eliminate the price volatility and say, "I promise to give you one maturing Treasury bill in return for a bitcoin." Michael and Andy, I worry a lot about eliminating all anonymity in transactions. In your system, the government has a record of every transaction you've ever made. The civil liberties and

political freedom implications seem pretty dire. Also, our government passes all sorts of aspirational laws, like you shouldn't hire illegal aliens or people without the right licenses. Enforcing every law will bring the economy to a crashing halt. Finally, I have two questions. Why the Fed? Why don't we just have the Treasury issue government debt via the blockchain, and then we can trade the government debt directly, and we don't need any Fed involvement?

LAURIE HODRICK: I don't want to get too geeky answering your question, but there are technological ways to deal with how much history the ledger keeps. The amount of history needed depends on the asset, because the ledger is about keeping an asset's provenance, its true history. For assets where the long history is important, there is a need to maintain the complete record. Examples might include a house or a Hermès Birkin bag—and there are all sorts of neat applications emerging for assets where provenance is important. For other assets, only a shorter history of transactions is necessary—a monetary unit obviously much less than even a share of stock, for which the tax basis is important and a firm might want to allow shareholder voting based on tenure. So the amount of history needed in the ledger depends critically on the nature of the asset.

JESÚS FERNÁNDEZ-VILLVERDE: There are many cryptocurrencies in the market, and every day there is a new one. I am not quite sure whether any of them have tried to do a bit of price targeting or follow some policy rule. My view at this moment is that the regulators follow some type of benign neglect and just let people try different things and see what happens. And if, in fact, cryptocurrencies are going to become a means of exchange that people want to use, my hope is that sooner or later some entrepreneur will establish a business model that is welfare improving.

Let me say something, however, about public debt. In some sense, we are ready to do that, because the best way, perhaps, to

think about the US dollar is as nominative short-term government debt. And in fact, dollars were introduced during the Civil War precisely as public debt. They were payments by the federal government to finance the war. So, in some sense, it will be coming back to what we have already been doing for a long time.

ANDREW LEVIN: The question about privacy is something we've been discussing a lot with Peter Fisher. And he certainly persuaded us that actually these cryptocurrencies need to be supervised and regulated, that any financial institution which takes deposits in cryptocurrencies also needs to be a supervised institution. I hope I'm representing Peter's views accurately.

But the key issue is one of relative privacy. Because in a democratic society with a rule of law, there have to be some limits to privacy. Now, the Federal Reserve already has access to a lot of confidential, proprietary information, and it strictly protects that information. What we have in mind here is that the same kinds of protections would apply to the use of central bank digital currencies. And people would be free, if they wanted, to continue having their payments and accounts at private institutions. And as Mike said, we envision that most people would probably continue to do that.

MICHAEL BORDO: I wanted to say something. The limo driver taking me from San Francisco airport to Stanford asked me what I was doing here. I told him about my work with Andy on central bank digital currency. His reaction was, "Why would people want to have an account with the government?" I said, "It is not the government, it is the Federal Reserve." This suggests that the issue of trust in the Fed has to be dealt with.

ANDREW LEVIN: Coming to your other question, though, which I think is important, for practical purposes, the central bank would become a lot like a narrow bank. Its assets would be short-term government securities, and the bulk of its liabilities would be the digital currency. So the question you asked is, Why do

you need it at all? And the answer is because the interest rate on digital currencies still has to be set. And that evolves over time, and there has to be a price-level targeting arrangement. It could be a Taylor-type rule, or a Volker Wieland rule, or a Williams rule or whatever. So that's the crucial role for a central bank committed to a stable unit of account. In principle, you could hand everything over to the Treasury and make Treasury responsible for maintaining the stability of the unit of account. But I think in our modern economies, that seems to be something that everyone agrees central banks should do.

MICHAEL MELVIN: Bob Hodrick raised a question that I was thinking about. Maybe it's not the same question, but there is a monetary theory literature on competitive monies. Theory suggests that if monies are perfect substitutes, they all have to have the same return—right?—or demand goes to zero. I haven't traded Bitcoin, but let's say all these monies have their own units of account but are really very close substitutes. How is this dealt with? It strikes me that it will be difficult to sustain many alternative competing digital monies over time.

JESÚS FERNÁNDEZ-VILLAVERDE: That gets into the details of the paper. We have two versions of the model. In one version, currencies are not perfect substitutes. Thus, you have monopolistic competition. In the second version, currencies are perfect substitutes and have the Kareken-Wallace-type result of portfolio/price indeterminacy. However, there is, as you suggested, an equilibrium condition equating the rates of return of different monies. It is precisely this equating of the rates of return of different currencies that imposes constraints on what the Fed can do. The intuition is, basically, that if the Fed is not providing the same rate of return on the other currencies, agents will move away from the Fed's money. So, yes, there is a Kareken-Wallace result at the very core of any war with multiple monies, and then the issue is how you get around that problem.

LAURIE HODRICK: And if I may add, the existing ledgers are definitely not perfect substitutes in a number of ways. As I noted in my remarks, current differences include permissions and privacy, whether they've been hacked, and how they are perceived in terms of cyber security. People definitely do not see them as perfect substitutes at this point.

ANDREW LEVIN: I'll also handle both of the questions Bob Hodrick asked. Jesús mentioned this issue with bitcoin in China. Imagine that over the next few years, some cryptocurrency becomes very popular in the United States. So popular that everyone's using it on their cell phones and people start quoting prices in that instead of US dollars. In fact, that's similar to the reasons why the Federal Reserve established its reverse repo facility. The Fed needed to deal with a wider range of counterparties, not just the depository institutions. If we had a situation where the cryptocurrency was run by . . . just think of a large country in eastern Europe that isn't always friendly. *[Laughter]* Okay? That's the sort of risk that I think we have to take seriously now. So you're right, Bob. We could be in situations where people are moving their assets quickly from one thing to another. And so it's crucial for the central bank to provide the unit of account and to maintain the public's confidence so that digital currency is widely used enough that the central bank can be effective in maintaining price stability.

JESÚS FERNÁNDEZ-VILLAVARDE: Can I add a small point that reinforces the comment you made about these two lawyers saying the United States should be a lever in this area? What has worried me in reading some of the technical details of these cryptocurrencies is that they are designed by computer scientists. God bless them, they give us great things, but their understanding of incentives and general equilibrium is not as nuanced as I would like. *[Laughter]* And what I'm worried about is we may end up accidentally using a cryptocurrency, designed by someone who

hasn't taken monetary theory, that may not implement the social optimal. I think central bankers of advanced economies should play a role in designing the new means of exchange.

DAVID MULFORD: Let's assume that this system is established. If it is established, and it's established in a way that satisfies all the things that have been said here, how vulnerable is it to cyber attack by an outside force?

ANDREW LEVIN: I think that's a really important question. That's why it's probably going to take one to three years for a central bank to implement a digital currency. But in principle, because the central bank is in control of the digital currency ledger, it can look for suspicious transactions, in the same way that major credit card companies do. And in some circumstances the central bank can impose limits—say, on this account you can't withdraw more than a hundred dollars a day, or you have to call us before we approve a transaction over a thousand dollars. We know what happened with the central bank of Bangladesh. I guess you know about this, right? A hundred million dollars. These issues already exist, and it's absolutely critical, again, coming back to the quote, that the Federal Reserve and other central banks need to work on this expeditiously and carefully.

LAWRENCE SCHEMBRI: Regarding the comment about cash just disappearing, there's still going to be an inherent demand from people who want a private means of payment. So if you let cash disappear, these people are going to move into the fringes. And so there's going to be an incentive to create private currencies that are truly private. How do you manage that situation?

ANDREW LEVIN: So again, I just want to revisit what Peter Fisher taught us, which is that central banks, government agencies, and financial regulators are going to have to be on top of this. If the cryptocurrencies are being created faster, and depository institutions are taking in those cryptocurrencies faster, we could end up having financial crises and bank runs on institutions we

barely know anything about. So there has to be a rule of law that's put into place here. And maybe Laurie Hodrick will be the first head of the cryptocurrency regulator!

Again, privacy has to be relative, because the government needs to prevent money laundering and other sorts of illegal activity. Even cryptocurrencies are not beyond the scope of a legitimate law enforcement transaction to find out what's going on.

MICHAEL BORDO: Look at Sweden, where cash has not been abolished but people do not use it much. There are only a few people (2 percent of the population) who still do. Our plan is not to abolish cash, but we think that as time goes by less and less people will use it.

JESÚS FERNÁNDEZ-VILLAVERDE: A simple proposal that I have presented for Europe is to issue a prepaid debit card up to some limit, let's say five hundred euros. And those prepaid credit cards can be perfectly anonymous. Five hundred euros should be enough for legitimate purposes, such as buying gifts for your partner without her knowing in advance (my problem now is that every time I try to buy a gift for my wife, she gets a notification in her iPhone from the credit card company, killing the surprise), but you are not going to finance a fraudulent operation with a few hundred euros.

JOHN DUCA: Two minor things about implementation. One, aside from the issue of the sordid substitution for currency, this strikes me as a substitute for demand deposits, even money funds, and that raises issues of how we manage the liquidity requirements on banks in a world where the federal government is now competing with them. And two, this issue of substitution involves some learning by the central bank about the optimal amount of government money and private money. This raises another issue: should we be first? Maybe it pays to see some minor advanced country try it first rather than adopt Andy's "America-first" proposal.

MICHAEL BORDO: I have a paper with Pierre Siklos, “Central Banks: Evolution and Innovation in Historical Perspective.” It takes a broad historical sweep and looks at two hundred years of data for ten countries. We found that central banks learned from each other. The leader in the nineteenth century was the Bank of England. In the twentieth century, it may have been the Federal Reserve and to a certain extent the Bundesbank. In the past thirty years, it has been small open economies like Canada, Australia, New Zealand, Sweden, and Norway. The move toward central bank digital currency will come from those countries, as was the case with inflation targeting, and probably the United States will catch up.