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SHORT COMMUNICATION

Discussion on: "Programmable money: next generation blockchain-based conditional payments" by Ingo Weber and Mark Staples

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Abstract

My comment on Weber and Staples (Digit Financ, https://doi.org/10.1007/s42521-022-00064-8, 2022) elaborates an economic perspective of their "programmable money" proposal. While claims issued and tendered for goods and services resemble money, a number of issues must be resolved before this innovation is feasible as money in analog trade or digital finance. These include secondary tradability, permissioned access, standardization and transparency. Programmable money is an important step towards the implementation of contingent commodities in the sense of Arrow and Debreu (Econometrica, 22(3):265–290, 1954) and Debreu (1959).

Keywords Cryptocurrency valuation · Programmable money · Permissioned ledger · Conditional payments · Arrow-Debreu commodities · Jevons' functions of money

JEL Classification E42 · G12 · D83

This paper does a splendid job of explaining how a permissioned distributed ledger (DL) system works on the ground, and I congratulate the authors for this deep dive into details of a practical public policy application. They present convincing evidence that DL applications are suitable for public policy and, possibly, for execution of digitally driven decentralized finance (DeFi) tasks. In their implementation, a major industrial economy uses DL technology to implement targeted social policy. In the midst of the current correction of cryptocurrency values, it is worth focusing on the real (as opposed to hyped) value of digital assets, and in particular of cryptocurrencies and DeFi linked to the Ethereum platform. The comments that follow

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should be considered "friendly fire" in support of multidisciplinary investigation of the nooks and crannies of this important innovation.

What are we talking about: programmable money or programmable contracts? From an economics perspective, Weber and Staples demonstrate how DL can implement what Arrow and Debreu (1954) and Debreu (1959) called "state contingent contracts"—exchange involving delivery of goods and services in particular places, points in time, and states of the world—i.e., under certain well-specified conditions. Arrow and Debreu argued that in a world of complete markets, goods and services—as well as further options to execute conditional transactions in the future—translate into a set of executable commands specifying when, where, under which circumstances goods would be deliverable and consumable. In theory, these state-contingent goods could be purchased in bundles allowing households and firms to construct linear combinations of the commodity space and tailor purchases precisely—e.g., buying an umbrella to be delivered where I am standing but only if it is raining or snowing, or purchasing an insurance policy that restores my house to its original state after a fire has destroyed it, but not if the fire was caused by me or an "act of God".

Kenneth Arrow and Gérard Debreu, awarded the Nobel Prizes in Economics in 1972 and 1983, respectively, identified mathematical conditions for existence and uniqueness of equilibria in such economies and elaborated their efficiency properties. In the intervening seven decades, their contributions were often criticized or even belittled as impractical academic fantasy. The mechanism of programmable money described by Weber and Staples is not only feasible from a technological perspective, but it is also convenient and even efficient. The notion of smart or programmable money, however, is less central to their achievement than conditional delivery of product transacted—as the authors correctly argue --attaching the instructions immutably to the means of payment—money—is the key innovation that makes this possible.

Yet, for that very reason, the conditional payments system described by Weber and Staples is not money in the strictest sense. Money is a fungible means of holding wealth for future use that is readily accepted by others as a means of payment. Following Jevons (1875), a money's features include a medium of exchange, a unit of account or measure of value, store of value, means of deferred payment. It is noteworthy that the last of Jevons' "big four" is rarely mentioned in textbooks (but by Wikipedia!); interpreted expansively, it includes contingent payments. Jevons himself described conditional payments and deferred convertibility when referring to the use of bills of trade, contingent debt of the US Confederate States or the bonds issued by the notorious William "Filibuster" Walker in Honduras. Obviously, "deferred payments" Jevons wrote about were a far cry from the complexity of the technological wave that Weber and Staples are describing—but it is not a stretch to imagine that Jevons, like Wicksell after him, understood the potential complexity of financial dealings and the economic importance of contingent payments. Wicksell stressed the necessity of a centralized ledger to keep track of debits and credits. DL is a quantum leap towards solving this problem.

The programmable money contracts discussed here are not liquid or tradable, are not used as a widely accepted means of payment, or as a store of value. They fall

short of what we tend to consider money. The world of privately supplied cryptos and DF has yet to solve the problem of cleanly separating Jevon's monetary functions. Yet I want to be optimistic, and the rest of my remarks center on conditions that may be individually necessary or sufficient to truly implement conditional money in the world of digital finance.

Necessary conditions for widespread adoption of programmable money permissioned versus tradability: naturally, digital finance is an umbrella concept that includes exotic derivatives, automated transactions, and dynamic portfolio allocation using digital assets. The ability to trade contracts is an essential characteristic. High dimensionality of attributes, however, makes it likely that a single issuer of customized contracts would emerge, and would reap monopoly profits—as do Amazon, Google, Netflix or similar providers. An open trading system is essential for competitive valuation, just as in markets for Bitcoin, Ethereum, and other digital assets. Trading smart money contracts would reveal the social or public value of "tied" money, or more precisely, the services that they can purchase.

What are the barriers to making them tradable on the blockchain? One is that the system is permissioned, that is to say, closed to outsiders. At the moment, the government distributes conditional claims on social services to households that are exchangeable vis-à-vis vendors for conventional, unconditional means of payment. If the contracts can be delegated, they could even trade at a discount—in the event that, say, the wheelchair is not needed. This would be the first step. Market-based valuation of programmable money is a question of economics. Yet NTS contracts cannot be traded, just as trafficking "food stamps" (SNAP) in the US is illegal. It will be difficult to prohibit trade in these contracts, and as with SNAP, it may be worth allowing some conversion into cash if the benefit is not needed. At the same time, "permissioning" too many outsiders may lead to excessive market fluctuations, requiring a market maker to stabilize or set the price. Here, much more research is needed.

Transparency and scalability: in the quadrillion-dollar world of financial derivatives, over-the-counter (OTC) contracts continue to dominate, despite their exposure to significant counterparty risk. Standardization cannot be enforced in a DeFi world, but transparency would assist the purchaser to recognize the fine print involved, or even to connect to a clearinghouse organization, making use of these contracts more like a visit to a dentist than a rocket launch. The value-added of Weber/Staples system seems to be the end-user interface—being able to conduct business using a smart phone. The complexity of contracts need not spill over to conditions of use. As the authors make clear, complex aspects need not be flashed to the user immediately but could be consulted upon request. This notwithstanding, I am concerned that DeFi applications might still be difficult to put on a smartphone. The scalability of this system may be superior to cryptos because unlike truly decentralized consensus-based systems in which the number of nodes is linear in the number of users, this permissioned system can be run on a much smaller number of nodes. Might it not be possible to have this form of "representative democracy" as an alternative to the radical Swiss type?

Inserting external information into the blockchain: how the oracles function is not clear in the Australian NTS application. For a reader of this journal who is only

familiar with digital assets, the main puzzle remains: how does information enter the blockchain in a credible, trustworthy and immutable way? Recall that the ledger of the Australian NTS is still run and validated by a relatively low set of nodes—the central authority or several different authorities at different junctures—but not by the community as a whole. "Proof of Authority" means a closed, permissioned blockchain system with a very small number of validators. But this is not the application fantasized about by digital finance aficionados, and much less than what people expect in permissionless digital finance. While I would call it this "representative democracy" others might consider it a centralized authority. When is the set of permissible policies defined, and can it change? Exactly how the validation of real-world processes occur remains unclear for me, however, just as is the incorporation of credible and unalterable external information (by way of an oracle). This would be a central issue for a DeFi application.

Separation of Jevon's functions: when I first read the paper, I began to fantasize about how money is used and how Weber and Staple's programmable version could be implemented in everyday life. One of the reasons cryptocurrencies have failed seems to be that that different functions of money interfere with each other. For example, the ability to hoard money when yields are low raise its value above and beyond facilitating transactions, possibly affecting the real economy via the willingness to invest and consume real goods. On the other hand, speculation-driven volatility of crypto values impedes the attractiveness of its use in transactions, especially involving consumption goods. Increasing the cost of using coins as a store of value would be easy to design and enforce. I have suggested elsewhere (Burda, 2021) that adding an algorithmic Tobin tax, as opposed to a mining or broker's fee, could solve one of these problems. A one-off percentage fee for transactions collected by the network would encourage longer term asset holding. In a similar vein, demurrage money (negative interest on ownership in excess of some minimal period) could attenuate the store of value function and, if applied to central bank digital currencies (CBDC), open up new avenues for monetary policy.

How much of the Weber-Staples experiment is applicable to crypto, DeFi or even CBDC supplied by a central bank? The notion of money in different colors is an old one, but advances have increased its technological feasibility. The use of the blockchain generates an increase in credibility and a reduction of uncertainty and fraud in the payment system without a central administrator. Their application should remove some of the fear of an "oligarchy" of nodes that could abuse or manipulate the blockchain. Rather than a Swiss democracy in which all vote, a small group of nodes could certainly manage decentralized validation—and use less energy. Most importantly, Weber and Staples show that attaching means of payment to conditional contracts is a viable vehicle for implementing social, economic and environmental policy.

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