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# Does digitalization mitigate or intensify the principal-agent conflict in a firm?

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## Abstract

In this article, we analyse the impact of business digitalisation on the principal-agent conflict. While there are several studies of impact of digitalization on corporate governance, the empirical evidence has so far been relatively scarce. We examine the principal-agent conflict from several angles: the number of shareholder-sponsored proposals submitted for the shareholder meetingsб the level of support for management-sponsored proposals and the frequency of proxy contests. As a proxy for the active digitalisation of a firm, we use the blockchain technology that has the potential to fundamentally change the distribution of power within an organisation, potentially mitigating the principal-agent conflict. We analyze a sample of 2813 NYSE, Nasdaq and AMEX-traded firms for the year 2018, during which rapid blockchain adoption was exhibited. Our results suggest that firms active in business digitalisation overall have a lower level of principal-agent conflict. We find that such firms generally have shareholders that are more active, which indicates an environment less prone to the principal-agent conflict. While on average, proposals submitted by the management receive less support during voting, the share of approved proposals does not change for the digitising firms. Proxy contests appear relatively rare among the firms active in digitalisation, however, there is not yet enough data to confirm this.

**Keywords** Corporate governance · Blockchain · Digital transformation · Corporate voting · Proxy contest · Shareholder activism

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## 1 Introduction

The principal-agent conflict has been a major framework of corporate governance research for more than 40 years—at least since the landmark (Jensen & Meckling, 1976) article and earlier in works as (Berle & Means, 1932). Due to different objectives motivating the behaviour of managers and shareholders, the former sometimes make decisions which prove suboptimal for the latter, and even for themselves over the longer term (Aghion et al., 2013).

Passive investors create the environment that makes the principal-agent conflict possible (Roe, 1991). According to a study by Broadridge Financial Services, which tabulates votes in most U.S. corporate elections, voter turnout rates have been reported at 83% for institutional investors, but only 28% for household retail investors.[1] Studies show that investors do not actively monitor portfolio firms (Coles et al., 2014; Fich et al., 2015) or blindly follows recommendations of proxy-voting advisors such as ISS (Iliev & Lowry, 2015; Malenko & Shen, 2016).

Since the 1940s, shareholders have had the right to submit proposals for voting. This mechanism serves as a way for shareholders to get actively involved in governance of the firms. Multiple authors argue that those proposals giving the shareholders the right to be heard decrease the intensity of the principal-agent conflict (Ryan, 1988; Gordon, 1993; and Pozen, 1994). Several authors, e.g. Karpoff et al. (1996) explore the characteristics of firms receiving these proposals and conclude that "measured by the market-to-book ratio, operating return on sales, and sales growth rate, firms attracting proposals are poor performers."

In the current "age of shareholder activism" (Foldsey et al., 2015) the topics of principal-agent conflict, its causes, and the corporate governance mechanisms designed to mitigate it, are as relevant as ever, and recent technological developments further increase their relevance. Active exploration of digital technologies has become an imperative for firms recently and as such should play an important role in the agenda of the board of directors (Grove, Clouse, & Schaffner, 2018). However, there is limited evidence as to the impact of the digital transformation of business on the principal-agent conflict.

From a practical point of view, digital transformation is the implementation of digital technologies with transformative potential. There are multiple technologies that have a significant impact on the business overall, and corporate governance in particular. Examples of technologies commonly surveyed in the research literature include artificial intelligence, big data, 3D printing, and blockchain (Zhu, 2019; Grove, Clouse, & Schaffner, 2018).

Research shows that firms actively and continuously implementing digital technologies outperform the market by a variety of metrics (see e.g. Westerman et al., 2012). Research also shows that well-performing firms tend to have a weaker

[1] See http://media.broadridge.com/documents/Broadridge-PwC-ProxyPulse-1st-Edition-2015.pdf.

principal-agent conflict (see e.g. Karpoff et al., 1996). Hence, it is reasonable to expect that on average, firms actively pursuing digital transformation should have a weaker principal-agent conflict. We explore the impact of the digital transformation on the principal-agent conflict by selecting a set of firms which are particularly active in the digital sphere and comparing the principal-agent conflict intensity for them with average companies on the market. To build the set we need to choose the firms exploring the technology, clearly signaling the shareholders the seriousness of a firm's digital ambitions. Public information on exploration of this technology would serve as a proxy for the digitalisation.

The aforementioned technologies have strong potential impact on corporate governance. Some technologies have a relatively clear impact on corporate governance, while others do not. For example, Big Data has been explored for a very long time, and has a documented positive impact on corporate governance e.g., by preventing information abuse by managers (Zhu, 2019). A particularly attractive technology from a research perspective is blockchain. Multiple authors call blockchain the technology with the most transformative potential for business, including corporate governance (Cong & He, 2019; Economist, 2015; Yermack, 2017). Although, it is a relatively advanced technology with multiple established market players and solutions, the empirical research remains scarce. Hence, we select it as the focus technology.

According to Swan (2015) the "blockchain concept… is a new organising paradigm for the discovery, valuation, and transfer of all quanta (discrete units) of anything, and potentially for the coordination of all human activity at a much larger scale than has been possible before." The survey on blockchain applications for corporate governance shows that researchers consider them to be an instrument capable to help corporate boards in mitigating the conflict at least partially (Ivaninskiy, 2019).

As with most new technologies, data on the firm's exploration of the blockchain technology is scarce. Thus, we use a very general definition of blockchain application and approach to data collection that we discuss later. Hence, we believe our results should be interpreted more as association of principal-agent conflict with digitalization overall rather than specifically with blockchain. Nevertheless, blockchain possess certain characteristics important from the corporate governance perspective which we discuss later in the paper and which we intend to test in the subsequent more focused research.

We contribute to the literature by exploring the influence of digital transformation with three lenses: likelihood of submission of a shareholder proposal; level of support for the proposals (sponsored both by management and by shareholders); and likelihood of a proxy contest against the firm. We find mixed evidence. On the one hand, the results show that firms active in digital transformation have more active shareholders submitting more proposals for the annual meetings, which indicates the environment is less fertile for the principal-agent conflict. However, those more active shareholders demonstrate less agreement with the management, which may seem to be a sign of more intense conflict. Yet, the overall share of proposals that end up approved does not differ between blockchain adopters and non-adopters. As for the proxy contest, there is some evidence that they may be less frequent among firms active in digitalization, but there is not yet enough data to confirm this.

The rest of the article is structured as follows. In Sect. 2, we very briefly survey the literature on shareholder proposals as a governance mechanism. In Sect. 3, we provide an overview of the blockchain technology and its potential impact on the principal-agent conflict. In Sect. 4, we describe our model and summarise our hypothesis. In Sect. 5, we discuss the data under research. In Sect. 6, we present our research results. Section 7 presents our conclusions, identify the limitations of the study and outline the next steps for ongoing research.

## 2 Overview of shareholder proposals as a corporate governance mechanism

Shareholder activism in a form of shareholder proposals is one of various measures that investors can apply to get actively involved in the working of their firms, including involvement in corporate governance (Gillan & Starks, 2007). Other measures include soft actions such as selling shares—"voting with their feet" (Parrino et al., 2003) or hard actions such as initiating a buyout or a takeover (Fama & Jensen, 1983). However, surveys show that shareholders try to hold private negations first, prior to taking public actions (McCahery et al., 2016; Levit, 2014).

Both theoretical and empirical literature is split between proponents and opponents of shareholder proposals as governance mechanisms. For example, (Bebchuk & Cohen, 2005) and (Harris & Raviv, 2008) in their theoretical works, argue that shareholder proposals mitigate agency problems, associated with managerial decisions. (Ertimur et al., 2010; Thomas & Cotter, 2007) highlight that 40% of proposals that pass the majority vote are implemented despite their non-binding nature. (Renneboog & Szilagyi, 2011) point out that the "firms that ignore passed proposals have been shown to draw negative press, receive downgrades by governance rating firms, or end up on CalPERS's "focus list" of poor financial and governance performers".

However, activist shareholders do not necessarily have the 'proper' objectives themselves. Multiple authors argue that shareholders, including pension funds, may either have their own agendas (see e.g. Prevost et al. 2012) or may simply not have enough information for corporate governance decisions. Some legal authors even argue that shareholder proposals may be even harmful for firms and that there has to be a higher hurdle to submit a proposal (see e.g. Bainbridge, 2006). Multiple empirical studies show there are no positive abnormal returns associated with submission of shareholder proposals (e.g. Karpoff et al., 1996), indicating that the market does not recognise shareholder proposals as a viable control device. Some studies even show negative returns associated with 'poison pill' removal proposals (e.g. Prevost & Rao, 2000).

While acknowledging the aforementioned issues, we believe that the shareholder proposals act as a viable governance mechanism, serving as *aurea mediocritas* in a shareholder's governance toolkit, and hence serve well for the purpose of our research.

There is a debate in literature about what shareholder-sponsored proposals mean in terms of quality of corporate governance of a firm and shareholders' satisfaction with management. (Renneboog and Szilagyi, 2010) argue that normally, firms

receiving more shareholder-sponsored proposals have weaker corporate governance mechanisms. However, (Akyol & Carroll, 2006) find no connection between the number of shareholder-sponsored proposals and the quality of corporate governance. Nevertheless, multiple authors (e.g. Bebchuk & Cohen, 2005) argue that shareholder participation in corporate governance in the form of shareholder-sponsored proposal has mitigating effect over the agency problems. Hence, it is reasonable to assume that at the very minimum they show the higher engagement of shareholders, which in itself is a sign of a weaker principal-agent conflict (Fich et al., 2015).

## 3 Brief overview of blockchain and its impact on corporate governance

### 3.1 Blockchain technology

Multiple articles describe the technical characteristics of blockchain technology and its benefits (see e.g. Swan, 2015; Yermack, 2017). "A blockchain is a database shared among its users that allows them to transact valuable assets in a public and pseudonymous setup without reliance on an intermediary or central authority… From a technical perspective, a blockchain is a composition of a distributed database, a decentralised consensus mechanism, and cryptographic algorithms. More specifically, transactional data is stored in a potentially infinite sequence of cryptographically interconnected data blocks. These blocks are ordered by a decentralised time stamping algorithm, which allows users to vote on the validity of database updates, and eventually agree on the correct order of transactions and a shared system state at any given point in time. As a result, the users of a blockchain system can interact without the need for a central authority that resolves conflicting views of the correct order of transactions." (Hawlitschek et al. 2018). Research literature covers two types of blockchain application: a reliable distributed ledger coupled with a platform for transactions and smart contracts.

First, given it is a public register, there is no third party or central authority overseeing the system, in case somebody wants to manipulate the register it would be necessary to change all the past history of the register on a global scale. Such a change would require an overwhelming computing power (Magnier & Barban, 2018). This blockchain application is the basis of cryptocurrencies such as Bitcoin. However, it may be used for recording any type of transaction of a firm, making it more transparent and trustworthy.

Smart contracts are obligations stored in the computer code that execute themselves without the control of third parties (Swan, 2015; Macrinici et al., 2018). While smart contracts were envisioned as early as the 1990s (Cong & He, 2019; Lee, 2015; Szabo, 1997), the first real world applications were built only with the creation of blockchain. Smart contracts have a strong potential to challenge the nature of modern business organisation. Smart contracts can reduce the power of third parties and create transparency for shareholders (Buterin, 2014; Wang et al., 2017). Various researchers propose applications of smart contracts, e.g. for financial markets e.g. (Malinova and Park, 2016; Caytas, 2016), in trade finance (e.g. Cong &

He, 2019), for supply chain management (e.g. Min, 2019), government services (e.g. Ølnes et al., 2017), the energy sector (e.g. Andoni et al., 2019) etc. No matter what form of blockchain activity a firm pursues, it has multiple implications for business life, including corporate governance, which we will discuss in the next section.

### 3.2 Business benefits of blockchain implementations

There are multiple papers demonstrating significant business benefits of blockchain implementation in a firm, primarily through cost savings on transactions settlement. There are various aspects of corporate life that may benefit from blockchain implementation, and they differ depending on industry (e.g. Beck et al., 2017) highlight the potential benefits for storing medical data) Hughes et al. (2019) offer a comprehensive literature review of business benefits offered by blockchain. However, there are two aspects that are relevant to most industries and that stand out strongly: financial operations and supply chain management. (Dobrovnik et al., 2018) review the blockchain applications for logistics and conclude that it creates significant benefits, achieved through savings. The authors are cautious, however, of the fact that there a lot of hurdles to overcome before blockchain becomes mainstream. (Kshetri, 2018) takes a deeper look at a blockchain implementation case by Walmart and IBM to track food-based products in US and China. Authors show that blockchain helped to significantly reduce time and cost in tracking products. The benefits extend further than just tracking, e.g. Lakhani & Iansiti, (2017) review a case of smart contract application where the shipment of goods tracked by GPS triggers a financial payment. Michelman (2017) argues that blockchain can indeed reduce costs in a significant way by accelerating transactions and increasing accuracy. While speed and accuracy of transactions benefits all the sectors, the firms that benefit most are the banks and financial institutions. Rabah (2017) argues that the financial industry is among the most mature in terms of blockchain readiness. Hence, it comes as no surprise that there are multiple local and global bank consortiums seeking to implement blockchain to minimise time and cost of transactions. E.g. Hughes et al. (2019) and Manikandan (2019) discuss a recently announced consortium of Indian banks, while (Guo and Liang, 2016) discuss other efforts such as those of the R3 consortium. The consortium logic is in line with (Lacity, 2018) who argues that blockchain is a way of increasing disintermediation and facilitating the direct transactions of suppliers and customers.

While blockchain offers multiple business benefits for a firm, there are of course hurdles to overcome to implement blockchain at scale, which is a reason why most blockchain efforts stay at the level of pilot implementation or proof of concept (Lakhani & Iansiti, 2017). Beck and Müller-Bloch (2017) point out that a firm should have a skillset for radical innovation implementation to successfully scale a blockchain effort.

Overall, the aforementioned direct and indirect cost reduction and profit increases are beneficial for shareholders. Hence, we believe it is reasonable to assume that shareholders in general should appreciate this, which should lead to a weaker principal-agent conflict in a blockchain-implementing firm.

Another argument as to why blockchain implementation may decrease the level of conflict, is related to abnormal returns generated by the hype wave associated with blockchain. There are multiple examples when share prices experience extreme abnormal growth following the change of company name, or a statement that the company is now focusing on blockchain (Pollock, 2018). Prominent investment banks such as J.P. Morgan suggest that firms would benefit from blockchain technology, creating additional confidence for the investors (Rooney, 2018). Moreover, blockchain creates special benefits for corporate governance, which we discuss in the next subsection.

### 3.3 Blockchain implications for corporate governance and shareholder activism

Literature discusses a variety of ways blockchain can affect corporate governance. On one end of the spectrum, there are relatively straightforward technical applications, such as using blockchain in the form of a distributed ledger for shareholder voting recording on annual meetings (Van der Elst and Laffare, 2017). On the other end, there are far reaching applications of smart contracts. Examples of this include automating corporate boards of directors functions like auditing (Byström, 2019; Peters & Panayi, 2016; Van der Elst & Lafarre, 2017) or even creation of organisations without management, or so called decentralised autonomous organisations (DAOs) (Buterin, 2014; DuPont, 2017; Kristof, 2017). Overall, there is a consensus in literature on the ability of blockchain to improve corporate governance, decreasing the principal-agent conflict (Ivaninskiy, 2019; Yermack, 2017).

While most research on blockchain implications for corporate governance is conceptual in nature, there are many pilot implementations in process: Nasdaq's project of e-voting in Estonian 2016 AGMs, proxy voting introduced by CSD Working Group on distributed ledger technology, which is a consortium of Central Securities Depositories (NSD in Russia, Strate in South Africa, Six Securities Services in Switzerland, Nasdaq Nordic, and DCV in Chile). Lafarre and Van der Elst provide a comprehensive summary of efforts with a status as of 2018 (Lafarre & Van der Elst, 2018).

Despite an overall positive attitude towards blockchain for governance, there are, of course issues to consider. (Lafarre and Van der Elst, 2017) highlight several issues even with a relatively basic usage of blockchain for shareholder voting. If blockchain-based voting replaces the traditional meetings, will it be able to replace a forum function of the meeting? (Maginer and Barban, 2018) argue that blockchain increases transparency of ownership, which may not be desirable to shareholders. Authors also point out that using blockchain poses a question of liability if a mistake occurs with a shareholder meeting results.

While smart contracts create bigger opportunities, they are at the early stages of development and as such create risks. An example of such a risk that materialised in the pilot implementation of a DAO is the quality of computer code and the ability of people to assess it. Kristof (2017) describes a DAO investment fund built on the Etherium platform. The fund raised 150 million dollars with the promise that only the investors would decide which projects to pursue via usage

of smart contracts. However, the computer code that encoded the smart contracts contained a loophole that allowed a group of hackers to freeze a significant part of the funds. To get money back to investors, the founders of the Etherium platform altered the computer code affecting the entire platform. The debate is open as to whether it was an appropriate response. The idea of smart contracts is that the computer code is more trustworthy than people. Some authors argue that the investors should have been studying the code closer before investing money (The Attacker, 2016).

Colourful fails like the DAO investment fund described above, booms and bursts on cryptocurrencies markets, and a general lack of legal clarity further contribute to uncertainty around blockchain (Böhme et al., 2015; Cagli, 2019; Kajtazi & Moro, 2018; Fry, 2018). This uncertainty may scare shareholders and make them oppose managerial efforts to implement blockchain, making conflict stronger.

Overall, conceptual literature and pilot implementations show that while a firm implementing blockchain solutions may face a weaker principal-agent conflict, the opposite may also be true if shareholders are skeptical. However, as with more general blockchain implementation, we believe that the potential benefits outweigh the risks and investors will, on average, appreciate this. Therefore a firms' exploration of blockchain technology, whether specifically for corporate governance reasons or more generally, should be appreciated by the shareholders as it promises significant business and governance benefits and may also trigger a positive market response to a popular technology implementation. Hence, it should make the principal-agent conflict weaker in an implementing firm. A weaker conflict could be identified through a more active shareholder base. However, it is important to explore not only whether shareholders become more active, but also whether they oppose management more often, which would be a sign of a stronger conflict.

The principal-agent conflict, in the extreme form, takes the shape of investor activism in a form of proxy contest. While multiple authors argue that blockchain should make activist campaigns less frequent (see Yermack, 2017), they refer to using blockchain for recording transactions with a firms' securities, which is still very rare. A firm's exploration of blockchain in general can go either way. It may make conflict more frequent if shareholders, generally skeptical of blockchain, see it as a sign of low quality of management and want to oppose the management overall. Alternatively, it may make conflict less frequent if shareholders are attracted by the abnormal returns often associated with blockchain.

The literature on the role of blockchain technology in corporate governance is still missing empirical evidence. There is no consensus among the researchers on the direction of influence of blockchain on the shareholder activism and no empirical research to verify it. We aim to fill these gaps by exploring the association of blockchain application by a firm with the principal-agent conflict between shareholders and management. We first analyse overall level of involvement of shareholders in the governance of a firm represented by submission of shareholder-sponsored proposal. We then analyse the level of conflict represented by the level of shareholder support for management-sponsored decisions and the likelihood of their approval. However, as mentioned earlier, data restrictions lead us to use a very general blockchain

application definition. Hence, we interpret our results as association of principal-agent conflict with overall digitalization rather than specifically with blockchain.

## 4 Model and hypothesis

### 4.1 Shareholder activity and the level of shareholder support for management

We use several metrics as proxies for shareholder activity. First, following (Renneboog & Szilagyi, 2011) we use the likelihood of receiving a shareholder-sponsored proposal at an annual meeting. For the purpose of the model, this means that a variable equals 1 if there is at least one shareholder proposal at the meeting, and 0 if there are no shareholder proposals. Second, following (Iliev et al., 2018) we use the number of shareholder proposals received by a firm as a proxy for the level of shareholder activity. Finally, following (Fos, 2017) we intended to use the likelihood of proxy contest launched by shareholders of a firm as a measure for direct hostility of shareholders against the management. However, as we discuss later, the dataset we use does not provide enough evidence, and this analysis has to be postponed. A full set of variables, with data sources, is provided in Appendix 1.

To measure the level of shareholder support for management, we follow the approach suggested by (Renneboog & Szilagyi, 2011) and apply the level of support received by proposals at the meetings. We distinguish between the total set of proposals and management-sponsored proposals to assess if there is any difference. As an additional proxy for the level of shareholder support, we measure the share of management-sponsored proposals, approved during voting. When assessing the models on the likelihood of receiving a shareholder proposal, we use logistic regressions.

### 4.2 Digital transformation of a firm

As discussed earlier, as a proxy for active digitalization of a firm we use the blockchain technology. We assume that a firm's application of the blockchain technology signals the market the seriousness of digital transformation ambitions. To identify blockchain activities of the firms we use two separate variables. First, we collect the data on initiatives taken by a firm. By initiatives we mean joining a blockchain consortium, launching an independent blockchain-related initiative, or partnering with a blockchain industry player. This metric effectively measures whether a firm actually does something significant in the blockchain space. We call it "strong" form of blockchain activity. In the model it is a dummy variable which equals one if there is a reported activity by the firm, and zero if there is no information. An example of a firm that is recorded as blockchain 'active' is the bank JPMorgan Chase, which develops several proprietary blockchain solutions, including JPM Coin—a digital currency—and published the following in a press release on its website[2]: "J.P.

[2] https://www.jpmorgan.com/solutions/cib/news/digital-coin-payments

Morgan this month became the first U.S. bank to create and successfully test a digital coin representing a fiat currency. The JPM Coin is based on blockchain-based technology, enabling the instantaneous transfer of payments between institutional clients".

Second, we weaken the definition of blockchain activity and identify not only reported activity by a firm, but also any public expressions of opinion regarding blockchain by a company's executives. This metric is "weak" form of activity and it is expressed by dummy variable which equals one if there is a public activity by the firm and zero if there is no information. An example of a firm that actively talks about blockchain implications for the business but is not yet doing anything in that sphere is real estate firm Cushman & Wakefield, which publishes opinions and reports on the implications of blockchain for commercial real estate.[3]

While the weak version of blockchain involvement is clearly less representative of actual activity, we believe it is still relevant. The central question of our research is whether firms pursuing digital transformation experience weaker or stronger principal-agent conflict. Public expression of opinion on blockchain shows that a firm is exploring the transformative digital technology and is advanced enough in its exploration to openly discuss it. One may argue that 'strong' blockchain involvement is a signal of blockchain-focused digital effort, while 'weak' involvement is a broader signal that a firm sends out to the shareholders and to the market overall on its broader digital ambitions. We describe a step-by-step process of data collection for both variables in the next section of the article. However, we believe that given the broad way we define the blockchain activity of a firm in the current research, there should be a positive correlation between such blockchain activity and the digital transformation that it represents and the level of shareholder activity in both definitions. The reason being that even if digital transformation has not yet generated a tangible impact for a firm, it at least should attract the shareholders' attention reflected in the likelihood and the number of shareholder proposals.

As for the association of digital transformation with the level of shareholder approval of proposals, we expect to find a negative correlation, because a higher probability of receiving a shareholder proposal may be associated with lower overall support rate for proposals. However, given the aforementioned reasoning, we do not have a set expectations on the direction of association of blockchain with the share of management-sponsored proposals that get approved as a result of the vote.

In the future, as more structured data becomes available, we will break blockchain activity into several categories, clearly singling out the ones targeted specifically on corporate governance. This will allow us to draw more specific conclusions on the relationship of blockchain and not overall digital transformation with the principal-agent conflict.

[3] https://www.cushmanwakefield.com/en/united-states/insights/us-articles/2019-02-dc-blockchain-and-the-future-of-cre

### 4.3 Control variables

There seems to be a consensus among the research surveyed on the set of control variables used for analysis of shareholder activity. For example, (Karpoff et al., 1996; Thomas & Cotter, 2007) suggested the following set of firm characteristic as for the voting patterns: (1) firm size, (2) growth, (3) profitability, (4) valuation, (5) leverage, (6) institutional ownership, and (7) insider ownership. In our research we are following a similar logic. The calculation of the variables and the data sources are summarised in Appendix 1. Based on the results of the prior research we expect to find the impact of the control variables as summarised in Table 1. We also add a set of dummy variables for the main sectors of operations of firms. For that, we use "The Global Industry Classification Standard" – a standard sector classification suggested by Standard & Poors and MSCI. You may find the details in Appendix 1.

## 5 The data

### 5.1 Data sources

For this research, we use the data on US-listed public firms whose shares are traded on NYSE, NASDAQ or AMEX. To get the majority of the data we use standard data sources. For all the variables related to voting, following multiple studies we use ISS data on shareholder voting outcomes. The data for control variables is obtained from the S&P capital IQ database. All the data sources are listed in Appendix 1. There is no universally accepted way yet to measure blockchain activity by a firm. Neither is there a single source of data collecting blockchain initiatives. Hence, we collect data from open sources. We started with full list of the firms, which included 4395 items. We then conducted a firm-by-firm research on the internet to catalogue the firms that have any relationship to blockchain differentiating between two levels of blockchain activity: weaker and stronger. The process of data collection involved the following: 1) for each firm in the list we systematically scanned the annual reports for mentions of blockchain; 2) if no mentions were available in the annual reports, we searched the words "firm name blockchain" using the Google search engine; 3) in the search results we looked for the evidence that a firm has some form of blockchain activity, giving preference to official websites of the firm; 4) if we found information on blockchain activity elsewhere other than the official site, we crosschecked it on the official site; 5) if there was no information on the official site, we checked that the information is published at least in 3 sources before recording the data to the dataset. Once we confirmed the activity of a firm, we looked for the earliest mention to record the year the firm started blockchain activities. In total, we ended up with a sample of 557 firms, which constitutes the sample of firms for a weaker

**Table 1** Expected impact of the control variables

| The control variable | The expected impact on the likelihood of receiving a shareholder proposal | The expected impact on the level of shareholder support of the proposals | The expected impact on the likelihood of a proxy contest launched for the firm |
|---|---|---|---|
| Firm size | + | − | − |
| Growth | − | − | |
| Profitability | − | + | + |
| Valuation (market to book value) | − | − | − |
| Leverage | + | − | + |
| Institutional ownership | − | + | + |
| Insider ownership | + | − | ? |

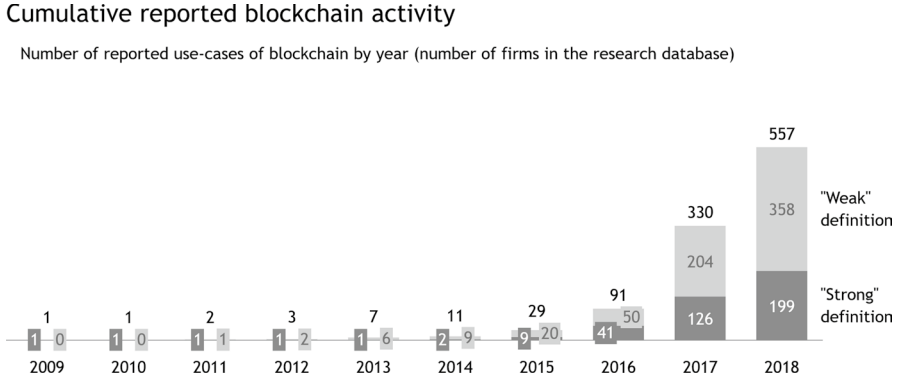



**Chart 1** Number of firms with blockchain activity by year

definition of blockchain activity. Within 557 firms, 199 are reported to be pursuing blockchain-related initiatives, which gives us a sample of firms for the stronger definition of blockchain activity. The remaining 358 firms are a part of the sample with the weaker form of definition.

For each firm, we catalogued a year of reported blockchain related activity.[4] The number of mentions grows from 1 in 2009 to 557 in 2018, as shown in Chart 1 below.

The absolute majority of firms have reported blockchain activities in 2018 and afterwards. We appreciate that this may be the result of internet search engines showing the more recent sources in the top of the results. In the future, we plan to conduct an investigation on prior periods for each of the firms in the sample. However, for this research we used the data only for year 2018 as this is the year of maximum number of firms in the sample and the year of latest available data on voting at the time of submission of this paper.

### 5.2 Descriptive statistics

Prior to calculating the descriptive statistics for the research sample, we merged the data on the set of control variables with the data on shareholder voting outcomes and cleaned it of potentially erroneous data points. This reduced our total sample size to a 2813 firms of which 412 had some relationship to blockchain (in the 'weak' sense of the definition) and 258 were pursuing blockchain-related initiatives ('strong' definition). When comparing the blockchain-related firms with the rest of the sample, we see that on average blockchain adopters have significantly higher market capitalisation: $48 billion for adopters in the strong sense of definition, and $36,4 billion using the weak form of definition compared with for non-adopters ($5,1 bln). This,

[4] We make an assumption based on the expert interviews that for a firm to go public with a blockchain initiative, it takes approximately 1 year to develop it privately. Hence, for that the firms that are mentioned in the press in 2019, we assume that the year of beginning blockchain activity 2018.

most likely, shows that to get involved in the blockchain space, a firm has to have a significant scale. A similar dynamic is visible when comparing other variables.

Blockchain adopters have a return on assets (RoA) with an average level of 10%, similar to the set of blockchain non-adopters. Blockchain adopters, in the strong sense of the definition, have a higher level of EBITDA margin: 20% compared to 10% for the weak form of definition and non-adopters. Blockchain adopters have a higher level of market-book ratio of (5,1 and 5,9 for the strong and weak definitions) compared with 3,3 for blockchain non-adopters. These facts suggest that in addition to being bigger, we can characterise blockchain adopters as having higher valuation.

Blockchain adopters have a slightly higher leverage, with the average level of 1,2 and 1,1 compared to 0,9 for non-adopters. Revenue growth rates are at similar levels for the two subsets of firms at the level of 10%. Blockchain adopters and non-adopters have similar levels of insider ownership at 10%, and comparable levels of institutional ownership, at 70%.

We see that on average blockchain adopters receive a higher number of shareholder-sponsored proposals: 0,7 proposals for the strong definition, 0,5 for the weak one per meeting for blockchain adopters, compared with 0,1 for non-adopters. While there is only a minor difference between the levels of support for proposals (80% for non-adopters compared with 70% for non-adopters using the weak definition, and 60% using the strong one) or the share of proposals that pass the voting.

It is important to note that our sample contains information on just 18 cases of proxy contests, of which only 2 were launched against the blockchain adopters. While this prompts us to think that blockchain adopters may be less prone to proxy-contest, the current size of the sample is clearly too small to make any firm conclusions and this conclusion has to be postponed more data is available.

While the sector breakdown of the sample of analysed firms shows a relatively balanced distribution, the levels of blockchain adoption (share of adopters in the total sample) vary significantly by industry with the highest levels observed in IT (31% for weak and 19% for strong form of definition). Also obsevered are the communication services (28% and 18%) and consumer staples (20% and 14%) sectors. This distribution comes as no surprise, given the use cases (e.g. logistics), discussed earlier in the paper. The only sector that seems relatively surprising is financials (14% and 9%), but the relatively low levels of adoption there are most likely caused by the large number of firms in the sample (644 – the highest among all the sectors).

We provide the full set of descriptive statistics for the variables as well as sector breakdown of blockchain adoption in Appendix 2.

When looking at the structure of all the submitted (i.e. management-sponsored and shareholder-sponsored) proposals we do not see any differences between the blockchain adopters and non-adopters. The top three reasons for the shareholder proposal submission are the election of the director (the dominating topic), ratification of an auditor, and executive compensation, with distribution being very similar among adopters and non-adopters. The situation differs slightly when we only look at the shareholder-sponsored set of proposals. Here, the top three proposal reasons are the same, however, the proposals to elect a director are less frequent among the blockchain adopters. We show the structure of the all the proposals in Appendix 2.

The similarity of the proposal topic structure between adopters and non-adopters, paired with a smaller frequency of proposals related to director election, suggests that a higher than average number of shareholder-sponsored proposals for blockchain adopters is a sign of a more active shareholder base, which is at the very minimum not more hostile towards the management. The less frequent director election related proposals may be even interpreted as an indication of less hostility towards the existing management team by the shareholders.

Going forward, as the data for the upcoming years becomes available, it will be possible to run a separate analysis on various types of shareholder proposals and see if there is any difference on the approval levels between the adopters and non-adopters. At the time of this paper's submission, the data is available only for 2018, and the dataset on the proposal level is too small.

## 6 Modelling results and interpretation

To investigate whether the blockchain technology indeed has a significant association with the shareholder activity we build the multivariate regression models, discussed in Sect. 4.

### 6.1 Likelihood of proposal submission and number of proposals

First, we analyse the association of blockchain with the likelihood of receiving the shareholder-sponsored proposal. Table 2 represents the results of all the regressions. We find that, consistent with our hypothesis, involvement in the blockchain space has a significant positive correlation with the likelihood of receiving the shareholder proposal, even after accounting for the control variables. We run separate regressions on the two types of blockchain activity and see that the "stronger" level of blockchain activity (which indicates that a company actually does something in the blockchain space and does not merely talk about it) yields a more significant result in terms of likelihood of receiving a proposal.

The results suggest that the hypothesis that firms active in digital transformation have, on average, more active shareholders, was correct. Active shareholders imply a corporate environment less prone for the principal-agent conflict. The results also suggest that the stronger involvement in the digital transformation has a stronger link with the level of shareholder activity. Going forward, as more data becomes available, it would be interesting to analyse if involvement in more than one type of blockchain activity or more than one blockchain project has a similar connection with shareholder activity, especially for the blockchain applications specifically targeted on the corporate governance.

We find that the influence of the set of control variables is mostly in line with our hypothesis, based on prior research (Karpoff et al., 1996). Firm size, measured as a natural logarithm of the market capitalisation value, has a significant positive impact on the likelihood of receiving a shareholder-sponsored proposal. The growth rate of the firm's revenue has a significant negative impact on the dependent variable,

**Table 2** Results of regressions on the likelihood of receiving a shareholder-sponsored proposal and number of proposals received by a firm

| | Dependent variable | |
|---|---|---|
| | sh_prop | |
| | (1) | (2) |
| *Results of logistic regression* | | |
| blockchain_weak | 0.494*** | |
| | (0.185) | |
| blockchain_strong | | 0.574*** |
| | | (0.205) |
| size_lnmarcap | 0.777*** | 0.780*** |
| | (0.056) | (0.055) |
| growth_revenue | − 1.195*** | − 1.182*** |
| | (0.357) | (0.357) |
| EBITDA_margin | − 0.417 | − 0.472 |
| | (0.480) | (0.479) |
| market_book | − 0.001 | − 0.001 |
| | (0.005) | (0.004) |
| leverage | 0.001 | − 0.001 |
| | (0.026) | (0.026) |
| Institutions | − 0.651* | − 0.608 |
| | (0.386) | (0.388) |
| Insiders | − 1.051 | − 1.028 |
| | (0.946) | (0.949) |
| sector_energy | − 0.208 | − 0.236 |
| | (0.517) | (0.517) |
| sector_materials | − 0.385 | − 0.429 |
| | (0.579) | (0.579) |
| sector_industrials | 0.550 | 0.535 |
| | (0.445) | (0.445) |
| sector_cons_discr | 0.446 | 0.389 |
| | (0.458) | (0.459) |
| sector_cons_stapl | 0.462 | 0.449 |
| | (0.520) | (0.518) |
| sector_healthcare | 0.353 | 0.308 |
| | (0.470) | (0.471) |
| sector_finance | − 0.463 | − 0.474 |
| | (0.477) | (0.478) |
| sector_IT | − 0.739 | − 0.733 |
| | (0.485) | (0.486) |
| sector_communication | 0.381 | 0.363 |
| | (0.536) | (0.538) |
| sector_unilities | 1.010** | 0.981** |
| | (0.496) | (0.495) |

**Table 2** (continued)

| | Dependent variable | |
|---|---|---|
| | sh_prop | |
| | (1) | (2) |
| Constant | − 8.130*** | − 8.132*** |
| | (0.663) | (0.663) |
| Observations | 2,813 | 2,813 |
| Log Likelihood | − 641.687 | − 641.368 |
| Akaike Inf. Crit | 1,321.374 | 1,320.736 |
| | Dependent variable | |
| | N_sh_prop | |
| | (1) | (2) |
| *Results of linear regression* | | |
| blockchain_weak | 0.212*** | |
| | (0.042) | |
| blockchain_strong | | 0.320*** |
| | | (0.050) |
| size_lnmarcap | 0.126*** | 0.124*** |
| | (0.010) | (0.010) |
| growth_revenue | − 0.121*** | − 0.120*** |
| | (0.046) | (0.046) |
| EBITDA_margin | 0.024 | 0.017 |
| | (0.074) | (0.074) |
| market_book | 0.002* | 0.002** |
| | (0.001) | (0.001) |
| leverage | − 0.003 | − 0.003 |
| | (0.003) | (0.003) |
| Institutions | − 0.460*** | − 0.440*** |
| | (0.063) | (0.063) |
| Insiders | − 0.210* | − 0.194 |
| | (0.123) | (0.122) |
| sector_energy | 0.034 | 0.027 |
| | (0.088) | (0.087) |
| sector_materials | − 0.177* | − 0.186* |
| | (0.100) | (0.099) |
| sector_industrials | − 0.038 | − 0.042 |
| | (0.081) | (0.081) |
| sector_cons_discr | − 0.028 | − 0.042 |
| | (0.083) | (0.082) |
| sector_cons_stapl | 0.019 | 0.011 |
| | (0.101) | (0.101) |
| sector_healthcare | − 0.023 | − 0.033 |

**Table 2** (continued)

| | Dependent variable | |
|---|---|---|
| | N_sh_prop | |
| | (1) | (2) |
| | (0.086) | (0.086) |
| sector_finance | − 0.152* | − 0.157** |
| | (0.080) | (0.080) |
| sector_IT | − 0.160* | − 0.162** |
| | (0.083) | (0.083) |
| sector_communication | 0.179* | 0.172* |
| | (0.099) | (0.098) |
| sector_unilities | 0.033 | 0.027 |
| | (0.113) | (0.112) |
| Constant | − 0.357*** | − 0.351*** |
| | (0.093) | (0.093) |
| Observations | 2,813 | 2,813 |
| $R^2$ | 0.122 | 0.127 |
| Adjusted $R^2$ | 0.117 | 0.121 |
| Residual Std. Error (df = 2794) | 0.719 | 0.717 |
| F Statistic (df = 18; 2794) | 21.611*** | 22.592*** |

*p < 0.1; **p < 0.05; ***p < 0.01

*p < 0.1; **p < 0.05; ***p < 0.01

indicating that, consistent with prior research, a faster growing firm on average has a lower likelihood of receiving a shareholder-sponsored proposal. Consistent with prior research, the valuation variable (ratio of market-to-book value of equity) has a negative impact on the dependent variable, while the leverage has a positive impact, however, these variables are not statistically significant in our regressions. Also consistent with the prior research, we find that the share of equity owned by institutions has a negative impact on the likelihood of receiving a shareholder-sponsored proposal. As with the blockchain activity variable, the variable is more significant for the stronger definition of blockchain involvement. The only variables which have signs not in line with expectations are profitability and insider ownership, however, neither is significant in the regression.

To test the stability of this result, we run the regression on the number of shareholder proposals received by a firm with a similar set of independent variables. As with the logistic regression described above, we run two separate regressions – one each for the strong and weak forms of blockchain activity. We find that the blockchain activity variable has a significant positive sign, which is consistent with the former logistics regression. The results indicate that firms active in digital transformation not only have a higher likelihood of receiving a shareholder proposal, but also the average number of proposals is higher for them. The results are similar for both forms of blockchain activity. We also see that the coefficient for the stronger

form of blockchain activity is higher than the one for the weak form, indicating that as for the logistic regression, the stronger form of blockchain involvement has a stronger association with the dependent variable.

For the set of control variables, we find the results that are similar in terms of signs and significance to the logistics regression discussed above. The only exception is the market to book ratio of a firm, which has the opposite sign. An additional area for further improvement and research is the low value of R-squared, despite the overall significance of the model. This suggests that some important inputs are missing in our model, e.g., related to corporate governance. Please see Table 2 for the results of all the regressions.

While the results show that blockchain adopting firms have shareholders that on average are more active, they do not yet tell us anything about whether the principal-agent conflict in the organisation is more or less intense. To test for this, we run a second set of regressions, as described in the next subsection.

### 6.2 Approval rates for proposals and share of passed proposals

To assess the connection of digital transformation with the intensity of the principal-agent conflict we analyse the association of blockchain with the approval rates of proposals at the shareholder meetings. We run a set of four regressions: for the two types of blockchain activity mentioned earlier (strong and weak), and two sets of proposals: sponsored by management and the total sample of proposals submitted for the meeting. We do not run a separate analysis for the shareholder-sponsored proposals, as the dataset would be too small.

We find that digital transformation has a significant negative association with the approval rates for proposals. The result is consistent across both types of blockchain involvement, as well as across the two subsets of proposals. The results that we get indicate that while digital transformation increases is associated with higher level of shareholder activity, it also has a negative correlation with overall level of support for proposals, which is in line with our hypothesis.

We find that in all four regressions the control variables mostly have influence on the approval rate of proposals in line with prior research (see e.g. Renneboog & Szilagyi, 2011). We see that the firm's size has a negative influence on the approval rate. This indicates that a larger firm in general has a larger shareholder base, which because of size is less prone to collusion because it leads to smaller approval rates. We see that profitability, measured as the EBITDA margin has a significant positive impact on the depending variable, indicating that shareholders tend to be supportive of the proposals of more profitable firms. The impact of the leverage variable on the approval rate is negative, which is consistent with the research of Thomas and Cotter (2007). Shares reflecting both institutional and insider ownership have a significant positive impact on the approval rate. The former is in line with hypothesis, while the latter is not. Since we do not analyse the approval rates of shareholder-sponsored proposals separately, we can interpret the results as an indication that both institutions and corporate insiders tend to approve proposals, most of which are management-sponsored. We provide detailed results in Table 3.

**Table 3** Results of regressions on the level of support of proposals

| | Dependent variable | | | |
|---|---|---|---|---|
| | level_of_support_total | | level_of_support_mgmt | |
| | (1) | (2) | (3) | (4) |
| *Results of regression on level of support* | | | | |
| blockchain_weak | − 0.033*** | | − 0.033*** | |
| | (0.010) | | (0.010) | |
| blockchain_strong | | − 0.040*** | | − 0.040*** |
| | | (0.012) | | (0.012) |
| size_lnmarcap | − 0.045*** | − 0.046*** | − 0.044*** | − 0.044*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| growth_revenue | 0.021** | 0.021** | 0.020* | 0.020* |
| | (0.010) | (0.010) | (0.011) | (0.011) |
| EBITDA_margin | 0.044** | 0.045*** | 0.042** | 0.044** |
| | (0.017) | (0.017) | (0.017) | (0.017) |
| market_book | 0.001*** | 0.001*** | 0.001*** | 0.001*** |
| | (0.0003) | (0.0003) | (0.0003) | (0.0003) |
| leverage | − 0.002*** | − 0.002*** | − 0.002*** | − 0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Institutions | 0.264*** | 0.263*** | 0.262*** | 0.260*** |
| | (0.015) | (0.015) | (0.015) | (0.015) |
| Insiders | 0.241*** | 0.239*** | 0.243*** | 0.241*** |
| | (0.028) | (0.028) | (0.028) | (0.028) |
| sector_energy | − 0.021 | − 0.020 | − 0.021 | − 0.021 |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| sector_materials | 0.051** | 0.052** | 0.050** | 0.051** |
| | (0.023) | (0.023) | (0.023) | (0.023) |
| sector_industrials | 0.056*** | 0.056*** | 0.056*** | 0.056*** |
| | (0.019) | (0.019) | (0.019) | (0.019) |
| sector_cons_discr | 0.034* | 0.036* | 0.037* | 0.039** |
| | (0.019) | (0.019) | (0.019) | (0.019) |
| sector_cons_stapl | 0.041* | 0.042* | 0.044* | 0.045* |
| | (0.023) | (0.023) | (0.023) | (0.023) |
| sector_healthcare | 0.029 | 0.030 | 0.031 | 0.032 |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| sector_finance | 0.073*** | 0.073*** | 0.073*** | 0.073*** |
| | (0.018) | (0.018) | (0.018) | (0.018) |
| sector_IT | 0.023 | 0.021 | 0.022 | 0.021 |
| | (0.019) | (0.019) | (0.019) | (0.019) |
| sector_communication | 0.037 | 0.036 | 0.039* | 0.038* |
| | (0.023) | (0.023) | (0.023) | (0.023) |
| sector_unilities | 0.005 | 0.005 | 0.012 | 0.013 |
| | (0.026) | (0.026) | (0.026) | (0.026) |
| Constant | 0.826*** | 0.827*** | 0.819*** | 0.820*** |

**Table 3** (continued)

| | Dependent variable | | | |
|---|---|---|---|---|
| | level_of_support_total | | level_of_support_mgmt | |
| | (1) | (2) | (3) | (4) |
| | (0.021) | (0.021) | (0.022) | (0.021) |
| Observations | 2,813 | 2,813 | 2,813 | 2,813 |
| $R^2$ | 0.214 | 0.214 | 0.206 | 0.206 |
| Adjusted $R^2$ | 0.209 | 0.209 | 0.200 | 0.201 |
| Residual Std. Error (df = 2794) | 0.165 | 0.165 | 0.166 | 0.166 |
| F Statistic (df = 18; 2794) | 42.344*** | 42.384*** | 40.162*** | 40.194*** |

*p < 0.1; **p < 0.05; ***p < 0.01

However, the fact that blockchain adoption has a negative association with approval rates does not mean that shareholders are more hostile towards management. It may also be a sign of a more active shareholder base, which decreases the support for proposals. The logic is similar the impact of the firm's size. To check for this, we analyse whether the lower approval rates actually result in less proposals being passed. Thus, we run a set of another four regressions with a set-up similar to the one described above, but with the dependent variable being not the approval rate of proposals, but the share of proposals passed. Please see the results in Table 4.

We find that blockchain has a significant negative association with the share of total proposals passed, but does not have a significant impact on the share of passed management-sponsored proposals. The results suggest that while digital transformation makes shareholders more active (as reflected by a higher likelihood of receiving a shareholder-sponsored proposal) it does not make them more hostile (as measured by the share of passed proposals) towards the management and the decreased average level of support mostly reflects the impact of a more involved shareholder base. The control variables mostly have expected influences similar to discussed above, though significance is not always at the required level.

## 7 Conclusion and discussion

Our results contribute to the literature on corporate governance, shareholder activism and on business digitalisation. The results that we received suggest that firms active in business digitalisation—signaled by exploration of the blockchain technology—overall have a lower level of the principal-agent conflict. This conclusion is supported by two results. First, we find that on average, firms active in digital transformation receive more shareholder-sponsored proposals, which is a sign of a more active shareholder base, indicating lower level of conflict. Second, while an average level of support of proposals is lower for digitally-transforming firms, there is no difference in the likelihood of a management-sponsored proposal passing, which may

**Table 4** Results of regressions on the share of proposals passed

| | Dependent variable | | | |
|---|---|---|---|---|
| | level_passed_total | | level_passed_mgmt | |
| | (1) | (2) | (3) | (4) |
| *Results of regression on share of proposals passed* | | | | |
| blockchain_weak | − 0.012*** | | − 0.003 | |
| | (0.005) | | (0.004) | |
| blockchain_strong | | − 0.020*** | | − 0.003 |
| | | (0.005) | | (0.005) |
| size_lnmarcap | − 0.006*** | − 0.006*** | 0.003*** | 0.003*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| growth_revenue | − 0.003 | − 0.003 | − 0.008* | − 0.008* |
| | (0.005) | (0.005) | (0.004) | (0.004) |
| EBITDA_margin | 0.016** | 0.017** | 0.011 | 0.011 |
| | (0.008) | (0.008) | (0.007) | (0.007) |
| market_book | − 0.0001 | − 0.0001 | − 0.0001 | − 0.0001 |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| Leverage | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| | (0.0003) | (0.0003) | (0.0003) | (0.0003) |
| Institutions | 0.027*** | 0.026*** | 0.0001 | − 0.00002 |
| | (0.007) | (0.007) | (0.006) | (0.006) |
| Insiders | 0.021 | 0.020 | 0.019* | 0.019* |
| | (0.013) | (0.013) | (0.012) | (0.012) |
| sector_energy | − 0.008 | − 0.008 | − 0.004 | − 0.004 |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_materials | 0.012 | 0.013 | 0.007 | 0.008 |
| | (0.011) | (0.011) | (0.009) | (0.009) |
| sector_industrials | 0.006 | 0.006 | 0.009 | 0.009 |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_cons_discr | 0.003 | 0.004 | 0.009 | 0.009 |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_cons_stapl | 0.004 | 0.004 | 0.009 | 0.009 |
| | (0.011) | (0.011) | (0.009) | (0.009) |
| sector_healthcare | 0.013 | 0.014 | 0.019** | 0.019** |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_finance | 0.016* | 0.016* | 0.012 | 0.012 |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_IT | 0.014 | 0.014 | 0.009 | 0.009 |
| | (0.009) | (0.009) | (0.008) | (0.008) |
| sector_communication | − 0.007 | − 0.006 | 0.008 | 0.008 |
| | (0.011) | (0.011) | (0.009) | (0.009) |
| sector_unilities | 0.001 | 0.001 | 0.018* | 0.018* |
| | (0.012) | (0.012) | (0.011) | (0.011) |

**Table 4** (continued)

| | Dependent variable | | | |
|---|---|---|---|---|
| | level_passed_total | | level_passed_mgmt | |
| | (1) | (2) | (3) | (4) |
| Constant | 0.981*** | 0.980*** | 0.945*** | 0.945*** |
| | (0.010) | (0.010) | (0.009) | (0.009) |
| Observations | 2,813 | 2,813 | 2,813 | 2,813 |
| $R^2$ | 0.029 | 0.031 | 0.015 | 0.015 |
| Adjusted $R^2$ | 0.023 | 0.025 | 0.008 | 0.008 |
| Residual Std. Error (df = 2794) | 0.078 | 0.078 | 0.068 | 0.068 |
| F Statistic (df = 18; 2794) | 4.656*** | 5.008*** | 2.312*** | 2.316*** |

*p < 0.1; **p < 0.05; ***p < 0.01

be interpreted as that while shareholders are more active, they are not more hostile towards the management. More involvement in governance without increased hostility towards the management shows that shareholders may consider the firms active in digitalisation an important investment, even after controlling for other parameters such as size, profitability, etc.

Our conclusions complement the existing body of literature showing the benefits of digitalisation for various business aspects. We show that business digitalisation promise not only direct business benefits such as cost-cutting, but also additional benefits such as getting shareholders more deeply involved in governance, which is beneficial over the longer term. This evidence may serve as an additional reason for the boards of directors to encourage management to actively explore emerging digital technologies. While we use the blockchain technology as the proxy for active digitalization, we acknowledge the fact that due to general definition of the blockchain involvement our conclusions should be interpreted as relevant for overall digitalization rather than specifically for blockchain.

The preliminary results also suggest that firms active in digitalization have a lower likelihood of a proxy contest launched against them. However, to confirm or deny this hypothesis we will need a broader dataset, which we intend to obtain in the upcoming research.

To the best of our knowledge, our paper is among the first empirical papers exploring the link between the business digitalization overall and blockchain technology in particular, and the corporate governance. As such, this paper has at least six limitations, which we intend to overcome in the future research.

First, we define firms actively pursuing digitalisation as those firms which are exploring the blockchain technology. While we have no doubt that blockchain is an important technology, the research would benefit from exploring other technologies such as artificial intelligence to check the consistency.

Second, we acknowledge the fact that more shareholder activity may be interpreted as a sign of shareholder dissatisfaction with management and hence, more intense conflict. While we control for the share of management-sponsored proposal

passed and see that it is not lower for the firms pursuing the digital transformation, our results would still benefit from additional metrics for the conflict such as proxy contests, etc. to ensure consistency.

Second, the definition of blockchain application is a very general one, and may be broken down to a set of more narrow definitions (e.g. participation in blockchain consortiums, etc.) and concrete blockchain applications (e.g. supply chain management, shareholder voting, etc.). This would allow us to draw more specific conclusions for the blockchain technology.

Third, the sample size should be extended and include both the precedent years (provided there is a confirmation of earlier blockchain activity by a firm) and the subsequent years as the data becomes available. This would allow us to check the results for the robustness and hence draw conclusions on the causal relationship between the digital transformation and the principal-agent conflict.

Fourth, we do not look at the contents of individual proposals, e.g. whether shareholders of more digitally active firms more frequently suggest election of directors with a technical background or not.

Fifth, while our models are statistically significant, the overall explanatory power is still limited, and hence it may be argued that there are other firm characteristics explaining the variations in the number of shareholder proposals received by different firms besides digitalisation in the form of blockchain. Identifying these characteristics will also help to answer the question as to whether these firms receive a larger number of proposals e.g. for reasons related to corporate governance or longer-term managerial behaviour other than digitalisation.

Nevertheless, the overall significance of the models and variables on digitalisation in particular suggests that the identified relationship is a significant one. Hence, we see these identified limitations as a set of open questions that we intend to answer in subsequent research.

## Appendix 1: Variables used in the research

| Variable | Description |
|---|---|
| blockchain_weak | Dummy variable equal to 1 if a company has any public association with blockchain technology, such as a comment by the firm's executive or a published report on the topic and 0 otherwise [Source: open sources, internet search] |
| blockchain_stronSOg | Dummy variable equal to 1 if a company has a confirmed blockchain initiative, such as participation in a consortium or development of a in-house blockchain solution [Source: open sources, internet search] |
| sh_prop | Dummy variable equal to 1 if a company received at least one shareholder-sponsored proposal for the annual meeting [source: ISS voting database] |
| N_sh_prop | Number of shareholder-sponsored proposals received by a firm for the annual meeting [source: ISS voting database] |
| level_of_support_total | Average % of votes in favor of all proposals for the meeting [source: ISS voting database] |

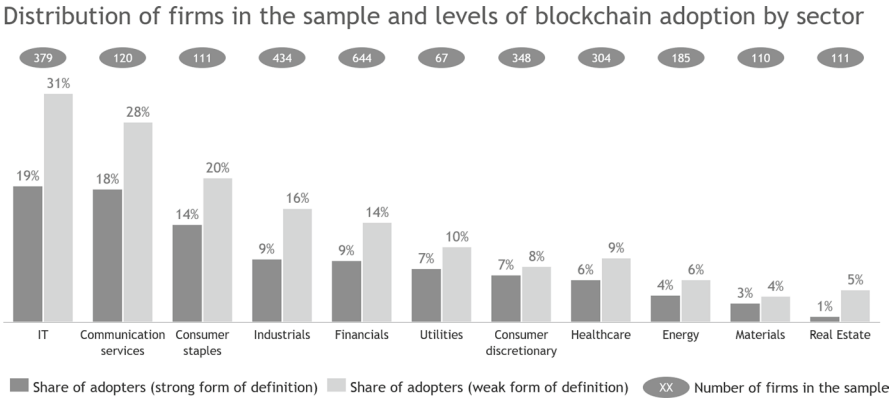
| Variable | Description |
|---|---|
| level_of_support_mgmt | Average % of votes in favor of all management-sponsored proposals for the meeting [source: ISS voting database] |
| level_passed_total | % of passed proposals at the meeting [source: ISS voting database] |
| level_passed_mgmt | % of passed management-sponsored proposals at the meeting [source: ISS voting database] |
| size_lnmarcap | Natural logarithm of the company's market capitalisation [Source: CapitalIQ] |
| growth_revenue | Compound annual growth rate of revenues for 3 years prior to the meeting[Source: CapitalIQ] |
| EBITDA_margin | Company's EBITDA divided by the company's revenues [Source: CapitalIQ |
| market_book | Ratio of company's market capitalisation to the company's book value of equity [Source: CapitalIQ] |
| leverage | Ratio of company's total debt to the total book value of equity [Source: CapitalIQ] |
| Institutions | Fraction of company's shares owned by institutions [Source: CapitalIQ] |
| Insiders | Fraction of company's shares owned by company's insiders [Source: CapitalIQ] |
| Sector dummies | Set of variables identifying the main sector of operations for a firm (Energy, Materials, Industrials, Consumer discretionary, Consumer staples, Healthcare, Financials, IT, Communication services, Utilities, Real Estate) as reported in CapitalIQ database [Source: CapitalIQ] |

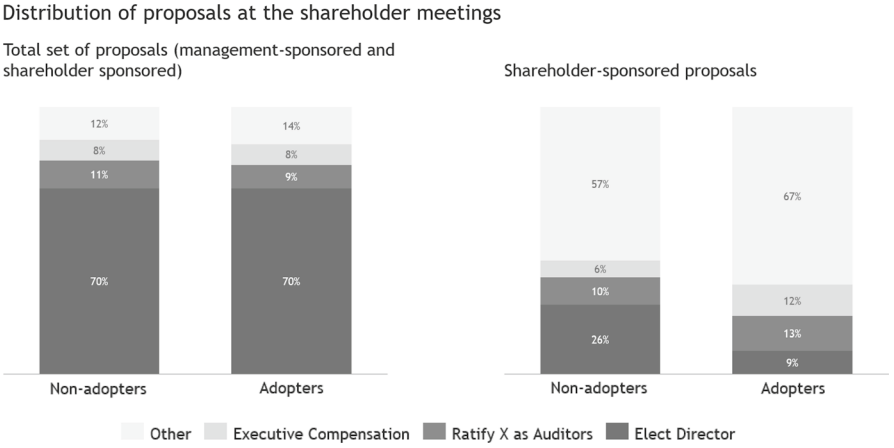
## Appendix 2: Descriptive statistics: Blockchain adopters vs non-adopters

| Statistic | N | Mean | St. Dev | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| Descriptive statistics for blockchain adopters (Strong form of definition) | | | | | | | |
| sh_prop | 258 | 0.3 | 0.5 | 0 | 0 | 1 | 1 |
| level_of_support_mgmt | 258 | 0.6 | 0.2 | 0.1 | 0.5 | 0.9 | 1.0 |
| proxy_contest | 258 | 0.004 | 0.1 | 0 | 0 | 0 | 1 |
| blockchain_weak | 258 | 1.0 | 0.0 | 1 | 1 | 1 | 1 |
| level_of_support_total | 258 | 0.6 | 0.2 | 0.2 | 0.5 | 0.8 | 1.0 |
| N_sh_prop | 258 | 0.7 | 1.3 | 0 | 0 | 1 | 7 |
| level_passed_total | 258 | 0.9 | 0.1 | 0 | 0.9 | 1 | 1 |
| level_passed_mgmt | 258 | 1.0 | 0.1 | 0 | 1 | 1 | 1 |
| blockchain_strong | 258 | 1.0 | 0.0 | 1 | 1 | 1 | 1 |
| size_lnmarcap | 258 | 8.9 | 2.5 | 1.4 | 7.5 | 10.7 | 13.6 |
| growth_revenue | 258 | 0.1 | 0.3 | − 0.8 | 0.02 | 0.1 | 3.3 |
| EBITDA_margin | 258 | 0.2 | 0.2 | − 0.6 | 0.04 | 0.3 | 1.0 |
| market_book | 258 | 5.1 | 11.6 | − 30.8 | 1.4 | 5.5 | 111.1 |
| leverage | 258 | 1.2 | 3.3 | − 12.1 | 0.3 | 1.5 | 33.3 |
| Institutions | 258 | 0.7 | 0.3 | 0.000 | 0.6 | 0.9 | 1.2 |

| Statistic | N | Mean | St. Dev | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| Insiders | 258 | 0.1 | 0.1 | 0.0 | 0.003 | 0.1 | 0.6 |
| ROA | 258 | 0.1 | 0.1 | − 0.4 | 0.02 | 0.1 | 0.7 |
| marcap | 258 | 48.1 | 101.3 | 0.004 | 1.8 | 45.1 | 832.6 |
| sector_id | 258 | 6.3 | 2.2 | 1 | 4 | 8 | 11 |
| sector_energy | 258 | 0.03 | 0.2 | 0 | 0 | 0 | 1 |
| sector_materials | 258 | 0.01 | 0.1 | 0 | 0 | 0 | 1 |
| sector_industrials | 258 | 0.1 | 0.4 | 0 | 0 | 0 | 1 |
| sector_cons_discr | 258 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_cons_stapl | 258 | 0.1 | 0.2 | 0 | 0 | 0 | 1 |
| sector_healthcare | 258 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_finance | 258 | 0.2 | 0.4 | 0 | 0 | 0 | 1 |
| sector_IT | 258 | 0.3 | 0.4 | 0 | 0 | 1 | 1 |
| sector_communication | 258 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_utilities | 258 | 0.02 | 0.1 | 0 | 0 | 0 | 1 |
| Descriptive statistics for blockchain adopters (Weak form of definition) | | | | | | | |
| sh_prop | 412 | 0.3 | 0.4 | 0 | 0 | 1 | 1 |
| level_of_support_mgmt | 412 | 0.7 | 0.2 | 0.1 | 0.5 | 0.9 | 1.0 |
| proxy_contest | 412 | 0.005 | 0.1 | 0 | 0 | 0 | 1 |
| blockchain_weak | 412 | 1.0 | 0.0 | 1 | 1 | 1 | 1 |
| level_of_support_total | 412 | 0.7 | 0.2 | 0.1 | 0.5 | 0.9 | 1.0 |
| N_sh_prop | 412 | 0.5 | 1.2 | 0 | 0 | 1 | 8 |
| level_passed_total | 412 | 0.9 | 0.1 | 0 | 0.9 | 1 | 1 |
| level_passed_mgmt | 412 | 1.0 | 0.1 | 0 | 1 | 1 | 1 |
| blockchain_strong | 412 | 0.6 | 0.5 | 0 | 0 | 1 | 1 |
| size_lnmarcap | 412 | 8.7 | 2.3 | 1.4 | 7.5 | 10.2 | 13.6 |
| growth_revenue | 412 | 0.1 | 0.2 | − 0.8 | 0.03 | 0.1 | 3.3 |
| EBITDA_margin | 412 | 0.1 | 0.2 | − 0.9 | 0.02 | 0.2 | 1.0 |
| market_book | 412 | 5.9 | 26.8 | − 30.8 | 1.4 | 4.9 | 508.5 |
| leverage | 412 | 1.1 | 3.2 | − 12.1 | 0.2 | 1.4 | 33.8 |
| Institutions | 412 | 0.7 | 0.3 | 0.000 | 0.6 | 0.9 | 1.2 |
| Insiders | 412 | 0.1 | 0.1 | 0.0 | 0.004 | 0.1 | 0.7 |
| ROA | 412 | 0.1 | 0.1 | − 0.4 | 0.02 | 0.1 | 0.7 |
| marcap | 412 | 36.4 | 83.7 | 0.004 | 1.8 | 28.1 | 832.6 |
| sector_id | 412 | 6.3 | 2.3 | 1 | 4 | 8 | 11 |
| sector_energy | 412 | 0.03 | 0.2 | 0 | 0 | 0 | 1 |
| sector_materials | 412 | 0.01 | 0.1 | 0 | 0 | 0 | 1 |
| sector_industrials | 412 | 0.2 | 0.4 | 0 | 0 | 0 | 1 |
| sector_cons_discr | 412 | 0.1 | 0.2 | 0 | 0 | 0 | 1 |
| sector_cons_stapl | 412 | 0.1 | 0.2 | 0 | 0 | 0 | 1 |
| sector_healthcare | 412 | 0.1 | 0.2 | 0 | 0 | 0 | 1 |
| sector_finance | 412 | 0.2 | 0.4 | 0 | 0 | 0 | 1 |
| sector_IT | 412 | 0.3 | 0.5 | 0 | 0 | 1 | 1 |
| sector_communication | 412 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |

| Statistic | N | Mean | St. Dev | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| sector_utilities | 412 | 0.02 | 0.1 | 0 | 0 | 0 | 1 |
| Descriptive statistics for blockchain non-adopters | | | | | | | |
| sh_prop | 2,401 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| level_of_support_mgmt | 2,401 | 0.8 | 0.2 | 0.1 | 0.7 | 0.9 | 1.0 |
| proxy_contest | 2,401 | 0.01 | 0.1 | 0 | 0 | 0 | 1 |
| blockchain_weak | 2,401 | 0.0 | 0.0 | 0 | 0 | 0 | 0 |
| level_of_support_total | 2,401 | 0.8 | 0.2 | 0.1 | 0.6 | 0.9 | 1.0 |
| N_sh_prop | 2,401 | 0.1 | 0.7 | 0 | 0 | 0 | 14 |
| level_passed_total | 2,401 | 1.0 | 0.1 | 0 | 1 | 1 | 1 |
| level_passed_mgmt | 2,401 | 1.0 | 0.1 | 0 | 1 | 1 | 1 |
| blockchain_strong | 2,401 | 0.0 | 0.0 | 0 | 0 | 0 | 0 |
| size_lnmarcap | 2,401 | 6.9 | 1.9 | 0.8 | 5.6 | 8.2 | 13.7 |
| growth_revenue | 2,401 | 0.1 | 0.3 | − 3.1 | 0.02 | 0.2 | 5.7 |
| EBITDA_margin | 2,401 | 0.1 | 0.2 | − 1.0 | 0.0 | 0.2 | 1.4 |
| market_book | 2,401 | 3.3 | 10.5 | − 92.4 | 1.2 | 3.5 | 286.6 |
| leverage | 2,401 | 0.9 | 5.1 | − 45 | 0.1 | 1.1 | 124 |
| Institutions | 2,401 | 0.7 | 0.3 | 0.0 | 0.4 | 0.9 | 1.4 |
| Insiders | 2,401 | 0.1 | 0.1 | 0.0 | 0.01 | 0.1 | 1.4 |
| ROA | 2,401 | 0.1 | 0.1 | − 2.1 | 0.0 | 0.1 | 1.7 |
| marcap | 2,401 | 5.1 | 22.2 | 0.002 | 0.3 | 3.8 | 928.2 |
| sector_id | 2,401 | 5.6 | 2.6 | 1 | 3 | 7 | 11 |
| sector_energy | 2,401 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_materials | 2,401 | 0.04 | 0.2 | 0 | 0 | 0 | 1 |
| sector_industrials | 2,401 | 0.2 | 0.4 | 0 | 0 | 0 | 1 |
| sector_cons_discr | 2,401 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_cons_stapl | 2,401 | 0.04 | 0.2 | 0 | 0 | 0 | 1 |
| sector_healthcare | 2,401 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_finance | 2,401 | 0.2 | 0.4 | 0 | 0 | 0 | 1 |
| sector_IT | 2,401 | 0.1 | 0.3 | 0 | 0 | 0 | 1 |
| sector_communication | 2,401 | 0.04 | 0.2 | 0 | 0 | 0 | 1 |
| sector_unilities | 2,401 | 0.02 | 0.2 | 0 | 0 | 0 | 1 |

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