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Technological Change and Central Banking

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Abstract

The decentralized autonomous organization (DAO) represents a radically new way to manage databases. Since money and payments are all about managing databases and since banks play a central role in money and payments, DAO-based money and payments systems are potentially a disruptive force in the banking system—which includes central banks. One would normally expect regulatory frameworks to evolve with a changing technological landscape. However, the decentralized governance structure characteristic of DAOs renders it near impossible to regulate these entities directly—a property that makes them ideal vehicles to exploit regulatory arbitrage. In this article, I discuss some of the monetary policy implications of DAO-based money and payment systems. I highlight the prospect of a globally accessible DAO-based stablecoin that may conceivably end up financing a large fraction of global trade. To the extent that such a structure imposes systemic financial risk and to the extent it cannot be regulated directly, an alternative strategy is to offer a competing product. A central bank digital currency accessible to firms involved in the global supply chain may be one way to mitigate the systemic risk associated with an emergent, unregulated global stablecoin.

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1. INTRODUCTION

It is said that the only things we can be certain of in this world are death and taxes. Perhaps so. But I'm inclined to add technological change to this list. It is human nature to want to build a better mousetrap. And when technology changes, inescapable Darwinian forces compel institutions to adapt to their new environment. This includes central banks.

Central banks are, as their name suggests, central hubs in the networks that characterize modern day financial systems. They are typically delegated a host of responsibilities, including the conduct of monetary policy, along with the regulation, supervision, and oversight of the banking system. Banks are special in an important way. Unlike other businesses, the demand deposit liabilities created by banks

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to finance their assets are money. And because people value money for its ability to make payments, banks are necessarily involved in the payments system. Central banks play a key role the process of clearing and settling payments across banks in the payments system. It follows that technological advances that disrupt the money and payments system are likely to have both tactical and strategic repercussions for a central bank.

The technological changes that impact banking most dramatically are those that provide new or better ways of communicating, managing, storing, and analyzing information. This should hardly be surprising, as the successful operation of a money and payments system essentially boils down to an exercise in secure messaging and honest recordkeeping. The internet is probably the most important innovation in communication technology since the telegraph, at least as far as banking is concerned. Combined with advances in cryptography (necessary to secure communications), personal computers, computer processing power, and data storage capacity, the internet has transformed the way banks organize themselves and conduct their business. Virtually everyone now has access to online bank accounts and handheld devices to make payments.

Of course, technological change impacting the banking sector did not begin with the appearance of the internet. In 2003, James Dingle of the Bank of Canada wrote about technological changes from the 1970s:

> It is a challenge today to recapture the degree to which the financial world of the 1970s, indeed the entire society of that time, was awakening to the astonishing power of the combined technologies of computers and communications devices. The titles of two widely read and influential books of the period are suggestive: *The Coming of the Post-Industrial Age* by American sociologist Daniel Bell was published in 1975, and a report entitled *L'informatisation de la société*, by publisher and intellectual Simon Nora, appeared in 1978 in response to a request from the President of France. It is also noteworthy that, during this decade, the Canadian government felt it appropriate to have a Department of Communications, a ministry that worked jointly with the Department of Finance on several major policy papers shaping financial sector legislation.[1]

These pre-internet innovations resulted in a massive migration away from paper to electronic recordkeeping. The evolution in governance that these innovations spurred in Canada included the creation of a federal department of communications as well as new legislation (Canadian Payments Act, 1980), which established the Canadian Payments Association. The Canadian Payments Association (now Payments Canada) was assigned two legislated objectives, namely, to "establish and operate a national clearing and settlements system and...plan the evolution of the national payments system." While the Ministry of Finance retained oversight responsibilities for Payments Canada, the Bank of Canada was granted oversight responsibilities for the Large Value Transfer System (LVTS) and the Automated Clearing Settlement System (ACSS), which handle the bulk of retail and wholesale payments in Canada. The LVTS, in turn, changed the manner in which the Bank of Canada implemented monetary policy.[2]

Which emerging technologies today are likely to have a material impact on the future of commercial and central banking? The big invention, in my view, was Bitcoin: a radically new form of money and payments system introduced to the world in 2009. In a public lecture I delivered on March 31, 2014, I described Bitcoin as "a stroke of genius" and outlined the threat the innovation posed for central and private banks.[3] Regulators, including central banks, will have to think hard about how to deal with the risks these new structures are likely to present.

1. Dingle, James F. "Planning an Evolution: The Story of the Canadian Payments Association 1980-2002," Joint Publication of the Bank of Canada and the Canadian Payments Association, 2003.

2. See https://www.bankofcanada.ca/core-functions/monetary-policy/lynx/implementing-monetary-policy/.

3. Bitcoin and Beyond: Dialogue with the Fed, March 31, 2014; https://www.stlouisfed.org/dialogue-with-the-fed/the-possibilities-and-the-pitfalls-of-virtual-currencies/videos/part-1-introduction-and-welcoming-remarks.

2. DECENTRALIZED AUTONOMOUS ORGANIZATIONS

A decentralized autonomous organization (DAO) is an organization governed autonomously by a set of rules encoded in an open-source computer program. It is decentralized in the sense that there is no central authority—that is, no concentration of power—involved in any of its operations. People are free to participate in the organization anonymously if they wish. Participation may take the form of consumers availing themselves of the services provided by the DAO or in the form of a employee contributing to a collective effort needed to fuel the enterprise. Fees and compensation take the form of a tradeable native token that serves as a money instrument.

As far as I know, Bitcoin is the world's first DAO. There is no CEO of Bitcoin. There are no Bitcoin headquarters. There are no conventional Bitcoin employees. It exists as open-source computer code distributed across thousands of computers around the world. Its database, consisting of a ledger of money accounts—the so-called *blockchain*—is visible to the public. Its monetary policy, its protocol for clearing and settling payments, and its manner of compensating its voluntary workforce—the so-called *miners*—are all written in (virtually) unalterable open-source computer code.

An important property of a DAO is that it cannot be regulated in a direct manner by anyone, including any government authority. A DAO is basically a robot that anyone with access to the internet is free to use and help operate. Because a DAO exists simultaneously on potentially millions of computers located around the world, it is virtually impossible to shut down. Only indirect regulation is possible, for example, by placing restrictions on how identifiable individuals or registered businesses are legally permitted to interact with a DAO.

The implication of this property is that, in addition to any inherent benefits, DAOs are in a position to generate value for their community through regulatory arbitrage. Regulatory arbitrage is not new, of course. But whereas regulators in days gone by were in a position to identify and discipline transgressors, similar actions may no longer possible with a DAO. In those circumstances where a DAO poses a systemic risk, an alternative strategy is needed. This alternative strategy may entail having the government offer a competing product that diminishes the value of a potentially problematic DAO to its potential users. Of course, this strategy can be employed as a complement to indirect regulation designed to discourage the demand for the product, assuming that doing so is in the public interest.

While DAOs have potential uses in a wide variety of traditional economic activities, for the purpose of this article I will focus on their application as money and payment systems. It is important to keep in mind two things. First, DAOs come in a variety of flavors; and second, we are still in the early days of development. Much of what I have to say, therefore, is necessarily speculative in nature. But central bankers and regulators need to be prepared for all important future contingencies, even if some these events are unlikely to unfold.

3. FLOATING EXCHANGE RATE DAOs

DAOs related to money and payments can be divided into two broad categories—namely, fixed and floating exchange rate regimes. Bitcoin is a floating exchange rate regime because the value of its native token (BTC) is determined entirely by market demand (the supply of the token is essentially fixed).

Central bankers and regulators have a long history of dealing with currency competition. In some countries, the domestic demand for foreign currency is sufficiently strong to elicit a variety of currency controls designed to boost demand for the local product. In some jurisdictions, locals may even be prohibited from opening foreign bank accounts. Such restrictions are evidently binding. Americans traveling to foreign countries are familiar with how locals are often very eager to acquire US dollars (USDs).

3.1 Limits to Seigniorage

Foreign currency controls permit local governments to extract more seigniorage revenue than they might otherwise be able to collect. And, indeed, it is no surprise to see that inflation rates are often very high in lesser-developed economies. There is no need to take a stand here on whether high levels of seigniorage are a good or bad thing; the answer depends on how inflation tax revenue is employed. The point is that less seigniorage revenue will generally be available if locals can easily substitute into a competing currency. Might Bitcoin prove to be an important form of currency competition for some sovereigns? There is some evidence suggesting at least the potential for this to happen. A report issued by the United Nations Conference on Trade and Development, for example, found that 10.3% of citizens in Venezuela held cryptocurrencies in 2021.[4]

In countries with extreme currency controls, foreign currency might circulate in the underground economy and only in physical form. Locals would not have access to digital forms of money, like online bank deposits. Bitcoin, however, is a digital bearer instrument that can be used by anyone with access to the internet. Moreover, Bitcoin is permissionless, in the same way paper currency is. That is, no permission is needed to hold or spend the object. Enforcing currency controls over a permissionless digital bearer instrument might prove exceedingly costly. The only recourse a sovereign may have is to alter its monetary and fiscal policies in a manner that lowers the domestic inflation rate to a level that makes Bitcoin less attractive as a monetary instrument. It would also be advisable to upgrade the domestic payment system to further the same end. Alternatively, a government may be willing to give up on seigniorage and promote cryptocurrencies as a way to overcome inefficient or incomplete domestic payment systems. El Salvador, for example, has gone so far to declare Bitcoin legal tender.

3.2 Maturity Transformation

While Bitcoin is unlikely to displace a major world currency any time soon, it may conceivably play a prominent role in certain niche markets. I am reminded of the role the USD plays in some countries. An issue that arises in those jurisdictions is the creation of USD-denominated bank deposit liabilities by foreign-based banks. Might domestic banks (or, more likely, shadow banks) be similarly inclined to issue BTC-denominated loans or finance their assets with deposit liabilities demandable in bitcoin? How should regulators respond to such an activity? How can a central bank act as a lender-of-last resort when, in a crisis, people are wanting their BTC bank deposits and not the local currency? What role, if any, might the fiscal authority play in these circumstances? Lender-of-last resort interventions are not limited to central banks, after all.

The issue of USD-denominated debt in many countries is problematic enough. For better or worse, the practice has been supported by a set of relatively new policies introduced by the Federal Reserve. In response to the mounting pressures in bank funding markets in December 2007, the Fed established dollar swap lines with the European Central Bank and the Swiss National Bank. These swap lines effectively provide foreign banks that depend on dollar funding to manage liquidity crisis events. The number of countries with access to these swap lines has only grown over time. Second, the Fed introduced the Foreign and International Monetary Authorities (FIMA) repo facility at the onset of the COVID-19 crisis in March 2020. The FIMA essentially makes it more attractive for foreign financial firms to hold US Treasury securities, which they can now easily repo for needed dollar funding.

It seems difficult to imagine similar liquidity support programs managed by governments to support intermediaries that rely on BTC funding. For this reason, it seems prudent for domestic authorities to discourage the practice if it were ever to become too popular. On the other hand, given the extreme

4. See https://unctad.org/system/.les/official-document/presspb2022d8_en.pdf.

volatility of the bitcoin-dollar exchange rate, it seems unlikely that such a business model might even attract depositors in the first place. However unlikely it may be, regulators should nevertheless be prepared.

3.3 Bitcoin as a Safe Asset

In March 2016, I asked whether Bitcoin might be the next safe asset.[5] A safe asset is not a risk-free asset. Rather, it is a "flight to safety" asset. According to Yale economist Gary Gorton, a safe asset is "an asset that can be used to transact without fear of adverse selection; that is, there are no concerns that the counterparty privately knows more about the value of the asset."[6] Economists refer to assets with this property as "informationally insensitive."

The US dollar and US Treasury securities are classic "flight to safety" assets because they are informationally insensitive. But the same is potentially true of DAO securities like Bitcoin because the protocols creating and managing token supply are perfectly transparent. There is no asymmetric information. Safe assets often yield a very low return in normal times and extraordinarily high returns in low-frequency events like a financial crisis. In the case of the US dollar, a flight to safety imparts disinflationary forces, since the demand for money rises. In the case of US Treasury securities, flight to safety puts downward pressure on bond yields. Both of these forces make room for looser monetary and fiscal policies.

A question worth pondering is what might happen if one day DAO securities like Bitcoin are very much larger in terms of market capitalization and if they are viewed by investors as safe assets? An added attraction of DAOs is that their policies operate independently of forces that may cause fiscal strains for governments. A flight-to-safety event in this case may cause a large shift in wealth portfolios away from government securities into crypto assets. Such an event is likely to be inflationary and to put upward pressure on bond yields. These forces would greatly hinder the normal countercyclical response expected from monetary and fiscal authorities in a recession.

4. FIXED EXCHANGE RATE DAOs

Fixed exchange rate DAOs attempt to peg the value of their currency relative to the price of some other asset. These "stablecoins" come in a variety of flavors. The most popular stablecoins peg their value relative to the US dollar. Variations may peg relative to other dominant currencies, such as the euro or even gold.

Stablecoins also vary in how they back their liabilities. The most prominent stablecoins hold conventional securities, like US Treasury securities and commercial paper, as assets. This latter class of stablecoins resembles money market funds or uninsured banks. Another class of stablecoins back their liabilities with cryptoassets. Stablecoins differ from conventional structures in terms of their front-end services (e.g., permissionless access and use) and in their back-end protocols (e.g., their use of blockchain database management systems).

To a macroeconomist, stablecoins look very much like unilateral fixed exchange rate regimes, or currency boards, or money market funds, or uninsured banks. As such, they are prone to all the usual ills that often afflict these structures—namely, speculative attacks or bank runs that turn out to be self-fulfilling prophecies. What are the implications, if any, for central banks and regulators? Not surprisingly, the answer is likely to depend on several details.

To begin, many popular stablecoins do not organize themselves as pure DAOs. For example, USDC stablecoin is issued and managed by an incorporated company that submits itself to the relevant

5. See http://andolfatto.blogspot.com/2016/03/is-bitcoin-safe-asset.html.

6. Gorton, Gary. "The History and Economics of Safe Assets." *Annual Review of Economics*, 2017; https://www.annualreviews.org/doi/10.1146/annurev-economics-033017-125810.

regulatory authorities. These types of stablecoins are money funds by another name and can be regulated accordingly. They are no more problematic than regular money funds.

Other quasi-DAO stablecoins are potentially more problematic. Tether, for example, is incorporated in the British Virgin Islands and does not submit itself to US regulators. At the same time, Tether allegedly holds a substantial quantity of US commercial paper and US Treasury securities as part of its assets backing its liabilities (which are pegged to the USD). As of this writing, Tether is now the largest stablecoin by market capitalization, being valued at almost $80 billion.

The problem for regulators is not what Tether looks like now, but rather what Tether or Tether-like structures may look like in the near future. At the moment, Tether is used primarily to facilitate crypto asset exchanges. But the structure (or some similar structure) might conceivably operate as an unregulated global money fund payment system. The question is, what happens if such a structure grows by an order of magnitude or more and begins to be used extensively by businesses in the global supply chain to make payments among themselves? And then what happens when the inevitable run occurs and stablecoin is compelled to dispose of its commercial paper assets in a fire sale? Will the Fed stand ready to act as a lender of last resort? Should the Fed open a currency swap line with systemically important stablecoins? Should such entities be granted access to the FIMA facility? This is a troublesome issue and I am not sure what the answers should be.

Finally, there is a class of stablecoins organized as DAOs. The stablecoin DAI, for example, pegs a senior tranche of its liabilities to the USD, leaving a large junior tranche to absorb fluctuations in the underlying collateral, which takes the form of ETH, the second-most-popular cryptocurrency after Bitcoin.

Unlike the money fund model, a stablecoin backed with crypto assets is not as likely to be a source of systemic risk because a fire sale of, say, ETH, is not the same thing as a fire sale of, say, commercial paper. This is to say that the interlinkages between a stablecoin like DAI and conventional securities markets are not as direct as they are with conventional money funds. Nevertheless, interlinkages are possible, for example, if firms begin to use DAI extensively as collateral to support lines of credit. While regulations may in principle limit the extent to which registered businesses interact with a DAO stablecoin, in practice this could prove very difficult since it would require the coordination of regulatory agencies around the world. Moreover, as mentioned above, it is impossible to regulate a DAO directly. If stablecoins like DAI were to one day become large and sufficiently interconnected to constitute a systemic financial risk, there may be very little that regulators could do about it.

5. PROACTIVE STRATEGIES

As new technologies appear on the scene, entrants stand to profit in one of two ways. First, they may benefit from bona fide cost advantages made available by a better technology. While new technologies are often available to incumbents as well, entrants are typically able to exploit advantages more effectively and more rapidly. This is fair game—competition is generally encouraged in market-based economies. Second, they may benefit from lower costs that emanate not from an inherently superior technology, but rather by using the technology to circumvent existing regulations that constrain incumbents. In other words, new technologies may instead provide opportunities for regulatory arbitrage.

Regulatory arbitrage is not necessarily undesirable. It may very well be the case that new technologies imply the need for a new or revised regulatory framework. For example, if smart contracts are demonstrably able to make bank runs less likely, lower capital buffers may be in order. If this is the case, then the privilege should be extended to incumbents as well as entrants. On the other hand, it may be that the existing regulatory framework is judged to be adequate and that the purported benefits of a new technology stem entirely from regulatory arbitrage. The implication in this case is that the social cost of DAO-based money and payment systems exceed their private costs and that existing regulations

should be applied to the new entities. But what to do if these new entities are difficult, or even impossible, to regulate?

If direct regulation is not practical, there are other steps governments might take to mitigate the potential systemic risk of DAO-based money and payment systems. While some of what is driving DAO-based money and payment systems is regulatory arbitrage, I also believe the products are poised to satisfy a market place want. To the extent that this is the case, then rather than preempting risk through regulation, why not preempt it by providing—or paving the way for—a competing product?

The product I am envisioning is unlikely to compete on every relevant dimension. For example, a big attraction of DAO-based money and payment systems is permissionless access and use. While such a property is perfectly feasible using existing technology, it may not be desirable because of KYC and AML requirements.[7] But people do value a fast, secure, and cheap way to move money both domestically and internationally. This is a service that is easily within the grasp of existing technology. The issue is more one of coordination across multiple jurisdictions.

The idea here is not necessarily to eliminate DAO-based money and payment systems. They will continue to serve the needs of their constituents; and, in any case, it is probably not feasible to abolish them completely. This should not, in my view, be considered alarming. Coexistence is possible and desirable. The idea is to offer a product that can successfully compete for business that would otherwise be drawn to DAOs. The goal is to make sure that no DAO-based money and payments system becomes sufficiently large to be considered a systemic financial risk to the global economy.

5.1 Central Bank Digital Currencies

A central bank digital currency (CBDC) is basically an online checking account at a central bank. In the United States, these accounts are presently made available to depository institutions, the federal government, and a select number of other domestic and foreign agencies. In a sense, we already have a CBDC. The question is whether to expand the set of agencies who are granted access to central bank checking accounts. In the limit, one could imagine CBDC to be made available to all US persons (as is the case with online accounts with the US Treasury) or, indeed, to everyone in the world (as is the case with central bank liabilities in the form of paper bills).

The desirability of direct central bank involvement in clearing and settling payments for CBDC would likely depend on whether it is to be made available widely at the retail level or more exclusively at the wholesale level. Central banks already have experience at the wholesale level, so extending the privilege to a larger, but limited, set of reputable fintechs should not be problematic. But because government agencies are not built to service a large and demanding retail sector, daily payment operations should, in my view, be delegated to qualified private sector intermediaries.

Two versions of CBDC have been proposed. A "synthetic" CBDC is essentially a program where money accounts are offered through qualified narrow banks holding assets consisting only of reserves and possibly short-term Treasury bills. This is basically the wholesale CBDC I described above. An "intermediated" CBDC would permit the general public to have access to central bank checking accounts, but with private intermediaries handling customer service. A difference between these two versions is that depositors have direct claims against the central bank in the latter case but only indirect claims in the former. I do not consider this an important difference as long as fintechs operate as narrow banks.

5.2 Monetary Unions

From the perspective of facilitating payments in a monetary union, the value of a CBDC relative to what is presently in place is likely to depend on individual country characteristics. In Europe, for example,

7. "KYC" is know your customer, and "AML" is anti money laundering.

the Single European Payments Area (SEPA) appears to function sufficiently well for retail users. The same might be said of M-Pesa in Sub-Saharan Africa and of We-Chat and AliPay in China. Note that these latter three payment systems were private sector initiatives that now provide efficient payment services to literally billions of people.

While the United States continues to lag many other jurisdictions in terms of the cost, speed, and efficiency of making retail payments, the situation is improving rapidly. Americans now have 24/7 real-time payments services available via The Clearing House, a consortium of some of the world's largest banks. The Federal Reserve will soon offer a similar service for all US banks through FedNow. While a CBDC for these countries is not essential for facilitating retail payments, arguments can be made in their support.

A neglected aspect of CBDC is how it is likely to impact the shadow bank sector. Money market funds and repo arrangements are used extensively by corporate treasuries to manage cash flow. Because deposit insurance covers only small-value accounts, parking large amounts of cash in banks is not perfectly safe. Even if the cash is safe, access to it may be delayed if a bank becomes financially distressed, defeating the purpose of cash-on-demand. Repo arrangements with safe assets serving as collateral are particularly attractive in this regard because, if a deposit is not repaid, the corporate cash manager can seize and dispose of the collateral. Collateral in the form of a $50 million US Treasury bill is like a fully insured interest-bearing bank account.

Suppose that a CBDC is available and that it offers an attractive deposit rate (say, consistent with prevailing money market rates). Here, we have a product that offers fully insured (or fully reserve-backed) interest-bearing money accounts that offer 24/7 real-time payment services. It seems to me that corporate cash managers are likely to find such a product attractive. Such a product is likely to disintermediate government money funds repo arrangements that make use of Treasury security collateral. Some business may migrate to money funds that offer higher deposit rates supported by riskier assets, but current US regulations require such funds to price their units at net asset value (NAV), making them less desirable as a cash management tool.

The idea I want to stress here is that a well-designed CBDC is likely to disintermediate segments of the wholesale banking sector in a currency union like the United States or the European Monetary Union. Might the same principle be used to disintermediate potential private suppliers of global money and payments systems?

5.3 International Payments

From the perspective of a Martian looking in on the Earth's global payment system, things must seem a frightful mess. And yet, as always, we should keep matters in perspective. In particular, the situation was much worse fifty years ago. Travelers from North America to Europe, for example, would have to resort to cash or travelers checks. Today, one can hop on a plane, credit card in hand, and not give any thought to how one is to pay for things. Of course, there are still gaping holes in terms of access and interoperability of payment systems. And while the price of international money transfers remains high, competition does appear to be bringing these prices down. The question is whether a better-designed international payment system exploiting the most current technologies might broaden access and bring costs and prices down even further.

I am confident that the global payments system will continue to make advancements and that progress along this dimension will be sufficient to discourage the emergence and use of global stablecoins for retail use. I am somewhat less confident that the same will hold true at the wholesale level. The most popular stablecoin, Tether, requires a minimum deposit of $100,000, for example. While Tether is presently being used mainly to facilitate exchange of crypto assets, its USD peg may conceivably make it attractive for large corporate users.

Multinational corporations may very well avail themselves of the services provided by a global stablecoin for the same reason national corporate cash managers are attracted to the domestic shadow bank sector. Not only may large deposits be perceived to be safer, they may also be linked to highly efficient payment rails. If a sufficient number of multinational firms and their affiliates are connected via a global stablecoin, payments across firms along a global supply chain can be made without ever passing through a bank.

What sort of product might discourage a global stablecoin from growing to the point where it presents an ungovernable systemic financial risk to the global economy? Some sort of global CBDC seems to be in order. One could imagine, for example, the IMF setting up a payment rail and offering its special drawing rights (SDRs) as a global currency for multinational corporations. Something similar might instead be offered via the Bureau for International Settlements.

Alternatively, perhaps all that is needed is a set of CBDCs issued by a few of the world's largest common currency areas. Given the role of the USD as the world's reserve currency, a widely accessible wholesale CBDC issued by the US Federal Reserve seems like a natural candidate.

6. CONCLUSIONS

Central banks and regulators are accustomed to dealing with the repercussions of technological change. My discussion focused on money and payment systems, but there is also much happening in credit markets. The traditional local area expertise of bank credit officers is increasingly becoming less important given how artificial intelligence can be used to assess debtor characteristics anywhere in the country or even the globe. A number of interesting issues relating to data privacy and data ownership are also on the table.

In this article I considered how a new technology in payments—a DAO-based money and payment system—may one day grow to pose a systemic financial risk for the global economy. While my analysis has been speculative, I believe policymakers need to monitor these new technologies and consider their risk, even if the risk is perceived ex ante to be low.

As things stand today, I see the systemic risk of DAO-based money and payment systems at the retail level of less importance than at the wholesale level. Given the role of the US dollar as the world's reserve currency, a widely accessible wholesale CBDC issued by the US Federal Reserve is something I think should be considered with some urgency. The design and possible unintended consequences of such an arrangement need to be considered carefully. In addition to possibly crowding out global stablecoins, it may also crowd out money market funds and Eurodollar deposits. And if the arrangement is ultimately deemed to be socially desirable, the implementation must be thought through and managed carefully.