# The Diffusion of Blockchain as a General Purpose Technology Driving Digital Transformation

A. Jason Windawi

> *"The function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way, by opening up a new source of supply of materials or a new outlet for products, by reorganizing an industry and so on."*
>
> Joseph Schumpeter
> (1883-1950)

Digital transformation as a process is integrally linked to the creation and diffusion of a set of general purpose technologies (GPTs) that provide both the motive force, as well as the means, for the transformation of existing industries and the creation of entirely new ones. This article takes as its subject the diffusion of one such technology —blockchain —and explores the relationship between the Schumpeterian innovation at the core of its diffusion and digital transformation as a macro process. Theoretically, I work from Rogers' definition of diffusion as a locally heterogeneous process in which variation in a new technology's use and adaptation are driven by the decisions of entrepreneurs working in specific contexts, as well as Schumpeter's concept of innovation as a form of recombination. I explore variation in these processes of innovation and recombination across three broad clusters of implementations: Digital Economies, Digital Finance, and Extra-Institutional Trust. I find that each of these clusters is marked by a distinct form of innovation defined by differing patterns of recombination with other digital GPTs, and by the role that institutions and institutional actors play in this variation.

## Introduction

Digital transformation as a process is integrally linked to the creation and diffusion of a set of technologies that include blockchain as well as artificial intelligence (AI), machine learning (ML), the Internet of things (IoT), and virtual/augmented reality (AR/VR) (Schildt, 2020). As in prior periods of major transformation, these "general purpose technologies" (GPTs) provide both the motive force as well as the means for both the transformation of existing industries and the creation of entirely new ones (Bresnahan & Trajtenberg, 1995). Studies of GPTs have tended to work retrospectively to identify whether a given technology meets the definition of a GPT based on historical data from sources such as patent filings (for example, Feldman & Yoon, 2012). The fact that digital transformation is an ongoing process shifts the analytical terrain from merely being a binary identification of whether a given technology is a GPT, to a more nuanced question involving the mechanisms that underlie its diffusion into the world in the period of ferment (Tushman & Anderson, 1986).

Dominant theories of diffusion and innovation provide a tractable approach to identifying these mechanisms. In his pioneering work on the diffusion of new technologies, Everett Rogers (2003) described this

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diffusion as a "heterophilous" process in which new technologies are adapted and repurposed within each new setting where they are adopted. Schumpeter (1934) described one aspect of this process of innovation as the recombination of components. By extension, we should expect that a GPT will be reshaped in different ways by entrepreneurs working in different sectors of the economy, with recombinations varying by the nature of those sectors. This article takes as its subject the diffusion of blockchain as a GPT and explores the relationship between the Schumpeterian innovation as a mechanism of diffusion and digital transformation as a macro societal process. In particular, it asks: ***how does the development and implementation of blockchain as a novel general purpose technology vary across applications and domains?***

Encompassing all of the uses of blockchain as a GPT would require an analytical lens spanning thousands of potential applications. For the sake of parsimony, I draw from a taxonomy developed by applying topic modeling to a unique data set of more than 5,500 blockchain project documents (Windawi, 2021). For the present study, I build on that taxonomy through an interpretive exploration of variation within three broad clusters of blockchain innovation. I define the first of these as "**Digital Economies**" given that they each encompass existing industries and markets from the creation of raw materials through to the creation of end markets where consumers and producers meet. The second group — "**Digital Finance**" — spans various finance-based applications of blockchain technology, including those focused on managing and trading assets, as well as those more closely focused on money. I call the final set "**Extra-Institutional Sources of Trust**" in deference to the pioneering work of Zucker (1986) on the relationship between large-scale social change and the transformational character of trust. In contrast to the now well-established institutions Zucker studied, these new categories draw on computational and other digital methods to assume key functions of traditional institutional actors for use in digital spaces.

Taking this variation as a focus, I emphasize two types of recombination that are particularly germane for GPTs. The first begins from the idea that digital transformation is driven by multiple forms of GPT, which implies that blockchain will interact with other digital GPTs, though the nature of these interactions are unclear ex ante. The second, contrasting form of recombination focuses on institutions (for example, money, law) and institutional actors (for example, central banks, courts), commonly viewed and theorized as sources of stability rather than disruption. To the extent that blockchain is a GPT, these two poles help tease out the strands of its diffusion.

In what follows, I examine both innovation and recombination involving blockchain technology within each of these clusters, as well as the sources of variation both within and across them.

## Digital Economies and Pragmatic Innovation

I use the umbrella descriptor "economies" for the largest grouping of top-level categories. These groupings have many of the hallmarks of sectors or industries in their incorporation of all stages of production, from sourcing basic inputs through to the construction of two-sided markets for consumers and producers of finished goods. I call them "economies" because of their added capacity to create their own programmable money. Rather than engaging with institutions or institutional actors, pragmatic innovation instead draws on established forms such as platforms and multisided markets. It then recombines these with blockchain technology to address existing challenges in established domains, such as fraud in online advertising. I call this pattern *pragmatic* or problem-solving innovation.

In this context, blockchain technology is generally used to support the creation of operational and business models seeking to reorient power and control away from a central actor or institution. These can be monopsonistic firms in consolidating industries such as food or energy, or the more widely discussed platform monopolies in social media and the gig economy (Schor & Attwood-Charles, 2017; Zuboff, 2019). These models are grounded in the creation of new forms of property rights in digital and physical objects, distributing those rights through incentives and transactions related to tokens that embody them, and creating markets and other platforms on which those tokenized rights can be earned and traded. These digital representations in turn enable the tracking of provenance and authenticity not only of the end product such as a song, but also of its components across their entire histories, allowing for more finely grained monetization (for example, the percussion track of an individual song that is resampled in another).

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*Physical Economies*

The Physical Economies subcluster within Digital Economies includes projects that are linked by efforts to embed distributed and networked sensors, combining blockchain with the Internet of Things. This subcluster includes agriculture, energy, and materials, as well as logistics, shipping, supply chain, and other modes of transporting these and other materials. In each of these cases, the role of blockchain technologies is primarily one of embedding data at an early stage of production into goods, and then tracking those goods as they make their way into end markets. The ability to create new networks and markets using blockchain technology (Catalini & Gans, 2016), when coupled with the use of distributed sensors and other technologies, has also underwritten the expansion of energy projects to include "prosumer" markets. These allow participants to trade the energy they generate on local micro grids connected with their private home usage.

*Data Economies*

The second subcluster within Digital Economies is the site of the most intensive recombination of blockchain and other digital GPTs. The Data Economies grouping includes projects that seek to deliver alternative forms of distributed storage and computation that don't rely on existing monopoly cloud platforms. These projects generally seek to build on blockchain's background in distributed systems engineering to build technology that allows those providing nodes to offer some combination of data, storage, and computational capacity. The economic aspect involves the creation of markets where those seeking that computational capacity can pay for it, typically using a project-specific token.

*Creative Economies*

The Creative Economies subcluster comprises an array of classifications in media, gaming, entertainment, and art linked by the common concept of tokenizing definitive (and thus tradable) ownership rights in creative works, as well as the development of multisided markets where those rights can be monetized and traded. Within this group, entertainment projects encompass a wide range of activities, from crowdfunding production and idea development to distribution by streaming and other methods. Advertising projects using blockchain are almost entirely focused on online advertising, and in particular on using blockchain technologies to address both operational challenges such as poor data and fraud, as well as economic problems such as the oligopolistic power of platform incumbents Google and Facebook.

Rather than through recombination with other digital GPTs, the Creative Economies subcluster is instead marked by the development of a novel form of digital token. One of the most widely known developments in blockchain in recent years grew directly out of concerns for establishing the provenance and authenticity of rare creative goods. As a counterpart to traditional cryptocurrencies, Non-Fungible Tokens (NFTs) create unique digital representations that theoretically establish digitally secured proof of ownership. While NFTs originated as tokenized collectibles in the gaming sector, they became a more public phenomenon when they became linked to digital artwork. NFTs have subsequently become an intense focus of luxury and other forms of branding, as well as offering a broadening set of potential uses in consumer markets (Sundararajan, 2022).

**Competitive Innovation in Digital Finance**

In contrast to the prior two clusters, the Digital Finance cluster is marked by intensive recombination across other digital GPTs, as well as with both institutions and institutional actors. Both the Digital Assets and Digital Money and Payments subclusters are defined by fundamental transformations to the core institutions of the global financial system that are being pursued simultaneously by incumbent organizations and challengers. These efforts were initially conducted in parallel, as blockchain and cryptocurrency startups following the lead of Bitcoin and Ethereum worked entirely outside of traditional institutions, while incumbent institutional actors focused largely on the infrastructure or "plumbing" of the traditional financial system. In more recent years, however, both traditional institutional actors and blockchain-native projects are developing variants of the same technology to create their own versions of a digitized and tokenized financial system. This convergence leads me to term this pattern *competitive innovation*.

*Digital Assets*

At first glance, the categories in this cluster align well with the frequently used term "fintech," a growing set of digital innovations that are creating new products, services and business models in all aspects of finance (Philippon, 2016). The convergence of categories across this cluster is driven in large part by the ambiguous nature of cryptocurrencies and other forms of digital

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tokens. From the historical perspective of Bitcoin, these forms of "crypto" are variants on digital money, making them most relevant to individuals and to institutional actors traditionally involved in using and building infrastructure for money and payments systems. This characteristic made cryptocurrencies and crypto payments the initial core of the *Digital Money and Payments* subcluster. Unlike traditional forms of money, however, these digital tokens are also intentionally linked to actively changing market prices. Peer-to-peer (P2P) markets for cryptocurrency initially grew out of the reliance of these tokens on market prices to give economic force to the incentives that govern participation in their networks, along with the attractive boom dynamics of crypto prices. These markets and exchanges for cryptocurrencies, together with related services such as wallets, were the initial infrastructural core of the Digital Assets subcluster.

Over time, any distinction between digital and traditional financial markets has increasingly been challenged by the expansion of the function and nature of digital tokens beyond their original use as cryptocurrency, though popular usage often conflates these assets under the moniker "crypto". One of the earliest expansions was into the domain of digital representations of traditional investments such as real estate, stocks, and bonds to make them tradable on token (rather than regulated equity and bond) markets and registered on a blockchain. States have also begun to issue new tokenized securities such as government debt in blockchain-based trials, bypassing traditional markets entirely. The arrival of NFTs and the explosion of interest in (and hype around) them has aggressively expanded the frontier of investable digital assets to include representations of digital art, collectibles, and other goods.

This growth in the range of investable digital tokens has been met with increasing interest from more conservative institutional investors. The entrance of these traditional, regulated institutions into markets for Digital Assets has been accompanied by the entrance of traditional providers of infrastructure for custody and other services required by those investors. As a result, some of the oldest financial institutions in the world, such as BNY Mellon and State Street, are now either partnering with digital asset startups, such as Copper, or launching their own services (or both) to capture a share of markets that until recently were seen as entirely speculative.

*Digital Money*

As noted above, the Digital Money subcluster was initially dominated by cryptocurrency and crypto payments, though it has traced a similar trajectory to Digital Assets in terms of the increasing competition between P2P and state institutional actors. This competition has its roots in the nature of state (fiat) currency and its pivotal role in the current financial infrastructure. Central banks are national entities with various mandates rooted in their ability to issue and provide transactions in currency that they issue. Often called "central bank money" (and distinguished from "private" or "bank money" issued by banks based on deposits), this money is regarded as a country's risk-free asset (Brunnermeier & Niepelt, 2019). Larger central banks also manage national systems for the settlement of inter-bank transactions for payments and various kinds of securities transactions, making them central actors in financial markets beyond those for national currencies. The construction of technology-enabled Real-Time Global Settlement (or RTGS) systems has been a focus for central banks around the world for decades.

The importance of settlement is easy to overlook precisely because of the success of these and other, private payment and settlement systems, such as Visa's. The ability to make transactions final, and to ensure timely payment from one party to another, is foundational to the viability of both money and of property rights, and thus of a functioning banking and investment system. RTGS systems play a special role among settlement systems in that they allow network participants to settle their transactions in central bank money, which means that the central bank (as the sponsor of that money) provides an added layer of risk protection for institutions able to access its systems. This combination of state or central bank money and security has resulted in enormous amounts of money flowing through these systems. For example, the US Federal Reserve's RTGS system is called FedWire. It settled more than US$77 trillion of transactions in the month of February 2022 (Federal Reserve, 2022).

It is on precisely this terrain of central banks —the ability to produce "safe" money and to provide transaction finality —that a relatively new form of cryptocurrency has arisen. So-called "stablecoins" seek to pair the P2P character and payment mechanisms of cryptocurrencies with the relative price stability of state currencies, gold, or money market funds. Stablecoins vary primarily in

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the means they use in their attempt to deliver price stability. The earliest variants defined "stability" in terms of the price of a more traditional asset —typically the US dollar or gold —and sought to peg the coin's value to that asset by using the proceeds of coin sales to purchase the same asset to ensure that the coin's price moved that of the asset. Another approach to stability involves using an underlying portfolio of cryptocurrencies that are actively traded, echoing the approach of traditional money market funds.

*Decentralized Finance, Stablecoins and CBDCs*

Beginning in 2020, a new wave of stablecoins and other P2P finance offerings came to market under the banner of "DeFi," or Decentralized Finance. Elements of DeFi as a P2P form of finance existed prior to the popularization of the term (particularly in P2P lending and insurance), but it wasn't until 2020 that it began to cohere in practice and in identification as a coherent set of practices and business models. The core impetus of DeFi is the replacement of centralized actors in financial markets and systems with solutions and practices that claim to be more decentralized.

The centralized building blocks DeFi seeks to replace are generally hidden from nonprofessionals but include infrastructural providers of liquidity and capital, as well as credit scoring, trading clearinghouses, and other forms of financial infrastructure. In DeFi, these are typically replaced with some combination of algorithmic (for example, automated rather than centralized market making) and collective alternatives. The collective alternatives vary in their goals, but typically provide incentives for individuals to bond or stake their tokens, and then aggregate those staked holdings into larger pools that provide liquidity for the trading mechanisms and exchanges that are at the core of the offering.

Like other DeFi projects, these new forms of stablecoins are largely based on some combination of algorithmic management and sophisticated arbitrage trading, which the projects rely on for executing whatever monetary policy they enact in the pursuit of price stability. In many cases, these involve creating an underlying portfolio of collateral and then offering multiple tokens with different rights in that portfolio (for example, an equity token with capital appreciation rights and a bond token with income rights), distinct from the stablecoin itself. The tokens are actively traded on a project-specific exchange allowing both long and short positions (rather than being traded against a variety of other tokens, as occurs on most exchanges), and their prices are designed to play a significant role in valuing the underlying portfolio and thus (ideally) supporting the value of the stablecoin linked to the portfolio. This combination makes DeFi stablecoins relatively complex entities, with aspects of both bank accounts (interest-bearing deposits denominated in a stable currency) and speculative investments (actively traded sub-tokens with debt and equity characteristics).

The claim of stablecoins to provide a price-stable cryptocurrency operating outside of the traditional monetary system has made them a focus of central banks that are already in the midst of significant changes to payment and settlement systems. Central banks and related institutions, particularly the Bank for International Settlements (BIS), often called "the central bank of central banks", have responded to the rise of DeFi and of DeFi stablecoins with a rapidly growing body of research and pilot projects on central bank digital currencies or "CBDCs," digital variants of central bank money (Auer & Böhme, 2020; Bank of England, 2020; Chaum et al., 2021). As a rationale, most of this research cites advances in payment networks and the advent of stablecoins, along with the declining use of physical cash. Many of these projects also link blockchain-based advances in central bank digital cash to blockchain-based efforts to innovate on existing RTGS systems for central bank settlement, though this is not universal.

Two of the most advanced pilot projects capture some of the range of possibilities for central banks engaging with blockchain technology. In Sweden, the central bank has been among the most active in the world in exploring new cash and payment systems given the country's unusually low use of physical cash (Sveriges Riksbank, 2021). The shrinking use of physical cash threatens to reduce the Riksbank's role in the Swedish economy since that cash is currently the only form of central bank-issued money available to individuals. To address this, the Riksbank has explored an alternative payments network in which individuals can access tokens linked to the value of the Swedish Krone, but held in individual accounts, and available to be used in payment networks. The companies involved in these networks would be the nodes in the blockchain-based network and would have access to Sweden's RTGS system "RIX", where they would be able to conduct settlement in e-Krone. Given its focus on use by individuals, the e-Krone project is considered a

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potential retail CBDC.

At the other end of the use spectrum are wholesale CBDCs, whose users would be financial institutions focused solely on settlement. Given the global scope of many of the banks operating in these settlement networks and the relative size of their markets, wholesale projects often contemplate the possibility of both domestic as well as cross-border (and thus multi-currency) settlement. One of the most advanced projects in wholesale, cross-border CBDC grew out of initial pilot projects for blockchain-based settlement platforms initiated by the central banks of Singapore and Thailand. In 2021, these projects merged into a larger, collaborative effort spearheaded by the Bank for International Settlements exploring a new concept they call m-CDBC, or multiple CBDC. The core concept of the project is the use of digital state currencies (available only to financial institutions with access to central bank settlement) to make cross-border settlements more efficient. As with the e-Krone project, the nodes in this closed network would be run by approved financial institutions rather than open to individuals.

**Creating Extra-Institutional Trust**

Of all the institutional characteristics invoked in discussions of blockchain technology, trust is perhaps the most cited (Economist, 2015; Werbach, 2018; Lemieux, 2022). While some scholars and practitioners describe the technology as "trustless", others write more convincingly about the production of new kinds of trust that shift the locus of trust from existing intermediaries to a distributed set of actors in a blockchain network (Seidel, 2018). This claim is similar in spirit to Zucker's (1986) pioneering work on the production of new modes of trust during the industrialization, another period of fundamental transformation. These new modes, which Zucker called institutional-based trust, were made necessary by the disruption of traditionally localized market interactions based on interpersonal trust. The new modes replaced interpersonal trust with structures such as intermediaries (for example, banks, insurance companies, financial markets) and intermediary functions (for example, escrow, formal contracts) that allowed strangers to transact via what Shapiro (1987) called "guardians of impersonal trust".

The projects in this cluster engage directly with the functions of many of these core institutions while operating largely outside of the traditional institutional actors that have historically produced them. This leads me to define them as sources of *extra-institutional trust*, a term I apply to the final categories of the taxonomy. Because these projects seek to provide digital alternatives that assume many of the functions of traditional institutions while working largely outside of them, I define them as involved in *institutional reinvention*. The projects providing these alternatives to traditional sources of trust ground their claims of effectiveness in the ability of blockchain ledgers to provide tamper-free records, and in the automated execution of increasingly complex smart contracts, though each combines these in a different way.

*Digital Truth*

The Digital Truth subcluster collects projects that involve the establishment and verification of truth claims. Digital identity-focused projects seek to fill a gap in the Internet's structure and functioning, neither of which originally incorporated an identity layer. The solution of many projects, such as Civic, is to build on some combination of attestations to an individual's identity claims from traditional state records such as a passport or driver's license as well as from individuals and organizations taken as authoritative within that project's framework. Many of the projects in this subcluster are focused either on building on the outputs of existing institutional actors (such as notaries) who provide the initial attestation that then is digitized and verified within the system, or replacing them entirely by creating purely digital forms of verification. Others build on the central role of ratings and reputation in establishing online credentials useful to those seeking to navigate markets or platforms in which their information is limited. Blockchain projects focused on building reputation systems seek to create reputations that are secure and verified, but also portable from one setting to the next. This latter characteristic would allow individuals to incorporate their amassed reputation from all of their activities online into a portable form of identity, a possibility not currently feasible given the forms of enclosure central to the business models of platform incumbents (Zuboff, 2019).

This subcluster also incorporates approaches that use market and computational methods to establish alternative sources of truth. Although blockchains are based on the secure storage of data, they ironically have no native mechanism for accessing data in the real world beyond what is entered directly into the ledger. Such data is particularly important for smart contracts,

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which are self-implementing code linked to blockchains whose execution is often conditional on some event in the real world (for example, "pay Alice $100 if the temperature exceeds 75 degrees"). Such contracts often rely on a construct called an oracle that feeds data to the smart contract from an authoritative external source. This crucial role has also made oracles a central component of blockchain-based prediction markets. Although forms vary, prediction markets typically combine some form of exchange on which predictions are traded in order to establish a collective prediction and an oracle to establish the definitive outcome. Some prediction market protocols (such as Augur, a market on the Ethereum blockchain) also incorporate a decentralized oracle based on other market mechanisms. In all cases, the assumption that participants are incentivized to converge on the correct outcome typically means that predictors are rewarded for alignment with the majority.

*Digital Governance*

The second subcluster is Digital Governance. These projects are distinguished by their formalization of mechanisms that replicate aspects of core institutions of law, democratic voting, dispute resolution, and formal organization, as well as their focus on providing them to other projects as product offerings.

Digital Governance projects include both functions and structures of governance and are increasingly becoming modularized so that the functions can be recombined in new structures. These functions include mechanisms for collective decision-making through various forms of token-weighted voting, as well as related mechanisms for groups to resolve disputes. In both cases, participation is often further mediated by reputation and verified expertise using the tools I describe above.

Structurally, Digital Governance is increasingly accomplished through the creation of decentralized autonomous organizations, or "DAOs". These are encoded forms of coordination that seek to retain the coordination benefits of formal organizations, while replacing most of the substance of bureaucracy with a combination of code, open source modes of governance, and membership rules. This substitution is enabled by the increasing sophistication of smart contracts that comprise this code, as well as by the visibility of ongoing experimentation with the form, which has created an unofficial knowledge base regarding its implementation. This experimentation has in turn expanded rapidly from the initial emphasis of DAOs on investments to include DAOs governing protocol development (for example, Gnosis), DAOs for curation and funding of public goods (for example, Gitcoin), DAOs for social connection (for example, Friends with Benefits) and an expanding collection of other group objectives. Many of these efforts are entirely new, purpose-built collectives, while others are recent additions to ongoing, protocol-based projects engaged in the progressive decentralization of their governance

While earlier efforts at forming DAOs were often reliant on DAO hosting platforms such as Aragon and DXdao, the rapid proliferation of the form and its uses has spurred the creation of a growing collection of projects that provide specific services or "tooling" available to be incorporated as modular code components. These services include a range of possible organizational supports such as compensation (for example, Coordinape), governance and voting (for example, Snapshot), and token fundraising (for example, Fairmint). These pluggable services provide a rich and growing set of design choices to groups seeking to create or tune a DAO to their objectives.

Much as this cluster is defined by the absence of traditional institutional actors, it is also marked by the general absence of other GPTs of digital transformation. By implication, the ability to construct internally consistent truth claims, validation, and modes of governance are uniquely linked to blockchain as a form of digital transformation.

**Discussion and Conclusion**

The patterns described above establish three broad meta-categories of applications, and the specific forms of recombination and reinvention that have characterized each during the diffusion of blockchain as a GPT. They also point to two broad findings regarding interactions among GPTs, institutions, and digital transformation. The first is qualitative differences in the relationship between GPTs and institutions in each of the three patterns. What makes them especially salient in their imbrication appears to be related to the extent of overlap between the types of GPTs and the institutional functions for which they might be used.

From an institutional perspective, the most dramatic potential transformations I describe above are the result of the closest alignment between the general purpose

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aspects of the technology and the functions of institutions involved in the transformation of a domain such as banking or law. As a first approximation, the greater this alignment, the more likely the pattern of transformation will result from either competitive or institutional reinvention, which is to say, the more likely the pattern will appear to involve a fundamental revision to existing institutional arrangements. By contrast, domains in which the technology is largely used for solving well-established problems of coordination in existing industries are less intensely engaged with underlying institutions and very rarely with institutional actors.

The other dimension along which these patterns vary is the extent to which other digital GPTs are involved in digital transformation. Here again, technological-institutional alignment may play a role, though seeing it clearly requires expanding the perspective to include other digital GPTs. The various incumbent industries I describe above as Digital Economies would appear to complicate the role of blockchain as a GPT by limiting its role in transformation in these settings, given the more central role being played by the Internet of Things, machine learning and other digital GPTs. A closer look reveals that blockchain technology is not sufficient in these settings to be transformational on its own, but can contribute to larger processes of transformation being driven by other technologies. Those other technologies are likely more closely aligned with institutionalized functions (for example, the Internet of Things aligning with global supply chains) than is blockchain technology as a GPT.

These findings also point to several potential areas for future research as blockchain technology and its uses continue to grow. The first will become increasingly possible with the passage of time, allowing for a richer investigation of not only the diffusion of uses for blockchain technology laterally across domains (as this paper explored), but also longitudinally within them. The question of why some institutions have responded with their own innovations (in competitive reinvention) while others don't (leading to institutional reinvention by new technologies) is one for further study that will reward closer analysis of individual cases. More broadly, a closer analysis of the interactions between blockchain and other digital GPTs could provide an important perspective on the layering of these technologies. The proliferation of data on these and other topics point to a rich future for research on the dynamics of digital transformation.

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