Blockchain and the problem of social cost

Externalities, Allocation of Property Rights, and the Role of the Law

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ABSTRACT

In the past decade, the legal and economic literature on blockchain technology and its applications flourished. However, a sensible Law & Economics framework for the analysis of the blockchain seems to be missing.

This article aims to fill this gap by looking at the blockchain technology through Coasean lenses. According to the "Coase Theorem", decentralised decision-making is superior in handling externalities compared to centralised regulation. This holds true so long as property rights are clearly allocated and transaction costs are negligible.

The article shows that much of the enthusiastic views on the blockchain promises comes from fundamental misconceptions on these assumptions. Against this background, the article discusses the externalities generated in the blockchain, explains why these externalities cannot be fixed by the decentralised actors acting on the blockchain and discusses the preferable legal strategies to handle such externalities.

Keywords: blockchain technology, Coase theorem, social cost, transaction costs, trust.

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I. Introduction

Thirty years ago, Ronal Coase received the Nobel Prize in economics "for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy" or, in other words, for smuggling the legal system into the economic analysis.

Since then, an enormous body of literature used the basic, yet revolutionary, intuition by Ronal Coase to analyse virtually any field of the legal domain.[2] This article wants to contribute to this stream of literature, discussing the nature of blockchain technology through Coasean lenses. In so doing, it is worth starting from the beginning, which is going back to the salient features of Coase's seminal contribution.

Coase demonstrated that a decentralised market solution – the Coasean bargain – is superior to centralised solutions in handling externalities, under the assumptions of zero transaction costs and clear allocation of property rights.[3] From this standpoint, one could argue that the blockchain represents a technological innovation that generates a sort of Coasean Nirvana, where transaction costs are negligible and property rights are perfectly allocated by design. This position, at least implicitly, is supported by many enthusiasts of the various blockchain technology applications.[4] Should this hold true, the law would be irrelevant. In contrast, the code would be law.[5] More specifically, the 'code' should merely guarantee that the blockchain ecosystem works with negligible transactions costs and clearly allocates the initial property rights.

However, in its Prize Award speech, Coase highlights that the main legacy of his "theorem"[6] is to provide a framework for the analysis of a world where transaction costs are positive and where the solution to the problem of social cost largely depends on the

[2] For a comprehensive survey, see Medema, Steven G. "The Coase theorem at sixty." Journal of Economic Literature 58, no. 4 (2020): 1045-1128.

[3] R. H. Coase, The Problem of Social Cost 3 J. Law & Econ. 1-44 (1960); in contraposition with A. C. Pigou, The Economics of Welfare (1920).

[4] See, for instance, Davidson, S., De Filippi, P., & Potts, J. (2016). Economics of blockchain. Available at SSRN 274475

[5] Borrowing from a famous expression from Lessig, Lawrence. "Code is law." Harvard magazine 1, (2000).

[6] Coase never formulated a theorem and was always very reluctant to do so. What is called the "Coase theorem" was formulated by Stigler based on the seminal work of Coase 1960. See Stigler, George Joseph. "The theory of price." (1966).

legal system.[7] In this vein, this contribution will show why the blockchain does not generate a Coasean Nirvana, why transaction costs are positive and non-negligible and, especially, why property rights are not always clearly defined by the blockchain. This latter point is of crucial relevance as it confirms the relevance of legal norms and institutions in solving the problem of social costs.

This article unfolds in four parts. Part I introduce the positive and normative formulation of the "Coase Theorem", the relevance of the allocation of property rights and the role of the law in allocating them efficiently. Part II introduces the blockchain technology and discusses why its promises resemble a Coasean Nirvana. In this part, I explain why the basic promises of the blockchain technology may not hold and what this means in terms of transaction costs and allocation of property rights. Part III decomposes the ecosystem generated by the blockchain technology into three layers: 1) the indirect interaction with the blockchain; 2) the direct interaction with the blockchain; and 3) the interactions within the blockchain (i.e.: the blockchain governance). In this part, I pinpoint the different externalities brought about by each of the layers. Part IV provides a framework for the interaction between the law and the code. It is argued that the desirable legal tool depends on the type of interactions.

II. The Problem of Social Cost

The 'Coase Theorem holds that, regardless of the initial allocation of property rights and choice of remedial protection, the market will determine ultimate allocations of legal entitlements, based on their relative value to different parties'[8]. This goes under two main assumption: first, the market is perfectly competitive which, crucially, implies that transaction costs are negligible; second, property rights are clearly defined and enforced. This represents the positive formulation of the Coase theorem, where the role of the law is simply to allocate and enforce property rights. Different initial allocation of rights does not impact the efficiency of the final outcome, but only impact the wealth distribution.

[7] Coase, Ronald. The Institutional Structure of Production. No. 1991-1. Nobel Prize Committee, 1991, https://www.nobelprize.org/prizes/economic-sciences/1991/coase/lecture/.

[8] Parisi, F. (2008). Coase Theorem. In New Palgrave Dictionary of Economics (pp. 855-861). Macmillan Ltd.

However, as several seminal contributions,[9] Coase's framework is of the utmost interest when the assumptions it is built upon do not hold, which is when transaction costs are positive.[10]

In a (real) world of positive transaction costs, externalities are not internalized solely by the market interaction, as efficient transactions may be impeded by their (transaction) costs. In this scenario, the law not only affects the wealth distribution but also the efficiency of the final outcome. This can be labelled as 'normative Coase theorem'.[11] The law can facilitate efficient outcomes in two ways.

First, legal rules can reduce transaction costs, minimizing the obstacles to private bargaining, so that parties can freely interact and come up with efficient solutions.[12] Second, when transaction costs are prohibitive, legal rules should allocate rights mimicking the outcome of a hypothetical Coasean bargain.[13] It is worth noting how, in this second contingency, the efficient solution may well be the centralized imposition of regulation or taxes, similarly to the Piguvian conclusions. However, Pigou posits that in perfectly competitive markets, externalities should be treated with centralized imposition. In contrast, Coase proposes that centralized solutions can be desirable not because of the existence of social costs (externalities) per se, but because of transaction costs.[14]

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[9] Similarly to the seminal contribution by Modigliani and Miller to corporate finance. The authors posit the irrelevance of the capital structure of the firm for its value. The seminal contribution highlights how different capital structure allocates the risk differently when leverage change, but this does not affect the value of the firm. However, the crucial impact of the Modigliani and Miller "irrelevance proposition" comes when the assumptions are relaxed and the baseline scenario of Modigliani and Miller allows to investigate the optimal capital structure of the firm in a world where frictions exist. See Modigliani, Franco, and Merton H. Miller. "The cost of capital, corporation finance and the theory of investment." The American economic review 48, no. 3 (1958): 261-297.

[10] Epstein, R.A. 1993. Holdouts, externalities, and the single owner: one more salute to Ronald Coase. Journal of Law and Economics 36, 553–86. ('As is well known, one of Coase's great achievements was to stress the importance of thinking about zero transactions costs settings, not because we ever encounter these in our ordinary lives, but because thinking about them sets up a useful foil for thinking about the positive transactions cost world that is inescapably our').

[11] Parisi (2008).

[12] Id. What Parisi calls 'Simple normative Coase theorem'.

[13] Id.What Parisi calls 'Complex normative Coase theorem'.

[14] Coase (1960).

II. Blockchain technology and the problem of social costs

The growing literature on legal and economic analysis of blockchain technology appears fragmented and largely unsatisfactory as it often does little more than revealing the authors' priors.

On the one hand, a part of the literature – the enthusiasts – takes for granted that the blockchain is a desirable innovation and focus on the legal and economic issues that must be ironed out to unleash its full potential.[15] On the other hand, the sceptics challenge the desirability of unleashing the potential of the blockchain, looking at the risks it brings about as well as at the legal and economic barriers that would make a generalized application of the blockchain.[16]

Neither of the contesting parties lacks sensible arguments. However, a sensible Law & Economics framework for the analysis seems to be missing.[17] As the proceeding of the paper will argue, the concrete promises of the blockchain technology make the Coasean framework particularly fit for purpose.[18]

In its essence, the blockchain technology aims at creating an environment where strangers can safely interact at minimal transaction costs.[19] Also, the 'property'[20] of

[15] Among many others, see Yermack, David. "Corporate governance and blockchains." Review of Finance 21, no. 1 (2017): 7-31.

[16] I am not immune from some sort of partisanship as I have argued elsewhere that blockchain is not likely to deliver its promises. See Kaja, Fatjon, Edoardo Martino, and Alessio M. Pacces. "FinTech and The Law & Economics of Disintermediation." European Corporate Governance Institute-Law Working Paper 540 (2020).

[17] Some authors have discussed specific points using law and economics. See, for instance, Vatiero, Massimiliano. "Smart contracts and transaction costs." Discussion Papers). Pisa, Italy: Dipartimento di Economia e Management (DEM), University of Pisa (2018); Arruñada, Benito, and Luis Garicano. "Blockchain: The birth of decentralized governance." Pompeu Fabra University, Economics and Business Working Paper Series 1608 (2018).

[18] This article takes into consideration the seminal contribution on externalities. The other seminal article on the nature of the Firm is also highly relevant in the discussion of the blockchain, an its applications, as alternative organizational solutions. See Coase, Ronald H. "The nature of the firm." Economica 4 (1937). This feature falls out of the scope of this paper and will be discussed in another study.

[19] Davidson, S., De Filippi, P., & Potts, J. (2016). Economics of blockchain. Available at SSRN 274475, at 9.

[20] I use here property in a non-technical way, indicating the possibility control the destiny of the crypto assets encoded in the chain. On the more technical definition of property rights, properly defined, in the blockchain see Sarel, Roee, Property Rights in Cryptocurrencies: A Law and

cryptoassets[21] is immutably recorded on the ledger after the nodes reached consensus. Setting aside several details on how the blockchain works, the first interim conclusion that one may reasonably draw from this preliminary description is that the blockchain ultimate promise is to create a Coasean Nirvana, where property rights assets are clearly defined and transaction costs are close to nil.[22]

Thus, the blockchain (and the algorithmic consensus protocol proofing the validity of the transaction happening there) would represent the institutional setting that largely satisfies the assumptions on which the positive formulation of the Coase theorem is built. Implicitly, or even explicitly,[23] the most enthusiastic supports of the blockchain argue that the code is enough to assure the efficiency and fairness of the transaction. In other words, the code is law.[24]

In this perspective, the role of the traditional legal system is negligible, as there is no need for trusted intermediaries that allocates property rights, record transactions in a centralised ledger or enforce the promise. Everything, so the argument goes, can be done more efficiently on the blockchain. The only thing left for the law is to step aside and avoid burdening the blockchain with unnecessary requirements or regulations.[25] We could translate this into a motto for crypto enthusiasts: if you have to decide what you want to be in life, be Coase and not Pigou.

Economics Perspective (February 21, 2020). North Carolina Journal of Law and Technology, Vol. 22, No. 3, 2021

[21] Assets that are cryptographically secured digital representations of value or contractual rights that use some type of distributed ledger technology (DLT) and can be transferred, stored or traded electronically. See, Financial Conduct Authority, Cryptoassets. https://www.fca.org.uk/firms/cryptoassets#:~:text=Cryptoassets%20are%20cryptographically%20secured%20digital,transferred%2C%20stored%20or%20traded%20electronically.

[22] Some empirical evidence show how blockchain decreases transaction cost in foreign exchanges. See Kim, Thomas. "On the transaction cost of Bitcoin." Finance Research Letters 23 (2017): 300-305.

[23] De Filippi, Primavera, and Samer Hassan. "Blockchain technology as a regulatory technology: From code is law to law is code." arXiv preprint arXiv:1801.02507 (2018).

[24] Borrowing from a famous expression from Lessig, Lawrence. "Code is law." Harvard magazine 1, (2000).

[25] Wright, Aaron, and Primavera De Filippi. "Decentralized blockchain technology and the rise of lex cryptographia." Available at SSRN 2580664 (2015).

However, Coase already warned us about possible Nirvana fallacies.[26] In his Prize Award speech, Coase discussed stock and produce exchanges, which are often seen as examples of near-perfect competition. However, looking closely at these marketplaces, one realises how there are several "legal" layers determining what can be exchanged, who can participate in the exchange, the rules for settling and clearing, etc.[27]

Similarly, this article aims at decomposing the blockchain ecosystem, looking at the various institutional components that make blockchain transaction possible. This exercise will allow us to critically review the applicability of the positive formulation of the Coase Theorem to the blockchain. Also, the statement according to which "the code is law" will need critical re-evaluation. Ultimately, this article will demonstrate that the use of blockchain implies the creation of several social costs and those costs cannot be internalised by the parties acting in the blockchain so that legal systems and centralised solutions are still needed.

In so doing, the first step is to look closer to the promise of the blockchain(s) and its essential building blocks, critically discussing the extent to which those can be really delivered.

The article will focus on four characteristics of the blockchain: decentralization, self-enforceability, immutability, and trustlessness. Those characteristics are essential for the creation of an environment where the positive formulation of the Coase theorem applies. Immutability, together with decentralised consensus protocols, guarantee the clear allocation of 'property rights' on the blockchain. The other characteristics aim at minimising transaction costs: the lack of a needed central trusted party allows to get rid of costly intermediaries, such as banks and other financial institutions. The absence of pre-established trust among parties and the self-enforceability of promises made in the blockchain decrease both ex-ante and ex-post transaction costs.

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[26] Borrowing from a famous expression in Demsetz, Harold. "Information and efficiency: another viewpoint." The journal of law and economics 12, no. 1 (1969): 1-22. ('The view that now pervades much public policy economics implicitly presents the relevant choice as between an ideal norm and an existing "imperfect" institutional arrangement. This nirvana approach differs considerably from a comparative institution approach in which the relevant choice is between alternative real institutional arrangements")

[27] Coase, 1991.

However, if one looks at the overall blockchain ecosystem, it is easy to appreciate how those promises are far from being achieved. Take, for instance, decentralisation. If it is true that decentralised consensus protocols allow to distribute the ledger among several different nodes throughout the world, it is also true that this does not equate to the elimination of intermediaries. First of all, for validating the transaction, a certain amount of computing power must be exercised by miners. As the main blockchains currently used are designed as 'computationally intensive' protocols,[28] the mining powers tend to concentrate in the hands of few powerful miners that can be effectively seen as intermediaries between the transacting parties. Also, the vast majority of cryptoassets are not simply left in the blockchain but deposited in user-friendly wallets. Those do not work in the blockchain and thus are easier to hack, an inconvenience that consistently happened over the last decade, with some spectacular cases.[29] Needless to say, crypto wallets and crypto exchanges are picked by the holders of cryptoassets based on the contractual conditions that these offers but also on the trust that cryptoassets holders have in different wallets or exchanges. Ultimately, consensus protocols do not magically arise but are written by coders. The reliability of the quality and honesty of the code cannot be simply assumed, especially in a prospective stage where the technology scales up and many users will be fully ignorant in terms of cryptography and algorithm. Even more so, if one thinks of strings of code that can run on the 'naked blockchain', such as smart contracts.[30]

One could go on with examples and also consider all the other characteristic.[31] However, the gist of the argument is that the blockchain, at least at this technological

[28] Difference between proof-of-work and proof-of-stake protocols. See Chepurnoy, Alexander, Tuyet Duong, Lei Fan, and Hong-Sheng Zhou. "TwinsCoin: A Cryptocurrency via Proof-of-Work and Proof-of-Stake." IACR Cryptol. ePrint Arch. 2017 (2017): 232.

[29] In 2014, the largest crypto wallet and crypto exchange in the world, MtGox filed for bankruptcy after it was hacked. See https://thenextweb.com/hardfork/2019/03/14/a-brief-history-of-mt-gox-the-3b-bitcoin-tragedy-that-just-wont-end/

[30] The DAO (Decentralised Authonomous Organization) was a smart contract running in Ethereum. It raised finance through the issuance of DAO tokens, exchanged for ethers. The DAO should have acter as a venture capital entity where the participants would have voted on the projects to undertake. The DAO was hacked before the start of its operation. This event generated an hard-fork where the community split between Ether and Ether Classic. See https://www.coindesk.com/understanding-dao-hack-journalists

[31] In the final version of the article, these aspects will be discussed more systematically.

stage, just changes the intermediaries at play that still need to be trusted. More generally, the blockchain does not eliminate transaction costs just reshuffle those less transparently. If transaction costs are reshuffled, one could wonder whether the blockchain is still able to privately internalise the social costs (externalities) it generates.

III. Blockchain technology and the problem of social costs

The analysis of the blockchain ecosystem is three-fold.

1) Indirect interaction with the blockchain;
2) Direct interaction with the blockchain;
3) Interactions within the blockchain (blockchain governance).

More specifically, I will firstly analyse feature that interacts indirectly with the blockchain, where the inapplicability of the Coase theorem is evident and the need for legal, regulatory or even tax strategies is clear. Among the several possible angles, I will briefly look at the environmental footprint of the blockchain.

Second, I will look at the modules through which the blockchain interacts with the outside world, highlighting the trusted third parties needed for these interactions. In particular, I will look at new gatekeepers that guarantee these interactions and at the ability of the blockchain or the market to handle the externalities stemming therein. In particular, I will look at crypto exchanges; crypto wallets and, more generally, the modules through which convertibility between crypto and physical is provided.

Third, I will look at the interaction within the blockchain assuming out any other friction and looking closely at the ability of the blockchain to deliver on its promises. One key point in Nakamoto's construction (valid also for other blockchains) is to build an "incentive compatible" system, where the key players in the blockchain.[32] Specifically, I look at the role of miners, who validates the transactions through an incentive-compatible consensus

[32] 'The incentive may help encourage nodes to stay honest. If a greedy attacker is able to assemble more CPU power than all the honest nodes, he would have to choose between using it to defraud people by stealing back his payments, or using it to generate new coins.' Nakamoto, Satoshi. Bitcoin: A peer-to-peer electronic cash system, 20108, 12

mechanism; the role of (core) developers that code and update the blockchain, the role of coders who set smart contracts (in Ether)

One aspect of interaction within the blockchain community deserves more specific attention: the possibility to create "islands of conspicuous power"[33] in the blockchain. This is crucial in understanding why even the blockchain strictly defined is not a Coasean environment. In particular, I will analyse soft and hard forks, ie the ability of few, powerful, individuals to re-write the history of the blockchain and affect the value of the remaining participants.

Thus far, the analysis demonstrates that at any level of the blockchain ecosystem the conditions of the Coase theorem are not fulfilled, so that the legal framework underpinning the activities carried out in blockchain is crucial for achieving second-best results. Here, the discussion moves from positive to normative: how can the law account for the social costs (potentially) generated by and in the blockchain if those costs are non-contractible.

IV. Blockchain, regulation and private law

The final part of the article will argue that the tools better suited to achieve this goal differs, depending on which layer of the blockchain ecosystem is considered.

Specifically, for the indirect interaction with the blockchain, regulation (or even taxes) should be preferred; for the direct interactions with the blockchain, one can mainly think of regulation and supervision, even though there is space for private law solutions. Finally, for the interaction within the blockchain, one should avoid regulation. In contrast, a system of private law disciplining the rights and duties of the main blockchain players represents the key challenge.

[33] Coase (1937).