

Blockchain: The New Intellectual Battleground Within Economics



Max Rangeley

Innovations in ledger systems have played a role in the development of mathematics and culture to a degree which remains undervalued even in academic economics circles. The development of ledger systems in Mesopotamia was instrumental in the advancement of early mathematics¹. In 1494, Luca Pacioli described double-entry bookkeeping; this was an important enzyme for the growth of the Italian banking dynasties of the Renaissance and beyond. Pacioli also taught mathematics to Leonardo da Vinci and understood that, like other areas of mathematics, accounting systems have a logic to them which has a certain aesthetic quality as well as the obvious functional aspects². During the seventeenth and eighteenth centuries, the maturation of stock markets and joint stock companies³ meant that ledgers now played a key role in allocating ownership of the entities themselves rather than just the underlying assets. What stock markets were to the eighteenth and nineteenth centuries—the first age of globalisation—blockchain technology has the potential to be to the current age of globalisation—the internet age. Writing in Harvard Business Review, Marco Iansiti and Karim R. Lakhani (2017) called blockchain a

¹For a more detailed analysis of Mesopotamian ledger systems, see Snell's (2007) *Ledgers and Prices: Early Mesopotamian Merchant Accounts* (Yale Near Eastern Researches).

²It was in the *Summa de arithmetica, geometria. Proportioni et proportionalita* (1494) that double entry bookkeeping was first outlined in print along with other areas of mathematics including algebraic theories of the time. Double-entry accounting also possibly developed independently in Korea in the Goryeo dynasty (918-1392) during a time when Kaesong was a regional trading centre.

³Although around the middle of the thirteenth century in Toulouse 96, shares of the Société des Moulins du Bazacle (Bazacle Milling Company) traded at a value derived from the profits of the mills the society owned, arguably making it the first company. This concept, however, did not proliferate at the time as it would later in the eighteenth century.

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“foundational” technology as opposed to, for instance, a “disruptive” technology since it has the potential to affect many different sectors of the economy. As they put it,

With blockchain, we can imagine a world in which contracts are embedded in digital code and stored in transparent, shared databases, where they are protected from deletion, tampering, and revision. In this world, every agreement, every process, every task, and every payment would have a digital record and signature that could be identified, validated, stored, and shared. Intermediaries like lawyers, brokers, and bankers might no longer be necessary. Individuals, organisations, machines, and algorithms would freely transact and interact with one another with little friction. This is the immense potential of blockchain.

The ledger system that currently forms the basis of our financial and monetary system was well summarised in a Bank of England paper on blockchain (Ali et al. 2014b, p. 263):

In modern payment systems, payments are made by reducing the balance in a customer’s account and increasing the balance in the recipient’s account by an equivalent amount—a process that has not changed since the sixteenth century. The difference lies in the technology employed to record the balances and transfer them between different banks. Technological developments over the past 50 years have affected payment systems in two key ways. First, the records and ledgers have been converted from paper to electronic form, which has increased the speed of completing transactions and reduced operational risks. Second, the emergence of low-cost technology has allowed new payment schemes to emerge, such as mobile money schemes.

Despite the application of new technology, the basic structure of centralised payment systems has remained unchanged. At the heart lies a central ledger, with settlement taking place across the books of a central authority, acting as a clearing bank (a service usually undertaken by the central bank of a given economy). Each participant, typically a commercial financial institution, holds a balance at the central bank, recorded in the ledger, but also reflected in the participant bank’s own (internal) ledger. Individual customers, branches, or even other (typically smaller) banks would then hold balances at the participant bank, which would again be reflected in their own ledger.

Such pyramidal ledger systems are increasingly impractical in a modern economy. A cheque written in America for a company in Britain, for instance, can take up to four weeks to clear. To put that into perspective, the SS *Royal William*, the first steamship to cross the Atlantic, did so in 1831 in only 25 days. Blockchain provides a ledger structure for the economy which challenges the nature of modern financial and trading systems at their most fundamental level. The internet as it exists today is good for exchanging information⁴; blockchain allows value to be exchanged with the same ease and without the timocratic elements of the current financial structure.

In his *Theory of the Origins of Money*, Menger (1892, p. 15) stated “The enigmatic phenomenon of money is even at this day without an explanation that satisfies; nor is there yet agreement on the most fundamental questions of its nature

⁴See Cerf et al. (2012) in “Brief History of the Internet” from the Internet Society.

and functions. Even at this day we have no satisfactory theory of money”. When Satoshi Nakamoto, the pseudonymous creator of Bitcoin, wrote his initial paper in late 2008,⁵ which outlined how a currency could work and allow the exchange of currency units (and potentially other assets) without the need for a central caretaker, he initiated a cynosure which could affect trade as extensively as the accounting techniques developed during the Renaissance. The method by which Bitcoin maintains its integrity without the need for a controlling party is by using what is known as a blockchain. A blockchain, at least in its initial incarnation, is a ledger system with no central authority⁶—anybody can download the ledger and view all of the transactions which have occurred. As transactions occur, in other words as currency units are transferred between accounts on the blockchain in a peer-to-peer manner, anybody can offer the processing power of their computer to verify the transactions and is then rewarded in bitcoin for doing so. The transactions are then formed into a block and the updates to the ledger are then sent to all computers which have the ledger stored. Consequently, a blockchain can record transactions safely and securely without the need for a central body like a bank or stock market.⁷

In an interview on the future of economics in 1999, Milton Friedman prophetically stated “I think that the Internet is going to be one of the major forces for reducing the role of government. The one thing that’s missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B, without A knowing B or B knowing A”.⁸ This is of course correct, but the concept could now be expanded a little—what is needed for global commerce and trade to flourish in the internet age is a method whereby assets in general, including money, can be registered and traded reliably without the need for central authorities.

This chapter will look at three key areas of importance to the Austrian School of economics wherein blockchain will have a defining character over the coming years. It is proposed that the most important aspects of blockchain not only support the key tenets of the Austrian School but in fact will make it increasingly difficult to rely on certain tenets of other schools of economics as trading systems become progressively decentralised and distributed.⁹

⁵Nakamoto, S (2009) “Bitcoin: A peer-to-peer electronic cash system”. (<http://bitcoin.org/bitcoin.pdf>).

⁶There are now different types of blockchain; some are permissioned (require permission from an authority to access them) while some are permissionless. See the UK Government’s Chief Scientific Adviser’s report on blockchain (Walport 2016) for more information.

⁷For a more general introduction to blockchain, see Swan (2015).

⁸This is from a 1999 interview with Nobel Laureate Milton Friedman conducted by NTU/F (<https://www.youtube.com/watch?v=6MnQJFEVY7s>).

⁹In most of the key textbooks of macroeconomics, for instance Mankiw’s *Principles of Economics* (1997, 2014), it is axiomatic to many of the arguments that central banks can “stimulate” the economy through control of the quantity of money.

- First, we shall examine the Austrian School conception of the nature of money. This began with Carl Menger and then following Menger and von Böhm-Bawerk the line of thought continued through twentieth century economic thinkers. The Austrian School places great importance on the nature of money, including in its foundational texts.
- Second, we will look at Hayek's notion of the fatal conceit, both from his 1988 book of the same name and also his related papers and his Nobel Prize acceptance speech *The Pretence of Knowledge*.¹⁰ This essay will make the case that nowhere do these principles hold faster than in the quickly developing world of blockchain technology, especially in how this relates to our very notions of what constitutes money.
- Third, we will look at Austrian business cycle theory and how blockchain will both lead to new thinking in this area and also serve as a natural complement to traditional Austrian thinking with respect to the causes of the business cycle. Business cycle theory is a key aspect in the overall framework¹¹ and has gained attention in recent years following the financial crisis that threatened, and continues to threaten, the global economy.

These three elements of Austrian School thinking are useful together to understand the current predicament in which the world finds itself and also the ways in which blockchain technology can lead to a revitalisation of the economy based on Austrian principles. Although there are typically a handful of significant innovations which occur each century, few of them have such a broad application within the field of economics as blockchain. Also, few of them have such an importance for the philosophical foundations of our economic system. Blockchain is, thus, a uniquely interesting technology in recent years for both economic theorists and practitioners of finance. There are already a myriad of papers looking at the structure of different types of blockchains and assessing their various merits in particular circumstances (for some interesting examples, see Peters and Panayi 2016); although there will be occasions when specific blockchain types or digital currencies will be mentioned, this chapter will focus on the broader economic considerations rather than individual use cases or abstruse Bitcoin hermeneutics.

¹⁰Lecture to the memory of Alfred Nobel, December 11, 1974.

¹¹See Roger Garrison *Time and Money: The Macroeconomics of Capital Structure*, Routledge, 2001.

1 Blockchain and the Austrian School Conception of the Nature of Money

The foundational texts of the Austrian School have money at their core.¹² Not only does the Austrian School conception of money define its origins, but it also gives it a central role in how business cycles occur and how these cycles may be mitigated, or indeed prolonged and exacerbated in the case of our current monetary system. Carl Menger's lectures to Crown Prince Rudolf of Austria in the late nineteenth century¹³ show that he had an intuitive grasp of how money affects interest rates and the wider economy which is more astute than many of the models used by economists today. Money represents half of every transaction—at least in the absence of barter—and is therefore at the crux of trade theory and microeconomics as well as monetary economics. Mainstream economics generally holds that monopolies are inefficient; the monopoly that constitutes half of every transaction that takes place over an individual's lifetime should be as much open to competition as any other sector of the economy.

In Menger's discourses on the nature of money, he delineates how money arises out of the free market without the need for state intervention. In *On the Origins of Money* (1892), Menger summarised this point as follows:

Under these circumstances, when anyone has brought goods not highly saleable to market, the idea uppermost in his mind is to exchange them, not only for such as he happens to be in need of, but, if this cannot be effected directly, for other goods also, which, while he did not want them himself, were nevertheless more saleable than his own. By so doing he certainly does not attain at once the final object of his trafficking, to wit, the acquisition of goods needful to himself. Yet he draws nearer to that object. By the devious way of a mediate exchange, he gains the prospect of accomplishing his purpose more surely and economically than if he had confined himself to direct exchange. Now in point of fact this seems everywhere to have been the case. Men have been led, with increasing knowledge of their individual interests, each by his own economic interests, without convention, without legal compulsion, nay, even without any regard to the common interest, to exchange goods destined for exchange (their 'wares') for other goods equally destined for exchange, but more saleable.¹⁴

Money, of course, generally becomes formalised and acquires through the state its legitimacy (in the most literal sense of the term), but the state is by no means necessary for the development of money to occur. In fact a free market in money is likely to produce something preferable to that which is state-issued, given that if the money produced by the free market does not serve adequately the needs of exchange, then it can be quickly replaced with another form of money. The beauty of Nakamoto's paper and the abstractions therein are that not only does the money

¹²See especially Carl Menger *The Origins of Money* (1892).

¹³Carl Menger's *Lectures to Crown Prince Rudolf of Austria* (1994) edited by Erich and Monica Streissler, see p. 171 where Menger also relates interest rates to the "abundance of capital" in the economy.

¹⁴Carl Menger *The Origins of Money* (1892, pp. 34).

arise from the free market but it is also maintained by the market itself in the aggregate in that there is no need for a central caretaker. The development of blockchain technology is not only itself the Mengerian money which serves as one of the keystones of Austrian thought, but actually provides the substrate on which these moneys can rise and fall according to the needs of the market.

When analysing the Eurodollar market, Fritz Machlup (1970) used the term *moneyness*,¹⁵ which conveys the idea that many products in a market have certain money-like characteristics and that they can take the form of money in given circumstances, for instance the use of cigarettes as money in prisons (also see the Bank of England's reference to this¹⁶). Machlup composed his PhD dissertation under Ludwig von Mises and initially wrote on credit creation and capital formation; when he later worked in the USA, he wrote *The Production and Distribution of Knowledge in the United States* (1962) which presciently popularised the notion of the information society, a concept which would later, with the development of blockchain technology, complement his notions of money in ways which he could not have predicted at the time. Hayek's *The Denationalisation of Money* re-introduced Machlup's idea of moneyness, where Hayek pointed out that it would be preferable if the term "money" were used as an adjective rather than noun so that it could convey the idea that different goods have a "money-like" quality, or "near-moneyness" in Machlup's terminology, to different degrees. Hicks (1935) also pointed out that the liquidity of different goods meant that they could take money-like forms and, as Hayek put it, "shade into each other in the degree to which they function as money". While there have been sound arguments in favour of the basic concept of moneyness in other schools of economics¹⁷ as well as by thinkers including Aristotle and Copernicus,¹⁸ the Austrian School gives it a prominent role in the overall conception of how markets function.

¹⁵See for instance p. 225.

¹⁶In this vein The Bank of England, in their analysis of digital currencies (Ali et al. 2014a: 278), considered Radford (1945) with respect to the three functions of money—a store of value, a unit of account, and a medium of exchange—who documented "that cigarettes served all three of these roles within prisoner of war camps during the Second World War".

¹⁷In *The General Theory of Employment, Interest, and Money* Chapter 17, Keynes (1936) noted that "As a footnote to the above, it may be worth emphasising what has been already stated above, namely, that 'liquidity' and 'carrying-costs' are both a matter of degree and that it is only in having the former high relatively to the latter that the peculiarity of 'money' consists....There is, clearly, no absolute standard of 'liquidity' but merely a scale of liquidity—a varying premium of which account has to be taken".

¹⁸In Aristotle's *Politics* Book 1:9[1] (c.350 B.C. translated by Sinclair, revised and re-presented by Saunders (2000)) The Philosopher considered money and came to the conclusion that in a market every good has two uses, first it has the use for which it was designed, the second use being as an item to sell or barter—effectively a form of moneyness as value of such goods in the secondary sense rests largely on their liquidity in the market. Copernicus, in his 1526 report on monetary systems to the King of Poland and the Prussian Diet, included a rudimentary form of the quantity theory of money and Gresham's Law as well as an early notion of moneyness.

The Austrian conception of moneyness takes on new features with blockchain technology. Many of the innovations that have occurred thus far on the Bitcoin blockchain have served to expand its functionality beyond money. The development of “coloured coins” began from 2012 as a way to attach other assets or pieces of data to the blockchain.¹⁹ As an example, someone could attach the right to ownership of a bond, stock, copyright title, or other asset to a particular bitcoin (or more generally bitcoin fraction); this can then be traded on the blockchain like any other. The value of the fraction of bitcoin to which the assets are attached does not in any way have to equate to the value of the assets and in fact generally utilises only a nugatory amount of bitcoin so that costs of trading are minimal. The majority of the discussion among central banks thus far with respect to blockchain focuses on the money aspect, and to the extent to which other assets are discussed, it is generally within a context that these are conceptually separate from money and will be traded as such.²⁰

Blockchain networks such as Ethereum use a monetary unit to enable Turing-complete distributed computer systems. Increasingly, blockchain networks will integrate a monetary unit, or units, but will not have the monetary system as their core functionality. There is no reason why there must be a defined monetary unit even for a single blockchain and certainly not for the agglomeration of blockchains that will define much of the economy as the technology becomes more widely adopted. On a blockchain with sufficient liquidity what constitutes money could be defined by demand and supply at any moment. Hayek spoke of the desirability of a currency backed by a basket of commodities and why this would likely have several advantages over a currency backed by a single commodity like gold or silver. Among these advantages is that the value of the currency is not as subject to swings in value resulting from the demand and supply of the underlying asset.²¹ In an economy in which blockchains are widespread, the types of asset which have a high degree of moneyness could and would be constantly evolving.

¹⁹See Rosenfeld, Meni (2012). Overview of colored coins. White paper, bitcoil.co.il.

²⁰Hayek (1978, p. 57), in *The Denationalisation of Money*, explained that the roots of this conception of money may lie in the legal convenience of it, “Similarly, the legal fiction that there is one clearly defined thing called ‘money’ that can be sharply distinguished from other things, a fiction introduced to satisfy the work of the lawyer or judge, was never true so far as things are to be referred to which have the characteristic effects of events on the side of money. Yet it has done much harm through leading to the demand that, for certain purposes, only ‘money’ issued by government may be used, or that there must always be some single kind of object which can be referred to as the ‘money’ of the country. It has also, as we shall see, led to the development in economic theory of an explanation of the value of units of money which, though under its simplified assumptions it gives some useful approximations, is of no help for the kind of problems we have to examine here”.

²¹One of the key criticisms of Bitcoin has been the volatility, for instance the Bank of England point out that “The standard deviation of daily moves for bitcoin is roughly 17 times greater than that for sterling. The worth of bitcoin as a medium or long-term store of value, however, depends on the strength of demand over time, which will in turn depend on users’ evolving beliefs about the ultimate success of the digital currency”.

On a blockchain, the money itself becomes programmable so that smart contracts²² can be written into transactions. The applications for which assets can be used can also be programmed into the blockchain. As Charles Hoskinson, head of blockchain company IOHK, put it:

You can put all kinds of extremely advanced terms and conditions on a digital account for money: where, when and who can spend it, and how much I can spend. That can happen with a bank account on a digital ledger.²³

An example from an individual consumer level would be a parent whose child is at university and wishes to send them money but wants to ensure that it will be spent on textbooks; with a blockchain-based currency, this can be programmed into the money itself. Hayek's composite currencies could be continuously evolving depending on the state of the market and could take on a more aleatory nature through the programmable nature of the blockchain.

At the moment, there are several hundred altcoins²⁴ in existence. Some of the more famous ones include Ether, Dash, and Litecoin, but there is now a rather fascinating ecosystem emerging of different currencies which are not as famous but nevertheless introduce interesting new ideas to the flora and fauna of the new monetary environs. It would not be possible to go through these exhaustively in this chapter, but some of the more interesting currencies include Gridcoin which arose from science departments at the University of California at Berkeley; with Gridcoin by offering spare computational resources from a home computer people are in turn rewarded in newly created coins; the computation donated is used for scientific research in biology, physics, and mathematics. Computation is one of the most important scarce resources in the information age—the others being algorithmic efficiency and information itself—so a currency which can harness a distributed network of computers to aid scientific development is an important step forward. Related to this is Curecoin from Stanford University; Stanford's Folding@home program allows people to offer resources from the processor on their home computer to be used for research into protein folding to find new medicines—by offering computation users can also be paid in newly created Curecoins.

The Neoclassical Synthesis generally views money as a static concept or even seeks to abstract away from it (see, for instance, the Bank for International

²²For one of the pre-Bitcoin analyses of smart contracts, see Szabo, N. 1997. *Formalizing and securing relationships on public networks*—Szabo summarises the concept neatly “The basic idea behind smart contracts is that many kinds of contractual clauses (such as collateral, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make breach of contract expensive (if desired, sometimes prohibitively so) for the breacher”.

²³See the Financial Times article “Central banks explore blockchain to create digital currencies” (<https://www.ft.com/content/f15d3ab6-750d-11e6-bf48-b372cdb1043a>).

²⁴Altcoin is the term given to the plethora of digital currencies which arose following the development of Bitcoin, for a list of market capitalisations, see here (<https://coinmarketcap.com/>).

Settlements writing on this theme²⁵). The ways in which money will evolve on the blockchain will be largely in line with traditional Austrian School thinking—we are now entering the first truly global free market in money where what constitutes money will be constantly evolving to meet the needs of the market.

2 The Fatal Conceit: The Use of Blockchain for Monetary Central Planning

In his 1988 book *The Fatal Conceit*, Hayek commented on the nature of the state and its implicit belief that it can design the future using the tools and knowledge of the present; spontaneous order, on the other hand, means that adaptation can take place organically and can achieve innovations which would not be possible in a designed system:

Such an order, although far from perfect and often inefficient, can extend farther than any order men could create by deliberately putting countless elements into selected ‘appropriate’ places. Most defects and inefficiencies of such spontaneous orders result from attempting to interfere with or to prevent their mechanisms from operating, or to improve the details of their results. Such attempts to intervene in spontaneous order rarely result in anything closely corresponding to men’s wishes, since these orders are determined by more particular facts than any such intervening agency can know.²⁶

At the moment, central banks and other policy makers are looking at how blockchain could be adopted.²⁷ It did not take long from the inception of Bitcoin for policy makers to understand the potential usefulness of both the currency itself and the underlying protocol used. As well as forming their own ideas of how a central bank issued blockchain could work, policy makers are also looking at how to regulate blockchain technology. The track record of the state in regulating new technologies has not been exemplary. In the late nineteenth century, the first

²⁵The Bank for International Settlements (BIS Working Papers No 346) has commented on this, “In the canonical New Keynesian paradigm, rather paradoxically, they are entirely redundant or at least inessential. The canonical model is that of a money-less economy that can do away with the ultimate settlement medium (Woodford’s (2003) “cashless economy”). Indeed, paradoxically, when settlement balances (money) are introduced, they act as a “friction”, not as the indispensable lubricant in an otherwise inefficient barter-exchange mechanism. It is an economy in which credit is just a vague shadow in the background: since credit does not affect behaviour, its evolution does not need to be tracked. When banks are introduced, credit may have more information content. But, even then, intermediaries do not generate purchasing power; they simply transfer real resources from one sector to the other. The underlying economy is, in this sense, a real economy disguised as a monetary one. Credit is just another real resource that households make available to entrepreneurs. This contrasts sharply with the essence of monetary analysis.”

²⁶Friedrich Hayek, *The Fatal Conceit* (1988, Ch. 5 p. 84).

²⁷See, for instance, the Bank of England’s “multi-year research programme into the implications of a central bank, like the Bank of England, issuing a digital currency” (<http://www.bankofengland.co.uk/research/Pages/onebank/cbdc.aspx>).

automobiles, or “horseless carriages”, were developed more or less simultaneously in Europe and North America. The regulations passed give us indications not just into the risk-averse nature of regulators but also the fact that they often have great difficulty perceiving how a technology will develop even in its most elemental forms—they interpret it using the language and products of the day and therefore cannot grasp the changes that will be brought forth by the new technology. In the UK, the “red flag laws” were passed (similar laws were passed in parts of the USA), whereby anybody driving a “horseless carriage” had to have someone walking 60 yards ahead carrying a red flag²⁸ and warning people about the oncoming vehicle. In Pennsylvania, a law was passed unanimously by both legislative houses (although eventually vetoed by the Governor) whereby anybody with a horseless carriage, upon chance encounters with cattle or livestock, by law had to “immediately and as rapidly as possible. . . disassemble the automobile”, and “conceal the various components out of sight, behind nearby bushes until equestrian or livestock is sufficiently pacified”. In 1896, the red flag laws were repealed and Lord Winchelsea symbolically ripped up a red flag in front of Parliament; enthusiasts of the new horseless carriages drove from London to Brighton to celebrate. When conceptualising the development of blockchain technology, it is important to understand that blockchain-based currencies are not just currencies without a central bank in the same way that the internal combustion engine is not just a “horseless carriage”.²⁹ Blockchain technology has the power to change our very notions of what constitutes money.

Writing for the World Economic Forum, Niepelt (2016) recently opined:

Should central banks oppose the new technology? If central banks don't join forces, they risk being cut out from intermediation and surveillance. They also run the risk that payment service providers may move to other currency areas with an institutional environment that is more appealing for buyers and sellers. Neither can be in the interest of monetary authorities, even if the technical and legal challenges of engagement are huge.

Central banks increasingly are under pressure to keep ‘their’ currencies attractive. They should let the general public access electronic central bank money, not just financial institutions (Niepelt 2015). To do this, they should embrace the blockchain.³⁰

Blockchain technology has sparked the interest of many who would like to see money returned to the market in such a way that the individual can choose how they receive payment for goods or labour. There is now a substrate on which any recusant can develop their own money, either as a standalone “application” or as a form of money which is embedded in a specific network, a trading platform, or prediction market for instance. Just as the market will use blockchain to produce forms of

²⁸Locomotive Act 1865.

²⁹For one of the first examples of a more elaborate blockchain network where the functionality goes well beyond the monetary aspects, see the evolution of Vitalik Buterin’s initial papers *from* Buterin, Vitalik (2014a). Multisig: The Future of Bitcoin. *to* Buterin, Vitalik (2014b). A next-generation smart contract and decentralized application platform. White Paper.

³⁰See here <https://www.weforum.org/agenda/2016/10/blockchain-cryptocurrencies-and-central-banks-opportunity-or-threat>

money that have hitherto gone unthought of, so central banks have also considered how the current monetary system might be advanced using blockchain technology. Chief Economist of the Bank of England, Andrew Haldane, in his speech “How low can you go?”,³¹ adumbrated how blockchain might allow central banks to pursue radical monetary policy such as negative interest rates—the *reductio ad absurdum* of all modern monetary economics—which would be difficult using traditional means. Orthodox monetary economics has traditionally been unnerved by the zero bound in interest rates,³² the concern being how interest rates can go below zero when the natural inclination for a substantial portion of the population would likely be to withdraw their cash from banks and store it in a way that does not incur the negative interest rate penalty. The use of blockchain to implement a central bank controlled digital currency would mean that negative interest rates and other forms of financial repression could be programmed into the money itself with nowhere to run and nowhere to hide for the saver. All of the innovations hitherto considered in this chapter could be brought to bear so that radical monetary policy can be implemented in ways which avoid the inconveniences, from the central bankers’ point of view, of our current system.

In *The Fatal Conceit*, Hayek wrote that the “The curious task of economics is to demonstrate to men how little they really know about what they imagine they can design”.³³ With a central bank issued blockchain-based currency not only would central banks have the ability to monitor transactions in real time but they would also be able to essentially programme the money to operate as they wish. Additionally, assets could be confiscated or funds withheld at their behest. Whereas Nakamoto designed Bitcoin to be a currency with no caretaker, the technology employed for this can be adapted for a currency which gives a caretaker considerable control over the money itself.

Writing in Bloomberg, Deputy Governor of the People’s Bank of China Fan Yifei stated “Digital currencies have shown considerable promise. . . [our research] suggests that the best way to take advantage of these innovations is for central banks to take the lead, both in supervising private digital currencies and in developing digital legal tender of their own”.³⁴ Over the coming years, money will take a form which is not possible to predict, but the Austrian School at least gives us the methodology to

³¹ See the full speech here <http://www.bankofengland.co.uk/publications/Pages/speeches/2015/840.aspx>

³² For a fuller discussion, please see IMF working paper WP/15/224 (Agarwal and Kimball 2015) *Breaking Through the Zero Lower Bound*.

³³ See Chapter 5 p. 76, the full quote is as follows “If we had deliberately built, or were consciously shaping, the structure of human action, we would merely have to ask individuals why they had interacted with any particular structure. Whereas, in fact, specialised students, even after generations of effort, find it exceedingly difficult to explain such matters, and cannot agree on what are the causes or what will be the effects of particular events. The curious task of economics is to demonstrate to men how little they really know about what they imagine they can design”.

³⁴ See here <https://www.bloomberg.com/view/articles/2016-09-01/on-digital-currencies-central-banks-should-lead>

understand the developments as money itself becomes less a defined “token” used by society and more a feature of particular networks or in other cases a miscellany of assets on distributed ledgers wherein the assets can be synthesised and programmed according to the needs of the market economy at any given moment. As state authorities pursue their own adaptations of blockchain currencies, it is likely that they will miss the broader point that the very nature of “money” is being redefined, and it is being redefined in ways which cannot be predicted—to try to do so would be an instance of Hayek’s fatal conceit.

Banking has certain characteristics which define it.³⁵ The changes in the ledger system that are now possible are not a continuation of the familiar technological “disruption” similar to retailers selling online rather than through catalogues, or movies being streamed over the internet rather than television, but rather a philosophical shift in the very nature of what constitutes money and credit. Other forms of financial technology, or “fintech”, have made changes in how lending occurs. Examples include peer-to-peer lending—the lending, however, still occurs by moving the money from one bank ledger to another; the peer-to-peer aspect is merely the intermediary.³⁶ The implementation of blockchain technology will not just provide adjunct services through the interoscultations of the banking sector, but potentially replace the entire ledger system upon which it relies and operates.

The title of this chapter is “Blockchain—The New Intellectual Battleground Within Economics”. The battle is not about whether blockchain will or will not become used but rather what type of economy it will lead to. We have seen that in less than a decade since the origination of Bitcoin, a complete ecosystem of monetary structures has already started to emerge. The intellectual battleground is now who will get to control these technologies, will they remain a function of Hayekian free market competition, or will the state see fit to ingurgitate their innovations and refashion them in a way more conducive to a *dirigiste* economy.

3 Blockchain and Austrian Business Cycle Theory

Before looking at how blockchain technology will likely affect the business cycle, it is worth providing an outline of Austrian Business Cycle Theory in a way that synthesises the main developments in this line of thinking from the late nineteenth century to the present day. In a purely free market, lenders would provide credit to

³⁵For instance see “The New Lombard Street” (2010) by Perry Mehrling for a good description of the banking system, taking into account recent developments such as the shadow banking system. This can be compared with Walter Bagehot’s 1873 classic “Lombard Street: A Description of the Money Market”.

³⁶For an interesting summary of peer-to-peer lending, see *The Business Models and Economics of Peer-to-Peer Lending* by Alistair Milne and Paul Parboteeah (European Credit research Institute No. 17 / May 2016).

borrowers at an interest rate which is set by the market.³⁷ Market interest rates would be constantly shifting, just like prices in other areas, in order to re-calibrate following changes in demand and supply, in this case the demand and supply of savings.³⁸ If the number of people wishing to borrow increases relative to the number of people wishing to lend, strictly speaking if the demand for the quantity of credit increases relative to the pool of loanable funds, then the interest rate rises so that the market can factor this; the rise in interest rates is itself a damping factor on credit growth as well as an incentive for more savings, and thus loanable funds, so that a new equilibrium can be found.

In our current monetary system, rather than interest rates being a function of the demand and supply of credit, they are rather a function of what economists at central banks deem to be the “optimal” rate of interest for the economy.³⁹ When a central bank lowers interest rates in order to stimulate an economy out of recession, the Austrian School posits that rather than stimulating the economy it is in fact distorting it. When prices are set in other areas of the market, the distortions caused are apparent to the broader Neoclassical Synthesis, for instance if the state were to set the price of rubber or butter, then the mismatch between demand and supply would be predicted by orthodox microeconomics. When interest rates are set by a central bank then by definition there is a differential relative to the rate of interest which is a function of demand and supply. As Mises (1944: 251) put it:

True, governments can reduce the rate of interest in the short run. They can issue additional paper money. They can open the way to credit expansion by the banks. They can thus create an artificial boom and the appearance of prosperity. But such a boom is bound to collapse soon or late and to bring about a depression.

The macroeconomic approach of the Neoclassical Synthesis implies a difference in the epistemic nature of interest rates relative to other prices given that it is accepted that no central planner would have the requisite knowledge of the wider economy to be able to set price controls in rubber or butter but implied that central banks do have this knowledge with respect to interest rates. For the Austrian School, any setting of interest rates by central banks also relies on the same pretence of knowledge on the part of the monetary economists as for other economic central planners. In the IMF outline on the Austrian School, it is expressed as follows by Oppers (2002 p. 4):

The coordination between the intertemporal spending plans of consumers and the investment plans of entrepreneurs has its basis in the market for ‘loanable funds’. This is where consumers offer their savings (the willingness to forgo consumption) to entrepreneurs who

³⁷See Roger Garrison’s “Time and Money: The Macroeconomics of Capital Structure” (2001) for an exposition of Austrian Business Cycle Theory compared to other related theories from other schools of economics.

³⁸I will avoid using the term “natural rate of interest” since it has been used by different economists to convey often incompatible ideas.

³⁹See for example this outline of monetary policy by the Bank of England (<http://www.bankofengland.co.uk/monetarypolicy/Pages/how.aspx>).

invest in production technologies to produce future output. After Wicksell, Austrians call the price that clears the market for loanable funds and, thus, makes the intertemporal allocation of resources internally consistent, the ‘natural’ rate of interest. At this rate of interest, the savers’ total reward for their patience—the interest payment—is exactly equal to the expansion of future output made possible by the added value of the longer, more roundabout production processes.

When interest rates are brought lower than they would be under free market circumstances, there are several effects. Initially, more bank credit is produced than would otherwise have been the case. When interest rates are set by the market then loanable funds match investment and thus time preferences are coordinated; the suppressing of interest rates by central banks distorts the time preferences of the economy. Mainstream economics is generally agnostic on the homogeneity of capital; the heterogeneity of capital, however, is fundamental to understanding Austrian School business cycle theory and developed primarily through Mises and Hayek⁴⁰ following von Böhm-Bawerk’s (1884) initial explications.⁴¹ As an excess of bank credit is generated through artificially low interest rates and time preferences become distorted, the capital structure becomes extended; entrepreneurs invest in projects with longer rates of return as the lower interest rates allow for levels of investment at costs below that which would naturally occur. Rather than “overinvestment”, the term “malinvestment” is used to convey the idea that the credit expansion has actually distorted the capital structure—the distortions to the economy are qualitative as well as quantitative.⁴²

Eventually, the economy reaches a point where the dislocations caused can no longer be sustained with more artificially cheap credit, what is known as a *katastrophenhausse* occurs—the resources in the economy must purge the malinvestment that took place during the boom period, the distortions caused in the capital structure by artificially low interest rates, and the only way this can happen is through a painful restructuring of the economy. A recent example is the housing bubble in the USA leading up to the 2008 crisis, the low interest rate policy of the Federal Reserve from 2002 to 2004 resulted in malinvestment, in other words more was invested in housing than would have been the case had credit come only from loanable funds (the aggregate savings of the economy) rather than credit created ex nihilo as a result of central bank low interest rate policy. The result was a dramatic surge in housing production⁴³ which diverted resources from other sectors of the economy into the bubble. The solution that central banks have pursued is a further period of artificially low interest rates thereby exacerbating the

⁴⁰See especially Hayek’s *Prices and Production* (1931) and Mises ([1912] 1980 and 1999).

⁴¹In *The Positive Theory of Capital* (1891), written 7 years after *Capital and Interest*, von Böhm-Bawerk outlines the heterogeneity of capital by using the metaphor of a growing tree; the tree grows in different ways at different stages and exogenous manipulation will distort its natural growth patterns.

⁴²See, for example, Murray Rothbard’s “America’s Great Depression” (1963) for an elaborate analysis of the formation of a bubble.

⁴³See *The Economics of Housing Bubbles* by Mark Thornton (2006).

malinvestment. In *Human Action*, Mises (1949) succinctly described the eventual effects of a boom built from such a foundation, “There is no means of avoiding the final collapse of a boom brought about by credit expansion. The alternative is only whether the crisis should come sooner as the result of voluntary abandonment of further credit expansion or later as a final and total catastrophe of the currency system involved”.

Institutions such as the Bank for International Settlements have drawn lessons from aspects of Austrian business cycle theory. Claudio Borio (2011), Head of the Monetary and Economic Department at the Bank for International Settlements, in BIS Working Paper 346⁴⁴ outlined some of the historical development of the “natural rate of interest” view as well as the consequences of a deviation of the natural rate:

The distinction between market and natural interest rates, and the key role played by credit, was already commonplace when John Stuart Mill (1848) was writing, and was the main preoccupation of thinkers such as Wicksell (1898) and those that followed him.

He then continued:

It is hard to imagine that goods markets can be in full equilibrium, and hence growth can be sustainable, in the presence of such credit booms (Borio and Lowe 2002, 2004). If anything, the subsequent full-blown financial crisis suggests that the unusually rapid credit expansion was a sign that market rates were below the natural rate. Indeed, the expansion of credit was part and parcel of Wicksell’s ‘cumulative process’ resulting from market rates lower than the natural rate. And while Wicksell saw inflation as the inevitable outcome, others, such as Hayek (1933), argued that the distortion would be reflected in relative prices, in this case between consumer and investment goods. This suggests that it would be important to develop formal analytical models in which such a gap is reflected also in unsustainable asset price booms.

Later concluding:

We have argued that the fundamental weaknesses in the international monetary and financial system stem from the problem of ‘excess elasticity’: the system lacks sufficiently strong anchors to prevent the build-up of unsustainable booms in credit and asset prices (financial imbalances) which can eventually lead to serious financial strains and derail the world economy. Reducing this elasticity requires that anchors be put in place in the financial and monetary regimes, underpinned by prudent fiscal policies.

The concept of *katastrophenhausse* as the endpoint of growth in artificially cheap credit is different to the concept presented by Hyman Minsky, known as a Minsky Moment, whereby credit becomes so extended that it becomes unsustainable. In the Minsky model,⁴⁵ as credit becomes more extended, the leverage structure of the economy moves from hedge finance to speculative finance to ponzi finance as credit becomes increasingly disproportionate to GDP. The heterogeneity of capital in

⁴⁴Austrian School tendencies are far from alien to the BIS which has cited the work of Hayek several times.

⁴⁵For a useful outline, see *Minsky’s Theory of Financial Crises in Global Context* by Martin H Wolfson (2001) see also Minsky (1982) and Minsky (1986).

Austrian capital-based macroeconomics means that the different phases which Minsky catalogues lead to progressively more distortionary effects not just on asset prices but on the very real capital structure of the economy. The key consequence is that for Minsky the appropriate response is stimulus so that the effects of the Minsky Moment are mitigated whereas for capital-based macroeconomics any further stimulus will delay the reallocation of resources that needs to occur for recovery to take place.

How does blockchain technology fit into this theory? There are two aspects: first during the initial boom period when the artificially cheap credit is causing the misallocation of resources to take place, second following the *katastrophenhausse* when resources must be reallocated as efficiently as possible so that the economy can return to a sound footing and revitalise growth. As we have seen, Friedrich von Hayek wrote during the 1970s about how competition in money would provide a solution to the gratuitous increases in the quantity of money that were occurring following the end of Bretton Woods in 1971. Hayek's perspicacity on this was not widely appreciated at the time, but a plurality of currencies would do much to mitigate the harmful effects of central bank-induced misallocation of resources due to artificially cheap credit as there would be other networks through which trade could occur. If radical monetary policy such as negative interest rates is pursued by central banks, then more widespread trading on blockchain(s) would make substitution out of the currency viable and easy, likely forcing a tighter monetary policy on the central bank. In fact, the familiarity people would develop with blockchain technology when using a central bank issued currency in this format would likely make the transfer to alternatives easier. Writing for the The National Bureau of Economic Research Raskin and Yermack (2016) also drew this conclusion:

Algorithmic digital currencies such as bitcoin appear to be viable competitors to central bank fiat currency, and their presence in the marketplace may pressure central banks to pursue tighter monetary policy.

Friedman and Schwartz (1987 p. 312) criticised Hayek's *The Denationalisation of Money* by pointing out that there is no law preventing voluntary exchange between two parties using any medium they choose and yet the adoption of competing currencies has not been widespread. Prior to Bitcoin, there were no realistic alternatives to the current monetary ledger structure. On a blockchain-based economy what constitutes "money" would be continuously evolving and therefore consumers and firms could easily move out of a central bank currency into a near-money asset on the blockchain such as gold—a commodity with which one would currently not be able to pay for goods at the local supermarket but which would likely have a high degree of moneyness on a blockchain economy. The European Central Bank (2012 p. 35) reinforces this idea with their view that a substitution effect could be deleterious to monetary policy instruments:

In this regard, a widespread substitution of central bank money by privately issued virtual currency could significantly reduce the size of central banks' balance sheets, and thus also their ability to influence the short-term interest rates. Central banks would need to look at

their existing tools to deal with this risk (for instance, trying to impose minimum reserve requirements on virtual currency schemes).

In the traditional economics discourse when a central bank is forced to tighten during a recession, it is procyclical. In the Austrian tradition, it is loose monetary policy which caused the malinvestment and what the economy needs to recover is free market interest rates which match the demand and supply of savings and loans—in other words time preferences must be coordinated by interest rates just as prices coordinate preferences for goods in other parts of the economy. In a recession, counter to what is posited by mainstream economics, further manipulation of interest rates by central banks will lead to increased distortions in the capital structure of the economy. The IMF (He et al. 2016 p. 34), in their guide to blockchain currencies, outlined how a higher prevalence of digital currencies could restrict monetary policy⁴⁶:

More generally, in an economy with a high share of VCs, the ability of monetary policy to manage the business cycle could be diminished. Some of the challenges would be similar to those faced by countries that are heavily dollarised. The current generation of VCs does not allow for an expansion of the money supply in response to negative demand shocks. This would tend to exacerbate recessions and could lead to a deflationary spiral, as during the Great Depression under the gold standard.

From an Austrian School position, the matching of time preferences through normalised interest rates will lead to a capital structure which reflects the desires and constraints of consumers in complementary time periods. As Mises (1944: 251) put it with respect to the gold standard,⁴⁷ which also restricted credit creation:

In a market economy the rate of interest has a tendency to correspond to the amount of this difference in the valuation of future goods and present goods. True, governments can reduce the rate of interest in the short run. They can issue additional paper money. They can open the way to credit expansion by the banks. They can thus create an artificial boom and the appearance of prosperity. But such a boom is bound to collapse sooner or later and to bring about a depression.

The gold standard put a check on governmental plans for easy money. It was impossible to indulge in credit expansion and yet cling to the gold parity permanently fixed by law. Governments had to choose between the gold standard and their—in the long run disastrous—policy of credit expansion.

Credit markets on a blockchain free of influence by central banks would likely take a different form to even Austrian School-inspired “free banking”. Hayek’s *Conceit of Knowledge* prefigured the idea that we should not try and predict the exact nature of how genuinely free credit markets might develop on a blockchain substrate, but we can take it as an assumption that the underlying economic nature of interest rates will not change; people and institutions will lend to each other at a rate

⁴⁶Note that “VCs” are “virtual currencies”.

⁴⁷The issue of deflation, which surrounds this, was addressed from an Austrian School perspective in Selgin, G (1997): *Less than zero: the case for a falling price level in a growing economy* in which he challenges the assumption in much of modern economics that deflation is harmful.

that reflects the demand and supply of savings as well as, of course, the credit-worthiness of the borrower. In such an environment where different assets have varying degrees of moneyness, it matters not whether people lend to each other in gold, silver, bitcoin, or indeed any other asset or even asset derivative. What matters is that the interest rates are set by the free market rather than by central banks. As long as this is the case then any credit markets taking place on blockchains will serve to mitigate the effects of artificial credit expansion by central banks and help to realign time preferences once a recession arrives. If the standard Austrian axioms are accepted—that resources must be reallocated following a recession so that the capital structure can return to an undistorted state, that further stimulus will delay this necessary adjustment, and that the best way to achieve the re-ordering is through the unhampered interactions between agents in a free market, then the ability to trade on blockchains using assets that are not manipulated by a central bank will accelerate the readjustment process and will mean that it can occur with greater transparency.

If the public is restricted to using a central bank-managed blockchain currency, then the radical monetary policy which might be implemented will mean that the distortionary boom can be continued for longer.⁴⁸ The detailed central planning that would be enabled by blockchain technology would mean that a central bank could employ measures other than the manipulation of interest rates in its monetary policy. As we have seen, on a blockchain currency, it is possible to program into the currency how it may be used as well as other features. A central bank seeking further stimulus following a recession could employ this so that low, zero, or even negative interest rates are augmented by further control in how money is spent in the economy or how assets are exchanged. One of the reasons given for the failure of monetary policy to deliver the expected gains following the near-collapse in 2008 is that there has not been sufficient fiscal stimulus to accompany it. With blockchain technology, the control afforded by central banks would allow another form of stimulus where they deemed appropriate—direct control over the programming of the money itself.

Finally, it is worth noting our present circumstances given years of artificially cheap credit. In their analysis, “Debt and (not much) Deleveraging” (Dobbs et al. 2015), McKinsey plotted global debt levels showing that during the period of supposed deleveraging since 2007 debt levels in fact rose by \$57 trillion to more than \$200 trillion in total. As one would predict using Austrian analysis, the years of artificially cheap credit pursued as a policy by central banks has resulted in a considerable global debt bubble which has distorted both asset prices and capital structure. While the credit has indeed coagulated in certain areas, particularly the bond market, there is a bubble across many asset classes globally including broad

⁴⁸In Bank of England Chief Economist Andy Haldane’s speech “How Low Can You Go?”, he set forth this very point (note that the ZLB he refers to is “zero lower bound”) “These questions do not have easy answers. That is why work on central bank-issued digital currencies forms a core part of the Bank’s current research agenda (Bank of England 2015). Although the hurdles to implementation are high, so too is the potential prize if the ZLB constraint could be slackened. Perhaps central bank money is ripe for its own great technological leap forward, prompted by the pressing demands of the ZLB”. <http://www.bankofengland.co.uk/publications/Pages/speeches/2015/840.aspx>

stock market indices. The cyclically adjusted price-to-earnings ratio of stocks, otherwise known as the Shiller P/E, is now at levels roughly the same as in 1929 just before the Wall Street Crash—the long-term average is 15 and now stands at 29.9.⁴⁹ Austrian School analysis would suggest that we are now in a credit bubble considerably larger than any other since the 1920s and that the coming financial peripeteia will uncover that there is a bubble across most asset classes globally. Let us hope that the currently inchoate blockchain trading networks come to fruition so that in the event of a global *katastrophenhausse*, a systemic banking failure, there are mechanisms through which trade can occur.

4 Conclusion

In the *Origins of Money*, Carl Menger (1892 p. 12) stated:

And hence there runs, from the first essays of reflective contemplation of a social phenomena down to our own times, an uninterrupted chain of disquisitions upon the nature and specific qualities of money in its relation to all that constitutes traffic. Philosophers, jurists, and historians, as well as economists, and even naturalists and mathematicians, have dealt with this notable problem, and there is no civilised people that has not furnished its quota to the abundant literature thereon. What is the nature of those little disks or documents, which in themselves seem to serve no useful purpose, and which nevertheless, in contradiction to the rest of experience, pass from one hand to another in exchange for the most useful commodities, nay, for which every one is so eagerly bent on surrendering his wares? Is money an organic member in the world of commodities, or is it an economic anomaly? Are we to refer its commercial currency and its value in trade to the same causes conditioning those of other goods, or are they the distinct product of convention and authority?

Blockchain technology constitutes one of the most innovative developments in ledger systems since the invention of modern accounting techniques during the Renaissance. It is already bringing about, and will continue to bring about, significant changes not only in how we use money but in how we conceptualise money itself. Within the three areas which we have examined—the Austrian School conception of the nature of money, the fatal conceit, and the Austrian business cycle theory—blockchain technology complements the Austrian framework and in fact realises some of the concepts which have hitherto not been given sufficient attention in economics such as competing currencies. The fact that on a blockchain money itself becomes programmable—in a sense assets themselves more widely become programmable—as well as the ease with which moving between different forms of “money”, or indeed from asset to asset, means that the neoclassical notions of money as a static unit of account for the economy will need to be updated with more traditional Austrian concepts.

⁴⁹See Robert Shiller’s *Irrational Exuberance* (2000); the updated 2015 version includes commentary on the current valuations of bonds and stocks.

As blockchain technology develops and the related protocols become progressively optimised as well as being more widely used, there will be increasing attention to Austrian School ideas with respect to money. Some of the very ideas that are axiomatic to Keynesianism, at least with respect to monetary policy, become not just impractical but largely nonsensical as blockchains become more widely adopted in finance and other sectors. Monetary stimulus, one of the cornerstones of modern macroeconomics, will become increasingly untenable if trading on private blockchains occurs more frequently as it relies on central bank manipulation of the money supply. This is likely to happen not just because people wish to use another form of “money”, but because trading in general on blockchains will be more efficient and hitherto unthought of money systems will be embedded into these new frameworks. For the Neoclassical Synthesis, this implies a weaker economy as monetary authorities will increasingly lack the ability to stimulate the economy through interest rate manipulation and other instruments of monetary policy; for the Austrian School it will mean the possibility of a revitalised economy as interest rates become increasingly set by the market and monetary “stimulus” becomes impossible, thus allowing free exchange and genuinely free markets.

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