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RESEARCH ARTICLE

Towards a Philosophy of Financial Technologies

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Abstract This special issue introduces the study of financial technologies and finance to the field of philosophy of technology, bringing together two different fields that have not traditionally been in dialogue. The included articles are: *Digital Art as 'Monetised Graphics'*: *Enforcing Intellectual Property on the Blockchain*, by Martin Zeilinger; *Fundamentals of Algorithmic Markets*: *Liquidity*, *Contingency*, *and the Incomputability of Exchange*, by Laura Lotti; '*Crises of Modernity*' *Discourses and the Rise of Financial Technologies in a Contested Mechanized World*, by Marinus Ossewaarde; *Two Technical Images*: *Blockchain and High-Frequency Trading*, by Diego Viana; and T*he Blockchain as a Narrative Technology*: *Investigating the Social Ontology and Normative Configurations of Cryptocurrencies*, by Wessel Reijers and Mark Coeckelbergh.

Keywords Financial technologies · Philosophy of financial technology · Ethics of financial technologies · Cryptocurrencies · Algorithmic trading

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In recent years, the emergence of innovative financial technologies, such as algorithmic trading, online banking and payment, and cryptocurrencies has left a decisive mark on our contemporary world. In popular culture, questions have therefore been raised concerning the impact of technologies on our financial world, ethics, and politics. How do high-frequency trading algorithms impact the occurrence of "flash crashes" (sudden stock market crashes that happen partly due to irregularities in algorithmic trading), and how can we regulate these potentially "immoral" practices (Smith 2014)? How could the blockchain, the technology underlying cryptocurrencies such as Bitcoin, change the relations between governments and citizens, and our notion of contractual obligations (Shubber 2016)? What role does algorithmic trading and the development of "financial robots" play in the world of big money (McGee 2016)? In parallel, the acknowledged importance of financial technologies has produced a revival of academic studies into the workings of the financial world across many different disciplines, such as anthropology (Graeber 2011; Maurer 2015), sociology (Dodd 2014; Ingham 2004), and political economy (Bjerg 2014; Karlstrøm 2014). These studies have produced a rich tapestry of new scholarship, including investigations into the diversity of monetary technologies, the global adoption of new payment methods, and the impact of digital technologies on economic and political relations.

The revived interest in the workings of money and finance represents a recovery from what Ingham framed as "one of the most serious casualties" of the separation and fragmentation of the social sciences (Ingham 2004, p.197). Prior to this new multidisciplinary interest, money and finance had been the almost exclusive domain of economic sciences, tied to and constrained by established economic models. Indeed, it was principally the ruptures preceding the 2008 financial crisis, which the economic sciences failed to predict or understand, and the devastation of the crisis itself, that prompted renewed interest in this thematic. Suddenly, scholars were trying to understand and open up the black box of money and finance to lay bare the specific cultures, power structures, and materialised models of the world it contained.

This special issue presents five articles that interrogate the connections between financial technology and philosophy. The authors investigate novel conceptual frameworks for understanding financial technologies, discuss specific financial technologies such as Bitcoin and high-frequency trading systems, and offer novel historical and social perspectives to think about the role of financial technologies in our social world. The included articles are: *Digital Art as* '*Monetised Graphics*'*: Enforcing Intellectual Property on the Blockchain*, by Martin Zeilinger; *Fundamentals of Algorithmic Markets: Liquidity, Contingency, and the Incomputability of Exchange*, by Laura Lotti; '*Crises of Modernity*' *Discourses and the Rise of Financial Technologies in a Contested Mechanized World*, by Marinus Ossewaarde; *Two Technical Images: Blockchain and High-Frequency Trading*, by Diego Viana; and *The Blockchain as a Narrative Technology: Investigating the Social Ontology and Normative Configurations of Cryptocurrencies*, by Wessel Reijers and Mark Coeckelbergh.

The thematic of money and finance has as yet only been scarcely touched upon in the field of philosophy of technology, despite the fact that money and finance represent an intricate and significant part of our technology-saturated lives. We engage daily with financial technologies, in visible and sometimes invisible ways, through e-commerce, cash withdrawals from networked ATMs, and, more opaquely, the management of subjectivities through biopower produced by secret financial algorithms (Pasquale

2015). Despite the insistence, pervasiveness, and ubiquity of these technologies, only a few philosophical inquiries have been aimed at understanding the interplay between our monetary, financial, and technological worlds. In line with Simmel's claim that money is "the purest example of the tool" (Simmel 1900, p.225), we believe that inquiring into the intricate relation between money, finance, and technology from a philosophical point of view leads to important new insights, both for the purposes of understanding our contemporary world, and for practical insights to create a more responsible and informed ethics and politics of money and finance.

This special issue testifies to the kinds of insights about financial technologies that can be gained through the lens of philosophy of technology. First, it sheds new light on the ontology of financial technologies—on their status as mediators of human interactions and the ways they shape the meaning of the concepts that capture our social reality (such as liquidity, financial flows, and the circulation of money). The papers of Lotti, Viana, and Reijers and Coeckelbergh contribute to this type of novel insight concerning financial technologies, each exploring the ontology of financial technology in an innovative way. Second, this special issue demonstrates how seemingly unrelated aspects of social life, such as the arts, commerce, and law become entangled through the use of financial technologies. Zeilinger discusses art's entanglement by exploring an emerging blockchain technology used to monetise digital art objects (such as digital images). Third, this special issue illuminates the importance of considering financial technologies and their impact on the history of ideas. Ossewaarde elucidates this connection, linking the philosophical thought of classical social thinkers Comte and Tocqueville to the contemporary debate on financial technologies and their role in the "crises of modernity".

Work on the nexus between finance, financial technologies, and philosophy may also benefit social theorists, media scholars, and philosophers who study the impact of technology and new media. The contributors to this special issue show that work on money, finance, and computation can stimulate the exploration of new avenues in the ontology and politics of technology. These works draw from and complicate existing philosophical investigations of social phenomena, such as information (Floridi 2011), media and mediation (Verbeek 2005; Zielinski 2006), social ontology (Searle 1995), and artefacts (MacKenzie 2008; Winner 1980). Revisiting these theories also requires the contributors to this special issue to look beyond traditional domains for inspiration—for instance, to the domains of art, media, and algorithms. Moreover, this special issue introduces a number of less common authors to the field of philosophy of technology, such as Flusser, Simondon, and Ricoeur. Through financial technologies, the contributors leverage these theorists to introduce new ways of thinking about technological mediation, information, and networks that ought to be central to the field of philosophy of technology.

Searching beyond the traditional domains of philosophy, Zeilinger explores the terrain of artistic intervention into financial technologies through an analysis of the blockchain platform Monegraph. Monegraph is an emerging monetisation platform for art that attempts to create artificial scarcity for digital objects. To do so, digital art objects, according to Zeilinger, are financialised and entered into the capital flows that "traditional" (physical) art has long been part of. He addresses the ways that the traditional tools for managing scarce resources, namely intellectual property law (copyright), have been both flexible and yet deficient when tackling the emergence

of digital art objects. To address these perceived deficiencies in law, the Monegraph platform positions itself as a kind of better version of Digital Rights Management (DRM), which, like the DRM systems that inspired it, works to "stand in" for copyright law. This technological inflexibility, however, worries Zeilinger, especially when manifested in a series of "smart contracts" immutably running on the blockchain. Zeilinger believes that while Monegraph's stated intentions are good (to create value and income for digital artists), the way that the system enters digital art and artists into existing (and problematic) capital flows curtails the real emancipatory potential for digital art (as a potential site of resistance). Moreover, the birth of Monegraph curtails different or future blockchain systems that could (and should) critically intervene into these financial imperatives, rather than creating more efficient onramps to the further commercialisation of art.

Focusing on algorithmic trading, Lotti offers a response to the intrusion of computational methods in finance. She philosophically investigates the concept of financial liquidity, a central concept in contemporary market-making and a term that is often used by those who defend practices of algorithmic trading. Connecting the ontology of computation with Simondon's philosophy of technology, Lotti then proposes a new definition of financial liquidity. Lotti argues that financial liquidity should be understood as ontogenesis, "the manifestation of the coming of the being of algorithmic markets". Lotti's re-conceptualisation of liquidity and markets does not just make a contribution to ontology and metaphysics, it also has implications for thinking about the politics of finance. In developing this new philosophical approach, she offers an interesting synthesis of being and becoming, as applied to both finance and computation. She also suggests that this gesture may support efforts to problematise price as an adequate measure of financial value, and instead seeks a different measure of worth. By resisting the neoliberal naturalisation of markets, Lotti proposes a way to see markets as inherently techno-social ensembles, which implies that markets (and their financial tools) can be changed, perhaps leading to "the invention of new socio-economic organisations". As such, Lotti contributes to ongoing thinking about the nature (or rather, artificiality) of markets, and demonstrates how work in metaphysics is necessary and politically relevant to this broader topic.

Ossewaarde connects discourses about financial technologies to three distinct histories in the crises of modernity. The first discourse is framed by the works of Comte and Tocqueville, with the crisis of modernity marked by disruptions and social revolutions such as the French revolution of 1848 and the Industrial Revolution. Characteristically, Comte views technology as a liberating force (the triumph of Newtonian science), while Tocqueville views it as a potentially weakening and enslaving force. The second discourse is marked by the ruptures of the twentieth century—the Great Depression of 1929 as remnants of the First World War, and leading up to the terrors of the Second World War. Liberal scholars such as Titmuss defended and legitimised the Keynsian welfare state as a response to this crisis, relying on the positive impact of industrial technological development. Radical scholars such as Sorokin, however, argued that technology paralysed the creative powers of the mind. The third discourse points to the financialisation of the world, with the financial crisis of 2008 as the decisive moment of rupture. Modern liberal scholars see technologies such as algorithmic trading of derivatives as liberating people from government control, while radical scholars criticise the crisis of democracy that resulted from this

financialisation as the loss of political alternatives in the wake of the hegemony of finance. Thus, Ossewaarde presents us with a historical framework that helps makes sense of the relations between laudatory contemporary accounts of financial technologies and their pessimistic counterparts, and how these can be linked to a discourse of the crises of modernity.

By connecting the ideas of the Czech philosopher Vilém Flusser to the study of financial technologies, Viana introduces a novel approach to understand high-frequency trading and blockchain technologies. Central to Viana's inquiry is Flusser's concept of the technical image. The technical image has three central properties: (1) it is generated by random particles that depend on underlying code, (2) it results from the activity of technical objects and systems, and (3) it implies the presence of human operators ("envisioners") who determine the meaningfulness of the image. The technical image, therefore, differs from the traditional two-dimensional character of the image, and the one-dimensional, linear character of text, by being non-dimensional and synchronous. Viana links this conceptual development of the technical image to theories of money. In existing literature, the ontological status of money has long been debated, sometimes thought to be due to the circularity of commodities (e.g. gold), or the linearity of text (e.g. ledgers) (for a full description of these debates, see Dodd 2014). Instead, by reading new forms of money and financialisation as "technical images", Viana argues that the digitalisation of finance is a non-dimensional form of money, which instead results from the calculation of present-value counterintuitively based on virtual, expected value. He uses this conceptual framework to analyse high-frequency trading, showing how it is based on algorithmic processes that create technical images of prices. He also uses the framework to analyse blockchain technologies, showing that the algorithmic processes underlying the blockchain network create a technical image of "sedimented" time, made present in the form of virtual coins in a digital wallet. Through these two examples, Viana produces a framework for understanding the enigmatic character of important contemporary financial technologies.

Reijers and Coeckelbergh [1] develop a framework of "narrative technologies" to discuss the social and political dynamics of cryptocurrencies and blockchain technologies. This framework also suggests an ethics of financial technology by problematising the ways financial technologies mediate relationships between people. Re-reading Ricoer's social theory in *Time and Narrative*, the authors argue that blockchain technologies are fundamentally 'narrative', in the sense that they rely on the social reality of a collectively held, socio-technical imaginary. In drawing this comparison, Reijers and Coeckelbergh tease out the symbolic mediations of value (as a feature of money, and a driver of social meaning). Using the example of cryptocurrencies and blockchain technologies, Reijers and Coeckelbergh also develop an ethics for financial technology. Deploying the framework reflexively, a series of hermeneutical possibilities emerge as a way to read latent social inscriptions. To do so, Reijers and Coeckelbergh operationalise the middle part of Ricoeur's theoretical triad—the "configured" time that runs through the (narrative) "plot". With their distinctive and characteristic narrative plots, cryptocurrencies and blockchain

[1] The article of Reijers and Coeckelbergh has been subjected to the regular editorial processes of *Philosophy of Technology* and excluded from the editorial process of this special issue. Also, the relevant parts of this introduction have been written by DuPont, after a personal review of the paper.

technologies alter our capacity to ethically use them and intervene into their design. Rather than being faced with the possibility of working through somewhat more authentic "first-order" narrative plots, these financial technologies "abstract" away the "actual" characters and events, leaving "remote" second-order activities that are mere representations. In doing so, the complex interplay of actual entities is potentially forgotten and uncritically replaced with another second-order narrative instead.

As these articles show, this special issue marks the start of a discussion rather than its critical and conceptual conclusion. Financial technologies will continue to play a large part of our lives, and will continue to pose new ethical, epistemological, and ontological challenges daily. The contributors to this special issue had a daunting task in front of them, and rose to the occasion by revising and responding to the reviewers' helpful feedback, and accommodating our editorial interventions. In being so willing to entertain our initial exploration of the thematic, *Philosophy and Technology*, its Editor-in-Chief, Luciano Floridi, and Springer show that editors and publishers are open to critical new approaches. The special issue editors, Coeckelbergh, DuPont, and Reijers, would like to extend our gratitude and thanks to the authors, reviewers, and journal editors that made this work possible.

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