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BLOCKCHAIN AND THE “SMART-IFICATION” OF GOVERNANCE

The last “building block” in the smart economy

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Introduction: blockchain as the last necessary building block in the smart economy

Blockchain has an almost romantic beginning. On 31 October 2008 (Halloween, in point of fact), a mysterious white paper was released to the internet entitled “Bitcoin: A Peer-to-Peer Electronic Cash System” under the authorship of Satoshi Nakamoto (2009). To this day, nobody knows for sure who Satoshi Nakamoto is. Whoever he/she/they is/are, Satoshi had good reason to be jealous of their anonymity: they had just invented a highly secure form of currency tradeable peer-to-peer over a decentralised anonymised network. In other words, they had invented a cryptocurrency that needed neither government nor bank nor any centralised authority to operate and handed possibly the greatest enabling technology since the internet to the cryptoanarchist movement (Ludlow 2001).

In order to build Bitcoin, however, Satoshi Nakamoto needed to invent an underlying technology for a distributed ledger of currency holdings to be held and updated by a decentralised network of computers on the internet through a consensus algorithm. It is this technology that became known as blockchain (Swan 2015; Swan et al. 2019; Mouyagar 2016; Tapscott and Tapscott 2016), so called for the way it enables a decentralised network of computers to come to consensus on a “block” of new records to be added to a “chain” of such blocks held by all nodes on the network. This was revolutionary, for while the first application and, at the time of writing, majority application of this technology was to recording purchasing power holding and transfers – i.e. supporting cryptocurrencies – there is no restriction on the kind of records that can be kept in such a ledger. In particular, blockchain allowed for the incorporation of a “smart contract” that executes algorithmically upon the obtention of certain conditions (Szabo 1994) into the distributed, decentralised ledger of records held and updated by the network. Three particularly notable blockchains emerged to support such contracts – Ethereum (Buterin 2013), EOS (Grigg 2017) and NEO (NEO 2018) – and facilitate the construction of, among other things, Decentralised Autonomous Organisations (DAOs) of interlinked smart contracts.

Our argument in this chapter is that Satoshi Nakamoto, perhaps inadvertently, invented the last essential “building block” in the smart economy – the last technology necessary for a nearly fully decentralised, distributed and automated economic system to emerge. Satoshi did
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This by inventing a new institutional technology that allows for decentralised, distributed and automated governance of internet-based platforms. With blockchain Satoshi invented, in other words, a new smart institutional technology for governance. Where robotics and artificial intelligence, the internet of things and platform technologies combine into smart technologies that enable decentralisation, distribution and automation of production and exchange (Brynjolfsson and McAfee 2014; McAfee and Brynjolfsson 2017; Agarwal et al. 2019; Sullivan and Zutavern 2017; Parker et al. 2016; Schwab 2016), blockchain decentralises, distributes and automates the governance of production and exchange. With blockchain added to the bundle of smart technologies available to us, therefore, we may decentralise, distribute and automate not only production and exchange systems, but also the governance of those production and exchange systems. We therefore have the smart technologies that enable a nearly complete smart economy that was hitherto impossible.

To establish this argument, and uncover avenues for future research, we first will introduce an evolutionary-institutional perspective on the economy as a complex evolving network of rules for production, exchange and governance activities. We then introduce the argument that pre-existing smart technologies – robotics, artificial intelligence, the internet of things and platforms among them – have the effect of decentralising, distributing and automating this network structure primarily at the levels of production and exchange. We then introduce blockchain as an institutional technology that enables a new kind of governance for internet-based socioeconomic platforms. We discuss how this provides the last “building block” that allows for the near-complete decentralisation, distribution and automation of economic systems through the application of smart technologies by enabling smart governance. We conclude by discussing how a new kind of economics must emerge to understand such systems, one that integrates institutional cryptoeconomics into the core of an evolutionary-institutional perspective on economies as complex evolving networks of rules.

**Conceptualising economies as networks of rules: an evolutionary-institutional perspective**

If we are to assess the form of an economy enabled by smart technologies, with them integrated into the core of its technological base, we ought to adopt a conceptualisation of economies that is designed for the purpose of considering the impact of technology on their form. This is something neoclassical economics struggles with, being less an exercise in understanding the response of the structure of economic systems to changes in technology as an exercise in understanding their impact on the relationship between macroeconomic aggregates of output, labour and capital (Nelson and Winter 1982). Instead of neoclassical economic perspectives, therefore, we will adopt a fused evolutionary-institutional perspective that is designed to consider the way that technologies enable new forms of economic interaction and organisation. We will adopt, in particular, the micro–meso–macro framework (Dopfer et al. 2004; Dopfer and Potts 2007) introduced by Kurt Dopfer, John Foster and Jason Potts in a seminal 2004 article that effectively fuses the evolutionary economics tradition (Nelson and Winter 1982; Metcalfe 1998) with the institutional economics tradition (Hodgson 1998; Williamson 1998).

The micro–meso–macro framework begins with the economic agent as a cognitively constrained human being who applies comparatively simple but adapted rules to guide their behaviour in economy and society (Dopfer 2004). Where these rules guide interaction with other human beings and artefacts, they create connections in a network that agglomerates across the population to form the economy. As new technologies and organisational and governance rules are introduced, these rules adapt to them and cause behaviour, and thus the connective structure...
of the economy, to change and evolve. The economy becomes a complex evolving network structure created by rules that evolve and change over time (Potts 2001; Foster 2005). The economy becomes a complex evolving network of rules.

As we try to conceptualise the complex network of rules that the economy comprises at a greater and greater scale, we require a conceptual device that allows us to categorise subpopulations usefully in order to see the macro-scale structure of the economy without loss of generality. This conceptual device is the meso-rule. A meso-rule is a rule that takes a form of sufficient commonality across a subpopulation of the economy such that we can agglomerate the members of that population into a whole – a meso-population – and observe their relationships with other meso-populations treated as wholes. Hence, the micro–meso–macro framework allows us to understand economic structures at the micro-scale of the individual rule-following human being and their immediate network neighbourhood in the economic system, and at the macro-scale of interconnected meso-populations.

For our purposes, we may think of the economic system as categorised into three superordinate sets of meso-rules: meso-rules for production of outputs by the transformation of inputs; meso-rules for exchange of those outputs and inputs between agents; and meso-rules for governance (organisation and dispute resolution) of those activities. We may think in these terms as, when considering smart technologies, we are considering not an individual technology that will disrupt the rule structure and interaction behaviour of a particular meso-population within the macroeconomic structure but rather general purpose technologies which disrupt the Rule structure of all meso-populations and disrupt the whole of the macroeconomic rule network structure (Lipsey et al. 2005). Smart technologies may have effects across the whole of the production rule network of the economy, the whole of the exchange rule network of the economy and the whole governance rule network of the economy.

Thus, we arrive at a conceptualisation of the economy as a complex evolving network of rules that can be categorised into interconnected meso-populations at a macroeconomic level. This network structure evolves at micro, meso and macro levels as new technologies emerge, and rule structures adapt to harness the expansion of human capabilities they enable. With general purpose technologies such as smart technologies, the network structure evolves across all meso subpopulations as rules change in response to the expansion of human capability in production, exchange and governance.

The smart economy as automation and distribution of economic rule networks: robotics, artificial intelligence and the internet of things

For our purposes, we could say that smart technologies arise from the confluence of three general purpose technologies: information processing technology (IPT), information communication technology (ICT) and cybernetics. Information processing technology is enabled by the computer and its capacity for expanding the range of human capability in the transformation of input information into useful output information. Information communication technology is enabled most powerfully by the internet and its capacity for expanding the range of human capability in the transportation of information between computers and the information processing technology manifest within them. Cybernetics allows for each of these technologies to be embedded within physical machines and a loop created whereby that machine, and others it is connected to, produces information inputs for computations that then control the function of that machine. Smart technology allows us to all but fully automate physical processes with machines, distribute those physical processes across a network of machines and effectively decentralise that network.
We are more familiar with manifestations of this confluence of IPT, ICT and cybernetics in smart technologies by other names. These technologies include robotics, artificial intelligence, the internet of things and platforms. Robotics is a direct outgrowth of IPT, ICT and cybernetic technology and is significantly enhanced by the infusion of artificial intelligence within its computational control systems. Robotics expands the range of human production capability to an extraordinary extent to the point of requiring human intervention only for maintenance and oversight (Brynjolfsson and McAfee 2014; Schwab 2016). Artificial intelligence is information processing technology taken to its logical conclusion of automating and exceeding the human capacity for cognitive information processing (von Neumann 1958; Simon 1968), especially once machine learning is overlaid that allows for the processing system to be updated in response to performance. Artificial intelligence drastically expands the range of human capability in information processing, calculation and computing to an extraordinary extent to the extent of only requiring human intervention to program a basic predictive objective and base updating algorithm into a computer (Agarwal et al. 2019; Sullivan and Zutavern 2017). The internet of things allows us to connect artificially intelligent cybernetic control systems to a network of similar systems and distribute highly integrated production systems across unprecedented scales (McAfee and Brynjolfsson 2017; Schwab 2016). Indeed, it allows us to connect entire cities or electricity grids into one smart grid of cybernetic control.

All these technologies combine to automate, decentralise and distribute the myriad technologies underlying production and exchange rules in socioeconomic systems, gradually transforming it into a largely (but before blockchain, not yet wholly) smart economy. We observed the rise of smart technologies in production perhaps most notably with the rise of Japanese car manufacturing in the latter 20th century, with artificially intelligent cybernetic control systems dramatically scaling their capabilities and putting them at the core of global manufacturing. Naturally, this trend has spread across the world so that not only manufacturing is increasingly enabled by smart technology (Brynjolfsson and McAfee 2014; McAfee and Brynjolfsson 2017), but service delivery as well (Agarwal et al. 2019; Sullivan and Zutavern 2017). With the rise of e-commerce (most famously, eBay), and their next-generation descendants in the internet platforms such as Amazon, Uber, Spotify, Google and Facebook (especially Facebook “Marketplace”), smart production technologies can now be “plugged” into highly automated, distributed interfaces for human users to interact and exchange the outputs of those technologies (McAfee and Brynjolfsson 2017; Parker et al. 2016).

What, then, does an economy, a smart economy, that integrates these smart technologies into its technological base look like? Firstly, a smart economy is one that at least integrates robotics, artificial intelligence, the internet of things and platforms into its technological core, such that that core becomes characterised by advanced interconnected cybernetic control systems embedded within work mechanisation technologies inherited from the first industrial revolutions (Landes 1969). This means the range of human capability in production and exchange can be expanded to cornucopian extents through near complete automation of physical work transforming inputs into outputs and cognitive work transforming base into useful information. It also means, because of the power of the communication technology created by the internet, that that capability can be distributed over integrated production and exchange systems at a scale hitherto unimagined.

A smart economy is therefore a network of production and exchange rules that is nearly fully automated and distributed over a substantially decentralised system. It has production and exchange capabilities in supply chains that require vanishingly little human physical or cognitive work and that can extend over vast geographic surfaces and integrate with other systems at virtually unlimited scale. To the extent that human beings need to interact with these automated, distributed and decentralised systems and with each other, they can do so within
internet enabled platforms that effectively lift geographical constraints on said interaction. It is, increasingly, an economy where a human being need hardly leave their home but for leisure and work. They hardly even need interact with economic exchange networks at all – they need only intervene when artificial intelligences incorrectly predict their preferences. The economy becomes a network of automated, distributed and decentralised interconnected machines subject to automated, distributed and decentralised cybernetic control.

Yet, prior to the advent of blockchain, existing smart technologies (including robotics, artificial intelligence, the internet of things and platforms) could not yet affect the governance of economic production and exchange. The major platforms, Amazon, Uber, Facebook, Google and so on, are notable for their providing an infrastructure for the coordination of vast, automated, distributed and decentralised systems of production and (particularly) exchange. But they have been noted – especially in the realm of the “culture wars” – for the centralised governance they exert over an otherwise vast, distributed, decentralised network of production and exchange. It is possible to analyse organisational structures and dispute resolution scenarios and even to automate their function once decided using a confluence of IPT, ICT and cybernetics to some extent. But the governance structures themselves which decide the form organisations will take, grant authorisations to perform actions in those structures and resolve disputes remained inherently human and hierarchical. With existing smart technologies, in other words, production and exchange may have become smart and thus automated, distributed and decentralised, but governance did not. Hence, it was necessary for blockchain to be invented to complete the “smart-ificiation” – the automation, distribution and decentralisation – of this final superordinate category of meso-rules.

**Blockchain: an institutional technology enabling governance of internet-based socioeconomic platforms**

To understand how blockchain is an institutional technology that enables governance of internet-based socioeconomic platforms, we first need to understand what an institutional technology is, and then some of the technical aspects of blockchain that allow us to see that it is one such technology. We will focus on the most salient aspects of the technology here; a fuller discussion (from an economic perspective) of the technical aspects of the technology and their general importance is provided by Bheemaiah (2015) and Mouyagar (2016). We can then see that blockchain is a new kind of institutional technology characterised by its form as an intermediate between existing institutional technologies, displaying significant contractual and constitutional control of interaction like firms, governments and clubs, yet also distributing and decentralising authority like markets and commons. Because, in this, blockchain automates, distributes and decentralises governance, we can say that it is a smart governance technology, and thus provides the last “building block” necessary for the nearly complete smart economy.

An institutional technology as differentiated from an industrial technology has traditionally been obscured as an object of study, for the former tends to emerge and evolve over centuries and millennia, while the latter emerges and adapts within decades (Allen et al. 2020). Blockchain’s unusually rapid evolution is, indeed, what brought the concept of institutional technology to the interest of institutional economists. But, as a technology, institutional technology shares in common with industrial technology that it is, properly defined in the economic sense, a set of rules for the operation of a set of artefacts to expand the range of human capability. However, where industrial technology such as electrical engineering, mechanical engineering, cybernetics and robotics increases the range of human capability in production and exchange, institutional technology increases the range of human capability in the governance (organisation...
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and dispute resolution) of socioeconomic interaction. One may think of institutional technolo-
gies as the infrastructure of trust – verifying and validating that certain interactions have or will
take place (Novak et al. 2018; Davidson et al. 2018).

Of such institutional technologies, there have traditionally been accounted five. Markets
are characterised by the agglomeration of distributed and decentralised mutual exchange con-
tracts between consenting individuals or groups (Hayek 1945; Williamson 1985). Firms are
characterised by contracts which establish a command and control hierarchy that obviates
the need for extensive and costly negotiation over the performance of certain actions (Coase 1937;
Williamson 1985). Governments are characterised by the monopoly granted to them on
the use of coercive force by a sufficiently powerful proportion of the population (Downs 1957;
Buchanan and Tullock 1962). Commons are characterised by the use of a shared resource sub-
ject to emergent social norms emergent from voluntary interaction and association (Ostrom
1990). Clubs are characterised by the use of low-cost goods and services by members of a group
who exclude access to non-members through the imposition of membership costs (Buchanan
1965). Blockchain is considered the sixth and is characterised by its manner of establishing gov-
ernance of interaction on internet-based platforms (Davidson et al. 2018).

Blockchain is, in the pure technological rather than economical sense, a distributed ledger
technology (Swan 2015; Swan et al. 2019; Mouyagar 2016; Tapscott and Tapscott 2016). It con-
sists of a set of protocols for the holding and updating of a ledger of records by a distributed and
decentralised network of computers within the internet. The data concerning socioeconomic
interactions that the parties thereto wish to include in the ledger are broadcast by one of these
computers to the network as they occur and are made known to that computer. Periodically, the
protocol directs a set of computers, called “consensus nodes” in the network, to collect a set of
such records into a block that will be added to the “chain” of such blocks in the ledger (thus, a
“block-chain”). If one such block is successfully selected by a consensus algorithm, of which there
are many variants but which all ultimately require a majoritarian or super-majoritarian consensus,
it is added to the ledger held by the consensus nodes. This is, naturally, automated by computers
in the network which support and action the blockchain protocols. If consensus nodes disagree
with the block to be incorporated, or the underlying protocols, they may lobby the network as
a whole, or engage in what is known as a “fork” whereby they in effect “cryptosecede” from the
main network and form a new network with an alternate ledger from that point in time onward.

Why would parties to some interaction wish to include data thereon in a blockchain? The
initial reason was that it rapidly becomes an extremely secure and immutable record that can-
ot be manipulated or tampered with without the malign agent incurring massive costs that
would make such activity unprofitable. “Hacking” a blockchain requires a bad actor to not
only overpower or game the consensus algorithm, but also to convince the entire network to
continue using the modified blockchain rather than “fork” the blockchain at the point the bad
actor intervened and erase their gains and influence. By keeping an automated, distributed and
decentralised ledger held across nodes in the internet, blockchain creates records that are very
difficult to tamper with, and they are additionally, typically, heavily encrypted so that the por-
tions of the distributed ledger pertaining to any given actor can only be read by the holder of
their private key. In principle, the data held in a blockchain are therefore vastly more secure,
immutable and anonymous than those under the custody of a government or major corpora-
tion. It magnifies the effect of the two traditional nonviolent methods for keeping governments
or large organisations in check: democracy and secession.

The original data recorded in blockchain was, of course, holdings and transfers of purchasing
power, and thus the first blockchains supported cryptocurrencies. But it was quickly realised by
Vitalik Buterin particularly that the technology underlying Satoshi Nakamoto’s Bitcoin could
be used as a basis for implementing Nick Szabo’s concept of a “smart contract”. With the Ethereum blockchain, and soon after EOS, NEO and a host of others, blockchains thus became ledgers of interconnected smart contracts executing algorithmically upon realisation of certain conditions. Blockchains became the basis for the Decentralised Autonomous Organisation, a set of nodes interconnected into a web of smart contracts for the execution of certain actions under particular conditions.

Blockchain thus facilitates the emergence of protocols that govern the formation, validation and execution of socioeconomic interactions and delimit what can and cannot be included in the record of verified and validated interactions. It facilitates the establishment of authorisations and obligations to perform actions as part of a socioeconomic interaction. Thus, we can say that it is an institutional technology, because it provides for the governance of interactions that take place on internet-based platforms for socioeconomic interaction.

As an institutional technology for the governance of socioeconomic interaction, blockchain is distinguished by the intermediate form it takes, blending aspects of existing institutional technologies. Blockchain reflects the automated, distributed and decentralised nature of the internet for which it provides governance. Like a government or firm or club, it establishes substantial and extensive contractual and constitutional control of socioeconomic interaction through the operation of the verification and validation protocols as well as the formulation and execution of contracts. But, like a market, the web of extensive contractual control emerges through the agglomeration of distributed and decentralised voluntary mutual exchange of free agents. And, like a commons, the constitutional protocols establishing the base norms emerge from the voluntary association of a community organised around a common resource. Extensive obligations and substantial authority are established by blockchain protocols and smart contracts, but these are distributed and decentralised across the network of consensus nodes and socioeconomic agents. The institutional governance of internet platforms for socioeconomic interaction that is enabled by blockchains is, like the internet from which it emerges, highly controlled but in an automated, decentralised and distributed manner.

Thus, we can establish that blockchain is not only an institutional technology that reflects the automated, distributed and decentralised nature of the internet platforms it provides governance for but also a smart technology. Specifically, it is an institutional technology that enables smart governance. The governance structures that are established by blockchain protocols enable, in the first instance, vastly more sophisticated and extensive contracts to be written because they will execute algorithmically. This vastly expands the range of organisational production and exchange interaction that can be automated, and it vastly expands the capacity for the structure of that organisation to be distributed and decentralised because it is automated. But beyond enabling the “smart” organisation – the Decentralised Autonomous Organisation of interlocking smart contracts – the blockchain protocols themselves enable smart governance. Verifying and validating records of the formation and execution of socioeconomic interaction, and thus effectively dispute resolution as well as the overall actioning of institutional governance becomes automated and distributed across a decentralised network to an extent hitherto unimagined. Blockchain enables a form of smart governance that automates, distributes and decentralises the creation and actioning of institutional authority.

The complete smart economy: decentralised, distributed and automated rule networks for production, exchange and governance

Thus far, we have adopted a conceptualisation of the economy as a complex evolving network of rules that can be categorised into interconnected meso-populations, and which evolves as
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new technologies emerge to harness the expansion of human capabilities they enable. General purpose technologies, of which smart technologies are a kind, cause the network structure of the economy to evolve across all meso-subpopulations in the superordinate categories of production, exchange and governance. We have established that prior to blockchain, a smart economy which integrated smart technologies deeply into the core of its technological bases is a network of production and exchange rules that is nearly fully automated and distributed over a substantially decentralised system. It has supply chains that integrate at virtually unlimited scale and require vanishingly little human physical or cognitive work. The economy becomes almost completely a network of automated, distributed and decentralised interconnected machines.

Blockchain provides the final “building block” that is necessary to complete the “smart-ification” of the economy by providing the smart technology for the final superordinate category of governance of the rule networks of complex evolving economies. The governance structures that are enabled by blockchain protocols enable smart contracts that form the basic unit for Decentralised Autonomous Organisations, but they themselves are also automated, distributed and decentralised. Blockchain reflects the structure of the internet whence it emerges in its governance of socioeconomic interactions. It enables a form of smart governance that automates, distributes and decentralises institutional authority.

Thus, if we combine pre-existing smart technologies, including robotics, artificial intelligence, the internet of things and platforms, and introduce blockchains, we have a set of smart technologies that can form the technological base of a nearly completely smart economy. Meso-rules across the superordinate categories of production, exchange and governance become nearly completely automated, highly distributed and substantially decentralised. The human physical and cognitive work that is required to run an economy at global scale is reduced, in principle, to an absolute minimum as human capability is expanded exponentially by automation of production and exchange, but also governance.

What does such an economy “look” like structurally? Present theory in the emerging sub-discipline of institutional cryptoeconomics (led by scholars at the RMIT University Blockchain Innovation Hub) predicts that it will be substantially less hierarchical than existing economic systems as smart technologies infuse into the technology base and find an equilibrium with existing institutional technologies. But it will also be more continually disrupted within the superordinate category of governance meso-rules as the ability for smart governance technologies to be developed using blockchain will be expanded and distributed significantly to the private sector.

Smart technologies infused into meso-rules across production, exchange and consumption are likely to contribute to the emergence of what has been called the V-form organisation (Allen et al. 2019) and de-hierarchicalisation of corporate and regulatory structure more generally (Berg et al. 2018a). Where previously corporate and regulatory structure was M-form and deeply hierarchical with multiple multi-level management departments across major conglomerates and regulatory bodies, smart technologies, and especially smart governance, allow for a V-form organisation between two parties striking one contract registered with one custodian of the verified and validated ledger. The automation of trust by the application of blockchain-enabled smart governance allows layer upon layer of human labour dedicated to verifying and validating to be reallocated (Novak et al. 2018).

Indeed, government, broadly, as an institutional governance structure becomes far less critical in a smart economy, at least in its existing form (Berg et al. 2020). Blockchain-enabled smart governance facilitates the privatisation of large parts of not only institutional governance hitherto actioned by government in the realm of dispute resolution but also its social and distributional functions. Even voting (Allen et al. 2019), identity (Berg et al. 2017) and social
welfare (Novak 2018) can be automated, distributed and decentralised by private actors with blockchain-enabled smart governance.

In terms of statics, we may therefore expect an economy that is characterised by a far less hierarchical and human directed, and far more automated, distributed and decentralised rule network structure. But we can expect also novelty in terms of dynamics of this structure. Blockchain smart governance technology expands the range of private entrepreneurial capabilities and competition beyond production and exchange technology to the level of institutional governance (Markey-Towler 2018; Berg and Berg 2017; Berg et al. 2018b; Allen et al. 2020). Institutional entrepreneurship and competition in the past would typically take the form of mass emigration, political revolution or war. The institutional smart governance enabled by blockchain, however, allows for constitutional protocols for institutional governance systems to be drafted by a few individuals with laptops connected to the internet. The accretion of activity onto the platform it supports is entirely voluntary, and not only agents, but also consensus nodes, can “crypto-secede” (MacDonald 2019) from one governance system to another if they become sufficiently dissatisfied. With the scope for institutional discovery and competition thus greatly expanded by blockchain-enabled smart governance technologies, we can expect for the governance structure of economic rule networks to be subject to evolutionary dynamics comparable if not equivalent to those of production and exchange technologies.

The near-complete smart economy that has been made possible by the introduction of blockchain to the bundle of existing smart technologies may lead to an economy that looks quite different to that which we observe today, although traces of its structure can be found. It is a complex evolving rule network structure that reflects the internet upon which it is built. Across production, exchange and governance, it is nearly completely automated, distributed and decentralised and subject to substantial evolutionary dynamics across all three categories. It is an economic system that is de-hierarchicalised relative to today’s economy, and it is an economy that requires far less human labour to achieve substantially more production, exchange and governance across it. It is an economy where not only the structure of production and exchange meso-rules but also governance meso-rules are subject to disruptive evolutionary pressure through entrepreneurial activity developing and applying smart technologies. The nearly complete smart economy enabled by robotics, artificial intelligence, the internet of things, platforms and blockchains in combination is flatter, faster and fantastical in comparison to the structure which presently exists.

**Conclusion: integrating institutional cryptoeconomics into a new kind of economics**

We began with a romantic image of a mysterious white paper released on Halloween by an author shrouded in mystery to this day, who handed the cryptoanarchist movement its greatest enabler since the invention of the internet. What we have argued following this image was that, by having to invent blockchain technology, that shadowy author, Satoshi Nakamoto, did more than introduce the world’s first true cryptocurrency. We have argued that Satoshi provided the final “building block” technology for the smart economy. Satoshi invented the institutional technology that made smart governance possible and expanded the potential for “smart-ification” beyond the superordinate categories of production and exchange. Satoshi made the nearly complete smart economy, a nearly fully automated, distributed and decentralised economy, possible.

To establish this argument, we first introduced an evolutionary-institutional perspective on the economy as a complex evolving network of rules for production, exchange and governance.
activities. We then introduced the argument that existing smart technologies — robotics, artificial intelligence, the internet of things and platforms among them — have the effect of decentralising, distributing and automating this network structure primarily at the levels of production and exchange. We then introduced blockchain as an institutional technology that enables a new kind of governance for internet-based socioeconomic platforms. We showed how this provides the last “building block” that allows for near-complete decentralisation, distribution and automation of economic systems through the application of smart technologies by enabling smart governance.

A new kind of economics will be needed to understand the complete smart economy. Existing economic theory, even evolutionary-institutional economic theory, tends to view the economy as either a completely decentralised emergent network of individual voluntary mutual exchanges, or a hierarchical command and control structure. The new economy, even more than the existing one, will be a fuzzy blend of both. It will be characterised by extensive cybernetic control, but that control will be distributed over a decentralised structure in the internet of things, subject to blockchain governance.

Evolutionary-institutional economics is well placed to address the challenge of studying this new smart economy. Indeed, even preliminary formal modelling has begun (Allen et al. 2020), and initial textbooks have been written (Berg et al. 2019) within the subfield of institutional cryptoeconomics. Institutional cryptoeconomics at present is an application of, in particular, Williamsonian institutional economics (Allen et al. 2020) where it focuses on the implications of blockchain for transaction cost structures across the economy, and Ostromian institutional economics (Markey-Towler 2018) where it focuses on the emergence and evolution of different rules for coordinating socioeconomic interaction from blockchain protocols. Much is to be done to integrate the field of institutional cryptoeconomics and its study of smart governance enabled by blockchain with the evolutionary economics of smart technologies and evolutionary economics proper. New models are required that explain the intricacies of the contractual networks that comprise the smart economy, the constitutional protocols that govern it and how these technologies map into the production and exchange rules that actually produce and distribute goods and resources. These new models need to be integrated with our existing models of the evolution of complex economic networks in response to new industrial technologies so that the micro–meso–macro framework may be extended to understand the evolution of meso-rules for governance as well as production and exchange. Empirical and policy implications need to be derived and appreciative, history-friendly models must be developed.

The invention of blockchain provided the last building block necessary for the “smartification” of the economy. The final piece of the technological puzzle preventing the emergence of a nearly completely smart economy, a nearly fully automated, distributed and decentralised economy, slotted into place when Satoshi released his Bitcoin white paper. To understand the economic world to come, we will need a new kind of economics.

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