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Blockchain agency theory

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ABSTRACT

Longstanding assumptions underlying strategic alliances, such as agency theory, are actively being revoked by dynamics in the new economy. The mechanism of inter-firm cooperation is increasingly being altered by radical developments in blockchains and artificial intelligence among other technologies. To capture and address this shift, this review takes a problematisation approach and focuses wholly on the pertinence of agency theory. First, it begins by acknowledging the established corpus in the area before, second, appraising the seven long-held assumptions in the principal-agent relationship encompassing (1) self-interest, (2) conflicting goals, (3) bounded rationality, (4) information asymmetry, (5) pre-eminence of efficiency, (6) risk aversion and (7) information as a commodity. Third, to add a fresh perspective, the review proceeds to proffer seven assumptions to advance a novel 'Blockchain Agency Theory' that would better describe new attributes and relaxed agency behaviour in blockchain alliances. These counter assumptions are (1) common interests, (2) congruent goals, (3) unbounded rationality, (4) information symmetry, (5) smart contracts, (6) mean risk and (7) information availability. In the fourth part, the prior audience of principals and agents is appraised and this culminates into, fifth, a consideration of a new audience of blockchain agency in algocratic environments. Altogether, the seven new assumptions extend and provoke new agency thinking among scholars and blockchain practitioners alike.

1. Introduction

While technological innovation is generally rife in the fourth industrial revolution (Khan et al., 2021a; Khan et al., 2022a; Khan et al., 2022b), blockchains, in particular, have piqued the interest of the general population (Abdullah and Faizal, 2018; Kimani et al., 2020). To explain, blockchains are technologies that securely store and transfer data using mathematical equations and cryptography (Meiriño et al., 2019). They are also a distributed ledger system that group records into blocks made secure by a cryptographic signature (Maesa and Mori, 2020). As a database, blockchains facilitate validated and tamper-resistant transactions across a large number of network participants (Glaser, 2017). Yet, when participants are organized in a cooperative forum, the particulars of blockchain alliances elude mainstream theories because they 'eliminate the need for a hierarchy and day-to-day management' as characteristic coordination problems that preoccupy organizations (Pietrewicz, 2018: 1).

Indeed, existing models for explaining strategic alliances are mostly based on the principle of intermediation and the need to verify asset ownership during transaction processing (Nofer et al., 2017). Whereas, in blockchain alliances, source codes assume the agent role as decentralised ledgers, cryptography and smart contracts perform activities previously undertaken by human agents (Hassan and De Filippi, 2021). For example, in a cryptocurrency alliance, agency resides in the decentralised autonomous programme encoded and controlled by virtual members (Buterin, 2014). This agent is then able to trade Bitcoin and appropriate the proceeds for renting additional capacity on the platform. In turn, the principals in a blockchain alliance are key actors including software developers, miners, nodes, coin holders and other stakeholders such as cryptocurrency exchanges (Antonopoulos, 2016). The locus of trust shifts from agents to cryptography as human intervention becomes defunct (De Filippi et al., 2020), and there is a single truth (Beck et al., 2017). Although blockchain has been mostly heralded in finance owing to the popularity of cryptocurrencies like Bitcoin and Ethereum, it has also been employed in verifying electronic voting, managing healthcare records, validating identity, access control, intellectual property protection and supply chain management (Maesa and Mori, 2020).

Moreover, prior conceptualisations describing the motives and mechanisms of strategic alliance have been blindsided by the acute

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speed, non-linear, decentralised and informal modus of radical technologies and their actors. As a result, the widening extent by which dynamics in modern alliances outpace and challenge prior understanding of interfirm cooperation is increasingly apparent to scholars. For instance, the utility of agency costs arising in blockchain alliances has been questioned by Schmidt and Wagner (1979), as parties' opportunism and bounded rationality do not arise (in blockchains). Similarly, pondering the fitness of agency costs in blockchain solutions for start-up funding, Ahluwalia et al. (2020: 6) called for a more 'evolutionary approach' for investigating such relations. Limitations of the explanatory power of information theory, institutional theory, network theory and the resource-based view to blockchain-based applications, such as digital currencies, have also been articulated (Kummer et al., 2020). Nevertheless, the present focus is on blockchain alliances comprising of corresponding entities (Guo et al., 2020). Firms enter into a blockchain alliance to advance strategic needs such as increasing market share and consumer confidence, as well as for operational purposes to reduce overheads and lead time (Song et al., 2020). Blockchains' high level of adaptability is said to be amenable to optimising a vast array of business relationships whether they are vertical, horizontal or diagonal (Bedin et al., 2021).

Furthermore, there is an argument that (1) the unfettered nature of blockchains and (2) their relative novelty work in concert to rescind earlier theories. It is also probable that scholars' inclination to build from existing frames rather than contemplate new paradigms adds to the absence of holistic models that explain the mechanism and drivers of blockchain alliances in the new economy. Hence, there is no obvious answer to the question: 'what are the antecedents of strategic alliance in blockchain environments?'. Filling this theoretical vacuum compels greater immersion in mainstream corpus along with the ever-growing grey literature. Hence, this paper sets out to revisit and adjust agency theory for fitness with the new economy. It explores its underlying assumptions, challenges these assumptions and develops new concepts to apprise the academic and practitioner audience.

To offer an overview of agency theory, managing risks in the principal-agent relationship has perennially preoccupied scholars and practitioners (Wilson, 1968; Arrow, 1971; Jensen and Meckling, 1976). To a substantial degree, Berle and Means' (1932) early treatise on 'The Modern Corporation and Private Property' precipitated economists to contemplate the interrelations of power, ownership and control in the firm (Bendickson et al., 2016). This elicited a range of ideas that were ultimately codified in the 1970s as agency theory (Arrow, 1971; Jensen and Meckling, 1976; Harris and Raviv, 1978). By definition, agency theory is 'concerned with resolving two problems that can occur in agency relationships. The first is the agency problem that arises when (a) the desires or goals of the principal and agent conflict and (b) it is difficult or expensive for the principal to verify what the agent is actually doing…the second is the problem of risk sharing that arises when the principal and agent have different attitudes toward risk' (Eisenhardt, 1989: 58). Correspondingly, Mitchell and Meacheam (2011) believed that the agency view stemmed from assumptions that agents will behave opportunistically. Hence, Eisenhardt (1989) surmise that it warrants consideration in the analysis of activities of a cooperative nature.

For specificity, agency theory is grounded in assumptions about intrinsic human motivations such as the arguments that (1) principals and agents are rational actors solely intent on maximising wealth, (2) economic outcomes are produced by the exclusive actions of principals and agents, (3) principals and agents act on the basis of complete information, (4) principal-agent relationships are at the heart of value creation, (5) economic outcomes naturally gravitate towards equilibrium, and (6) principal and agents are self-interested/opportunistic (Burnham, 1941; Worsham et al., 1997; Bryant and Davis, 2012). Similarly, Eisenhardt (1989) and Bendickson et al. (2016) write that agency theory is underpinned by seven fundamental assumptions of self-interest, conflicting goals, the incidence of bounded rationality, information asymmetry, the pre-eminence of efficiency, the tendency for risk aversion, and the management of information as a commodity. The density of these assumptions leaves little room for the interplay of other mechanisms, such as the resource dependency theory, in firms' activities. Yet, these assumptions are increasingly challenged by shifting dynamics in the organization of modern firms (Bendickson et al., 2016), and similar misgivings are being legitimised in the emerging blockchain economy.

Pressing forward, the aim of this review is to challenge the utility of agency theory in blockchain alliances. Its contributions are fourfold: First, it draws rare attention to the professional/grey literature and grounds the ensuing conceptualisation in practice. Second, as opposed to a static view, it initiates a more evolutionary approach for examining blockchain applications such as in digital currency operations as solicited by Ahluwalia et al. (2020). Third, it clarifies and specifies dimensions that may support the development of scales to measure firms' propensity for strategic alliance in blockchain development. Last, to evoke the equifinality principle, it asserts that a configuration of drivers is more likely to stimulate alliances in blockchain operations, rather than individual factors.

2. The problematisation approach

In their seminal paper, Locke and Golden-Biddle (1997) cited a binary pattern in scholars' formulation of theoretical contributions that evokes gap-spotting and problematisation. In gap-spotting, scholars attempt to highlight coherence or incoherence in extant work (Hällgren, 2012). While acknowledging the value of gap-spotting research, Sandberg and Alvesson (2011) attest to the rarity of studies taking the more assumption-challenging problematisation approach. The dominant bias for gap-spotting is especially surprising because 'what makes a theory interesting and influential is that it challenges our assumptions in some significant way' (Alvesson and Sandberg, 2011: 247). Accordingly, Hällgren (2012) describes the problematisation method as a viable technique for identifying deficiencies in an existing theory and attempting to remedy them. Furthermore, it [problematisation] is predicated on identifying contentions that are potentially problematic in a discourse through one of four modes of disruptive inquiry comprising critical confrontation, new idea formation, quasi-problematisation and problematisation (Sandberg and Alvesson, 2011).

Following from the above, this review adopts problematisation as a rigorous path in disruptive inquiry for challenging assumptions in agency theory that may not apply in blockchain alliances. Underpinned by Alvesson and Sandberg's (2011) problematisation protocol, the methodological principles of (1) identifying a domain of literature, (2) identifying and articulating assumptions underlying this domain, (3) evaluating them, (4) developing an alternative assumption ground, (5) considering it in relation to its audience, and (6) evaluating the alternative assumption ground are abided here. Hence, the rest of this inquiry is structured as follows: Section 3 identifies key works in agency theory literature, while Section 4 evaluates the earlier identified assumptions and their ripeness for conceptual challenge. Next, Section 5 develops alternative assumptions specific to alliances in blockchain environments, then Section 6 associates agency theory with the principal-agent audience. In Section 7, the review ends by appraising a new audience of decentralised autonomous organizations, while Section 8 initiates a discussion. Conclusions are drawn in Section 9, flanked by limitations and future research directions in Section 10.

3. Key works in agency theory

Initial indication of managers' self-interest and opportunism stemmed from Burnham's (1941) writing on a 'managerial revolution'. Arguably, it was one of the first works to definitively question managerial intentions (Bendickson et al., 2016). The awareness of managers' divergent interests morphed into economists' interrogation of risk distribution among contracted parties in the 1960s and early 1970s

(Wilson, 1968; Arrow, 1971). At the time, scholars alluded to the risk-sharing problem faced by individuals and groups, which then extended to an agency problem when these parties pursued different goals and tasks (Ross, 1973; Jensen and Meckling, 1976). Subsequently, the theory evolved to describe 'the ubiquitous agency relationship, in which, one party (the principal) delegates work to another (the agent), who performs that work' (Eisenhardt, 1989: 58). Early on, as a mechanism for explaining and understanding contractual relationships, agency theory was espoused by scholars in diverse disciplines including accounting (Demski and Feltham, 1978), economics (Spence and Zeckhauser, 1971), finance (Fama, 1980), Marketing (Basu et al., 1985), organizational behaviour (Eisenhardt, 1985, 1988; Kosnik, 1987) and sociology (White, 1985).

In due course, while the unit of analysis remained the contract between principals and agents, agency theory advanced into two strands of (1) positivist agency and (2) principal-agent research (Fama and Jensen, 1983; Eisenhardt, 1989; Bendickson et al., 2016). In the first strand, positivist agency addressed the governance mechanisms put in place to mitigate managers' pursuit of own interests especially in large public corporations. The most influential works on this theme are Jensen and Meckling (1976), Fama (1980), Fama and Jensen (1983), Jensen and Ruback (1983) and Jensen (1984). Beginning with Jensen and Meckling (1976), the authors explored the nature of executive compensation and the governance mechanisms contrived to protect the interest of principals. Later on, Fama (1980) considered the efficiency of capital allocation and the labour market as possible sources of dynamic information for regulating managers' self-serving tendency. This inquiry was corroborated by Fama and Jensen's (1983) identification of the board of directors as representatives of shareholders with an active duty to monitor the opportunism of top executives. Successively, this discourse spurred debates around the legitimacy of golden parachutes and the motive of corporate raids in Jensen and Ruback (1983) and Jensen (1984). On the whole, the premise of positivist agency is best captured by Davis et al.'s (1997: 23) notion that 'to protect shareholder interests, minimise agency costs and ensure agent-principal interest alignment, agency theorists prescribe various governance mechanisms'.

The second strand of agency theory, principal-agent research, seemingly lagged behind positivist agency. It pertains to a somewhat mathematical determination of the optimal behaviour and contract-based incentives to align the interests of principals and their agents (Eisenhardt, 1985; Bendickson et al., 2016). To their mind, Grigore and Ştefan-Duicu (1976) believed that the optimum incentive for principals and agents resided in the balance of funding options (such as equity, debt and securities), and how this balance reconciles the conflicting interests of both parties. Accordingly, Sappington (1991: 45) alluded to 'incentive problems' vis-à-vis opportunities for optimal organizational designs. Sappington (1991: 63) also added that 'the common practice of compensating top corporate executives in part with their company's stock and stock options is readily explained. Stocks and stock options help align the incentives of executives and shareholders by making their payoffs coincide more closely'. To compare, the principal-agent research theme has not gained as much traction as positivist agency, as Fayezi et al. (2012) contend that the non-empirical orientation of the principal-agent research strand has undermined its utility, particularly in organizational studies. Yet, both positivist agency and principal-agent research advance understanding of the complexity of agency theory (Mitnick, 2006).

4. Assumptions in agency theory

Notwithstanding the plethora of assumptions attributed to agency theory, Eisenhardt (1989)'s inventory of (1) self-interest, (2) conflicting goals, (3) bounded rationality, (4) information asymmetry, (5) pre-eminence of efficiency, (6) risk aversion and (7) information as a commodity has been the most cited by scholars not limited to De Falco and Renzi (2007), Lubatkin et al. (2007), Bendickson et al., (2016), Toumeh and Yahya (2017) and Calvo and Calvo (2018). Acknowledging this precedent, it is now opportune to appraise and challenge these discrete assumptions.

4.1. Self-interest

The first assumption of agency theory is the incidence of opportunism which suggests that agents are inherently inclined to pursue and satisfy their personal interests with guile, to the disadvantage of principals (Wright et al., 2001). This guile takes the form of deceit or deception (Noreen, 1988), but may also be blatantly exuded through agents' outright lying, stealing and cheating (Williamson, 1985). Indeed, self-interested behaviour has long been deemed to be the only rational and viable explanation of economic conduct as scholars including Friedman (1953) and Mueller (1986) supported its predictive accuracy. As a result, self-interest has become a tenet in mainstream economics, strategy and management studies (Rocha and Ghoshal, 2006). To mitigate its perils, seminal works such as Jensen and Meckling (1976) and Eisenhardt (1989) maintain that outcome-based contracts are an effective tool for curbing the opportunism of agents. Nonetheless, Rocha and Ghoshal (2006: 585) have contemplated whether 'it is worth complicating the models of mainstream economics and management by assuming motives other than self-interest'. In a similar vein, Wright et al. (2001: 414) contend that this assumption is restrictive to the point of disregarding 'the possibility that diverse individuals in various situations may behave differently'. They also add that there are 'contingencies that may be more reflective of realities in economic relationships' (Wright et al., 2001: 414). For these reasons, Perrow (1986a: 15) decried the 'celebration of self-interest' by proponents of agency theory. A contingent of scholars have stressed that the narrow assumption of self-interest does not consider the prospect of agents' positive stewardship and pursuit of the firm's common interest (Davis et al., 1997; Hendry, 2005). To this end, Miller and Sardais (2011) have drawn attention to 'angel agents' who leverage their access to information for the benefit of the firm and its stakeholders. There is also a view that agents act benevolently if there is ground for moral trust (Hosmer, 1995). In blockchain alliances, these contentions may inform new assumptions of common rather than self-interest.

4.2. Conflicting goals

The second agency theory assumption is similar to the first. It presumes that principals and agents have divergent objectives, and agents do not always act in accordance with the preferences of principals (Messier et al., 2006). In essence, while principals seek to maximise their return, agents wish to maximise their income (Saam, 2007). To explain this occurrence, Cavanagh et al. (2017: 176) clarify that 'in order for the principal to achieve greater returns, agency theory states that the agent needs to invest greater effort. However, this results in greater disutility of effort for the agent, who wishes to put in only enough effort to maximise his/her income'. This assumption proceeds to suggest that conflicting goals increase agency costs (Tijjani and Bello, 2019), which Jacobs (1986) defines as exposure incurred by deviating from perfectly competitive outcomes. Agency costs also accrue because contracts are imperfect to the degree that not all contingencies can be accounted for, and monitoring is a difficult endeavour (Eisenhardt, 1989). Therefore, Eisenhardt (1989: 60) adds that 'contracts co-align the preferences of agents with those of the principal because the rewards for both depend on the same actions'. In the absence of such co-alignment, an 'agency problem' arises in which agents exercise autonomy and risk an adverse reaction from their principals (Delany, 2000; Schotter and Beamish, 2011). Nevertheless, this assumption is not without critique. For example, Smith and Warner (1979) pointed to principal-principal conflicts between bondholders and shareholders (Smith and Warner, 1979). In this vein, Bendickson et al. (2016) suggested that there is a potential long list of conflicts beyond the principal-agent relationship. A further

deficiency of the conflicting goals assumption is the clan control view that infers an abiding goal congruence between parties, making redundant the question of effort and motivation (Ouchi, 1979). In their consideration of firms' higher purpose, Mackey and Sisodia (2014) affirm that firms can tap into a wellspring of human motivation by a shift in focus from profit maximisation to purpose maximisation. In the domain of blockchain alliances, this assertion prompts a consideration of congruent rather than conflicting goals.

4.3. Bounded rationality

In the third assumption, agency theory reasons that contracted parties are boundedly rational or, in other words, intendedly logical to the extent that they do not foresee all eventualities of the contract (Bahli and Rivard, 2003a). Being 'intendedly logical' means that decisions are made only on the strength of principals and agents' cognition, prior experiences, expertise, available time and known routines (Puranam et al., 2015). This leads to a satisficing behaviour in which managers make rational decisions to achieve satisfactory rather than optimal economic outcomes (Simon, 1957). An explanation for this phenomenon is that logic reduces the ability of principals and agents to plan in a manner that will yield the most effective result for their alliance (Bahli and Rivard, 2003b). Also, faced with complex decisions, agents are 'forced to take mental shortcuts and fall back on what they have tried or seen work in the past' (Hambrick, 2007: 336). Hendry (2005) writes that bounded rationality only suffices as an assumption of agency theory because the limitations of rational understanding and cognition are considerations that cannot be modelled. As a counterargument, the extended resource-based view holds that decision-making and value creation in the firm attract input and know-how from a network of partners beyond principals and agents (Son et al., 2014). Therefore, although rationality cannot be completely unbounded, it is conceivable that economic performance can be dramatically optimised by quality network relationships (Lavie, 2006). Increasingly, parties in an alliance are able to optimise productivity by leveraging strategic assets in the form of knowledge availed by external networks (Paul and Rosado-Serrano, 2019). This explains the rising prevalence of firms with seemingly inferior resources and know-how surpassing expectations in productivity and yield. They complement existing capabilities with external resources which increase innovation and performance (Xiao et al., 2021). With respect to blockchain alliances, there is an argument that firms' rationality is markedly unbounded by a dynamic reliance on external networks and assets to deliver solutions such as digital currencies.

4.4. Information asymmetry

In the fourth assumption, information asymmetry is the postulation that there is an uneven distribution of intelligence between principals and agents (Eisenhardt, 1989), and this leads to an imprecise knowledge of firm value as well as different predictions of performance (Duffie and Lando, 2001). There is a contention that agents hold more information than principals, and this lop-sidedness has an adverse effect on the ability of principals to effectively monitor whether their interests are being served (Adams, 1994). Particularly, where agents are professionals, their highly specialised and abstract knowledge are a barrier to effective supervision and causes an intrinsic ambiguity in the service provided and efforts exerted (Freidson, 1983; Sharma, 1997). Lu et al. (2010) describe this occurrence as incomplete information producing uncertainty. It may stem from the opportunism of agents withholding information from principals or other managers (Litterer, 1961), or the ambiguous implications of new information (Zhang, 2006). Hence, in agency theory, contracts seek to specify mechanisms that minimise information hoarding (Bendickson et al., 2016). An obvious disputation is the contingency that principals themselves may hoard and exploit information opportunistically (Dawson et al., 2010). Also, the inherent problem of signalling and screening tacit knowledge may not apply to the governance of modern alliances, such as blockchains. To be specific, Berg et al. (2020) have drawn attention to commitment voting as an efficient mechanism for signalling the intensity of preferences and long-term commitment in the governance of proof of stake blockchains. The distributed ledger mechanism effectively replaces the principal-agent relationship with a decentralised peer-to-peer architecture that affords trusted data management, integrity and consistency (Nakamoto, 2008; Ølnes et al., 2017; Guo et al., 2020). Thus, it is conceivable that there is greater information symmetry in blockchain alliances than conventional partnerships.

4.5. Pre-eminence of efficiency

The fifth assumption of agency theory is that 'principals and agents will choose the most efficient contract' (Eisenhardt, 1989: 69). This appetite for efficiency stemmed from Frederick W. Taylor's time studies and scientific management view on the standardisation of work processes as a governance mechanism for improving the performance of individuals and groups (Bendickson et al., 2016). Thus, the contract between principals and agents is guided by a cost-benefit analysis (Droege and Spiller, 2009). Tasks are designed to be accomplished at the least cost or to generate the highest performance at a given cost (Davis, 1985). On one hand, principals are interested in generating greater profits while, on the other hand, workers seek shorter hours, better education, higher compensation and greater quality of life (Bendickson et al., 2016). Ostensibly, standardization in the pursuit of efficiency led to work becoming mundane for workers (Klaw, 1979). The efficiency goals of principals and agents were also at odds and often sparked conflict between principals and agents (Wren and Bedeian, 2020). Reverting to first principles, the prime retraction of the pre-eminence of efficiency assumption is Eisenhardt (1989: 69)'s articulation that 'efficiency is not directly tested' in the contractual process. Secondly, 'efficiency poses a fundamental dilemma to members of the organisation in that it limits the range of human reflection and choice' (Davis, 1985: 73). In particular, third, efficiency is a reified activity that reduces contracts into a phantom objectivity that conceals the fundamental relationship between people for their execution (Lukács, 1972). To stress this point, Davis (1985: 75) argued that when there is a pre-eminence of efficiency, the 'dialectical process of understanding totality is lost and is replaced by an experience and a conceptual of mechanical causality'. Accordingly, as opposed to 'efficient' contracts that do not reflect the dynamic and human nature of relations between parties, blockchain alliances are governed by smart contracts. To resolve the performance tension between principals and agents, smart contracts are blockchain algorithms that automatically execute parties' agreements when predetermined conditions are met without incurring time loss (Shahab and Allam, 2020). Hence, there is an argument that rather than efficient cost-benefit analyses, smart contracts in blockchain alliances offer a more robust and less contentious basis to assess parties' actual performance, and in real-time too.

4.6. Risk aversion

The penultimate assumption of agency theory is that agents are more risk averse than principals because they 'are unable to diversify their employment' (Eisenhardt, 1989: 60) while principals 'are capable of diversifying their investments' (Eisenhardt, 1989: 61). Therefore, in agency theory, numerous scholars describe principals as risk neutral and agents as risk averse (McAfee and McMillan, 1986; Cella, 2005; Barron et al., 2020). By definition, risk underscores the uncertain future facing principals and agents, and the limited influence held by both parties over this future (Haubrich, 1994). While recognising uncertainty, principals anticipate profits and agents expect utility as a reward for their efforts (Wang et al., 2020). Two dimensions of risk have been proposed by March and Shapira (1987) hinging on the (1) economic and (2)

managerial perspective. In the economic view, 'risk is the variance of a probability distribution of possible gains and losses associated with a given alternative' (Bahli and Rivard, 2003a: 211). This contrasts with the managerial view in which 'risk is associated with negative outcomes' and perceived as 'danger or hazard' (Bahli and Rivard, 2003b: 212). Regardless of whether the economic or managerial perspective is taken, the understanding of risks helps principals and agents make decisions on the optimal level of compensation (Lin and Liu, 2021), and all parties ought to absorb a portion of the effects of variable results (Macho-Stadler and Pérez-Castrillo, 2015). At any rate, the risk aversion assumption carries an imbalance in risk distribution between principals and agents. As a substitute to this binary risk neutrality versus aversion contention, Choi (2020) has considered a mean-risk approach to explain risk attitude in blockchain environments. It [mean-risk] is the mechanism by which all parties 'hand their individual losses over to a pool and each of them is liable for the conditional expectation of his own loss given the total loss of the pool' (Denuit and Dhaene, 2012: 265). Thus, there are grounds to ponder mean risk as an equalising factor in blockchain alliances.

4.7. Information as a commodity

The final assumption of agency theory is the thesis that information is an asset than can be purchased for a fee, and principals acquire information systems in a bid to curb the opportunism of agents (Eisenhardt, 1989). This endorses the thinking that adverse selection can be avoided when principals have all available information, and where the cost of obtaining information outweighs the risk of not doing so (Droege and Spiller, 2009). Allen (1990: 269) likened this assumption to the purchase of a newspaper in which 'economic agents decide whether to acquire information before they can learn the outcome conveyed by that information'. For agents, the utility of information as a commodity is that they can be used to update actions (Drakopoulos and Randhawa, 2021). Droege and Spiller (2009) contend that (1) adverse selection and (2) moral hazard are two facets of the information as a commodity principle. Adverse selection comes about when principals appoint agents for representation on the basis of inaccurate information (Mishra et al., 1998), and moral hazard is the likelihood that, once appointed, a competent agent will fail to perform in an adequate manner (Holmstrom, 1979). The basis of these assumptions has since been questioned by Droege and Spiller (2009). They argue that the 'selection problem can be eliminated if the information about the agent's ability to perform the task is available (Droege and Spiller, 2009: 45). Likewise, Droege and Spiller (2009) reason that moral hazards can be mitigated by the design and deployment of behaviour-based contracts that monitor agents' ongoing actions. Both adverse selection and moral hazards are a fundamental issue of trust. However, in blockchain alliances, 'each party already has a copy of all data available, trustable and non-repudiable, that can be used to confirm the veracity of contained information even if not directly accessible' (Companile et al., 2021: 2). Consequently, the assumption of information as a commodity can be challenged by information availability in blockchain alliances.

5. New assumptions for blockchain alliances

Before proceeding, it is timely to revisit the understanding of blockchain alliances. Within distributed ledgers, blockchain alliances are communication channels through which members of a forum authenticate transactions (Yang et al., 2019). These channels could be either permissioned or permissionless (Tapscott and Tapscott, 2016). In the first form, permissioned blockchains have restricted memberships and control procedures that regulate the access of alliance members, information written in the blockchain, and rights to admit new members to the alliance (Liu et al., 2019). In the second form, permissionless blockchains allow records to be shared by all the networks users, these are monitored by everyone, and not controlled by a single authority (Swan, 2015). To be sure, this paper focuses on advancing new assumptions for permissionless blockchain alliances. Consistent with the fourth step of Alvesson and Sandberg (2011)'s problematisation framework, alternative assumptions ought to be developed. Thus, following the review in the preceding Section 4, seven new assumptions to describe agency in blockchain alliances are proposed as (1) common interests, (2) congruent goals, (3) unbounded rationality, (4) information symmetry, (5) smart contracts, (6) mean risk and (7) information availability. These are now considered in turn.

5.1. Common interests

The opportunity to pursue self-interest over the common good of an alliance is constrained by the configuration of blockchains (Ba et al., 2001). Intrinsically, value is co-produced in blockchains and this is an inherent incentive for entering into an alliance to realise common interests in an authority-free and democratised environment (Unalan and Ozcan, 2020). Rather than the principal-agent relationship, the interactions in blockchain alliances take a many-to-many dimension and an ecosystem dynamic to co-evolve and co-create value in a mutual sequence (Samaniego and Deters, 2018; Buhalis, 2020). As a case in point, in alliances built on the Ethereum blockchain, transactional information relating to initial coin offerings, stablecoins and decentralised finance applications are validated by 'public' consensus of transactions deemed to be true by members rather than opportunistic parties (Tapscott and Tapscott, 2016; Zachariadis et al., 2019). To address common rather than self-interests in permissionless blockchain alliances, Crosby et al. (2016) indicate the incidence of 'trustfulness' in which no parties need to rely on the 'honesty' of others. This is made possible because transaction records are immutable once added to the blockchain, and attempts to alter them are futile as this will result in incongruent copies within the network (Beck et al., 2016).

5.2. Congruent goals

To circumvent the threat of conflicting goals in blockchain alliances, from the outset, members determine and agree how their data and transactions are to be represented on the blockchain, the rules governing the transactions and algorithms for resolving disputes (Barnett and Treleaven, 2018). Furthermore, since there is no third-party involvement and the encrypted records of transactions are shared across the blockchain alliance, the alteration of information to serve conflicting goals is obviated (Dilawar et al., 2019). Also, modifying a single record in the communication channel will warrant total reconstruction of the blockchain (Lee et al., 2019). Thus, ab initio, communication channels in blockchain alliances serve to reconcile conflicting goals by predefining the governance rules of impending transactions (Beck et al., 2018). Fundamentally, in the design phase of the blockchain, parties in an alliance are incentivised to frame their collaborative efforts 'towards the joint pursuit of a common objective and value creation' (Wang et al., 2021: 1469).

5.3. Unbounded rationality

Whereas bounded rationality in agency theory holds that transactions are executed within the limits of principal and agents' cognition, experience and available time, permissionless blockchains are open networks that are data and information rich (Nørfeldt et al., 2019). There is also an added transparency that enables users to access all available information (Hellier et al., 2020; Khan et al., 2021b), thus optimising economic performance. As an example, the permissionless Ethereum platform has averted bounded rationality by virtue of being open-source and allowing access to the public to join the alliance (Chen et al., 2019). In other words, on grounds of public governance, bounded rationality is better managed in blockchains through the volume of information provided by that public. Although rationality cannot be completely unbounded, open-sourcing in permissionless blockchains

makes it possible to contract for more eventualities than is feasible in conventional principal-agent relationships. Thus, unbounded rationality is realised by the fusion of artificial intelligence [AI] and cryptographic signatures within blockchains. This already obtains in healthcare record sharing, media royalties management, financial security operations and supply chain logistics (Khan et al., 2021c). The combination of the two technologies [artificial intelligence and blockchains] works well to build and organise big data, strengthen cyber security protocols and perform tasks at high speed. This has become known as decentralised artificial intelligence [DAI] or Blockchain + AI = DAI. As blockchains enable the storage of cryptographic records needed by AI, this then results in smarter contracts and a higher level of unbounded rationality (Bertino et al., 2019).

5.4. Information symmetry

Data-driven management and governance overturn prior concerns of information asymmetry through a decentralised peer-to-peer proof-of-work mechanism (Nakamoto, 2008; Ølnes et al., 2017; Guo et al., 2020). In practice, this warrants a member of a blockchain alliance to compute a memory-hard function, while another member makes a verifier request via channel communication to confirm that the memories have been filled by the proper function (Biryukov and Khovratovich, 2017). Consequently, there is greater information symmetry in blockchain alliances. Moreover, in permissionless blockchains, alliance members maintain an identical copy of the ledger and information consensus is achieved by continuously synchronising all copies to ensure accuracy and recency (Fan et al., 2018). Also, although alliance members do not publicise their identities during transactions, their activities are traceable and visible across the entire network and can be reconstructed for accuracy at any time (Hellier et al., 2020).

5.5. Smart contracts

To counter the assumption of pre-eminence of efficiency in principal-agent relationships, smart contracts are issued in blockchain alliances through algorithms that automatically execute transactions once programmed conditions have been met (Shahab and Allam, 2020). First considered in 1993, smart contracts are programs deployed in a distributed network that can acquire external information and automatically update blockchain transactions (Feng et al., 2019). The mechanism of smart contracts involves the deposit of assets into a contract by parties and subsequent redistribution of the assets among parties on the basis of the provisions of their inputs (Baghery, 2019). The automated nature of smart contracts means that no time is lost in reconciling errors that often result when principals and agents operate conventional systems (Christidis and Devetsikiotis, 2016). Smart contracts also automate workflows and trigger successive actions without third-party involvement (Lauslahti et al., 2017). When used in complex transactions as in blockchain alliances, smart contracts greatly improve transaction efficiency (Feng et al., 2019). This makes it superfluous for parties in an alliance to perform cost/benefit analyses.

5.6. Mean risk

In permissionless blockchain alliances, there is a 'pooling mechanism' that offsets principals' risk neutrality and agents' risk aversion (Denuit and Dhaene, 2012: 265). AICPA (2021) concurs that this pooling device spreads blockchain risks along the (1) infrastructure, (2) data, (3) management and (4) smart contracts governing the alliance in a manner that is shared by all parties. First, infrastructure risks pertain to blockchain functionalities or capabilities that are exposed to software vulnerabilities (AICPA, 2021). Second, data risks are the possibility that off-chain information is stored or transmitted in a computer-legible format to a blockchain and subsequently treated as a transaction. This may include non-standard transactions, data output, out-of-range data and orphan addresses[1] (AICPA, 2021). Third, management risks are the threat that public and private keys may be exposed in the course of executing or verifying transitions (AICPA, 2021). Finally, smart contract risks describe likely failures in the transfer of value in the course of recording a transaction (AICPA, 2021). Once more, through pooling, these risks are more evenly appropriated by parties in a blockchain alliance.

5.7. Information availability

Both adverse selection and moral hazard in the information as a commodity assumption are exposures that can be managed by smart contracts (Lorne et al., 2018). Besides, 'given the moral hazard problems connected to misreporting, using a blockchain seems particularly opportune' (Yermack, 2019: 13). When issued in communication channels, smart contracts address adverse selection and moral hazard by providing formal guarantees and zero transaction cost coordination of relationships between members of a blockchain alliance (Swan, 2015). The need to monitor agents, audit requirements, disclose regimes, market pressure and executive-agent compensation schemes is negated to the extent that efficiencies in alliances' corporate governance is drastically enhanced (Kaal, 2019). Too often, moral hazard 'sees management gambling with shareholder capital', but 'through smart contracts under blockchain, shareholders will be able to enforce the commitments executives make' (Tapscott and Tapscott, 2017: 13). As a case in point, blockchains also make it possible for alliances requiring special talent to access an abundance of information about potential members (Tapscott and Tapscott, 2017).

To summarise, below, Table 1 compares erstwhile assumptions in agency theory with new attributes of blockchain agency theory.

Table 1
Agency theory vs blockchain agency theory.

Agency theory assumptions	Descriptor	Blockchain agency theory assumptions	Descriptor
1. Self-interest	The opportunism of agents	Common interests	Trustfulness in permissionless blockchains
2. Conflicting goals	Principals' maximisation of returns and agents' maximisation of income	Congruent goals	Encrypted transaction records
3. Bounded rationality	Satisficing behaviour by principals and agents	Unbounded rationality	Transparency in permissionless blockchains
4. Information asymmetry	Uneven distribution of intelligence among principals and agents	Information symmetry	Decentralised peer-to-peer, proof-of-work architecture
5. Pre-eminence of efficiency	Contracting based on cost-benefit analyses of principals and agents	Smart contracts	Automated execution of agreements
6. Risk aversion	Agents' inability to diversify employment	Mean risk	Risk sharing in permissionless blockchains
7. Information as a commodity	Intelligence as a purchasable asset	Information availability	Intelligence as an essential utility

[1] Orphan addresses are proof-of-work that have not been accepted due to a time lag in the blockchain communication channel.

6. Principal and agent audience

Proceeding to the fifth stage of Alvesson and Sandberg (2011)'s problematisation method, the assumptions of agency theory challenged here are held by principals and agents entering into strategic alliances in various spheres. This includes relationships in accounting, industrial organization and marketing (van Ackere, 1993), technology contracts (Jinghua, 2009), finance (Gomm, 2010), human resources (Ceric, 2012) and supply chain (Wandfluh et al., 2016), to mention a few. Recent literature suggests that principals and agents are already cognisant of blockchain opportunities that may not only upend but improve their alliance. For example, Yin (2021: 10) draws attention to incentive-based contracts in supply chain financial alliances where principals and agents are able to 'screen the true operating conditions of core enterprises'. Similarly, Chawla (2020) contends that the nature of trust between principals and agents in the entrepreneurial financing is equally being redefined by blockchain algorithms and governance.

7. New audience of decentralised autonomous organizations (DAOs)

To close the loop, Alvesson and Sandberg (2011) implored scholars to consider a targeted audience for the alternative assumptions developed. To this extent, the blockchain agency theory established in this review will appeal to algocratic environments where current and impending decentralised autonomous organizations are likely to operate as decentralised autonomous organizations. Hence, the current discourse appraises three groups with a potential to enter into a blockchain alliance. These audiences are employment contract and labour relations alliances, public administration and governance, and supply chains. They are explained in turn.

7.1. Employment contract and labour relations

In the near future, it is anticipated that employment contractors and labour relations alliances such as worker unions will deploy blockchain communication channels to determine employees' incentives. To this end, optimal information sharing of employee performance and value contributed will replace compensation based on simplistic performance reviews (Pendergast, 1999). This also has implications for the compensation of team production and performance (Drago and Garvey, 1998), as the contributions of individuals can be more easily traced. In the gig economy (Gandini, 2019), it will also be possible for the commoditisation of labour to be mediated by blockchain communication channels and enable worker compensation to be driven by pool wide feedback, rankings and rating mechanisms.

7.2. Public administration and governance

It is foreseeable that public administrators will look to streamline social services, improve communication, access information, increase transparency and intensify social engagement using blockchains (Cavalcante, 2018). While reducing government bureaucracy, blockchain agency can also simplify public procurement in terms of company selection and the issuance of public notices. Precisely, information symmetry in blockchain agency theory can reduce the adverse effects of information-poor decisions and improve the level playing field for all participants in a public procurement tender.

7.3. Supply chain management

Agency theory has been extensively used to explain dyadic relationships in supply chain management, where both sides have self-interested motivations (Perrow, 1986b). However, as supply chains are growing in length and number of participants, multi-sourcing from geographically dispersed countries, Khan et al. (2021d: 5) note that blockchain technology makes it 'possible to monitor production and reallocate the surplus supply of products'. Thus, blockchain agency theory offers a lens to harmonise supply chain complexities by harnessing smart contract monitoring and performance management of inputs and outputs. Transaction costs are thereby reduced while performance and communication in supply chains are improved (Khan et al., 2021e).

8. Discussion

This study aimed at problematising agency theory by contemplating its relevance to blockchain-based alliances. As a method, Alvesson and Sandberg (2011)'s well-established problematisation protocol has been espoused to (1) generate fresh questions, (2) capture novel developments in the domain and (3) propose a new set of assumptions with policy and managerial implications. To a great degree, the principal-agent relationship has been extensively probed for harbouring moral hazards both in dyadic and multi-stakeholder contexts. In this critique, it is argued that although agency theory remains relevant in blockchain alliances, its manifestation takes a different form. Particularly, agency within a blockchain environment retains the contractual aspects but decreases information asymmetry among stakeholders. Thus, theoretically, this study advances knowledge by mooting a novel blockchain agency theory to fathom the monitoring of opportunistic behaviour in the presence of information symmetry, unbounded rationality, congruent goals, smart contracting and mean risk. Undoubtedly, these dimensions warrant additional research, especially through empirical investigation, to validate the constructs. Furthermore, blockchain agency theory clarifies the relationship dynamics in ecosystems that depend on evolving technologies. This micro-theoretical approach adds criticality to the conceptualisation of relationships in algocratic contexts.

In practical terms, blockchain agency theory suppresses the assumption of information asymmetry-based opportunism. As described in Section 5, encrypted transactions facilitate the congruence of goals and reduce moral hazard in a variety of fields including finance (Alexander and Cohen, 1999), business operations (Keser and Willinger, 2007), and supplier selection (Steinle et al., 2014). Equally, blockchain agency theory has the potential to drive the transition from single-sided supplier-buyer relationships into a multisided affair, while retaining objectivity and commercial sensitivity despite parties' interdependencies. Managers can reflect on blockchain agency theory as a framework to cultivate relationships based on common rather than self-interests within their ecosystems. For example, when assessing the performance of suppliers (Lasch and Janker, 2005; Steinle et al., 2014; Khan et al., 2021e), opportunity risk will be significantly reduced by permissionless blockchains where trustfulness is a prerequisite for participation. This is especially valuable in international supply chains with greater complexities and more significant vulnerabilities (Wagner and Bode, 2006). In this scenario, the principle of common interest will prevail over self-interest as engaged parties will be driven by mutual rewards. The value of the common interest principle also exceeds the supplier – buyer contract to the extent that it predicates all blockchain-based relationships.

Furthermore, information symmetry in blockchain agency theory expounds the ex-ante and ex-post information balance after contracts have been agreed by all sides. In a blockchain alliance, it is predetermined that parties will truthfully validate transactions with proof instantaneously disseminated to all participants. Hence, the pitfalls of communication frequency, length of relationships and award type are overcome by information symmetry, as all entities have access to information regarding, for example, a party's past performance. This is an interesting theme to be further explored by future research, alongside the principle of common interest in terms of parties' external dependencies.

9. Conclusion

To surmise, this review has appraised seven assumptions of agency theory and developed a new blockchain agency theory to address limitations in the former. In this vein, four contributions are reported. First, it has appraised the professional/grey literature to fathom and correlate the mechanism of blockchains with the classic agency theory. Second, as solicited by Ahluwalia et al. (2020), digital currency operations have been evaluated to offer a more dynamic view of blockchain operations. Third, seven new principles of blockchain agency theory are outlined bordering on common interests, congruent goals, unbounded rationality, information symmetry, smart contracts, mean risk and information availability. These features may inform the development of constructs to capture parties' propensity to participate in blockchain alliances. Last, consistent with the equifinality condition, this paper asserts that, rather than individual factors, a configuration of drivers is more likely to engender a blockchain alliance. Altogether, this review is one of the first to challenge and, by the same token, substitute the assumptions of agency theory in blockchain alliances. In this way, the review goes beyond gap-spotting to remedy growing deficiencies in agency theory.

10. Limitations and further research

The foremost limitation to acknowledge is the assumption that all parties in a blockchain alliance appropriate smart contracts. This is unlikely to be the case. Additionally, the assumptions ensuing from the problematisation process assume an open ecosystem with joint risk sharing and ubiquitous intelligence. However, the effect of lived realities including managers' actual conduct (Weisbach, 1988; Brickley et al., 1994; Alexander and Cohen, 1999), unhealthy competition (Khoreva and Wechtler, 2020) and double-sided moral hazard (Houben, 2003; Cai et al., 2021) have not been explored in this review. These faults pave way for new lines of inquiry. Relatedly, the posited blockchain agency theory assumes that information is instantly available upon the execution of transactions and the consequences are mutually observable. However, for certain transactions, consequences remain unknown due to confirmation lags. This is also acknowledged as a limitation of blockchain agency, as well as an avenue for future research. To advance theory, prospective research should examine the underlying motivation of principals and agents in different contexts as well as validate, as previously stated, the principles and their interdependencies. Evidencing and documenting the behavioural aspects of blockchain agency theory is essential for operationalising the seven principles and consequently the behaviour of participating stakeholders. Furthermore, investigating the incidence of double moral hazard is also essential, especially considering the occurrence of double-agency (Wilhelm et al., 2016; Homburg et al., 2020) and short-sighted principals and agents. This is particularly pertinent as blockchain primarily supports programmed transactions and does not offer an express remedy for misdemeanour. To this end, forthcoming studies can further explore aspects of governance in blockchain reliant alliances.

Declarations of interest

None.

Data availability

No data was used for the research described in the article.

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