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Governance rigidity, industry evolution, and value capture in platform ecosystems

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ABSTRACT

Existing work has shown how, in platform ecosystems, firms can capture above-average rents by controlling hard-to-replace segments. However, initial conditions can have a lasting effect on a platform owner's ability to capture value as the ecosystem in which it operates evolves. We develop a theoretical framework that first considers the role of bargaining power and industry life cycle stage, showing how these shape initial governance arrangements and the platform owner's subsequent ability to capture value based on the rigidity of these arrangements. We then develop propositions, focusing on contingencies that moderate this degree of governance rigidity in platform ecosystems. Our framework helps understand the combined effects of initial conditions and governance rigidity as key drivers of a platform owner's ability to capture rents. Once we consider these dynamics, controlling a hard-to-replace segment may neither be *sufficient* nor *necessary* to obtain a large share of the value created by an ecosystem.

1. Introduction

A growing literature in strategic management has highlighted the importance of ecosystems (Adner and Kapoor, 2010; Teece, 2018; Jacobides et al., 2018; Helfat and Raubitschek, 2018) as a form of coordination in which a firm's ability to create and capture value depends on a "*multilateral set of partners that need to interact in order for a value proposition to materialize*" (Adner, 2017: 40).[1] Existing work in this area shows that how economic activities are organized among ecosystem partners affects the degree to which a firm can capture a share of the total value created (Jacobides et al., 2006; Adner and Kapoor, 2010). In particular, the relationship between the owner of a platform ecosystem and its complementors is critical for value creation and value capture in platform ecosystems (Moore, 1996; Helfat and Raubitschek, 2018) and firms that operate in parts of the ecosystem characterized by higher complementarity and lower factor mobility than other segments can capture above average rents (Jacobides et al., 2006; Pisano and Teece, 2007; Jacobides, 2011; Jacobides and MacDuffie, 2013; Jacobides and Tae, 2015; Baldwin, 2018). However, while recent work has started to explore the dynamics of value creation and capture in ecosystems, in particular during its nascent stages (Hannah and Eisenhardt, 2018; Dattée et al., 2018), this work has overlooked the role of governance as a driver of how and when platform owners can profit (or not) from controlling a hard-to-replace segment. Our paper focuses on the role of governance arrangements and how initial conditions may result in path dependencies (Kenney and Von Burg, 1999) that have important long-term consequences for a platform owner's ability to capture value, particularly once the resulting relationships and interdependencies become formalized and costlier to alter.

As an illustrative example, consider Advanced RISC Machines Ltd. (ARM), the leading supplier of semiconductor intellectual property (IP) and licensor of chip designs. In 2013, ARM's processor architecture was used in over 95% of the world's mobile devices, with ARM's partners selling 4.6 billion chips (ARM Annual report, 2013). ARM's processor architecture is complementary with their partners' assets, such as mobile device designs and semiconductor fabrication plants, since these assets are mutually adapted and their combined use produces superior value (Jacobides et al., 2006). Also, as ARM licenses its designs to many complementors while facing little effective competition from other semiconductor IP providers, its factor mobility relative to its

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[1] As argued by Hou and Shi (2020), there are multiple approaches to understanding ecosystems, in particular a structural view of ecosystems and an evolutionary, affiliation-based approach. Our study draws on both of these views and we elaborate on the distinction between them and their implications in our Discussion section.

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complementors appears to be low. ARM therefore seemed to be well-positioned to appropriate a large share of the value created in the ecosystem serving the mobile device industry. However, ARM's revenues of $913.1 million were a small fraction of the $30.9 billion revenue generated by the mobile phone application-specific semiconductor ecosystem (Gartner, 2012) and their profitability was also lower than other ecosystem members.[2]

To delineate the set of relationships during the nascent stages of an ecosystem, we introduce a conceptual framework that considers governance inseparability (i.e., rigidity of governance arrangements, see Argyres and Liebeskind, 1999, 2002) and industry evolution (Langlois and Robertson, 1995; Klepper, 1996; Jacobides and Winter, 2005). We focus on two initial conditions: first, the bargaining power of the platform owner (e.g., Brandenburger and Nalebuff, 1996; Jacobides et al., 2006), which it can leverage to set up potentially favorable governance arrangements with complementors who agree to join the nascent ecosystem. Second, we focus on the life cycle stage of the industry (e.g., Gort and Klepper, 1982; Klepper, 1996) in which the ecosystem's value proposition materializes (i.e., the end product market), which affects, via demand growth, whether the primary concern of ecosystem participants is creating or capturing value (Di Stefano et al., 2012; Moore, 1993). We argue that commitments made by the platform owner to its complementors as part of the governance structure in the ecosystem's nascent stages limit its ability to alter governance mechanisms in the future (Argyres and Liebeskind, 1999, 2002) and that this effect is more pronounced as the industry served by the ecosystem matures. Using the bargaining power of the platform owner to influence the governance structure and the life cycle stage of the end consumer industry that is served by the platform ecosystem as initial conditions, we distinguish between four scenarios at time of ecosystem creation and provide an illustration of each. Our conceptual framework further highlights key contingencies that shape governance rigidity and we develop several propositions based on these contingencies.

Overall, our paper contributes to emerging work on platform ecosystems that has focused on how the ways in which firms collaborate subsequently affects value creation and appropriation (Nambisan and Baron, 2021). Our framework helps understand the combined effects of initial governance arrangements and industry life cycle stage, emphasizing the importance of initial conditions and governance rigidity as key drivers of a platform owner's ability to capture value. In particular, we show that operating in a hard-to-replace segment in an ecosystem at a given point may neither be *sufficient* nor *necessary* in the future for capturing a large share of the aggregate value created.

2. Background literature

2.1. Governance in platform ecosystems

Firms in platform ecosystems need to consider not only the end customer, but also other ecosystem participants, e.g., platform owner, users, and complementors, all of whom are necessary to deliver the final value proposition (Adner et al., 2013; Ozalp et al., 2018; Cutolo and Kenney, 2021). The multilateral dependencies within these horizontal and vertical relationships require complex forms of governance (Mayer and Argyres, 2004; Gulati et al., 2012), the management of which underlies the platform owner's ability to appropriate returns (Adner and Kapoor, 2010).

Since platform ecosystems have a logic of multilateral exchange that operates differently from markets or hierarchies (Moore, 2006; Adner, 2017; Jacobides et al., 2018), they can neither be purely self-initiated, self-organized, or self-governed open communities; nor be purely hierarchically organized through contractually specified employer-employee relationships. “Hence, platform ecosystems differ from markets in that governance decisions are made by the central platform that plays an important coordinating role in defining the rules for participation and exchange that ultimately generate network externalities (and other benefits from coordination), and in defining how the benefits from externalities and coordination are distributed among the participants” (Kretschmer et al., 2022:6). The current debate on the specific nature of platform ecosystems presents the platform model as a distinctive organizational form that co-opts assets, resources, and activities that are not part of the firm (Stark and Pais, 2020).[3]

Platform ecosystems are characterized by a system-level goal shaped by its architects (Gulati et al., 2012), whom we refer to in our study as “platform owners” and who actively manage their ecosystems using informal authority.[4] Platform owners are similar to platform sponsors (Eisenmann et al., 2009) in the sense that their role entails exercising design and property rights, hence assuming responsibility for determining who may participate in a platform-mediated network. A platform owner's informal authority stems from its knowledge, status, or control over key resources which creates stratification and asymmetric dependence (Thomas and Autio, 2014; Adner, 2017; Jacobides et al., 2018). Hence, the platform owner plays a crucial role in creating the ecosystem and managing the governance structure that surrounds it (Gawer and Cusumano, 2002; Pierce, 2009; Wareham et al., 2014). For example, several studies have pointed out the importance of strategic moves by platform owners, such as inducing coordination and stimulating value creation among partners (Gawer and Cusumano, 2002), incentivizing partners to join and invest in the ecosystem (Gawer and Henderson, 2007), and more broadly, designing the ‘rules of the game’ (Iansiti and Levien, 2004)—that is, ‘who does what and who gets what’ (Jacobides et al., 2006). In this sense, the governance characteristics reflect the alignment structure (Adner, 2017)—resulting from the power differences between firms (Beckert, 2010; Kenney and Zysman, 2016; Curchod et al., 2020)—in which the platform owner establishes its ecosystem by specifying task identification and assignment, decision-making, conflict resolution, membership control, and coordination for task execution (Eisenmann et al., 2009; Gulati et al., 2012). Accordingly, these underpinnings are overseen by the platform owner through governance arrangements that complementors need to adhere to (Thomas and Autio, 2014; Minà et al., 2015; Adner, 2017). These arrangements are likely to be the emergent result of multilateral influence contests between participants in nascent ecosystems, with the platform owner taking the lead in specifying the structure of collaboration and the governance arrangements. Thus, while the mutualistic view of these contests between platform owners and complementors appears to clash

[2] ARM's suboptimal value capture from the semiconductor ecosystem is also evidenced in its lower Return on Invested Capital (ROIC) ratios—a measure commonly used in the literature for value capture (Jacobides and Tae, 2015)—as compared with other key members of the ecosystem: Average ROIC between 2004 and 2013 for ARM = 8,6%, INTEL = 17,6%, Qualcomm = 18,3%, Texas Instruments =20% (Source: Authors' calculations from company annual reports & figures from Morningstar, Inc. Financial services).

[3] For example, instead of contracting workers and managing them in a traditional way (e.g., control-governance mechanisms between managers and subordinates), online labor platforms use information technology (IT)-enabled and automated governance mechanisms, known as “algorithmic management,” to control their non-employees (Rietveld et al., 2020; Stark and Pais, 2020).

[4] We define the *platform owner* as the focal firm that manages an ecosystem around its platform by specifying the structure of collaboration (e.g., rules and membership) and the governance arrangements (e.g., who does what and who gets what) with its ecosystem partners that complement the platform (Gulati et al., 2012; Minà et al., 2015; Adner, 2017). Hence, the platform owner is the focal firm that offers the governance arrangements which other peripheral participants need to adhere to if they choose to join the ecosystem, following the core-periphery distinction of platforms conceptualized by Baldwin and Woodard (2009) as well as the platform provider – platform sponsor distinction of Eisenmann et al. (2009) that highlights the adoption-appropriability trade-offs in platform openness decisions.

with the power dynamics described by several authors (Curchod et al., 2020; Cutolo and Kenney, 2021; Rietveld et al., 2020), in which, "for nearly all platform users, the terms and conditions of participation are non-negotiable" (Cutolo and Kenney, 2021, p. 15), this view stems from a focus on situations in which the platform owner has a substantial advantage over other ecosystem participants in their ability to influence the governance structure, while we take the presence or absence of such ability to be a key initial condition in our framework.[5] These governance arrangements can be embodied in formal and legally binding contractual agreements (e.g., technology licensing agreements, long-term supply contracts, exclusive dealership and franchise agreements) as well as informal agreements (e.g., "self-bonding" sunk costs or "social contracts" implying a commitment to respecting and upholding social norms) (Argyres and Liebeskind, 1999: 51–52).

Depending on the purpose or function of the ecosystem community and the degree of stratification, the contracts in ecosystems can be of different duration, such as long-term (or even perpetual) vs. short-term contracts and may contain several clauses designed to safeguard the interests of platform owners and facilitate adaptation to future changes. Due to these characteristics, platform ecosystems are a powerful context for theorizing how bargaining power contests can result in multilateral contractual agreements among different complementors.[6]

While uncertainties about technology and demand during ecosystem emergence can make it more difficult to design complete contracts, the lack of certainty can also translate into governance arrangements that are designed to safeguard the interests of the parties with greater initial bargaining power. Similarly, ecosystem membership can also be a constraint as complementors lock into unproductive relationships and increase the switching costs of partnering with other viable firms (Gulati et al., 2000; Jacobides et al., 2018; Cutolo and Kenney, 2021; Nambisan and Baron, 2021).

2.2. Governance rigidity

Our framework draws on the concept of "governance inseparability", which Argyres and Liebeskind (1999, 2002) introduced to the transaction cost economics (TCE) literature. Governance inseparability occurs when prior contractual commitments made by a focal firm constrain its ability to differentiate or alter future governance arrangements due to the costliness of contractual renegotiation, especially when accompanied by unexpected changes in relative bargaining power.

Given the multilateral nature of ecosystems, the initial governance arrangements among platforms and complementors may be costly to alter due to initial commitments made and changes in bargaining power. Shifts in the configuration of platform owner and complementors make ecosystem dynamics more intricate than considering a series of static, dyadic relationships. Therefore, the dynamic and multilateral aspects of ecosystem relationships are critical for understanding strategy in these contexts (Adner, 2017) and we expect governance rigidity resulting from governance inseparability to be particularly salient for firms aiming to control a favorable value capturing position (Jacobides et al., 2006).[7]

By explicating how contractual commitments create path dependence in governance arrangements, the literature on governance inseparability suggests that our understanding of value creation and capture in ecosystems would benefit from considering the impact of the initial governance arrangements and their rigidity on a platform owner's ability to benefit from them in the future. Existing work shows that contracts serve adaptive as well as safeguarding purposes, and act as complements, rather than substitutes for trust-based relational governance (Schepker et al., 2014). This knowledge then forms the basis for decisions regarding the ecosystem's development. However, such reliance on having high quality relationships with a multilateral set of complementors is likely to make governance rigidity particularly prevalent and more intricate in ecosystem contexts.

While the multilateral aspect of transactions within ecosystems is clear, the role initial governance decisions can play in relation to value creation and capture is less well understood. In multilateral transactions, instead of looking at each bilateral nexus independently (with customized contractual agreements with each partner), greater attention to an entire stream of transactions is needed (with standardized governance agreements). In particular, multilateral contracts cannot be decomposed to an aggregate of bilateral interactions: "For example, for parties A, B, and C, non-decomposability would be exemplified by a case in which a successful contract between A and B is undermined by the failure of the contract between A and C: Analyzing the relationship of A and B in isolation from C would lead to a false conclusion (Adner, 2017: 42)."

Similar to other multilateral bargaining processes considered in prior work, the complexity of multilateral renegotiations of governance arrangements in ecosystems increases with the number and heterogeneity of complementors involved, as both factors increase the number of competing claims that must be addressed to reach an agreement to change governance arrangement (Libecap, 1989). Such renegotiation is therefore likely to be particularly costly in an ecosystem's later stages, when the number of distinct groups of ecosystem members, as well as within-group heterogeneity, is highest. Unilateral changes of governance arrangements by the platform owner may thus become an attractive alternative (Cutolo and Kenney, 2021). However, completely unilateral actions can also threaten an ecosystem's survival (Eaton et al., 2015), in line with previous work examining collaborative ventures that suggests that unilateral action may lead to deterioration in relationship quality, and potentially even dissolution (c.f., Ariño and de la Torre, 1998). Therefore, by unilaterally changing governance arrangements, a platform owner risks reducing the quality of its relationships with ecosystem partners, potentially leading to more limited knowledge about their needs and those of end users, and a reduced ability to grow the value created by the ecosystem. Still, the more dominant a platform becomes, the more likely it is to unilaterally change governance arrangements independently of governance rigidity (Rietveld et al., 2020).

2.3. Industry evolution, firm specialization, and value capture

The industry evolution literature has long documented different stages of a single industry's life cycle (Gort and Klepper, 1982). Industry

[5] We understand that in established platforms, especially those facilitating transactions, like Uber or Airbnb, terms and conditions are not 'negotiated', they are take-it-or-leave-it. However, even those terms and conditions are initially set at some point in time when the platform owner starts its ecosystem and the accounts of the early stages of many such platforms do mention negotiations between the nascent platform owner and the initial participants (Lashinsky, 2017: 92–97, 106; McCann, 2015). In the case of innovation platforms, such as ARM (or other B2B type platforms), such negotiation of terms with initial participants is even more likely. We discuss later in the paper the idiosyncratic elements—such as presence of an established customer base, or number and nature of complementors targeted—that influence the initial ability of a platform owner to design a more favorable governance structure.

[6] Many of the interdependencies in this paper (and empirical ecosystems research more broadly) are in fact multilateral. Multilateral governance arrangements differ from dyadic ones in which companies strike agreements on a case-by-case basis with a particular partner (Lavie, 2007; Adegbesan and Higgins, 2011). In that sense, an ecosystem-specific treatment of multilateral interdependence is important as the risks of not carefully designing initial governance arrangements are higher and they may become standardized and more difficult to alter over time.

[7] For clarity of exposition, in our theorizing in the rest of the paper we will focus on "governance rigidity", which is created by governance inseparability, rather than on the governance inseparability itself.

emergence is characterized by rapid demand growth, while on the supply side multiple product designs compete (Anderson and Tushman, 1990; Utterback and Suárez, 1993). Industries mature as alternative technological growth opportunities diminish and demand growth slows down. Following the emergence of a dominant design, the industry consolidates and converges towards scale advantages in mass production of standardized goods (Klepper, 1996). This traditional monolithic view of industry evolution, however, rests on implicit assumptions that the industry's products are substantially homogeneous (Uzunca, 2018); that there is no scope for vertical disintegration or cooperation among firms; and that all firms are able to produce and sell that homogeneous product (Knudsen et al., 2014). However, ecosystems typically comprise firms from multiple industries and vertical layers (Adner and Kapoor, 2010; Ozcan and Santos, 2015; Jacobides et al., 2018), e.g., semiconductors, mobile operators, app providers, and accessory manufacturers within the Apple iPhone ecosystem, and are best conceptualized as a network of evolving and interrelated product (sub)markets (Klepper and Thompson, 2006; Uzunca, 2018). Importantly, demand is driven by the end-user product market that the ecosystem's value proposition serves (Adner, 2017); in the above example the smartphone industry that is served by Apple's iPhone ecosystem. The vertical layers that comprise high tech settings, such as the computer and mobile telephony industries, have been conceptualized as a layered architecture (Yoo et al., 2010; Tiwana, 2014) or technology stack (Kenney and Pon, 2011). Existing work in this area has shown how value can migrate to different layers in these stacks. For instance, while the operating system layer in the PC industry (specifically Microsoft's dominant Windows operating system) acted as a key control point, this "gatekeeper" position shifted in the mobile industry where value moved towards higher layers, for instance based on user services (Pon et al., 2014). More recent work has also shown how platform owners may defend their position by strategically changing the way boundary resources, such as, APIs or app store policies are used to retain control (Karhu et al., 2018).

The relationship between industry evolution and the rate at which entrepreneurial opportunities for value creation emerge has been a source of disagreement (Funk, 2015; Hang et al., 2015). On the one hand, the industry life cycle (Gort and Klepper, 1982; Klepper, 1997) and technology management (Anderson and Tushman, 1990; Utterback and Suárez, 1993) literatures suggest that the early phase of an industry is characterized by widespread opportunities for entry which decrease over time and ends with the coalescence of an industry around a dominant design (Christensen et al., 1998). On the other hand, recent studies analyzing interactions between industry participants suggest that as industries evolve, specialization overtakes vertical integration (Jacobides, 2005; Jacobides and Winter, 2005; Jacobides et al., 2006). This shift towards vertical disintegration might be so severe that the incumbent firms that are not able to develop integrative capabilities to reconfigure their activities cease to coexist with specialized firms (Kapoor, 2013; Helfat and Campo-Rembado, 2016). Here, interdependencies are crucial as entrepreneurial opportunities in vertically specialized segments become viable (Gulati et al., 2012) and formal mechanisms, including the management of standards and interfaces get established (Baldwin, 2012; Teece, 2014). The literature on modular design supports this latter view, stating that after the emergence of a dominant design, standard interfaces emerge (Ulrich, 1995; Baldwin and Clark, 2000), defining how functional components or 'modules' will interact, increasing compatibility and substitutability among component variations, and thus creating opportunities for specialized entrants (Funk, 2015; Tee, 2019). Despite this disagreement, the two views share the premise that during the mature stage of an industry demand growth slows down. The industry life cycle literature states that opportunities start decreasing right after a dominant design occurs, while the modularity literature suggests that opportunities increase after standard interfaces emerge, but eventually these opportunities decrease as well. The question remains, however, whether and how different stages of an industry's life cycle (emerging vs. mature) will offer greater or fewer opportunities for an ecosystem to create value and how this impacts value capture.[8]

Our approach combines an industry evolution-based view (focusing on industry life cycle stage in terms of demand growth) and an ecosystem perspective (where we focus on governance arrangements, governance rigidity, and the key contingencies shaping these) to consider how these influence the ability of a platform owner to capture value.

3. Conceptual framework

The previous section suggests the need for a framework that explains under what initial conditions a platform owner can capture a large share of the aggregate value created by its ecosystem. In this section, we integrate key elements discussed previously to develop this framework, delineating a rich set of relationships with illustrative examples. Our conceptual framework consists of two key parts. First, we focus on two initial conditions (bargaining power and industry life cycle stage) that determine an ecosystem's initial governance arrangements. We show how these initial conditions shape the platform owner's governance arrangements and how this subsequently influences a firm's ability to capture value based on the rigidity of these governance arrangements. We also provide several illustrative examples to show how governance rigidity can help or hurt the platform owner's ability to capture value. Second, we focus on several key contingencies that moderate the degree of governance rigidity and develop propositions based on this. Fig. 1 provides an overview of the mechanisms and propositions that comprise our conceptual framework.

3.1. Initial conditions that shape governance arrangements

Platform owners initially need to invest in joint value creation before they may capture above-average rents (Adner, 2012, 2017). The amount sacrificed and invested by the platform owner as opposed to other participants in the nascent ecosystem will vary with the platform owner's bargaining power at the time of ecosystem creation, our first initial condition. Bargaining power can be defined as the ability of one party to a contract to be able to influence the terms and conditions of that contract and of subsequent contracts in its own favor (Argyres and Liebeskind, 1999: 55). Therefore, bargaining power is often associated with oligopolistic market structures where boundedly-rational firms try to negotiate favorable agreements in light of possible future changes that are difficult to foresee. Applied to ecosystems, bargaining power reconciles multiple dyad-level bargaining powers into a collective aggregate, similar to the way in which Porter's five forces framework treats the concept of "bargaining power of suppliers" (Porter, 1980).

It is important to explain the idiosyncratic elements that influence the initial ability of a platform owner to design a more favorable governance structure. The initial bargaining power of the platform owner stems from a number of sources, such as asymmetric dependence of complementors due to the owner's unique resources (e.g., brands, reputation, access to customers, gatekeeping privileges driven by

[8] Similarly, every industry has been argued to have its own clockspeed—or rate of evolution—depending on its products, processes, and customer requirements (Fine, 1998). The faster the industry clockspeed, the shorter the time it takes to transition from value-creation-focused emergence stage of the industry life cycle to value-capture-focused maturity stage. As Fine (1998) argues, a company's real core capability is its ability to continuously design and manage its relationships along a "value chain" of partners, suppliers, distributors, and customers. While Fine (1998) devotes the majority of his book to the discussion of "supply chain management", the logic of vertical disintegration and short industry life spans requiring a deliberate ecosystem management—Fine gives the example of online retailing where platforms, such as Yahoo and Lycos, need to manage an increasing number of companies supplying the actual retail goods and services—applies to our theorizing here.

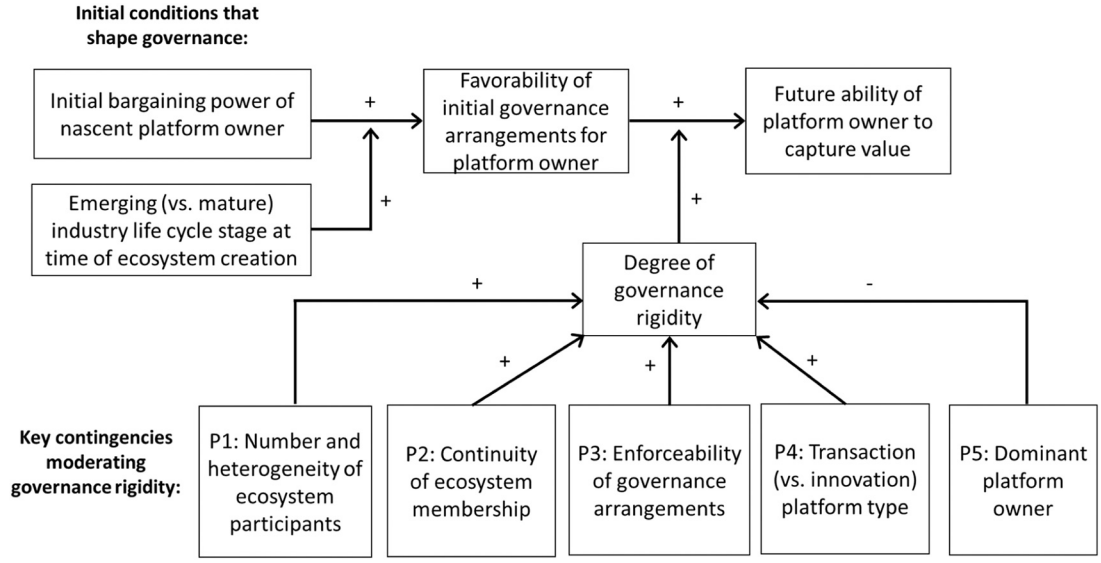

Fig. 1. Theoretical model and propositions.

architectural or technological arrangements, or platform features such as design, popularity, and uniqueness) (e.g., Jacobides et al., 2006; Gawer, 2009; Lumineau and Malhotra, 2011; Lumineau and Oxley, 2012; Ghazawneh and Henfridsson, 2013; Pon et al., 2014; Thomas et al., 2014; Tiwana, 2014; Jacobides and Tae, 2015; Chen et al., 2017); as well as ecosystem governance experience or negotiation capabilities, such as internal and external integrative capabilities, experience in writing contracts, contract design capabilities, previous contractual commitments etc. (Mayer and Argyres, 2004; Argyres and Mayer, 2007; Bercovitz and Tyler, 2014; Helfat and Campo-Rembado, 2016; Chen et al., 2017).[9] Similarly, platforms that have already solved the chicken-and-egg problem, i.e., which side of the platform to subsidize so that the other part joins and pays, (e.g., Apple's established customer base) can propose governance arrangements that are more favorable to their own interests, as they already offer an established customer base to a new set of complementors. Or, focusing on the number or nature of complementors targeted, platform owners that design an ecosystem where complementors are small firms or individual workers, e.g., most gig economy platforms (as compared with the case where complementors are established brands or celebrities, e.g., YouTube Masterclasses), can propose governance arrangements that are more favorable to their own interests. Another important antecedent to bargaining power is platform competition (Cennamo, 2021). Competition between platform ecosystems implies a stronger need for subsidizing complementors to join the ecosystem as more than one platform attempts to get complementors on board, assuming that complementor multihoming costs are substantial (Chen et al., 2022). Subsidies can take several forms, e.g., temporary penetration prices or permanent discounts (Parker and Van Alstyne, 2016).

A platform owner that lacks these sources of bargaining power mentioned above will have lower initial bargaining power vis-à-vis its prospective ecosystem partners. In such cases, low initial bargaining power will compel the platform owner to offer more favorable contractual arrangements to complementors to induce participation. These contractual arrangements are likely to include provisions and terms designed to favor complementors, for example by providing them with means of safeguarding their investments in the ecosystem (Schepker et al., 2014; Hoskisson et al., 2018). By contrast, a platform owner with high initial bargaining power developing an ecosystem will be better able to negotiate beneficial contractual terms with its nascent ecosystem partners. For example, Gurley (2013) provides a number of cases of different platform pricing strategies—like the 30% commission that Apple and Facebook were able to take from complementor app developers. Favorable arrangements may also include the dependent complementor organizations taking on the majority of the early costs and risks of developing the nascent ecosystem, with the platform owner delaying significant investment until uncertainty about the value that the ecosystem can create has been resolved (Dattée et al., 2018). This initial condition drives the first part of our theoretical model depicted in Fig. 1.

The second initial condition is the life cycle stage of the industry in which the ecosystem's value proposition materializes, which affects opportunities and incentives to collaborate and the co-creation of value. For the characterization of an emerging or mature industry, we should recognize that defining an industry's boundaries can be challenging in general (Cattani et al., 2017) and that it is particularly difficult to define a "relevant market" for a platform firm (Cabral et al., 2021). Hence, different assumptions about where to draw these boundaries need to be made.[10] For example, when considering the industry which Uber's car hailing ecosystem serves, one can argue that it could be either the "emerging" ride-sharing industry or the "mature" transportation or taxicab industry. Here, we take the view that one should focus on the demand substitution among existing industries. Since people have been using transportation (via taxis) long before Uber emerged, and since Uber gained a large portion of its market from traditional taxis, we see the specific example of Uber's car hailing ecosystem within the context of its relationship with taxis (i.e., UberPop in Europe) in a mature

[9] Our aim here is not to provide a comprehensive list of sources of bargaining power; alternatively, prior theories from the structural approach (alternatives, concentration, switching costs, transitivity of price sensitivity, etc.) can also explain and address the initial bargaining power differences. Bargaining power relies partly on the perceived value of the components / position in delivering the overall value proposition. However, at the time of ecosystem emergence, there may be significant uncertainty over the value proposition (e.g., Dattée et al., 2018). So, there may be asymmetries in the perceived value of a firm's position / product, which will affect relative bargaining power.

[10] For example, Cabral et al. (2021) highlight the absolute-size-threshold approach of the Digital Markets Act used by the European Commission to identify a subset of very large gatekeeper platforms. While this approach is deemed a good start by Cabral and colleagues, they also criticize it for not using more objective measures of market power, such as, cost of multi-homing on each side of the platform (2021:9).

transportation industry, rather than the newly emerging ride-sharing industry. Thus, while Uber also created some new demand with its lower prices in the industry, the growth dynamics of a newly emerging transportation industry (which mostly overlap with the advent of Model T and large-scale car manufacturing around 120 years ago) is clearly missing in this case.[11] Thus, we consider Uber to be part of a mature transportation industry with limited overall demand growth. In turn, using our end-customer needs reasoning, Apple's iPhone created its own smartphone market with several customer needs beyond mere calling and texting being enabled by its product. We therefore suggest that the smartphone industry was a high demand growth, emerging industry at the time of Apple's formation of the iPhone ecosystem.

The distinction between industry life cycle stages that we make is therefore between high and low growth industries (in terms of demand growth) rather than new and old industries (in terms of age), though these may often coincide. As the industry served by an ecosystem matures, the participants' focus shifts from value creation to value capture (Di Stefano et al., 2012; Moore, 1993). If the industry is in the emerging stage of its life cycle, this indicates increasing opportunities for collaborative value creation, and therefore the focus of the platform owner and its complementors will be on capturing value through rapid growth of the aggregate value created. On the other hand, if the industry is in its maturity stage, decreasing opportunities for value creation will lead to a change in focus of participating firms towards competing with one another to capture value. As a result, a platform owner with high initial bargaining power will be less focused on reaping a greater share of the value created in an ecosystem serving an emerging industry than if it were striving to create an ecosystem serving an industry that is mature.

The second initial condition central to our framework is therefore the distinction between emerging and mature industries as it explains differences in a) demand growth, and, consequently, b) complementors' emphasis on value creation vs. value capture. As depicted in Fig. 1, the life cycle stage of the industry moderates the relationship between the initial bargaining power of the nascent platform owner and the favorability of the initial governance arrangements for the platform owner. This negative moderation effect will be stronger if the industry served by the ecosystem is emerging, and weaker if it is mature.

3.2. Governance rigidity and value capture

We argued that the initial contractual arrangements entered into by the platform owner and its complementors in developing the nascent ecosystem will include provisions and terms designed to favor the party with high initial bargaining power relative to other ecosystem participants. Through contractual commitments and changes in bargaining power, the ecosystem's initial governance arrangements will therefore have an impact on the platform owner's future value capture in all cases, apart from those in which renegotiation of contractual arrangements is costless—a possibility that is ruled out by definition in the governance inseparability literature (Argyres and Liebeskind, 1999, p. 51). Furthermore, governance rigidity may also affect the degree to which a firm's apparent bargaining power can be exercised in practice. That is, in the case of substantial governance rigidity, we expect that there will be a gap between the latent bargaining power a firm has at a given point in time, i.e., the bargaining power it appears to have if solely the sources of bargaining power discussed earlier are considered, and how much bargaining power it can actually exert once the effects of governance rigidity are considered. These arguments drive the next part of our theoretical model depicted in Fig. 1.

The initial governance arrangements will matter more for future value capture by the platform owner if they become costlier to alter, i.e., if the degree of governance rigidity is high. Therefore, the higher the extent to which the governance arrangements remain stable as the ecosystem develops, such as when contracts are long-term (or even perpetual), the stronger the effect of the initial arrangements on the future ability of the platform owner to capture value (See Fig. 1).

A high degree of governance rigidity confines the platform owner that aims to change the initial governance arrangements in the future, i.e., when the owner has low initial bargaining power that increases over time. In this case, the exerted bargaining power and the ability to capture value from the ecosystem are likely to be suboptimal due to governance rigidity (see Fig. 2; in this and subsequent figures the extent of governance rigidity is denoted by the delta symbol (Δ), illustrating the difference between latent and exerted bargaining power). Conversely, when the platform owner has high initial bargaining power that decreases over time, the high degree of governance rigidity enables the owner to maintain the favorable initial governance arrangements in the future (see Fig. 3). Respectively, controlling a hard-to-replace segment in an ecosystem at a given point may therefore be neither *sufficient* nor *necessary* for capturing a large share of the value created in the future. The growing ecosystem literature has so far overlooked these path-dependent initial conditions in terms of governance choices and industry structure at the nascent stages of ecosystem development, which may *limit* or *safeguard* the platform owner's ability to capture value from its complementors in the future, respectively. These are the conditions which our conceptual framework addresses in the next section.

4. How governance rigidity and industry evolution shape value capture over time

We now proceed to analyze multiple scenarios that stem from different initial conditions of when a platform owner initiates its efforts to build an ecosystem, which in turn will be decisive for its future ability to control the development of (i.e., change or maintain) the governance arrangements and capture value. We depict these initial scenarios in Table 1 below.

We consider each quadrant in our framework in Table 1 as a starting point when the ecosystem is created, i.e., quadrants do not necessarily signify scenarios produced by a static interaction between the platform owner's bargaining power and the industry's life cycle stage, but they demonstrate the *beginning of a path-dependent process* (cf. Kenney and Von Burg, 1999), which may result in the platform owner having different ultimate bargaining power than it did at the beginning.

4.1. Quadrant A) High bargaining power platform owner targeting an emerging industry

In this case, the platform owner leverages its unique resources, experience with a network of partners, experience in writing contracts, or contract design capabilities to shape the initial ecosystem governance arrangements to its advantage while creating a new ecosystem that serves an emerging industry.[12]

As it implies a high initial bargaining power and high growth emerging industry, among the four quadrants, this is the most preferable

[11] To give further context to this example, in addition to offering lower prices, Uber also created a lower-friction way to summon a driver and pay for a ride and developed a feedback loop to show that the ride had been accepted and an estimate for when the driver would arrive. By tracking both rider and driver position, they also offered additional security for both since the system tracked precise locations. Therefore, the demand side of the market likely expanded for reasons beyond lower price.

[12] We assume that the ecosystem leader's unique resources and capabilities, experience of designing and negotiating governance arrangements, and/or its existing network of partners from previous activity might be leveraged, even to some degree only, in the new industry as well. That is, there are some economies of scope for firms with higher initial bargaining power across the ecosystems which they build.

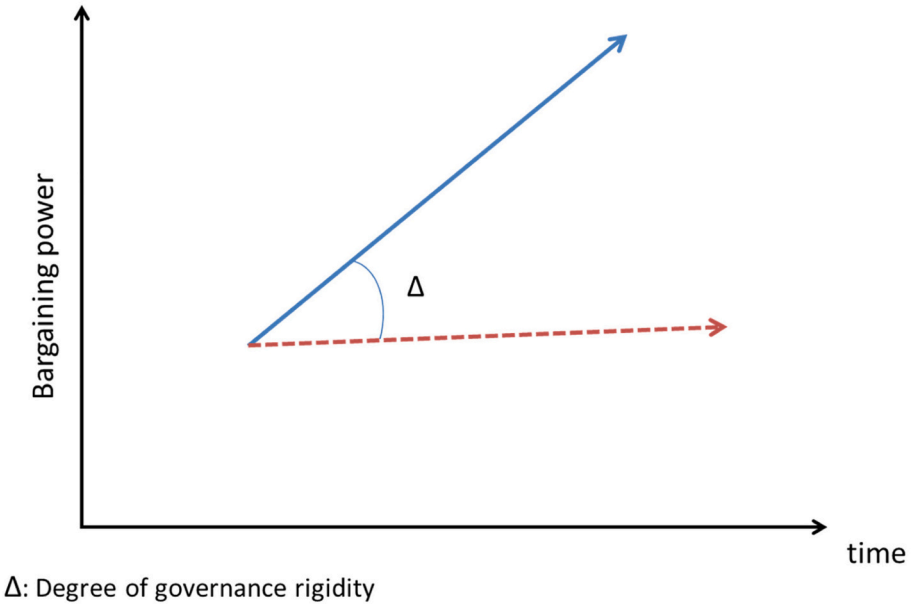

Fig. 2. Divergent development of latent (blue arrow) versus exerted (red dotted arrow) bargaining power – Governance rigidity *limits* the platform owner's ability to capture value in the future. Controlling a hard-to-replace segment is then not *sufficient* to capture a large share of the value created. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

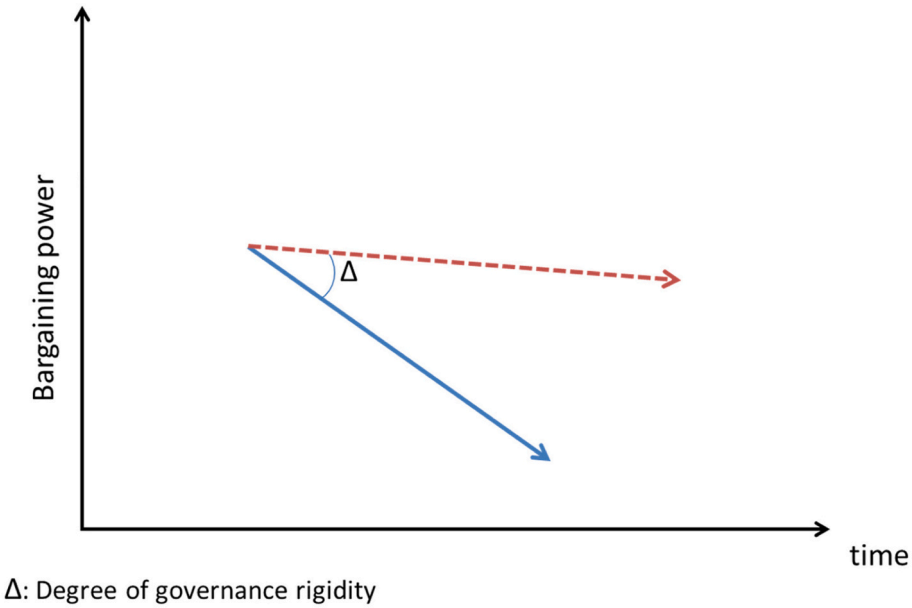

Fig. 3. Divergent development of latent (blue arrow) versus exerted (red dotted arrow) bargaining power – Governance rigidity *safeguards* the platform owner's ability to capture value in the future. Controlling a hard-to-replace segment is then not *necessary* to capture a large share of the value created. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

from the platform owner's perspective. While the afore mentioned demand and technology uncertainties during ecosystem emergence can make it more difficult to design complete contracts, the lack of certainty translates into governance arrangements favoring parties with greater initial bargaining power, i.e., the platform owner in this case. Due to governance rigidity, even if the owner subsequently loses its original position, the favorable initial governance arrangements protect its ability to continue capturing a large share of the value created. Operating in a hard-to-replace segment in this case is therefore not a necessary condition to capture a greater share of the value in the future as the initial favorable governance arrangements will safeguard the platform owner's large share of value captured.

An illustration for this quadrant is Apple's successful attempt to create a lucrative ecosystem in the smartphone industry around the iPhone. In this example, the company already had a well-established base of customers, developers, and other complementors who were part of its Apple Computer and iPod/iTunes ecosystems. Furthermore, Apple was active in multiple segments of the mobile industry's technology stack, controlling or designing infrastructural components, such as the mobile-optimized application processors (Systems-on-Chip designed to Apple specifications), mobile operating system (iOS), and digital distribution platform (App Store), all of which proved to be valuable resources in determining Apple's early bargaining power. By leveraging its existing design, partnerships, and platform features to

Table 1
Initial scenarios at time of ecosystem creation.

	Emerging stage of the industry (high demand growth)	Mature stage of the industry (low demand growth)
Platform owner has high initial bargaining power	A) Ecosystem side: Compete—high initial bargaining power results in favorable governance arrangements for the platform owner Industry side: Increasing opportunities for value creation—focus on capturing value through rapid growth of the total value created	B) Ecosystem side: Compete—high initial bargaining power results in favorable governance arrangements for the platform owner Industry side: Decreasing opportunities for value creation—focus on capturing value through reaping a greater share of the stagnant total value created
Platform owner has low initial bargaining power	C) Ecosystem side: Cooperate—low initial bargaining power results in favorable governance arrangements for partners Industry side: Increasing opportunities for value creation—focus on capturing value through rapid growth of the total value created	D) Ecosystem side: Cooperate—low initial bargaining power results in favorable governance arrangements for partners Industry side: Decreasing opportunities for value creation—focus on capturing value through reaping a greater share of the stagnant total value created

successfully launch the iPhone, Apple was well positioned to develop a vibrant platform ecosystem, despite its closed nature and requirements that complementors pay Apple a significant share of their revenues from iPhone compatible software and hardware.

As the smartphone industry matured and competing ecosystems from Google and Microsoft entered the market, complementors, such as application developers, gained alternative options to sell their products and services to end users, increasing their bargaining power relative to Apple. However, due to the large number and heterogeneity of participants in its ecosystem preventing them from potentially agreeing a collective bargaining position vis-à-vis Apple, Apple has largely been able to maintain its ability to capture value from its ecosystem in the face of these developments. Despite Google and Microsoft requiring developers wanting to sell apps through their stores to pay lower fees ($25 and $19 one-time fees, respectively), Apple has not changed its fee structure for developers, who must pay a subscription fee of $99 per year to publish apps on the Apple App Store, while also letting Apple take 30% of the revenue generated by downloads of their non-free apps (the competing app stores also take 30% of the revenue generated through paid app downloads).[13] The early governance arrangements of Apple's ecosystem have thus been maintained, despite the increasing bargaining power of other ecosystem members, who have additional options compared to when Apple's app store was launched.[14] Despite facing more competition from Google and Samsung than it did in 2007, leading to lower latent bargaining power of Apple relative to other ecosystem members, Apple's royalties and fees did not decrease, thereby illustrating how governance rigidity can facilitate continued high value capture from its dependent complementors, despite a reduction in latent bargaining power.

4.2. Quadrant B) High bargaining power platform owner targeting a mature industry

As the industry served by an ecosystem matures, the focus shifts from value creation to value capture (Di Stefano et al., 2012; Moore, 1993). Here, similar to quadrant A, as a result of high initial bargaining power, the leader's incentives for inducing cooperation and value creation are lower. The platform owner's high initial bargaining power might be further exercised against its partners as growth opportunities in a mature industry are limited. Hence, the platform owner exerts its bargaining power to set up conditions governing value creation and appropriation in the ecosystem such that it receives a greater share of the value created. However, a maturing industry also means slowing technological and/or demand growth, leading to fewer incentives for complementors to contribute towards ecosystem development. Decreasing opportunities for value creation reduces the positive effect of the platform owner's high initial bargaining power on the initial favorable governance arrangements to a moderate level. As demand stabilizes, platform owners that push the adoption of newer generations of their technology start to experience constraints in increasing the total value created.[15]

An illustration of this quadrant is provided by the ride-hailing company Uber which entered the already mature transportation industry. Unlike the previous example of Apple, which was active in multiple parts of the mobile industry's technology stack, Uber specialized at the app layer. This way, it was able to connect to mobile users that used the respective app stores as well as Uber's key complementors, its driver base. At the time of its establishment, Uber's co-founders started with a sizeable amount of venture capital. Uber's initial marketing efforts to frame the company as a service provider and its deep knowledge of demand patterns and customer behavior translated into high initial bargaining power, allowing the company to charge 20%–25% commissions from its drivers worldwide. Many stakeholders within Uber's ride-hailing ecosystem, such as customers, drivers, governments, communities, municipalities etc., were initially enthusiastic about how Uber would revolutionize the taxi sector (Uzunca et al., 2018). However, the launch of the controversial UberPop in Europe—i.e., unlicensed taxis in private cars operating as a business—and Uber's aggressive and non-collaborative approach to the regulatory authorities decreased its initial bargaining power, resulting in fines, subpoenas, and cease-and-desist orders. Low entry barriers and multi-homing by riders and drivers lead to subsequent entry by rivals (e.g., Lyft and Grab), which further diminished the bargaining power of Uber. Since then, Uber has been in an ongoing fight with taxicab companies and regulators around the world over whether it is a taxi provider or an online marketplace, where the latter would exempt the firm from costly licensing fees, tax liabilities, and various regulatory restrictions. Uber's latent bargaining power also decreased significantly when its license to operate in London was contested, and when it exited other markets in Asia, such as China, where it was unable to compete against its local rival, Didi. Still, UberX—i.e., licensed taxis—is active in many countries and the company is benefiting from its initial bargaining power against drivers to capture the lion's share of value created in the ride-hailing ecosystem. Despite these controversies, as well as new competitors entering the market, the initial governance arrangements that were favorable to Uber

[13] Additionally, Apple has maintained its policy of paying developers within 45 days of month-end if their total earnings are above $150, while Google pays developers within 15 days without an earnings threshold, and has continued to require apps that are to be released on the store to go through a thorough and sometimes lengthy review process, while this is not the case with the Google Play store.

[14] The exact mechanism for why Apple maintains its contracts requires a multifaceted explanation. One further argument is that giving up on existing favorable license agreements would result in decreasing royalties and fees, which in turn would damage the Apple's reputation for quality in the eyes of ecosystem partners. As a result, Apple commits to its initial favorable contractual position to exert a higher bargaining power than it actually has ex-post.

[15] This reflects a decrease in customer willingness-to-pay for the latest technology. Adner and Levinthal (2001) and Adner and Zemsky (2006) also consider the demand side and discuss the effect of decreasing marginal utility of consumers over time on the evolution of technology and value creation/capturing strategies.

have for the most part been retained due to high costs of renegotiating. Organizing to renegotiate is difficult for platform-dependent drivers due to the sheer size and heterogeneity of the driver base dispersed around the world. Furthermore, Uber spends extra effort in order to prevent its drivers from unionizing (The Guardian, 2017). Continuing to occupy a hard-to-replace segment in Uber's case was therefore not a necessary condition to continue capturing a larger share of the value created by its ride-hailing ecosystem. To the degree that the initial favorable governance arrangements endure via governance rigidity, Uber continues to capture significant value created by its dependent complementors in the ride-hailing ecosystem.[16]

4.3. Quadrant C) Low bargaining power platform owner targeting an emerging industry

In this scenario, the platform owner initiates its efforts to create an ecosystem serving an emergent industry without having high initial bargaining power. In the early stages of ecosystem development, firms with limited bargaining power are more preoccupied with inducing coordination and stimulating value creation, while also incentivizing partners to join and invest in the ecosystem (Gawer and Cusumano, 2002; Gawer and Henderson, 2007). As Moore (1993) states, during the birth of an ecosystem 'it often pays to cooperate' (p.76). While early stages of an *ecosystem* are characterized by a fluid architecture (Jacobides et al., 2006), i.e., less established templates for division of labor and value appropriation, the early stages of an *industry* are characterized by rapid change in customer needs (Adner and Levinthal, 2001) and technological alternatives (Klepper, 1996). This stage of an industry's evolution denotes increasing value captured through exploiting numerous opportunities for value creation, i.e., growing the aggregate value created. These opportunities can arise both from technology supply and demand sides (Uzunca, 2018). The combination of the rapid pace of growth in improved product characteristics and increasing demand both in quality and quantity of these products offers abundant opportunities to the platform owner and its complementors to rapidly enlarge the aggregate value created.

Governance arrangements in this scenario favor complementors, rather than the platform owner, as the initial bargaining power of the platform owner is low and the focus is on cooperation and value creation. However, if relative bargaining power changes in the future, these initial governance arrangements may limit the platform owner's ability to renegotiate the governance arrangements that are more in its own favor, resulting in a suboptimal share of the value captured from the ecosystem. In this case, even if the platform owner controls a hard-to-replace position in the future, this may not be sufficient to capture a greater share of the value from the complementors.

ARM's entry into the mobile device industry with low initial bargaining power in the semiconductor ecosystem in the 1990s provides an illustration of this quadrant. ARM is active in the chip architecture layer of the mobile industry technology stack, where it licenses processor designs to its customers (licensees), which licensees use for creating their own central processing units (CPUs). The low initial bargaining power of ARM relative to its early partners including Apple, Texas Instruments, and Nokia, resulted in these partners being offered *perpetual rights* as part of the licensing arrangements, reducing the risk of opportunistic hold-up behavior from ARM in the future. As new partners joined the growing ecosystem, ARM, despite its increasing influence, was unable to withhold perpetual rights for new partners, as doing so would put new partners at a disadvantage. This governance rigidity grew more binding as additional partners joined and benefitted from the perpetual rights to design and manufacture chips based on the ARM architecture, increasing the potential costs of both multilateral renegotiation and unilateral action.

ARM's choice of licensing terms, and in particular perpetual licenses, during the emergence of the mobile device ecosystem in the 1990s has therefore inhibited its ability to switch its governance mode for new licensees as the mobile device industry evolved towards maturity, causing incentives to shift towards competition rather than collaboration between ecosystem members, and has resulted in ARM capturing a relatively small share of the value created in the ecosystem.

4.4. Quadrant D) Low bargaining power platform owner targeting a mature industry

This quadrant is the least preferable option from the platform owner's perspective, as low initial bargaining power, combined with low growth potential of the industry it serves, result in lower ability to set initial governance arrangements in a favorable way. The focus in this case is on value capture at the expense of complementors, as collaborative value creation in the form of growing aggregate value is less viable due to slowing demand growth in mature industries. The initial governance arrangements made by the platform owner therefore become crucial determinants of their ability to capture value, as the platform owner faces the tradeoff between giving away favorable conditions to its potential complementors to establish the ecosystem and its position in it, and capturing a greater share of stagnating aggregate value created due to the decreasing opportunities in a mature industry.

An illustration of this quadrant is the introduction of Unity game engine by three amateur game developers in 2005. A video game engine is the core set of tools that developers use in order to create video games. Learning how to use a new engine effectively is time-consuming for developers and this know-how is only partially transferable to other engines, while developing a new engine that can match the capabilities of existing offerings in-house is costly. Having failed to achieve commercial success with their first video game, the co-founders of Unity decided to pivot to licensing their game engine, suitable for making a variety of games, to other developers.

The first version of Unity was launched in June 2005. By then the 30+ year old video game industry had been experiencing stagnant growth for over a decade, with annual global revenue fluctuating around $45bn.[17] Unity has since become the most popular game engine, allowing developers to publish their games on over 25 major platforms with minimal coding changes, and has achieved dominant market share with over 5.5 million registered users.[18] It has also grown an ecosystem of complements around its core engine product, including the Asset Store, through which third-party developers can buy and sell graphical and programming game components, as well as advertising and analytics "plug-ins". However, the ability of Unity Technologies to capture value from the vibrant ecosystem that it created has been limited. The company's attempts to increase the licensing prices and remove developers' perpetual rights to use their current versions of the software were largely reversed following developer complaints, suggesting significant governance rigidity.

[16] In 2019, California adopted a law, known as Assembly Bill 5 (AB5), which intended to regulate gig-economy companies to use a three-pronged test to prove workers are independent contractors, not employees. AB5 meant a hit on Uber's bargaining power as drivers will convert from independent contractors to employees with benefits. To the degree that AB5 will be able to change the initial governance structure between the workers and the platform, we may see Uber suffering from losing its favorable initial governance arrangements with drivers as the law is implemented.

[17] In 2012 US dollars, adjusted for inflation. http://vgsales.wikia.com/wiki/Video_game_industry (accessed on August 8th, 2018).

[18] https://web.archive.org/web/20160826015720/http://unity3d.com/public-relations (accessed on August 8th, 2018). The Unity game engine can thus be considered a specialized layer in the gaming industry technology stack, focusing on reducing the costs of developing games that can be run on multiple gaming platforms.

At launch, Unity 1.0 could be licensed by developers at a cost of $249 for a limited-feature version or at a cost of $1499 for the fully featured professional version, with developers receiving perpetual rights to use the version of the software that they purchased. From the release of version 2.6 in October 2009, the cost of the limited feature version was reduced to zero in order to drive ecosystem growth, however, developers using the professional version would have to pay an additional $1500 to take advantage of the new features of publishing their games on Apple's iOS or on Google's Android platforms.

Having grown to serve close to two million developers by summer 2013, the release of version 4.1 saw Unity Technologies make its first efforts to alter the licensing model from perpetual-licensing to a subscription-based model that does not offer developers perpetual use rights once they stop paying the subscription fees. Specifically, developers were offered the option of subscribing to the Pro version for $75 monthly payments, with further $75 monthly payments required for each of the iOS or Android Pro version add-ons. After further growth to 4.5 million registered users, a more forceful move towards a subscription-based model was attempted in May 2016. In a blog post on the Unity website, it was announced that Unity would be moving to a subscription-only model, with the subscription price of the Pro version going up to $125 per month (although this would now include both iOS and Android publishing without the need to purchase them as add-ons). Subscribers would receive perpetual rights only if they paid upfront for a 24-month (existing users) or a 36-month (new users) subscription.[19] These announcements generated an outcry among developers concerned about paying more for using the engine while losing the degree of protection against future hold-up by Unity Technologies provided by perpetual rights. As a result, Unity Technologies changed the proposed subscription options to automatically give Pro version subscribers perpetual rights after 24 consecutive months of subscription.[20] In December 2017, following further growth and investment, Unity Technologies made a further attempt to remove perpetual licenses by retrospectively editing a blog post about subscription options that was first published in June 2016 on their website, adding a statement that the possibility of receiving a perpetual license to the software was no longer supported, and removing all mention of the conditions under which licenses to use the software could become perpetual from their end-user license agreements. These changes were noticed by a developer who raised them with Unity Technologies, after which the retrospective changes to the blog post were reversed and assurances were given that the wishes of qualifying developers to obtain a perpetual license would ultimately be honored, although this would now require direct discussion with the Unity Technologies sales team.[21]

The above example clearly illustrates the difficulties that Unity Technologies had in its unilateral attempts to alter governance arrangements with the goal of increasing the share of value that it captured from the ecosystem that it created while having little initial bargaining power in the mature video game industry. Specifically, the reversal of changes designed to make perpetual license options far less attractive to developers following their widespread complaints continues to limit the ability of Unity Technologies to exploit its strong position in the video game engine market through increasing the share of value that it captures from its ecosystem.

Overall, due to different levels of governance rigidity originating from contractual commitments, we observe divergent patterns between the evolution of the latent and the exerted bargaining powers of the platform owners. The illustrative examples provided in each quadrant offer important insights as to when governance rigidity limits (e.g., ARM, Unity Technologies) or safeguards (e.g., Apple, Uber) the leader's ability to capture value in the future. These evolutionary patterns can be seen in Fig. 4 which make it important to clarify the conditions under which we would expect governance rigidity to manifest over time as ecosystems mature.

4.5. Propositions: key contingencies that shape governance rigidity

Our conceptual framework provides a rich set of relationships with illustrative examples to illuminate the initial conditions that influence the ability of the platform owner to capture value long-term. It is important to note that our illustrative examples demonstrate varying levels of governance rigidity (see the different "Δ" constructs that illustrate the difference between latent versus exerted bargaining power in Fig. 4). Such differences in governance rigidity can have important implications for platform owners and their ability to capture value. We therefore expand our framework and introduce several key contingencies that explain when governance rigidity will be more likely stronger, and under what conditions initial governance agreements are more likely to be malleable, and derive propositions based on each of these contingencies.[22]

The first of these contingencies concerns the number of distinct groups of dependent complementors as well as the heterogeneity within these groups. Previous work on bargaining contests over changing property rights has argued that the difficulty of renegotiating existing arrangements increases with the number of groups negotiating and their heterogeneity (Libecap, 1989). This is because more numerous and varied parties are less likely to have sufficient perceived common interest to be able to agree on novel governance arrangements that are acceptable to all (Libecap, 1989). This effect is arguably likely to be even stronger in platform ecosystem settings as the complementors are less likely to be able to form collective bargaining coalitions, due to greater geographical dispersion and a lack of collective organizing norms (e.g., Uber drivers), compared to the participants in the cases presented in Libecap (1989). As the number and heterogeneity of ecosystem participants operating under existing governance arrangements grow, the costs to the platform owner of renegotiating the established governance arrangements increase, increasing in turn the extent of governance rigidity. Therefore, we propose:

Proposition 1. The extent to which governance arrangements in an established ecosystem are similar to those agreed upon by ecosystem members at its inception will increase with the number and heterogeneity of participants that subsequently join the ecosystem.

To the extent that early participants fail and exit over time (as would be expected due to firm entry / exit, and related turnover (Uzunca and Cassiman, 2022) or industry shakeout), it is reasonable to expect that the contractual arrangements they were party to might not be maintained for other participants. This applies to all sorts of exit, such as bankruptcy and ownership changes, so long as new governance arrangements need to be agreed upon with the new entity. However, if the ecosystem succeeds in keeping its original members while growing and attracting additional participants, the initial governance arrangements will have more influence on the increasingly standardized arrangements offered to, and taken up by, prospective members. We therefore propose:

Proposition 2. The extent to which governance arrangements in an established ecosystem are similar to those agreed upon by ecosystem members at its inception will increase (decrease) with the continuity (turnover) of ecosystem membership.

Given our arguments about latent bargaining power, it becomes

[19] https://web.archive.org/web/20160601162631/https://blogs.unity3d.com/2016/05/31/new-products-and-prices/ (accessed on August 8th, 2018).

[20] https://blogs.unity3d.com/2016/06/16/evolution-of-our-products-and-pricing/ (accessed on August 8th, 2018).

[21] https://www.reddit.com/r/Unity3D/comments/89xvxd/unofficial_pay_to_own_no_longer_supported/ (accessed on August 8th, 2018).

[22] We thank an anonymous reviewer for prompting us to think about additional dynamics and contingencies that drive our conceptual framework.

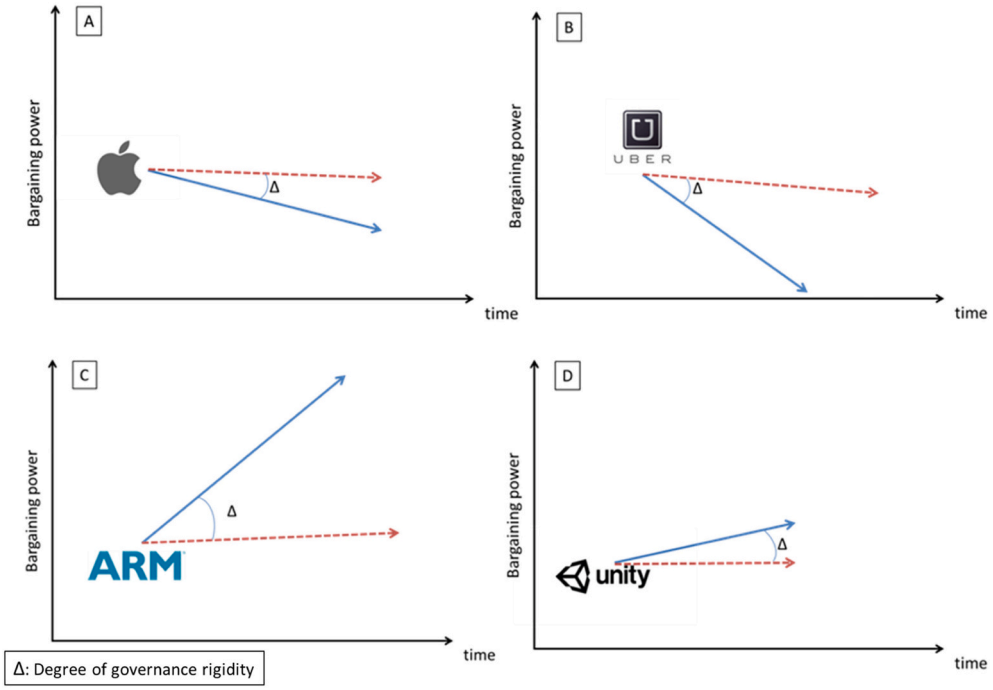

Fig. 4. Illustrations of development of latent (blue arrow) and exerted (red dotted arrow) bargaining power. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

important to consider the enforceability of and commitment to governance arrangements, particularly in cases where authority and agreements are largely informal. As we move from formal and legally binding contractual agreements (e.g., technology licensing agreements, long-term supply contracts, exclusive dealership and franchise agreements) to informal agreements (e.g., "self-bonding" sunk costs or "social contracts" implying a commitment to respecting and upholding social norms) (Argyres and Liebeskind, 1999: 51–52), the enforceability of and commitment to governance arrangements is likely to decrease. While we have argued that to the degree that informal agreements are enforceable, they constitute sufficiently high commitments that constrain future governance design (cf. Adner, 2017), the promises and/or expectations that are embedded in the shared understanding of exchange partners that constitutes informal agreements are likely to be less costly to alter than legally binding contracts. Therefore, we propose:

Proposition 3. The extent to which governance arrangements in an established ecosystem are similar to those agreed upon by ecosystem members at its inception will increase for a greater share of written formal contracts relative to informal agreements.

Our penultimate contingency concerns heterogeneity among platform ecosystems. To avoid possible incompatibility among different types of platforms, we draw on Cusumano et al. (2019)'s typology, which distinguishes between innovation platforms (e.g., ARM, Unity), transaction platforms (e.g., Uber), and hybrid platforms (Apple and its iOS and App Store platforms). Innovation platforms facilitate the development of complementary products and services that are built mostly by third-party companies without traditional supplier contracts, such as mobile devices developed using ARM's processor architecture or video games developed using Unity's game engine. Conversely, transaction platforms enable exchanges that would not otherwise occur without the platform as an intermediary, such as Uber matching riders with drivers and collecting a transaction fee. There are also hybrid companies, who operate both innovation and transaction platforms, such as Apple with its iOS mobile operating system (an innovation platform) and its App Store (which acts as a transaction platform). What is common in all these platforms is an architecture (Baldwin and Woodard, 2009) in which there is a relatively stable platform core (e.g., the ARM instruction set, or Uber's ride sharing app), to which complementary "peripheral" components might be added or removed in a modular way, generating high variety (see e.g., the multiplicity of devices built on ARM's technology, or different riders and drivers that connect to the Uber app).

Besides these commonalities, there are also differences among these platform types. In particular, we expect innovation platforms to be more complex in terms of enabling complementors or other partners to connect to the core platform. For instance, there are barriers to entry in terms of the knowledge and capabilities that are required to develop complementary products or services for the platform. Conversely, in transaction platforms, such entry barriers can be significantly lower. Returning to the example of Uber, the pool of potential complementors (such as drivers) or other partners (e.g., restaurants for Uber Eats) do not need to possess deep technological knowledge or capabilities to join the platform ecosystem. Thus, these pools of users are much larger than the firms possessing the specialized knowledge and capabilities required to act as a complementor for innovation platforms, e.g., ARM or the Intel CPU, architecture. Per our proposition 1, these differences also have implications for governance rigidity, in that—all else equal—we expect a higher number of complementors or other partners to be available for transaction platforms, which would make renegotiation of governance arrangements more costly and thus increase governance rigidity. On the other hand, there will be a lower number of complementors for innovation platforms, and it is more likely that those partners will have specialized capabilities, as well as greater resources and investments tied to the platform, which together would make renegotiation of governance arrangements more feasible. Given their effect on governance rigidity, it is important to recognize these platform-specific differences. We therefore propose:

Proposition 4. The extent to which governance arrangements in an established ecosystem are similar to those agreed upon by ecosystem members at its inception will be higher for a transaction platform than an innovation platform.

Finally, the extent to which a platform firm achieves a dominant

position in the market may influence governance rigidity, increasing the chances that a platform unilaterally changes the governance arrangements independently of the other factors (Rietveld et al., 2020). For example, Amazon has been steadily increasing its share of the revenue earned by the small businesses that depend on its marketplace platform, from 19% in 2014 to 32% in 2020 (Mitchell, 2021). Moreover, the presence of venture capitalists injecting financial resources allows a platform to afford substantial losses (Funk, 2021), with the intent to recover them by taxing the complements once a platform becomes dominant. Hence, we propose:

Proposition 5. The extent to which governance arrangements in an established ecosystem are similar to those agreed upon by ecosystem members at its inception will decrease with the extent of platform owner dominance in the market.

5. Discussion and concluding remarks

Though the platform ecosystems literature has recognized the importance of governance choices in affecting individual firms' value capture (Adner, 2017; Cusumano et al., 2019; Gawer, 2014; Jacobides et al., 2018), it has not considered how firms' initial decisions and conditions can, over time, constrain or protect platform owners in their relationship with complementors. While the ecosystem construct in strategy and innovation management has become more precisely defined and theoretically distinct, the coexistence of several perspectives can generate conceptual confusion.[23] We position our work by acknowledging the merits of different views—a structural one, proposed by Adner (2017) and Jacobides et al. (2018) focused on the tensions between value creation and value capture, complementarities, and particularly the need for an 'alignment structure' of ecosystem partners via governance arrangements; and a more evolutionary view centered around the work of Moore (1993, 1996, 2006) that focuses on power-based affiliation of a community of actors adhering to certain standards set by a focal firm or platform to take part in its ecosystem. Our conceptual framework accommodates these different views and allows us to address different conceptualizations of the ecosystem construct, encompassing vertical buyer-supplier relationships or complement providers, as well as narrower definitions, such as those based on non-generic complementarities (Jacobides et al., 2018).

Our framework contributes to the literature on how value is created and distributed between ecosystem members. We already know from existing work on ecosystems about the strategic importance of the competitive and collaborative relationships between platform owners and complementors (Iansiti and Levien, 2004; Adner and Kapoor, 2010; Adner, 2012, 2017) and how an industry or ecosystem's architecture determines the way value is distributed (Jacobides et al., 2006; Pisano and Teece, 2007; Jacobides and Tae, 2015; Baldwin, 2018). However, existing work has overlooked that the initial governance arrangements of a platform owner and its complementors can have a lasting impact on the ability of the platform owner to capture value. Our study draws on existing work that has focused on the different architectural layers that comprise high tech industries and how value migrates in such technological stacks (Kenney and Pon, 2011). We build on this line of research by focusing on the way value creation and capture is driven by governance arrangements and how much these change as the industry and ecosystem evolve. Specifically, by pointing to the importance of governance inseparability (Argyres and Liebeskind, 1999, 2002) and industry evolution (Langlois and Robertson, 1995), we show how platform owners that occupy a hard-to-replace segment might capture a lower or higher degree of value than anticipated originally. Such effects become even more pronounced as the industry matures and firms emphasize value capture over value creation (Di Stefano et al., 2012; Moore, 1993).

Our focus on the role of governance rigidity further helps explain existing work that has considered entry into an adjacent industry by an existing platform owner (Eisenmann et al., 2011; Kazan and Damsgaard, 2016; Gawer, 2021). Particularly relevant here is the concept of platform envelopment, referring to "entry by one platform provider into another's market by bundling its own platform's functionality with that of the target's so as to leverage shared user relationships and common components." (Eisenmann et al., 2011). Our conceptual framework helps explain the conditions under which such entry may be more effective. Specifically, when a platform owner can leverage its high bargaining power in its original platform market, it can then use this position to develop favorable governance arrangements in the newly emerging adjacent industry, and this effect is stronger when governance rigidity does not impede such envelopment. We noted how porous industry boundaries could be in digital markets (Cabral et al., 2021). One example is Uber's entry into the online food delivery market with Uber Eats. As we argue, Uber entered a mature (taxi) market. However, the online food delivery market is relatively early in its growth and that rate of growth increased during COVID-19. Similarly, Airbnb entered the "experience" market and was able to substantially increase its fees relative to its core short-term accommodation market. Reframed through our conceptual framework, platform envelopment constitutes another "cycle" of the processes described in Fig. 1, with potentially greater initial bargaining power of the platform owner. The issue of porous industry boundaries becomes even more relevant when we consider how easily platform owners can enter adjacent markets (Cabral et al., 2021).[24]

By focusing on the alignment structure of platform ecosystems, our study also helps extend governance inseparability (Argyres and Liebeskind, 1999) beyond its original focus on *dyadic* transactions and firm scope decisions. In platform ecosystem settings, there are by definition significant interdependencies between the platform owners and complementors comprising the ecosystem (Adner, 2017; Jacobides et al., 2018). The scale and complexity that arises from these interdependencies limits the feasibility for an individual firm to increase its scope, instead requiring firms to also focus on partnering with other firms in their ecosystem. The subsequent alignment structure that emerges because of such choices can have major strategic implications, particularly in terms of value creation and value capture. As such, we build on recent work that has emphasized the importance of considering the different relational interdependencies that exist in ecosystems (Kumaraswamy et al., 2018; Ozalp et al., 2018; Snihur et al., 2018). In particular, we focus on the long-lasting impact such choices can have due to governance rigidity that is particularly likely to be prominent in ecosystem settings comprised of multiple, heterogeneous groups of actors. These conditions make *multilateral* bargaining increasingly costly and complex due to the difficulties of reaching agreement on collective bargaining positions in the presence of competing claims. It may therefore produce differences between latent bargaining power that a platform owner appears to have based on its resources or experience in ecosystem governance at a given point in time, and the bargaining power that it can *actually* exert to maintain or increase its share of value captured from the ecosystem.

By examining changing incentives and approaches to value capture in distinct life cycle stages, we also connect the industry evolution literature with an emerging line of work on nascent industries (Benner and Tripsas, 2012; Moeen and Agarwal, 2016; Aversa et al., 2022). The nascent stages of a new industry are characterized by a high degree of uncertainty (Santos and Eisenhardt, 2009). Recognizing the long-lasting effects of governance and alignment structure choices is vital as firms shift their priorities between value creation and value capture. Investments in establishing an ecosystem during an industry's emerging

[23] We thank an anonymous reviewer for pointing out this distinction.

[24] We thank an anonymous reviewer for pointing out the role of platform envelopment in this context.

stage allows firms to capture value through rapid growth of the total value created. This "collaborative value capture in a growing market" mindset fundamentally changes to capturing value in the mature stage of industry's evolution. In the latter, due to decreased opportunities for market growth and collective value creation, firms try to reap a greater share of the stagnant total value created by the ecosystem, often at the expense of other ecosystem participants.

By using a governance perspective to explicate path dependency in platform ecosystem governance arrangements, our work opens up intriguing directions for future research in ecosystem settings from TCE, contracting, and dispute resolution perspectives. As ecosystems become more ubiquitous in various industries, analysis rooted in TCE tradition has many opportunities to contribute to scholarly and practitioner understanding of the organizational problems that ecosystems face and the governance challenges that they create (Cuypers et al., 2021). In particular, as platform ecosystems are characterized by multilateral interdependent transactions between various parties, such settings could be well-suited for identifying different kinds of interdependencies between transactions and exchange partners over time. Such work would contribute to enriching our understanding of the connections between the core mechanisms underlying TCE, which, to date, have largely been studied in isolation, thus hopefully resulting in models with greater explanatory power (Crook et al., 2013).

From a contracting perspective, there is potential to extend recent work on contract design (e.g., Schepker et al., 2014; Crama et al., 2017; Zanarone et al., 2016) to ecosystem settings with multiple interdependent participants. In such settings, given the governance rigidity that is likely to arise, what governance arrangements can be used to effectively incentivize ecosystem participation and productive investment, while creating credible commitments to refrain from opportunistically taking advantage of unexpected developments, such as changes in the degree of power asymmetry between the platform owner and other participants? The ARM example suggests the use of perpetual licenses may be one such mechanism, but other governance arrangements, such as delayed investment by the platform owner (e.g., Dattée et al., 2018) may also play similar roles. Further examination of such mechanisms may be a fruitful direction for future research.

Our work also suggests future research directions for scholars interested in mutual adjustment processes versus escalating conflict between parties involved in exchange relationships (e.g., Ariño and de la Torre, 1998; Reuer and Ariño, 2002; Lumineau and Malhotra, 2011; Lumineau and Oxley, 2012; Klein et al., 2019). Does our understanding of these processes and their effects, gained largely through the analysis of dyadic exchange relationships, translate to ecosystem settings with *multiple* interdependent groups of participants? Under what conditions does the degree of power asymmetry between the platform owner and its dependent entrepreneurs or complementors lead to effective (re)adjustments of the ecosystem's governance arrangements? If such power asymmetry results in the platform owner acting unilaterally (e.g., Unity), when will it result in the ecosystem being abandoned by dependent entrepreneurs and complementors?

Our theoretical framework also has managerial implications. For platform-dependent entrepreneurs and complementors, it is important to consider the initial conditions of relative bargaining power, which determines the favorability of initial governance arrangements, and of market growth, which affect opportunities and incentives to collaborate. For platform owners, our framework highlights the need to manage the tension between incentivizing complementors to join the emerging ecosystem and entering into governance arrangements that might affect platform owners' future ability control the development of these arrangements in their favor. To successfully start and scale up their ecosystems, platform owners need to understand their differentiating factor in the ecosystem (bargaining power and market growth) and be responsive and proactive with respect to scenarios in which they initiate their ecosystems. This is especially important when faced with unfavorable changing conditions in the future. To successfully manage their ecosystems, firms need to be cognizant that the nature of specific exchange relationships and their interactions (Argyres and Liebeskind, 2002) may have long lasting effects on value capture. For example, following our rationale for proposition 2, platform owners that aim to keep enjoying the positive effects of governance rigidity can put extra effort in keeping the initial partners, thus their governance arrangements, active in the ecosystem. Similarly, platform owners that aim to avoid the negative effects of governance rigidity can consider replacing their initial partners and offering altered governance arrangements to new ones. A further direction for future work is to explore what other strategies platform owners with low initial bargaining power can use to scale up their ecosystems while capturing value from them, and to identify the key features of the settings in which such strategies are more or less viable.

Future work can also test our theoretical framework in different ecosystem settings and consider the boundary conditions to our conceptual framework. For instance, the favorability of initial governance arrangements could be operationalized by the degree of longevity or other safeguards used in governance arrangements. The ability of the platform owner to capture value can be operationalized through market capitalization, ROIC, and profits of the platform owner relative to complementors. Finally, the strength of governance rigidity could be captured through the extent of change in governance arrangements, e.g., the proportion of perpetual or long-term contracts and licenses among all contractual or licensing agreements signed.[25]

In terms of limitations, our framework may apply in particular to settings marked by a high degree of uncertainty and interdependence between firms. Therefore, it is not entirely coincidental that our examples (Apple, Uber, ARM, and Unity Technologies) are derived from high-tech industries. Such settings are typically characterized by a high degree of technological complexity and interdependence between platforms and complementors, as well as a rapid rate of technological change. However, given the importance of contractual relations across a wide range of industries, we expect there to be a difference in degree, not in kind, of the effects we introduce in our conceptual framework in less technology intensive settings.[26] Our framework does not require that all transactions are governed by contracts, but rather that there are significant costs to changing the alignment structure (i.e., enforcement of and commitment to governance arrangements). The technology-driven platform ecosystems that we refer to in our conceptual framework are all based on such conditions.

In conclusion, in this paper we argued that path dependent initial conditions at the time of ecosystem creation, i.e., the initial bargaining power of nascent platform owners and the life cycle stage of the industry which the ecosystem serves, affect how the initial governance arrangements are set up within the ecosystem and have consequences for their ability to change these arrangements once the resulting relationships and interdependencies become more established and difficult to alter.

[25] There is a growing debate about the power of platform owners, implicitly referring to their high degree of bargaining power over complementors (Kenney and Zysman, 2016; Wen and Zhu, 2019). Changes in public policy and regulation may play a role in setting limits on governance arrangements between platform owners and complementors. These questions are beyond the scope of our paper and constitute another promising avenue for future research.

[26] One might argue that there is lack of consistency in how each example defined the platform owner, the nature of contracts, and subsequent value capture, i.e., Apple's ecosystem is more of complement product ecosystem, Uber links drivers and riders via a platform, and ARM is more of a technology licenser. This does not pose a problem for comparison across these illustrative examples as we adopt a broad enough conceptualization of platform ecosystems that encompasses vertical buyer-supplier relationships or complement providers, as well as the narrower definitions (Jacobides et al., 2018). For the purposes of our framework, the important definitional element of business ecosystems is having "*multilateral set of partners that need to interact in order for a value proposition to materialize*" (Adner, 2017).

We hope that our framework will encourage scholars to further explore the link between initial conditions and future value capture within platform ecosystems.

CRediT authorship contribution statement

Bilgehan Uzunca: Conceptualization, Writing – original draft, Writing – review & editing. **Dmitry Sharapov:** Conceptualization, Writing – original draft, Writing – review & editing. **Richard Tee:** Conceptualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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