Developing a Cryptocurrency Assessment Framework: Function over Form: Open Review

Andrew Burnie,*† James Burnie,‡ Andrew Henderson§

Reviewers: Reviewer A, Reviewer B, Reviewer C

Abstract. The final version of the paper "Developing a Cryptocurrency Assessment Framework: Function over Form" can be found in Ledger Vol. 3 (2018) 24-47, DOI 10.5915/LEDGER.2018.121. There were three reviewers involved in the review process, none of whom have requested to waive their anonymity at present, and are thus listed as A, B, and C. After initial review by Reviewers A and B (1A), it was determined that the submission required revisions. The authors responded to their feedback and revised the manuscript (1B). Reviewer A accepted the revisions, but Reviewer B was unavailable to review the revisions, and so a third reviewer, Reviewer C, was asked to review the revised manuscript (2A). The authors responded and made subsequent revisions in line with Reviewer C's feedback (2B) and the changes were accepted, thus completing the peer-review process. Authors' responses are bulleted for clarity.

1A. Review (Initial)

Reviewer A:

This paper presents an interesting new approach to classify cryptocurrencies based on the underlying characteristics of their tokens. The methodology seems legit and a classification of tokens worthwhile. However, some assumptions rely heavily on an unreviewed research paper (Hileman, 2013). Maybe these can be backed up with more established research.

While the category 'crypto-solution' can be seen as a mixture of 'other' blockchain applications, the distinction between 'crypto-transaction' and 'crypto-fuel' is somewhat

---

†A. Burnie (aburnie@turing.ac.uk) is a UCL Computer Science Doctoral Student at The Alan Turing Institute.
‡J. Burnie (JamesBurnie@eversheds-sutherland.com) is an associate lawyer at Eversheds Sutherland (International) LLP.
§A. Henderson (AndrewHenderson@eversheds-sutherland.com) is a partner at Eversheds Sutherland (International) LLP.
* 388AXJewhDiFLvgRqtZFPphFVAPe6UannX

fuzzy; in fact, the authors mentioned that. In these unclear cases further classification would be desirable and resorting to classic categories of types of blockchain might be helpful.

The actual process of the classification remains rather unmentioned. I can be convinced of the correct classification, but scientific research requires more than superficial observations. For example, it can be argued that most of the questions depicted in Figure 1 can be answered in the affirmative for Ethereum and/or applications building on its framework. This shows that these questions are not sufficient for classifying Ethereum as 'crypto-fuel', although it probably is correct.

In my opinion, sections 4 and 5 do not necessarily fit the rest of the paper. They present rather generic information around cryptocurrencies that are both well known to readers and are also not conclusively summarized. Are the costs of producing paper notes really among the most important aspects? These two sections could be omitted entirely. Instead, some further analyses as suggested in the conclusion could be integrated.

There are some minor typos, the paper could benefit from proofreading (e.g., page 2, underl[y]ing). Table 1 should be moved to the end of section 3 as the groups are not yet established. The paper is otherwise well written and very pleasant to read. When the aforementioned issues are resolved, I recommend the paper for publication.

Reviewer B:

The paper covers a timely and important issue, the classification of cryptocurrencies. As the authors note, this is a subject of importance to many cryptocurrency stakeholders, and particularly regulators who are seeking to understand how current regulations may apply to these new instruments or whether new regulations are needed.

My recommendation is for the paper be significantly revised and resubmitted for a second review. Revisions should address the following issues:

There are some issues with the proposed framework. For example, as the authors acknowledge on p.7, the lines between what is a crypto-transaction (e.g., bitcoin) and crypto-fuel (e.g., ether) cryptocurrency are fuzzy and overlap. Many ether holders are using it as a store of value and for the same types of payments as bitcoin. Bitcoin can be used as 'fuel' for timestamping or storage purposes. This speaks to the point that even though the developers of a cryptocurrency may intend for it to be used in a certain way, the market often has other ideas. While the authors flag this issues, they make not attempt to reconcile this problem. As a result, I lack confidence in the accuracy of their classification choices. Is there any empirical use data the authors can use to support their classification decisions? Should some cryptocurrencies, such as ether, be classified as 'hybrids'?

Recently the term 'cryptoasset' has received growing use, including in speeches by official such as Bank of England Governor, Mark Carney. The rising use of the term cryptoasset reflects the growth in use of cryptocurrencies like bitcoin and ether as investments. Indeed, there are estimates that as much as 90% of the use of cryptocurrencies is for investment purposes. However, this use is largely absent from the proposed framework and paper, other than a brief and unfocussed discussion of volatility (p. 9). I view the lack of attention to this issue in the paper as perhaps the paper's biggest shortcoming at present.

There are also some missing elements in the proposed definitions. For example, for a crypto-transaction cryptocurrency the authors state "Their value is not derived from some underlying asset, but rather from a network of users. Usually, this value is further supported by fixing the total amount of tokens that will ever be created." While true, this statement is incomplete. Missing here is any comment about the functionality or intrinsic utility of these cryptocurrencies (e.g., bitcoin has eight decimal places, which makes micro payments theoretically possible (albeit not practically given current transaction fees).

For crypto-fuel cryptocurrencies, the authors state "The blockchain platform often49–54 has *smart contract* functionality". Here I presume they mean native smart contract functionality, but I have questions about how they are defining the term 'smart contract'. Many crypto-transaction coins also support some form of smart contracts (e.g., bitcoin) both natively as well as through overlay networks/protocols.

I find the term 'crypto-solution' confusing and I would encourage the authors to consider a different term. Transaction and fuel tokens are also attempting to provide a 'solution' to a problem. The authors seem to be mixing asset-backed tokens (e.g., Tether) with utility tokens for reasons that are not clear. Also, per the terms of service, my understanding is that Tether holders do not in fact have any legal rights to paper currencies (p. 6, footnote 57).

The purpose and contribution of Section 4 (pp. 8-9) to the paper is unclear. The authors need to make more clear the purpose of this section and how it contributes to the paper's research question.

Finally, the authors declare confidently "There is currently a cryptocurrency bubble". Defining and recognizing a bubble is notoriously difficult, particularly during the bubble itself. The evidence or framework the authors rely on to make this declaration is absent. The also proclaim that "cryptocurrencies that serve a real purpose will dominate the market", but which market? The cryptocurrency sector or the broader market of currencies and assets?

1B. Authors' Response

Reviewer A:
This paper presents an interesting new approach to classify cryptocurrencies based on the underlying characteristics of their tokens. The methodology seems legit and a classification of tokens worthwhile. However, some assumptions rely heavily on an unreviewed research paper (Hileman, 2013). Maybe these can be backed up with more established research.

- Hileman (2013) is not being used as the basis upon which critical assumptions are being made. It is used in two places.
- First, to help define the scope of the paper (beginning of Section 2, *Scope*) we restrict our scope to blockchain supported cryptocurrencies, and cite both Hileman (2013) and PwC in support of this. It is important to differentiate cryptocurrencies from other forms of digital money, such as e-money.
- Secondly, Hileman (2013) provides an example of how one can use the economic functions of money as a way of trying to understand to what extent cryptocurrencies are a 'better form of money'. This approach is also used by Mark Carney, who has been referenced to further underpin the legitimacy and validity of this approach.
- Please note that in the revised paper, each citation of Hileman (2013) has been backed up by more established research.

While the category 'crypto-solution' can be seen as a mixture of 'other' blockchain applications, the distinction between 'crypto-transaction' and 'crypto-fuel' is somewhat fuzzy; in fact, the authors mentioned that. In these unclear cases further classification would be desirable and resorting to classic categories of types of blockchain might be helpful.

- Crypto-solution is not a mixture of 'other' blockchain applications. The name of this group in the revised paper has been changed to 'crypto-voucher' to make this clearer. Unlike crypto-transaction and crypto-fuel tokens, crypto-voucher tokens 'carry the right to a predefined asset' (please see Section 3, *Classification*).
- 'Classic categories of types of blockchain' presumably refers to public, private or hybrid, in which case such a classification is difficult to apply given that the scope in this paper is limited to publicly available cryptocurrencies (see Section 2, *Scope*).
- We do not acknowledge that the distinction between a crypto-transaction and crypto-fuel cryptocurrency is 'somewhat fuzzy'. Although the Omni Layer was developed specifically to give Bitcoin (in the crypto-transaction group) crypto-fuel functionality, the parent cryptocurrency Bitcoin remains in the crypto-transaction group because the primary function for the Bitcoin token continues to be in transacting value. Market forces have sometimes used Ethereum to purchase goods and services from merchants, although, in practice, this is very difficult (https://themerkle.com/what-is-myethershop/). The Ethereum whitepaper continues to describe ether a 'crypto-fuel'

(https://github.com/ethereum/wiki). This has been explained in further detail in the clarified section entitled '*Hybridisation*' (section 3, last para).

The actual process of the classification remains rather unmentioned. I can be convinced of the correct classification, but scientific research requires more than superficial observations. For example, it can be argued that most of the questions depicted in Figure 1 can be answered in the affirmative for Ethereum and/or applications building on its framework. This shows that these questions are not sufficient for classifying Ethereum as 'crypto-fuel', although it probably is correct.

- The actual process of classification is described in Section 2 (the Methodology), with further details included in the revised paper.
- The criteria upon which the classification was based are given in the Methodology (Section 2), under the heading '*Criteria—Applied to each cryptocurrency*'. These criteria were applied to each of the financially significant cryptocurrencies using information 'sourced from whitepapers, official websites and third-party commentary'.
- The questions raised in Figure 1 were not used to create the classification. To make this clearer, in the revised paper, Figure 1 is incorporated in Section 4 and no longer included as part of Section 3 (Results).
- In the Ethereum whitepaper (https://github.com/ethereum/wiki), ether is described as a 'crypto-fuel'. The reviewer agrees with this designation as a crypto-fuel. In terms of Figure 1, ether does not carry the right to a predefined asset, and it is not designed primarily for transacting value in an electronic cash system.

In my opinion, sections 4 and 5 do not necessarily fit the rest of the paper. They present rather generic information around cryptocurrencies that are both well known to readers and are also not conclusively summarized. Are the costs of producing paper notes really among the most important aspects? These two sections could be omitted entirely. Instead, some further analyses as suggested in the conclusion could be integrated.

- Sections 4 and 5 have been substantially revised to clarify the purpose of these sections in the context of the rest of the paper.
- Specifically, Section 4 shows how the classification produced in Section 3, using the methodology described in Section 2, can then be applied to identify the fundamentals of cryptocurrencies. It demonstrates the role of the classification system in providing an assessment framework for cryptocurrencies which can be used by potential investors and stakeholders.
- Section 5 is provided as a warning to investors that speculation may obfuscate the impact of fundamentals on cryptocurrency pricing.
- Regarding the cost of paper notes, The Federal Reserve is forecast to spend USD 726.6 billion on new paper notes in 2017, about 85% of which replaces deteriorated paper

notes (see Section 4, *Determining a "better" form of money…*As a long-term store of value).

There are some minor typos, the paper could benefit from proofreading (e.g., page 2, underl[y]ing). Table 1 should be moved to the end of section 3 as the groups are not yet established. The paper is otherwise well written and very pleasant to read. When the aforementioned issues are resolved, I recommend the paper for publication.

- Thank you for spotting the typo on page 2, we are sorry and have again proofread the document to remove any further typos.
- The allocation of the cryptocurrencies between the three different groups is given in Table 1 (Section 3, Results).
- To clarify the point that the groupings in Table 1 were the result of the methods applied in Section 2, we have left this table of groupings in the results section 3 along with a description of each of the three groups.
- To make it clear that Figure 1 is not the driver of this classification system, but the result of applying the classification system as an assessment framework for identifying the fundamentals of cryptocurrencies, we have put Figure 1 and the associated questions in a separate section, Section 4.

Reviewer B:

There are some issues with the proposed framework. For example, as the authors acknowledge on p.7, the lines between what is a crypto-transaction (e.g., bitcoin) and crypto-fuel (e.g., ether) cryptocurrency are fuzzy and overlap. Many ether holders are using it as a store of value and for the same types of payments as bitcoin. Bitcoin can be used as 'fuel' for timestamping or storage purposes. This speaks to the point that even though the developers of a cryptocurrency may intend for it to be used in a certain way, the market often has other ideas. While the authors flag this issues, they make not attempt to reconcile this problem. As a result, I lack confidence in the accuracy of their classification choices. Is there any empirical use data the authors can use to support their classification decisions? Should some cryptocurrencies, such as ether, be classified as 'hybrids'?

- All the most financially significant cryptocurrencies can act as a store of value, and so this is not in itself discriminatory (please see response to question 2, below).
- The paper does not acknowledge that the lines between a crypto-transaction and crypto-fuel cryptocurrency are 'fuzzy and overlap'. It does make the point that, over time, function can change and has given specific examples of this in the section entitled '*Hybridisation*' (Section 3, last para). Here we explain that the Omni Layer was developed specifically to give Bitcoin (in the crypto-transaction group) crypto-fuel functionality. The parent cryptocurrency Bitcoin remains in the crypto-transaction

group because the primary function for the Bitcoin token continues to be in transacting value. Market forces have sometimes used Ethereum to purchase goods and services from merchants, although, in practice, this is very difficult (https://themerkle.com/what-is-myethershop/). The Ethereum whitepaper continues to describe ether a 'crypto-fuel' (https://github.com/ethereum/wiki). Therefore, we do not see this as a problem with the classification.

- Empirical use data on cryptocurrencies is unavailable probably because of the privacy that cryptocurrencies grant their users. The Internal Revenue Service had to win a court order against Coinbase in order to identify the users who conducted annual transactions worth more than USD 20,000 between 2013-15.

Recently the term 'cryptoasset' has received growing use, including in speeches by official such as Bank of England Governor, Mark Carney. The rising use of the term cryptoasset reflects the growth in use of cryptocurrencies like bitcoin and ether as investments. Indeed, there are estimates that as much as 90% of the use of cryptocurrencies is for investment purposes. However, this use is largely absent from the proposed framework and paper, other than a brief and unfocussed discussion of volatility (p. 9). I view the lack of attention to this issue in the paper as perhaps the paper's biggest shortcoming at present.

- We agree that much of the use of cryptocurrencies is for 'investment purposes'. This applies to all the most financially significant cryptocurrencies, as listed in Table 1 Section 3, and means that this function cannot be used as a basis for distinguishing between them. Reference to the term 'cryptoasset' is an umbrella term included in speeches by Mark Carney to distinguish cryptocurrencies from fiat currencies and e-monies, and not part of a mechanism for their classification.
- Please see link to a speech by Mark Carney: https://www.bankofengland.co.uk/-/media/boe/files/speech/2018/the-future-of-money-speech-by-mark-carney.pdf?la=en&hash=A51E1C8E90BDD3D071A8D6B4F8C1566E7AC91418
- The paper discusses in depth both how investors might use our classification as an assessment framework for cryptocurrencies to identify fundamentals in Section 4, and the limitations to this approach in Section 5. Section 5 warns that despite being able to articulate fundamentals, the effect of first positive (2017) and then negative speculation (beginning 2018) is pronounced and this has led many high-profile investors such as Warren Buffett and Jamie Dimon to avoid investing in cryptocurrencies. Section 5 also refers to Appendix A where Figures 2-6 chart the variation in different cryptocurrencies' prices over time.

There are also some missing elements in the proposed definitions. For example, for a crypto-transaction cryptocurrency the authors state "Their value is not derived from some underlying asset, but rather from a network of users. Usually, this value is further supported by fixing the total amount of tokens that will ever be created." While true, this statement is incomplete. Missing here is any comment about the functionality or intrinsic utility of these

cryptocurrencies (e.g., bitcoin has eight decimal places, which makes micro payments theoretically possible (albeit not practically given current transaction fees).

- The function of the token is the basis of this new classification system and therefore the functionality of the cryptocurrencies is discussed in detail, in Section 3.
- The intrinsic utility of the three different types of cryptocurrencies is discussed in Section 4 (including Figure 1). Section 4 also compares the intrinsic utility of crypto-transaction cryptocurrencies (such as Bitcoin) with the economic functions of money and specifically addresses how they could potentially be used for micropayments, under *Determining a "better" form of money……*As a unit of account: "*A paper currency cannot measure value in fractions of a coin, whereas a digital currency is infinitely divisible, suggesting cryptocurrencies could be particularly valuable for micropayments.*"

For crypto-fuel cryptocurrencies, the authors state "The blockchain platform often49–54 has smart contract functionality". Here I presume they mean native smart contract functionality, but I have questions about how they are defining the term 'smart contract'. Many crypto-transaction coins also support some form of smart contracts (e.g., bitcoin) both natively as well as through overlay networks/protocols.

- Smart contracts have been defined (using the Ethereum whitepaper) in Section 3 of the paper under *Crypto-fuel* second para, as enabling 'the creation of accounts that behave in a pre-programmed, rule-based way in response to changes in the network, and so forms the basis of decentralised applications'. Smart contracts facilitate the development of applications, hence why many crypto-fuel systems have such technology intrinsic to their design.
- The whitepapers and websites of the crypto-transaction tokens that we examined did not reveal systems with smart contract technology embedded in the original design of the system. We accept that, over time, crypto-transaction systems may develop smart contract functionality by virtue of overlay protocols (discussed under '*Hybridisation*', i.e. the last para of Section 3).
- We have stated that crypto-fuel systems 'often' have smart contract technology, not that it is a requirement (*Crypto-fuel* second para). The requirement is that crypto-fuel systems 'intend to enable developers to create blockchain-supported applications' (*Crypto-fuel* first para).

I find the term 'crypto-solution' confusing and I would encourage the authors to consider a different term. Transaction and fuel tokens are also attempting to provide a 'solution' to a problem. The authors seem to be mixing asset-backed tokens (e.g., Tether) with utility tokens for reasons that are not clear. Also, per the terms of service, my understanding is that Tether holders do not in fact have any legal rights to paper currencies (p. 6, footnote 57).

- We understand that the term 'crypto-solution' can be confusing because both crypto-transaction and crypto-fuel tokens are attempting to provide a solution to a problem. Therefore, to avoid confusion, we have replaced the term 'crypto-solution' with 'crypto-voucher', since a voucher is something that can be 'exchanged for goods or services' (Oxford English Dictionary). Crypto-voucher tokens carry the right to a predefined asset and so have a functionality similar to a voucher.
- This is a new classification system which does not seek to describe tokens as 'asset-backed' or as 'utility' tokens, as the distinction between these terms is unclear and jurisdiction-specific.
- Tether was defined as a crypto-voucher due to the following quote from the whitepaper (p. 4):*"Tethers may be redeemable/exchangeable for the underlying fiat currency pursuant to Tether Limited's terms of service or, if the holder prefers, the equivalent spot value in Bitcoin."* The below links to Tether's whitepaper for convenience: https://tether.to/wp-content/uploads/2016/06/TetherWhitePaper.pdf

The purpose and contribution of Section 4 (pp. 8-9) to the paper is unclear. The authors need to make more clear the purpose of this section and how it contributes to the paper's research question.

- Section 4 has been substantially revised to meet these concerns and now incorporates Figure 1.
- Section 4 shows how the classification system can be applied to create an assessment framework for identifying the fundamentals of cryptocurrencies, which can then be used by potential investors and stakeholders.

Finally, the authors declare confidently "There is currently a cryptocurrency bubble". Defining and recognizing a bubble is notoriously difficult, particularly during the bubble itself. The evidence or framework the authors rely on to make this declaration is absent. The also proclaim that "cryptocurrencies that serve a real purpose will dominate the market", but which market? The cryptocurrency sector or the broader market of currencies and assets?

- Please see Sections 5 and 6, and Appendix A; these have been revised to reflect the downturn in cryptocurrency prices that occurred in early 2018. We have removed references to there currently being a cryptocurrency bubble.
- As regards which 'market', the paper was referring to the cryptocurrency sector, and this has been clarified in the revised conclusion.

2A. Review (Second Round)

Reviewer A:
I have now reviewed the new manuscript. The authors have addressed most of my concerns, I now recommend the paper for publication.

* Sections 4 and 5 have been significantly revised and now provide additional value
* The confusing term 'crypto-solution' has been replaced by the more descriptive 'crypto-voucher'
* Assumptions have been backed with established research
* The structure has been modified to clarify the methodology

Reviewer B:
N/A

Reviewer C:

Distinguishing cryptocurrencies based on their relative functions is an insightful means of analysis. That said, the previous reviewers are of the opinion that the distinction between the "crypto-fuel" and "crypto-transaction" categories include substantial overlap not adequately addressed by the revised paper or the responses to the reviewers.

The simplest way to deal with this would be to clearly state within the paper itself that (a) the two categories do involve a degree of overlap, (b) that categorization based on them requires a value judgement derived from what the sorter believes is the current "primary" function of the cryptocurrency in question (with a definition of how you would define "primary" in this context), and then (c) to state that others may come to a different conclusion based on a different judgement of the primary function of a given cryptocurrency.

Alternatively, a full-throated defense of the two categories being separate could be mounted, but this would need to be included in the text of the paper and at the very least need to address that major cryptocurrencies such as Ether, Bitcoin, and Bitcoin Cash were both designed with and continue to have multiple concurrent uses—for example the OP codes which were baked into the original Bitcoin design and which have been reactivated in Bitcoin Cash, which makes it both spendable and designed with smart contracts in mind. This would not be impossible, but again it would likely depend on an explicit explanation within the paper of how a given cryptocurrency's "primary" function is determined.

2B. Authors' Response (Second Round)

Reviewer C:

- We have incorporated your suggestions into the paper (please see section "Overlap", bottom of page 6 and page 7), and made a minor amendment to the abstract to reflect this. Please let us know if we can help further.