Relational Money

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"The quality of money consists exclusively in its quantity." (Georg Simmel, 1900)

ABSTRACT
This paper asks whether cryptocurrency technologies could be designed to make money more ecologically and socially regenerative. Currently, if rolled out as a global, comprehensive, peer-to-peer blockchain system, the stupendous energy requirements appear to make this an unaffordable option. Nonetheless, if implemented as a network of local currencies this could be helpful in several ways. Money is alienating because it reduces all contextual values and qualities down to numerical units. Our habitual focus on numbers and nouns hides from us the fact that relations are always more abundant, and valuable, than things-in-themselves. Whereas living systems survive by managing interdependent and opportunistic relations in concert with a diversity of other entities, the mathematics behind money is granular, inert and summative. This probably reflects the fact that humans have mined, shaped and collected physical objects for millions of years, therefore feel comfortable in exchanging individual tokens, or units. Indeed, it was the pessimistic logic of mining that inspired the 'law of diminishing returns', and which justifies the current obsession with economic 'growth' at all costs. Electronic peer-to-peer ledger exchange is a welcome option, partly because it might enable money to record more of the contextual relations that are intrinsic to value. Designing money to be less 'granular' and more 'relational' would encourage a new economic order based on thriving, autonomous localities. Euler's Law (1751) offers a starting point for sharing unforeseen dividends with more recipients, using existing assets. It would also encourage a monetary prosperity based on creative re-combinations within a diversity-of-diversities.

Money Shaped The Anthropocene
Today, money appears to be growing under its own momentum. This is a troubling situation, given its similarity with the last global financial crash in 2007-8. What is even more troubling is that most economic critics appear to focus on the social, rather than upon the ecological implications of our predicament. Admittedly, some economists have long been trying to persuade their colleagues that economic orthodoxy is out-of-sync with the global ecosystem (e.g. Douthwaite, 1992; Stern, 2006). This appears to have had little effect, as mainstream economists continue to promote policies that are part of the problem, rather than the solution. Even the Bank of England continues to subsidise the carbon energy industries in a bid to reduce financial risk (Macquarie, 2018). This is myopic and counterproductive. Humanity has crossed at least three of nine 'planetary boundaries' (Rockström, 2015) and we have now entered the era of the Anthropocene. If Homo sapiens is to avoid the very worst scenarios we must switch from the search for environmental 'sustainability' (Brundtland, 1987) and create economic policies that deliver ecological 'regeneration' (Wahl, 2016). We need radical change, but new paradigms tend to remain unthinkable until people learn to think in the language of the next one. This is exemplified by the majority of politicians, economists and journalists who refrain from challenging the clamour for limitless 'economic growth'. This is unfortunate as, in ecological terms, the term 'growth' (e.g. GDP) makes no distinction between those monetary transactions that are benign and others that are self-destructive (Jackson, 2009; Keen, 2017).

The Trickle-Up Effect
At the global scale, the factory-to-landfill economics of 'frictionless' consumption and thoughtless disposal is having a catastrophic effect on the biosphere. However, one of the main drivers of consumption has been a rapid growth in the financial credit market. The principle behind it is not new. One of the first futures markets (e.g. Code of Hammurabi 1750 BC), established a legal basis for delivering assets at a future date. This acted as a catalyst to human endeavour, because it could encourage new transactions in times of severe pessimism or scarcity. The principle of using 'future' money as an attractor to social regeneration is also implied in Adam Smith's 'invisible hand' thesis

(1776). Smith argued that, by actively encouraging local self-interest, the wealth accrued would inevitably 'trickle down' to the needy. Today, however, it is important to ask why money is trickling upward, rather than downward (Bregman, 2017). It would seem that increasing one's wealth has become easier than re-distributing it to others. Mansa Musa (c.1280–1337) is estimated to have been the richest person in history. However, in contrast with most of today's super-rich he stands out because of his altruism and promotion of learning. Currently, the richest fifty individuals own around $1.9 trillion - a quarter of the value of all the coins & banknotes in the world. However, few, if any, of these individuals appear to provide essential products, or services. Their social contribution includes 'one-click shopping', the automation of production and delivery systems and algorithms that persuade more citizens to buy more non-essential products. Of course, many in the rich-list gained their money simply by manipulating money (e.g. the notion that the pound could be shorted for personal gain via Brexit).

The Laundering of Value

For the most part, money is still issued by private banks, some of whom behave as financial predators (Ryan-Collins, Greenham, Werner & Jackson, 2011). As the management of monetisation process is extended throughout the whole system, with some exceptions, the creative potential of individuals becomes increasingly discouraged and dissipated because the majority are employed as minions who serve the growth of capital. Although economists may have enjoyed a high level of trust (Rapley, 2017), few of the rest of us appear to understand how money works. For example, what does the legend on the banknote "I Promise to Pay The Bearer The Sum of Fifty Pounds" actually mean? If it behaves exactly as one might expect the sum of £50 to behave, where, exactly is "the sum" to which it refers? A recent poll (2017) showed that only 15% of MPs in the UK House of Commons were aware that new money is created when banks make loans (Baaquie, 2018). Politicians appear to be concerned about money laundering, yet its intrinsic inertness and forgetfulness makes it a perfect vehicle for erasing its spending history and context. Bizarrely, its semantic elusiveness acts as a powerful attractor to avarice and, thereby, economic growth. As Georg Simmel said, “regardless of the amount, the liveliness of attached hopes gives money a glow” (Simmel, 1900). In cognitive terms, although today's money has been reduced to a number in a digital database, humans love to visualise its infinite potential. Part of Simmel's analysis explains how the acquisition and fetishisation of money is, for many, an end in itself. This is not a hapless chance, but because of the way money was designed. As he noted, "the quality of money...consists exclusively in its quantity" (Simmel, 1900).

Synergy

All of the above arguments go some way to explain why the derivatives markets now dwarf all other monetary transaction. Currently, these transactions are too big to count as a reliable sum, but are estimated to run at somewhere between $544 trillion and $1.2 quadrillion. The top-heavy nature of capital is unlikely to improve while we continue to regard commodities (e.g. sacks of X, barrels of Y, or 'n' number of slaves), as discrete units. In the past, the circulation of commodity money was limited by the availability of the commodity itself, whether it consisted of salt, cattle, or gold. On the other hand, fiat money can be issued in virtually unlimited quantities. By regulating the quantity of money issued, central banks can retain some level of control over inflation levels. Today, however, many believe that money would be better generated at a local, grassroots level. Some of these pioneers are driven by altruistic visions of a more egalitarian, 'bottom-up' economy. However, others include a motley range of technocentrists, innovators and opportunists. Perhaps this would enable it to keep pace with the fluctuating fortunes of global ecological wellbeing being. Unfortunately, even at the relatively low levels of use, for example, Bitcoin is making huge energy demands. As its early adopters need to create their new 'coins' at the lowest prices, this is serving to prolong the extraction and burning of some of the dirtiest non-renewable fuels.

Replacing Monetary Profit With Relational Opportunity

Ultimately, cryptocurrencies appear to be emulating the granular nature of fiat money. Although they are novel, in many respects, they work in a similar way to fiat currencies. A more sophisticated approach for the design of cryptocurrencies would be to focus on the auditing of relations, rather than things, as the cultivation of difference is an abundant source of synergies. (Full discussion of synergy is beyond the scope of this paper. C.f. Corning, 2003; Wood, 2012). However, although deriving synergy from the combining of existing ones is likely to be greener and cheaper than extracting new materials from the ground, the quantifiability of money makes it easier to use. This explains why businesses still seem to prefer the explicit logic of numerical profits, rather than learn-

ing to explore the often ineffable abundances that pertain to synergy. Whereas money was designed, literally, to 'add up', synergies are virtually countless. They emerge in mysterious forms and, therefore, operate outside the predictive order of mathematics. This implies that, in a greener, lower energy future, our most precious assets would be local synergies, rather than single products and cash crops (Wood, 2012). If so, money would be designed to encourage the cultivation of a diversities-of-diversities (Wood, 2007; Chamorro-Premuzic, 2017). This, in turn, would enable communities to harvest an ultimate 'synergies-of-synergies' (c.f. Fuller, 1975).

Our Monkey Brains

Perhaps currency designers can learn something from monkeys. Whereas human societies continue to use fiscal instruments as a form of social governance, our elder cousins stick prefer more direct, one-to-one methods. This does not necessarily mean they are less intelligent as, apparently, our chimpanzee cousins are smart enough to use fiat money (Chen, Lakshminarayanan & Santos, 2006). Perhaps unsurprisingly, they make cognitive errors that resemble the ones we make, albeit with less damaging environmental consequences. Some researchers observing the mutual grooming habits of Bonobo monkeys have identified them as a kind of currency exchange (Schroepfer-Walker, Wobber & Hare, 2015). However, this reflects a rather anthropocentric standpoint. Whereas monetary transactions are profoundly indirect and abstract, grooming looks to be much richer and rewarding. It is an important social lubricant, replete with hidden social and ecological synergies. This is because humans developed it to help them scale up their organisations beyond their cognitive limits, in evolutionary terms. Realistically, to make Blockchain systems work best we should consider reducing the scale of communities in order to obviate the need for a numbers-based bureaucracy. This is necessitated by our level of development, in evolutionary terms. Whereas our chimpanzee ancestors live in groups of up to 30 or so, modern humans are capable of maintaining effective convivial relationships in larger group sizes. According to anthropological studies, human individuals can sustain convivial relations with up to around 150 people (Dunbar, 1992).

Exchanging Responsibility With Accountability

Ten thousand years ago, the success of agricultural food production methods enabled the first farming communities to expand their numbers beyond their social comfort zones, which led to cruder and less direct modes of discourse. As organisations grow beyond the Dunbar number, the need to add additional layers of managers introduces barriers to communication within, and across, them. In top-down systems, when actions are stripped of their context, value is dissipated (c.f. Ashby, 1956). Before long, top-down rules and standards eclipse the local dialects of willingness. In short the cultures of responsibility gave way to systems of accountability. Five thousand years ago the first fiat currencies (unit-based monies) enabled emperors to assemble armies of unprecedented size; then to maintain power by managing the flow of money. (Graeber, 2012). Thus, it has proved to be an extraordinarily effective instrument for managing wars and empires, as it enabled rulers to account for numerous transactions over large distances and timescales. This illustrates Simmel's description of money as “…the purest example of the tool” (Simmel, 1900). However, as the scale of monetary circulations exceed the Dunbar limits, the greater will be the chance that investments will become, in effect, 'foreign investments'. This is because, as the number of unknown agents grows, proportionately, the money in circulation will become more dissipative and prone to 'external' exploitation or manipulation.

Four-Fold Thinking

In evolutionary terms, the invention of money was a very recent event. This is why, as humans, we all find it hard to overcome our innate cognitive biases (e.g. Kahneman & Tversky, 2013). Research suggests, for example, that we all tend to confuse 'quality' (e.g. product efficacy and longevity) with 'quantity' (e.g. price). It is well known that humans become confused by large or, even, moderately sized numbers (Du Sautoy, 2009). Perhaps we are even less literate, in numerical terms, than most of us would like to believe. In 1956, George Miller popularised the notion that the average person can conceptualise only between 5 and 9 interdependent things at the same time. In 2001, Nelson Cowan tested this hypothesis but concluded that our brains 'chunk' information in fours. Gobbet and Clarkson (2004) challenged Cowan's findings with evidence that many of us have to chunk information in twos, rather than fours. This was corroborated by Klingberg (2009) who showed that we may give the illusion of 'multi-tasking' by switching backwards and forwards between two 'paired' sets of tasks. Practically speaking, however, this paper argues that 4 is a realistic starting point for innovators, even if it might be ambitious. It is interesting that Buckminster

Fuller anticipated these findings in 1949, when he suggested that the mind works in a tetrahedral (four-fold) way.

Distributed Ledgers
In England, from around 1100AD until the early 19th century, the majority of monetary transactions were recorded on tally sticks (see Fig. 1). These were hand-made ledgers fashioned out of hand-sized lengths of wood. The several parties would use them to carve notches as a record of the agreement. The number, size and angle of the notches denoted the requisite number of pounds, shillings and pence. Once completed, the stick would be split along its length to give two halves, each with an identical notch profile.

Fig. 1 - a tally stick

Tally sticks have been compared with what, in the digital era, we now call 'distributed ledgers'. Technocentrists have shown much excitement about the advent of a new golden age of 'smart' AI widgets that will save humans from the tribulations of being human. However, despite the apparent sophistication of our Post-Enlightenment species, Homo sapiens remains a somatic creature. Perhaps our 'four-fold' brains evolved to accommodate the tacit world of two arms and two legs. Whatever the explanation, it is good to consider our unique sensory nature when we design a better currency system. In this regard, Tally Sticks offer certain benefits when compared with digital peer-to-peer systems. Where most Blockchain systems use remote algorithms to create authentic identities, the making of a tally stick record was a co-creative act made more memorable because of its embodied nature. This also made faking difficult, partly because of the wood's unique grain characteristics and partly because any subsequent tampering of one half would have shown up as a mismatch with the other, once the two halves were were put back together.

Summative Reasoning
It is worth noting that the vast complexity and potential of natural systems does not conform to the received logic of things. This is because the mathematics of money and accountancy is fundamentally summative. Perhaps we think in such a granular way because Homo sapiens has been mining and shaping minerals from the ground for around 3 million years (Armelagos & Cohen, 1984). Many interpret Pythagoras's (570–495 BC) famous saying: "all things are number" as a belief that the world is, in essence, atomistic. Others read this as a reference to 'ratios', rather than to discrete integers. When inanimate things have to be shared out equally, ratios are a handy shorthand for apportioning them. Moreover, a mutual faith in numbers may help to build trust within a transaction. However, whereas, relations are multi-dimensional, ratios are one-dimensional entities. In monetary terms, for example, ‘unity’ can be regarded as a final sum of identical quantities (Simmel, 1900, p. 271). By contrast, the ‘unity’ maintained by living systems exists as an ongoing act of self-regulation that is qualitative (Maturana & Varela, 1992. p. 51).

Relational Thinking
There are several practical reasons why counting nouns became the basis for monetary thinking, rather than the evaluation of transactional relations. Unfortunately, the imperialistic grammar intrinsic to money was designed to standardise human relations. Using it can blind us to the more subtle opportunities and new values. We may forget, for example, that the 'things' we may find in a particular room will always be outnumbered by their interrelationships. Secondly, we may overlook the fact that relations cannot be represented adequately (c.f. Rayner, 2012) without mapping both their intrinsic component parts (c.f. Kvitash, 2003) and the relevant context (e.g. Sperber and Wilson, 1986) that helps to nourish and sustain them. By focusing exclusively on numbers, raw materials, or the ratios between them we are likely to invoke the 'Law of Decreasing Returns'. This is be-

cause, ultimately, value is generated only by managing complex relations. Most importantly, if we wish to benefit from the 'Law of Increasing Returns' (Arthur, 1996) it is vital to uphold an optimistic economy of team relations. This may mean relinquishing predictive certainty in favour of a more creative and combinatorial way of thinking. At least, it probably means losing count of the certainties, in the quest to harvest more opportunities. As the economist, Paul Romer said, "...possibilities do not add up. They multiply." (Romer, 1991).

Towards A Relational Mathematics

A relational approach to money challenges the additive logic and imperialist grammar taught in schools. However, as most of us still inhabit this paradigm, such a departure may seem heretical, even self-contradictory. Relations are certainly more plentiful than their component parts, but they are also more useful (i.e. valuable). Each relationship may conceal unforeseen synergies, so 'accounting' for them may mean learning to think in manifold relations. The dividends that accrue can be evidenced when a given sum exceeds the 100% of its original ingredient parts. Unfortunately, relations can seldom be defined by the boundaries between disciplines, or categories. In other words, synergies do not respect customary distinctions, say, between animate and inanimate things. Hence, we can no longer usefully separate human agencies from each other. Nor can we separate these relational entities from the 'things' they choose to exchange. When we analyse the mathematical ratios that pertain among team members and the number of relationships among them we find, for example, that:

In a team of 8, each team member is responsible for 25% of all relations
In a team of 4, each team member is responsible for 50% of all relations
In a team of 3, each team member is responsible for 66.6% of all relations
In a team of 2, each team member is responsible for 100% of all relations

Euler's Intrinsic Profit

In the simplest terms, a synergy may consist of two existing 'assets' that become combined to create a new, additional asset. The more ingredients we use, the more possible synergies we may find. For example, if we combine three assets we get the same number of synergies as the assets we started with. (i.e. 3 ingredients gives us 3 relations). By adding just one additional (fourth) asset we can get up to six synergies. Hence, a quartet is six times more synergistic, potentially, than a duet. Beyond combinations of three, the number of possible synergies will always deliver this numerical 'profit' of two. Euler (1707-83) explains this visually by referring to polygons. Here, the number of vertices denotes the number of existing 'things', or 'assets'. The number of lines that join them denotes the number of relations that may be seen as synergies.

Euler's Law (1751) states that:

V + F = E + 2

where -

V represents the number of vertices

F represents the number of faces

E represents the number of edges

This implies that we would benefit from moving from a granular, object-defined logic of money to one that seeks to map relations in clusters that are small enough for humans to grasp, cognitively (e.g. say, four or five). The following example (see Fig. 2) uses a tetrahedron as a standard figure for visualising six simultaneous relations. In practical terms, we are continuing to use this model as a template for revealing multiple synergies in which the 'intrinsic profits' are (meta)designed to serve up to six beneficiaries.

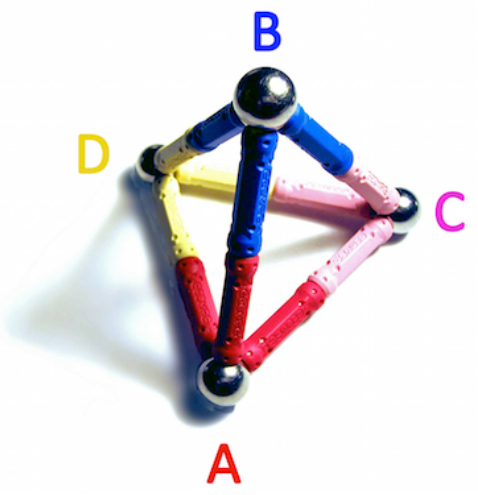

Fig. 2 - Sketch of a four-attribute Relational Currency Map

Where:
A - the donor
B - the recipient
C - the transactional purpose (e.g. covenanting future support as goods and/or services)
D - the circumstances of the transaction (immediate / local / global etc.)

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