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ETERNAL COINS? CONTROL AND REGULATION OF ALTERNATIVE DIGITAL CURRENCIES[1]

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ABSTRACT

The rise and scams of cryptocurrencies have attracted much public, academic, and economic attention. While most cryptocurrencies have already failed, less attention has been given to the long-term regulation of those that might be successful, all of which purport to be "eternal" stores of value or mediums of exchange. Now is a good time to review this experience and draw lessons for regulators, investors, and promoters interested in better management of risk around alternative currencies, and cryptocurrencies in particular. This paper concludes that conventional risk control concerns are relevant even when a technology is novel. The typical choice of blockchain technology with proof-of-work all but guarantees that efficiency concerns are material, and that the purely digital nature of cryptocurrencies offers opportunities for regulators to insist on comparison of outcomes with simulation modeling as one basis for regulatory control.

1. FUNDRAISING SCAMS

1.1 The issue

The problem, particularly from 2017, was people asking for money to develop the next big thing in cryptocurrencies, then either doing nothing of the kind or doing it incompetently. Exactly why so many people have put so much money into these projects and continue to speculate on cryptocurrencies is not fully understood.

Schemes were promoted energetically, often to people with little understanding of investment or the systems involved, with a thin veneer of respectability provided by websites, endorsements, language that sounded like real finance (e.g., "initial coin offering"), and seemingly-responsible disclaimers. This prompted the SEC to produce a website promoting a fake cryptocurrency project; if you clicked to buy in you were taken to an educational site to teach you to be more skeptical.

Purchasing a cryptocurrency, or investing in an initial coin offering (ICO), is very different to investing in a typical company's shares. Company investment is typically promoted as worthwhile because the company does something useful and should add some value somewhere, with the resulting profit being distributed. Even with the most famous and widely distributed cryptocurrency, bitcoin, the overall situation is that no new value has been created. Miners of the currency have gained economic benefit (or dropped out), hence most likely 'investors', on average, have lost or will lose the wealth that has gone to miners. Two groups that have almost certainly gained are electricity companies and computer hardware manufacturers selling to miners.

Worse than that, most cryptocurrencies launched have already failed. Dowson (2018) estimated that over 60 percent of all initial coin offerings failed to deliver a working cryptocurrency. Benedetti and Leonard (2018) "estimate that the survival rate for startups after 120 days (from the end of the ICO) is only 44.2 percent, assuming that all firms inactive on Twitter in the fifth month did not survive," i.e., 56 percent fail. The jury is still out on those that survive. A study by Satis Group [Dowlat (2018)] claimed that only 15 percent of initial coin offerings in 2017 led to coins trading on an exchange. Instead, 78 percent

[1] Parts of this research were funded by the Cardano Foundation

were scams, about 4 percent failed, and the remaining 3 percent had “gone dead”. Of those that did lead to coins trading on an exchange, a significant proportion quickly became dormant or nearly so.

1.1 Potential solutions

One approach to reform is to promote a voluntary code of conduct for promoters of new alternative currencies, with the idea that they can gain credibility and encourage wise investment if they can show that they are following the code sincerely and effectively.

The London Token Fundraising Manifesto [many signatories (2017)] is a good example of such a code and could be developed further with more detail and perhaps also an independent review process, an international standard, and a “kitemark” scheme with appropriate accreditation, certification, and periodic audits. Mainelli and Mills (2016) set out how to manage blockchain risks through standards and voluntary standards markets, concluding that standards would be particularly beneficial in the areas of taxonomies and performance, data governance and liability, and commercial governance and liability.

However, codes of conduct are unlikely to be sufficient for long-term, “eternal” coin projects. In fact, it is difficult to point to long-term fiat currencies. Of reserve currencies, the Swiss franc only dates to 1850, the U.S. dollar to 1972, but a structured U.S. dollar to the formation of the Federal Reserve in 1913. Arguably, the oldest extant currency in economic use is the British pound, circa 1694. If one takes cryptocurrencies to be “digital gold”, then longevity comparisons can certainly be extended, perhaps back to the sixth century BCE. Longevity is a rare commodity. Long-term systemic management is rarer. Much further thought needs to be given to consumer and economic management of cryptocurrencies, rather than just “legal or illegal”. Such long-term management needs to be appropriate, consistent, enforceable, and paid for.

2. INSUFFICIENT ATTENTION TO CONTROL IN PROJECTS

2.1 The issue

In addition to fraud, a contributing factor to failed cryptocurrency development and launch projects will have been insufficient attention to control of the projects and to designing control into the systems to be developed. This relates to all types of risk.

Typically, attention has been paid to the security issues of greatest interest to cryptocurrency developers (e.g., the details of their protection against Sybil attacks and other attempts at double spending), and to solving governance issues using voting mechanisms enforced by the systems. These issues are often addressed in their “white papers”.

Unfortunately, this leaves out a long list of more prosaic concerns covering control during the development and launch project, and control built into the system that is to be created. These include software development practices, computer operations, version control, testing and other quality assurance tactics, progress reporting, documentation, financial control, compliance with laws on sales practices and cryptocurrencies, funding, fraud by social engineering and simple methods like stealing private keys, and control of the currency’s supply and value. The extent to which these conventional risk concerns are still relevant to blockchain systems is explored in Mainelli and Leitch (2017), which examines blockchain from an audit perspective.

2.2 Potential solutions

Groups aiming to develop and launch an alternative currency need to have a positive and responsible attitude to managing risk, the skills and experience to do it well, and some kind of framework to help them organize their thinking and activities. Another project under the Long Finance research program has been to develop control frameworks for these purposes [Leitch and Matanovic (2018)].

3. FORESEEABLE TECHNICAL INEFFICIENCY

3.1 The issue

The leading group of current cryptocurrencies have two design features that virtually guarantee that they will not be cost effective compared to established payment systems. Firstly, they have multiple copies of their blockchain-based database – thousands of them in some cases. This means that the basic work of storing the database is duplicated thousands of times rather than the several times that would be necessary for a secure record. They also required all transactions to be communicated to all nodes, hence there is a communication overhead too. As scale increases (in the sense of having more blockchain copies), these systems become less efficient, rather than more efficient as one might expect. Secondly, the existence of each node is confirmed by doing intensive calculations that are duplicated over all the participants and have no other use. This "proof-of-work" technique compounds the massive duplication problem.

These two problems make these systems inefficient, and this inefficiency was obvious and predictable from the start. They could never have hoped to compete on a sustained basis as electronic payment systems with established services like Visa and Mastercard.

A number of attempts have been made to quantify the resource inefficiency of bitcoin. One of these comes from Mark Carney and the Bank of England. According to Carney (2018), the electricity consumption of bitcoin alone is roughly twice that of Scotland, with a population of over 5 million people. In comparison, the global Visa credit card network uses less than 0.5 percent of this while processing 9,000 times more transactions. (This translates into bitcoin needing at least 1,800,000 times more electricity per transaction than Visa card payments.) Carney further states that the full cost per transaction to retailers of cash is 1.5 pence, cards is 8 pence, and online payments is 19 pence. In comparison, bitcoin's charge for faster processing was £2 at the time but had been as high as £40. The processing speed is vastly better with Visa, which also offers further benefits.

In summary, bitcoin is far more costly than Visa and its established competitors, despite providing a service that is inferior in several ways. If Visa provided a "no frills" service as basic as bitcoin's then it could offer something even cheaper than the service it offers now. Consequently, for an alternative currency to offer a new service that is competitive over a sustained period it requires an inherently efficient design.

3.2 Potential solutions

What can be done to reduce the risk of such mistakes with future alternative currencies? The simplest regulatory response to this might be to decide that new or proposed systems based on massive duplication of computing effort and on proof-of-work cannot be competitive and probably are being proposed as a scam.

Objections might be that the security could be used to solve some problems that override efficiency, so a simple ban might not be acceptable. Another approach would be to require that some calculations be done and perhaps also published if funds are to be raised.

Since these efficiency issues were obvious from the beginning, some straightforward calculations should be enough to compare the future efficiency of new systems with that of conventional designs. The main comparison should be of computer power used, but an expanded comparison might include any human element needed, provided the comparison equates the services provided.

If the efficiency of a system is dependent on scale or on the behavior of users, for example, the calculations should be repeated to cover a wide range of potential future situations.

4. FORESEEABLE ECONOMIC PROBLEMS

4.1 The issue

The volatile exchange rates seen with most cryptocurrencies over the past few years are another predictable problem that needed to be taken more seriously earlier on. A highly volatile exchange rate means that the currency cannot be used as money. Prices of goods will not stay fixed. Money cannot be used as a store of value – only a speculative gamble.

These problems were predictable because they are the result of well-known economic principles and because, by the beginning of 2015, the price history of bitcoin already showed huge volatility.

Economic control of alternative currencies is a complicated but vital area. Typically, cryptocurrencies have had a scheme for creating new coins that creates them over time, but not in a way that is fully responsive to the extent to which the currency is being used. If the cryptocoins are used more widely for more transactions then either the supply of the cryptocoins must be increased or the prices of goods, when stated in cryptocurrency, must fall as the value of the cryptocoins rises.

Beyond this, the technical inefficiency of bitcoin and similar systems was a strong clue that they would not be successful as payment systems and, if they survived at all, would just be traded speculatively. In this role, there would be almost nothing to stabilize their value and reason for holders to welcome large value changes.

4.2 Potential solutions

To investigate these problems, we carried out a project to scope and design a simulation system capable of testing control mechanisms for alternative currencies. Early observations from a prototype were reported in Mainelli et al. (2018), and illustrative tests of control mechanisms were reported in Mainelli et al. (2019), still using the prototype. The overall program of work also involved:

- An analysis of control needs for cryptocurrencies
- A workshop and survey to explore interest in particular features for an interactive simulator
- Detailed design and description of an interactive simulation system to test control mechanisms for alternative currencies.

The simulator is described in Leitch (2019), in the form of a detailed user guide with technical details including calculations. This describes an interactive, agent-based simulation system with many options for specifying a proposed alternative currency and its environment, then simulating it in stages with human intervention if desired.

All the agents in a simulation make decisions. Modeling those decisions is one of the most complex and important aspects of simulation. The decision rules that agents can use in the specified simulator have been designed with some helpful principles in mind.

- **Agents are diverse and error prone:** the way agents "think" is not the same for all agents and they have differing priorities and circumstances. Consequently, even if they appear to be facing the same decision about the alternative currency they are usually not. In most cases, this is modeled by having the decision process control the probability of each alternative being chosen in a decision, but the final choice is randomized. In addition, agents sometimes have explicitly different philosophies and sometimes make mistakes randomly. Most alternative currency users are not professional currency traders using mathematical models and automated trading, so the simulation reflects reality.
- **Agent characteristics are controllable:** the mix of agents with different characteristics can usually be changed in the simulator as can some important characteristics of those agent types.
- **Collective behavior is broadly rational despite individual lapses:** this is a typical property of human thinking, but especially when people have different sources of evidence. The agents are partly rational and partly consistent, confronted with a theory of the world that is too complex and unquantified for them to deal with.

> "*If the alternative currency cannot be safely simulated, perhaps it is not safe for customers.*"

- **Not blatantly stupid:** although individuals may occasionally make blatantly stupid decisions, the collective tendency should be to avoid behavior that is clearly irrational. For example, opting in as a customer when no goods can be bought with the alternative currency, or when the exchange rate is chaotic, is illogical and few, if any, agents should do it in a simulation. (But it might still be logical for a speculator.)
- **Limited intelligence:** where a decision analyst should, in theory, go into detailed and sophisticated modeling but this is not what nearly everyone does, the simulator will sometimes avoid the detail and just choose a number randomly from a sensible range. This again reflects real thinking, which is bounded and inconsistent.
- **Consistent techniques:** where a decision is similar to another taken in the same or a different role then the mechanism of the decision is also similar.
- **Simplicity:** where there is no strong reason for choosing something more complex, the system uses the simplest mathematical approach available. For example, uniform distributions and simple multiplicative or additive models to combine variables. It has been assumed that causes do not interact unless it is clear that they do.
- **Real world variables:** wherever possible, variables have a real world meaning rather than being arbitrary coefficients. For example, a dimensionless index of publicity is not as good as a variable representing combined publicity in a way that might be measured in the real world, e.g., "number of positive messages received per day on average per person."
- **Real world calibration:** where practical, variables have been chosen so that real world data are available to compare with the simulation's numbers. The main limitation on this is that often real-world numbers are not available. For example, the number of people using bitcoin is unknown.

- **Imaginable calibration situations:** for some simulation settings, it is necessary for users to choose a value based on experience and judgement. To make this easier, there will sometimes be suggested defaults and users will usually be asked for a value of something that can be imagined and judged, rather than a seemingly meaningless parameter within a complex mathematical function. In some cases, what users choose is then converted into a parameter within a complex mathematical function.

From this effort, our observations are as follows:

- An agent-based simulation is probably the most suitable. A dynamical model using differential equations is not realistic enough and does not capture the rough and tumble of real alternative currencies.
- A wide range of features of the currency, its users, and related environment events need to be simulated.
- The progress of the currency cannot be reliably predicted, but the effect of control mechanisms may still be relatively predictable.
- The aim should be to test control mechanisms, not predict the future evolution of the currency in detail before it is launched.
- The complexity needed is quite high. Establishing if a currency can be controlled effectively is more difficult than establishing if it is competitively efficient.

Since the effort needed to simulate and test control schemes for an alternative currency is significant, it may be something that developers of alternative currencies with big ambitions need to be required to do by regulators, and it may be a further requirement to provide a simulator for regulators to use. A regulatory performance criterion might be conformance of the alternative currency with simulator predictions. If the alternative currency cannot be safely simulated, perhaps it is not safe for consumers.

5. CONCLUSION

A number of lessons can be learned for regulation and control of alternative currencies from recent experiences with cryptocurrencies.

Firstly, it is clear that conventional risk control concerns are relevant even when the technology is novel and expert attention has been paid to some aspects of security and governance. The honesty of people raising money is always a concern and attention needs to be paid to all areas of risk and all types of control.

Secondly, the typical choice of blockchain technology with proof-of-work all but guarantees that a cryptocurrency will not be a competitive payment system. Predictable efficiency problems like this need to be avoided and requiring some simple engineering calculations early on is an obvious precaution. There are alternative technologies in test, one such example being Mattereum's experimentation of linking the ChainZy high-speed smart ledger with Ethereum's payment platform. If a cryptocurrency can achieve conventional payment system characteristics, arguably, this might leave bitcoin itself as the only survivor of the first wave of cryptocurrencies.

Finally, to make an alternative currency work as a currency requires a much more thoughtful approach to economic control. Testing control mechanisms using agent-based simulation is one way this might be done, but the simulation work is quite difficult and regulatory pressure or facilitation would probably be required to get promoters and developers to do this adequately. The purely digital nature of cryptocurrencies offers opportunities for regulators to insist on comparison of outcomes with simulation modeling as one basis for regulatory control.

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