A Phenomenon-driven Exploration of Regulatory Sandboxes in FinTech Entrepreneurial Ecosystems

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Abstract

Research on incubation models has indicated that business incubators and accelerators, among others, are crucial catalysts for the development of new ventures in numerous industries. To facilitate testing and validation of new financial technology (FinTech) providers, and protect financial markets against systemic risks, a new incubation model called the 'regulatory sandbox' has been established or announced by regulatory authorities in more than 50 countries. Sandboxes are virtual trial-and-error instruments that grant financial market participants temporary licensing relief and thus provide the opportunity to test novel solutions in a controlled, real-world environment and engage with regulators who offer guidance and supervision. Despite the potential benefits of sandboxes for innovation and financial market stability, the management literature on the phenomenon is scarce, limiting our understanding of how regulatory sandboxes operate, how they differ from other incubation models and how regulator-regulatee interactions enable innovation and regulation practices. This doctoral dissertation addresses these gaps. In addition to the empirical exploration of regulatory sandboxes, an ecosystem perspective to entrepreneurship is adopted to understand how interactions among ecosystem actors contribute to new ventures in the FinTech context that hosts sandboxes. Conceptually, this study also reviews the literature on innovation facilitators and offers a research agenda. Grounded in a critical realist paradigm, the key methodological choices feature a qualitative research design driven by an exploratory-abductive approach and the Gioia methodology. With regard to data, 35 semi-structured interviews have been conducted, 39 archival documents from 5 leading regulatory sandboxes analysed and 46 research articles content analysed. The key contribution of this research is to the incubation literature by extending our knowledge of a unique incubation model and establishing a knowledge-based foundation for future research. Additionally, important contributions are made to the emerging fields of entrepreneurial ecosystems and FinTech research by conducting an empirical exploration and suggesting theoretical propositions to motivate future research.

Keywords Incubation models; Regulatory sandboxes; FinTech; Entrepreneurial ecosystems; Ecosystem dynamics; Financial innovation

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Key Definitions

Concept/construct	Definition/conceptualisation
Financial innovation	'The act of creating and then popularizing new financial instruments, as well as new financial technologies, institutions, and markets' (Lerner & Tufano, 2011, p. 6).
Financial technology (FinTech)	'Technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services' (FSB, 2017, p. 7).
Innovation facilitators	Initiatives that support FinTech innovation activities in terms of regulatory guidance, testing of financial solutions and collaboration with public and private financial institutions.
Regulatory sandboxes	'Regulatory sandboxes grant licensing exemptions to participants so that they can test their solutions for a set period of time, subject to conditions imposed by regulators in each jurisdiction' (Alaassar, Mention, & Aas, 2020, p. 2).
Incubation model	A support organisation that enables the survival and development of start-ups through provision of support services (Pauwels, Clarysse, Wright, & Van Hove, 2016).
Regulator-regulatee social interaction	'An enabling activity among regulators and sandbox participants that affects both groups and their practices' (Alaassar et al., 2020, p. 4).
Ecosystems in management	Adopted from the ecology literature, the concept of ecosystems was first introduced to the management literature in 1993 to explore firms' external environments (Moore, 1993).
Entrepreneurial ecosystems (EEs)	'Institutional and organisational as well as other systemic factors that interact and influence identification and commercialisation of entrepreneurial opportunities' (Audretsch & Belitski, 2017, p. 1031).
Ecosystem dynamics	Interactions that occur between entrepreneurs and ecosystem actors in EEs (Cao & Shi, 2020; Gartner, 1985).
Abduction	Abductive logic facilitates the creation of knowledge by combining a partly theory-driven and partly data-driven approach, requiring the researcher to shift back and forth

	between the data, literature and theoretical framework (Dubois & Gadde, 2002; Peirce, 1992).
Phenomenon-driven research	'Identifying, capturing, documenting, and conceptualizing a phenomenon of interest in order to facilitate knowledge creation and advancement' (Schwarz & Stensaker, 2014, p. 480).

Dissemination of Research Output

This dissertation is based on three full papers either published or under review at top-tier journals and one working paper that is being prepared for submission; all four papers are included in full in Part II.

Papers included in this dissertation and authors' contributions

Paper A: Alaassar, A, Mention, AL, and Aas, TH, 'Facilitating innovation in FinTech: a review and research agenda'; this is a working paper being prepared for submission to a peer-reviewed journal.

Paper B: Alaassar, A, Mention, AL, Aas, TH (2021). Ecosystem dynamics: exploring the interplay within fintech entrepreneurial ecosystems. *Small Business Economics*, https://doi.org/10.1007/s11187-021-00505-5.

The first author, Ahmad Alaassar, contributed to conceptualisation, methodology, formal analysis, investigation, writing – original draft, writing – review & editing, visualisation and project administration. The second author, Anne-Laure Mention, contributed to conceptualisation, resources, writing – review & editing, and supervision. The third author, Tor Helge Aas, contributed to conceptualisation, writing – review & editing and supervision.

Paper C: Alaassar, A, Mention, AL, and Aas, TH (2021). Exploring a new incubation model for FinTechs: regulatory sandboxes. *Technovation,* 102237. https://doi.org/10.1016/j.technovation.2021.102237.

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Paper D: Alaassar, A, Mention, AL, and Aas, TH (2020). Exploring how social interactions influence regulators and innovators: The case of regulatory sandboxes. *Technological Forecasting and Social Change, 160*, 120257. https://doi.org/10.1016/j.techfore.2020.120257. An earlier version of this paper was accepted and presented at the 33rd ANZAM 2019 Conference in Cairns, Australia.

The contribution of each author is similar to Paper B.

Other publication(s) not included in this dissertation

Aas, TH & Alaassar, A 2018, 'The impact of visual performance management on decision-making in the entrepreneurial process', *International Journal of Innovation Management*, vol. 22, no. 5, 1840002, https://doi.org/10.1142/S1363919618400029.

Part I: Introduction to Doctoral Dissertation

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1 Introduction

Enabling technologies like artificial intelligence, blockchain and big data analytics have revolutionised financial markets (Diaz-Rainey, Ibikunle, & Mention, 2015), allowing financial technology (FinTech) service providers to seize one-third of total global banking revenues (Accenture, 2018). Despite this growth, researchers have found evidence that regulatory challenges appear as innovation barriers for FinTech firms due to legal constraints, the high cost of compliance in acquiring financial licenses and a lack of regulatory knowledge (Appaya & Jenik, 2019; Arner, Barberis, & Buckley, 2015; Haddad & Hornuf, 2019; IOSCO, 2017; UNSGSA, MAS, & CCAF, 2019; Zilgalvis, 2014). As a result of these challenges, the rules of the game have changed, and regulators have come to understand the need for new approaches to enable innovation and regulate the increasing number of market participants to ensure financial market stability (Jenik & Lauer, 2017). A 'test-and-learn' approach or 'regulatory sandbox' has been the most common instrument adopted by regulators globally (Appaya & Jenik, 2019). A regulatory sandbox grants licensing exemptions to its participants, allowing them to test their solutions for a set period of time, subject to conditions enforced by the regulator in the designated jurisdiction (Arner, Barberis, & Buckley, 2016; Zetzsche, Buckley, Barberis, & Arner, 2017). While this freedom has clearly appealing features, there is a lack of the academic study of regulatory sandboxes in the management research field to understand whether these instruments deliver on their promise, a gap this doctoral research seeks to address.

Given that regulatory sandboxes as support instruments share similar objectives with incubation models (e.g., business incubators and accelerators), such as promoting innovation and reducing the high failure rates associated with new venture creation through the use of support services (Aerts, Matthyssens, & Vandenbempt, 2007), one might assume that existing knowledge from the incubation literature could be transferable to the sandbox context. While this is true to some extent, a closer examination of the literature shows that incubation models provide a wider range of services to support firm creation and entry into different industries than regulatory sandboxes, which generally focus on financial markets and segments like banking, insurance and wealth management (ESA, 2019). In addition, regulatory sandboxes have certain distinctive characteristics, such as the prominent role of regulators, being led by public institutions, providing licensing exemptions and regulatory support services and allowing for novel innovations to be piloted in such a way that no systemic risks are faced, all of which distinguish them from other incubation models (Alaassar et al., 2020; Arner, Barberis, & Buckley, 2017; Magnuson, 2018; UNSGSA et al.,

2019; Zetzsche et al., 2017). These differences raise the question of whether existing knowledge from the incubation literature could be transferred to the regulatory sandbox setting. Thus, it may be argued that, due to the unique peculiarities of regulatory sandboxes, it cannot be assumed that all knowledge from existing incubation literature necessarily applies to regulatory sandboxes, especially given the lack of research that explores these instruments from a management perspective. This is the fundamental argument motivating this doctoral dissertation.

With the rapid growth of information and data availability and the need to connect and collaborate with a diverse set of network actors to create and sustain competitive advantage, the study of interactions among actors in the business environment has been undertaken to grasp its impact on the start-up lifecycle (e.g., Gartner, 1985). However, most studies have investigated the influence of a single type of actor, like support organisations (e.g., Grimaldi & Grandi, 2005; Pena, 2004), or a selected set of actors like the government, industry and university (e.g., Etzkowitz, 2002), while overlooking other factors and actors viewed from the perspective of entrepreneurs. In addressing this gap, the entrepreneurial ecosystems (EEs) literature has gained considerable attention of both scholars and practitioners because of the importance of hospitable external environments to entrepreneurial activity (Alvedalen & Boschma, 2017; Motoyama & Knowlton, 2017; Spigel, 2017). Empirical research has focused on investigating selected EEs in regard to the conditions in those ecosystems that create a conducive environment for entrepreneurs and what policymakers, investors and role models could do to improve these conditions (e.g., Scheidgen, 2020; Spigel, 2017). However, there is limited evidence on how interactions among ecosystem actors contribute to start-ups (Cao & Shi, 2020), and industry-specific EEs research is downplayed. The latter is particularly important for digitalised ecosystems (Autio, Nambisan, Thomas, & Wright, 2018) like education technology (EdTech), clean technology (CleanTech) and FinTech that have rapidly emerged and challenged existing ecosystems in terms of regulations, support infrastructure and capital and labour needs, among other factors influencing entrepreneurship. This imbalance in the focus of existing research calls its generalisability into question. For instance, in financial markets, FinTech start-ups have grown so large that they can pose greater systemic risk burdens than traditional financial institutions (Magnuson, 2018). Against this background, the present study seeks to explore the influence of interactions between different ecosystem actors on FinTech start-ups.

The primary research objective of this PhD is to explore and explain 'how participation in regulatory sandboxes and ecosystem dynamics affect financial innovation in FinTech start-ups'. This objective is broken down into secondary ones, each of which is addressed in a

research paper. The dissertation begins by reviewing the emerging literature on innovation facilitators in financial markets (Paper A). Following this, FinTech EEs hosting regulatory sandboxes are explored to find out how interactions among ecosystem actors contribute to FinTech start-ups (Paper B). Thereafter, an exploration of the activities of regulatory sandboxes and how such activities are different in comparison to the activities of existing incubation models is achieved in Paper C. Finally, an empirical investigation of the social interactions within regulatory sandboxes is carried out (Paper D). The dissertation makes four contributions to research. First, it unifies the fragmented literature on innovation facilitators in financial markets, reviewing their characteristics and identifying avenues for future research. Second, it extends existing knowledge of EEs by empirically exploring the influence of ecosystem dynamics on start-ups and links those dynamics to the FinTech context, responding to numerous calls for empirical studies (Brown & Mason, 2017; Cao & Shi, 2020; Spigel, 2017). Third, it advances a novel debate on regulatory sandboxes as specialised incubation models (Gazel & Schwienbacher, 2020; Schwartz & Hornych, 2008); fourth, it contributes to the emerging FinTech literature, which remains inadequately theorised and understudied in management research by employing theoretical frameworks that help understand the social aspects of incubation and EEs.

1.1 Positioning and Rationalisation

This section presents how this dissertation is positioned across the relevant literature streams, offers a justification for each paper and demonstrates the theoretical relevance of the objectives selected. At the most basic level, the study is positioned at the intersection between the entrepreneurship and innovation literatures (see Figure 1.1).
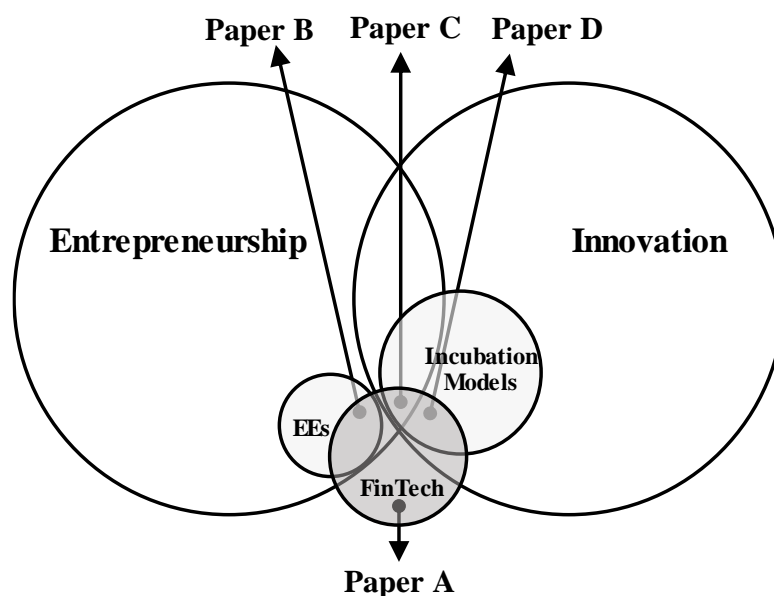
Figure 1.1: Positioning of this thesis and the four papers across literature streams.

Paper A is broadly positioned in several fields (management, business, economics and law) and the emerging FinTech stream. Here, a review of the growing literature is deemed necessary considering the perceived impact of regulatory sandboxes on supporting innovation in financial markets by regulators and policymakers and the fact that the impact has not been sufficiently demonstrated. There are also questions about other existing public and private initiatives and their roles in facilitating financial innovation in FinTech start-ups. A systematic review is needed to explore the innovation facilitators employed and synthesise the literature investigating their processes and consequences.

In Paper B, an ecosystem view of entrepreneurship is adopted to capture the interplay between institutional factors at the macro level and individual actions at the micro level (Van de Ven, 1993). The EEs framework introduced by Brown and Mason (2017) is used to explore the influence of ecosystem actor interactions on FinTech start-ups, given the sparsity of research exploring the interplay among EEs actors (e.g., Ghio, Guerini, & Rossi-Lamastra, 2019; Nicotra, Romano, Del Giudice, & Schillaci, 2018). FinTech is a distinctive – if not unique – context due to the rapid growth of market participants, the systemic risks and legal constraints associated with FinTech and the impact of digitalisation on the identification and acquisition of entrepreneurial opportunities (Autio et al., 2018), all of which challenge existing dynamics among ecosystem actors (Gazel & Schwienbacher, 2020; Hornuf, Klus, Lohwasser, & Schwienbacher, 2020) and therefore the generalisability of existing research.

Paper C is positioned at the intersection between the incubation literature stream and emerging FinTech research to explore the organisational level encompassing incubation models' internal mechanisms (Baraldi & Havenvid, 2016; Hackett & Dilts, 2004). The connection between regulatory sandboxes and incubation models like business incubators and accelerators is made because both instruments have the core objective of supporting newcomers. However, sandboxes have not been introduced as support organisations in the incubation literature and have mainly been studied from a legal perspective (e.g., Arner et al., 2017; Zetzsche et al., 2017), with limited output in management research (exempt recent contributions e.g., Goo & Heo, 2020). That said, regulatory sandboxes do have certain differences, including the role of regulators as innovation facilitators, being led by public institutions and providing licensing exemptions and regulatory support services, all of which raise the question of whether existing knowledge can be readily transferred from the incubation literature stream. Exploring regulatory sandboxes in this area of research is also justified by the need for sector-specific incubators (Schwartz & Hornych, 2008), which has been championed for fostering novelty in regulated sectors like financial and energy markets.

Also positioned at the intersection between the incubation literature and FinTech research stream, Paper D adopts a multi-level perspective capturing the organisational and tenant levels of analysis (Hackett & Dilts, 2004). Here, the theoretical lens of social capital theory (SCT) is employed to explore the influence of knowledge exchange on the practices of regulators and FinTech sandbox participants. SCT is used as an appropriate lens because social interactions are argued as enablers for knowledge transfer in the management literature (Inkpen & Tsang, 2005; Zahra, Ireland, & Hitt, 2000), yet limited knowledge of the social aspects of incubation has been uncovered (e.g., Scillitoe & Chakrabarti, 2010; Tötterman & Sten, 2005).

1.2   Research Questions

The objectives of this doctoral dissertation are explored in four research papers, each addressing its own research question:

Paper A. RQ1: What are the innovation facilitators established to support financial innovation activities in FinTechs?

Paper B. RQ2: How are ecosystem dynamics accelerating or inhibiting new ventures in FinTech EEs?

Paper C. RQ3: How are the activities of regulatory sandboxes different compared with the activities of business incubators and accelerators?

Paper D. RQ4: How can regulator-regulatee social interactions influence the practices of regulators and regulatees?

1.3   Structure of Doctoral Dissertation

This dissertation is divided into two main sections: the first serves as an introduction, while the second presents the full text of the individual papers (see Figure 1.2).

Part II
Individual papers

Introduction

Theoretical
background

Limitations
and future
research

Part I
Introduction to
doctoral dissertation

Philosophy
and
methodology

Research
implications

Research
output
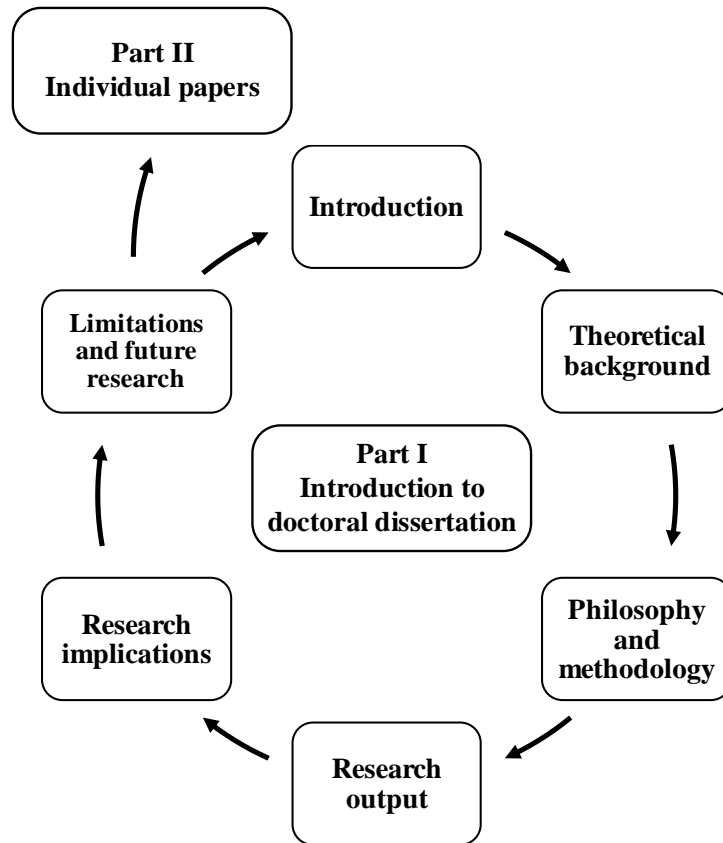
Figure 1.2: Organisation of dissertation.

2 Theoretical Background

This section defines the empirical context of the study before presenting a brief synthesis of the main theories, concepts and constructs that serve as a foundation to guide this research. This doctoral dissertation extends existing conversations in two main literature streams: the incubation literature and EEs research, focusing on the FinTech context and the regulatory sandbox phenomenon.

2.1 Financial Innovation in the FinTech Era

Financial markets are crucial for the stability of economies (Mention & Torkkeli, 2012). This sector has been undergoing a transformation as a result of financial innovation and technological change (Frame & White, 2014). Financial innovation has been defined as 'the act of creating and then popularizing new financial instruments, as well as new financial technologies, institutions, and markets' (Lerner & Tufano, 2011, p. 6). Despite the introduction of vital financial innovations such as automated teller machines (ATMs) and internet banking systems, the degree of innovation in financial markets was generally considered low (Hornuf et al., 2020; Lerner, Speen, Baker, & Leamon, 2016). This, however, changed with the emergence of FinTech start-ups, which challenged the existing dynamics of collaboration and competition among start-ups and traditional banks and drove regulatory change (Lee & Shin, 2018; Zetzsche et al., 2017).

In this research, FinTech is defined as 'technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services' (FSB, 2017, p. 7). The rise of FinTech market participants can be tracked to the period following the 2008–2009 financial crisis; new ventures and technology firms began delivering a wide range of digitally enabled financial solutions, competing fiercely with traditional financial institutions operating decades-old legacy systems (Arner et al., 2017; Gozman, Liebenau, & Mangan, 2018; Jenik & Lauer, 2017). However, it is worth noting that incumbents have other advantages such as established customer databases and extensive market data that give them the ability to project changes and take action (Philippon, 2016). The nascent FinTech literature can be synthesised using Gomber, Koch, and Siering's (2017) three-dimensional framework. The first dimension features business functions such as business-to-business (B2B) and business-to-consumer (B2C) models that provide different financial services; these can include digital payment solutions, fundraising (crowdfunding), lending, insurance, wealth management and capital markets (Lee & Shin, 2018). The second dimension is the underlying technology, like artificial intelligence and blockchain, that is used to enable the

delivery of financial services. The third dimension covers firm types: newcomers, technology firms and incumbents (Gomber et al., 2017).

FinTech start-ups have continued growing at a tremendous rate in the last decade. Accenture (2018) reports that, since 2005, FinTech service providers have captured one-third of total global banking revenues, clearly demonstrating their growing impact on economies. For example, the FinTech start-up Revolut, a digital bank offering consumers all-in-one banking services, has grown exponentially since its founding in 2015, with 12 million users, US$916 million in capital raised, more than 1600 professionals employed and a valuation of US$1.7 billion just four years later (CB Insights, 2019). Recent figures indicate the global presence of nearly 21,000 FinTechs (Statista, 2020), while Crunchbase reports 90 FinTech unicorns worldwide, with an aggregate value of approximately US$500 billion, and a ninefold rise in global FinTech investment: US$43 billion was invested in 2019, up from US$5 billion in 2010 (Crunchbase, 2020). Despite this growth, there is ample evidence that regulatory challenges remain barriers for the development of new FinTech ventures (Arner et al., 2015; Haddad & Hornuf, 2019; UNSGSA et al., 2019), leading to higher business failure rates (Pai, 2017).

2.1.1 Regulatory sandboxes

Given that financial markets must be highly regulated to ensure financial stability (Magnuson, 2018), regulators have realised that new approaches are needed to effectively regulate the increasing number of market participants and support FinTech innovations, which can promote financial inclusion of unbanked citizens and foster economic growth (Arner et al., 2016; Jenik & Lauer, 2017). Among the commonly adopted approaches by regulatory authorities, regulatory sandboxes and innovation hubs have gained the most attention (Appaya & Jenik, 2019; Arner et al., 2017; ESA, 2019). Regulatory sandboxes provide eligible participants with the opportunity to test and learn about their inventions within pre-determined parameters, while innovation hubs are engagement points for market participants to enquire about regulatory requirements from regulators (Allen, 2019). Only recently (since 2016), regulatory sandboxes have gained extensive attention among regulators and market participants due to their supportive role in incubating FinTech firms and transforming the ecosystem (Buckley, Arner, Veidt, & Zetzsche, 2020). However, because sandboxes are novel instruments led by regulators, much of the research into the sandbox phenomenon has investigated the legal rather than the management perspective (Arner et al., 2017; Zetzsche et al., 2017). Hence, scholarly knowledge of the operating and governance models, the stakeholders involved, performance measurements and the influence these instruments have on FinTech start-ups remains limited.

Regulatory sandboxes are novel types of customised support instruments made available for market participants in FinTech ecosystems. These organisations, operating at either the national or state level, grant eligible market participants licensing exemptions for a set period of time (Zetzsche et al., 2017). Regulatory sandboxes have grown rapidly since the first one was established in the United Kingdom in 2016; more than 50 regulatory authorities currently operate or have announced plans to operate a sandbox (see the overview in UNSGSA et al., 2019). It is further estimated that 522 financial market participants have applied to regulatory sandboxes globally, with 200 being successful in those applications (Appaya & Jenik, 2019). Figure 2.1 provides a timeline of the regulatory sandboxes launched to date. These instruments are designed to benefit 1) financial markets in terms of reducing systemic and consumer risks and increasing competition, 2) regulators by achieving more effective ways to regulate market participants, reducing administrative costs for regulators and staying updated on technological developments and 3) sandbox participants by reducing operational risk and compliance costs, providing knowledge of regulatory systems and offering the opportunity to test and validate their business models (Arner et al., 2017; ESA, 2019; FCA, 2017; Jenik & Lauer, 2017; UNSGSA et al., 2019; Zetzsche et al., 2017). Despite the increasing importance of these instruments from the perspective of both regulators and practitioners, this phenomenon has been largely ignored by scholars, particularly in management research.

2.2 Incubation Models

An incubation model is a support institution that enables the survival and development of new ventures through the provision of support services (Pauwels et al., 2016). The incubation literature is comprehensive as to different instruments like business incubators, accelerators, science parks and innovation centres (see the overview in Hackett & Dilts, 2004; Hausberg & Korreck, 2018). In a generic sense, incubators provide business support services, access to physical facilities and networking opportunities (Mian, Lamine, & Fayolle, 2016). That said, a single classification for incubators is problematic because business incubators traditionally have the objective of supporting new businesses in the early stages of development, whereas science parks target mature businesses (Hausberg & Korreck, 2018). Notwithstanding these differences, this study focuses on business incubators and accelerators as they both target innovative start-ups, despite having two distinct incubation models.
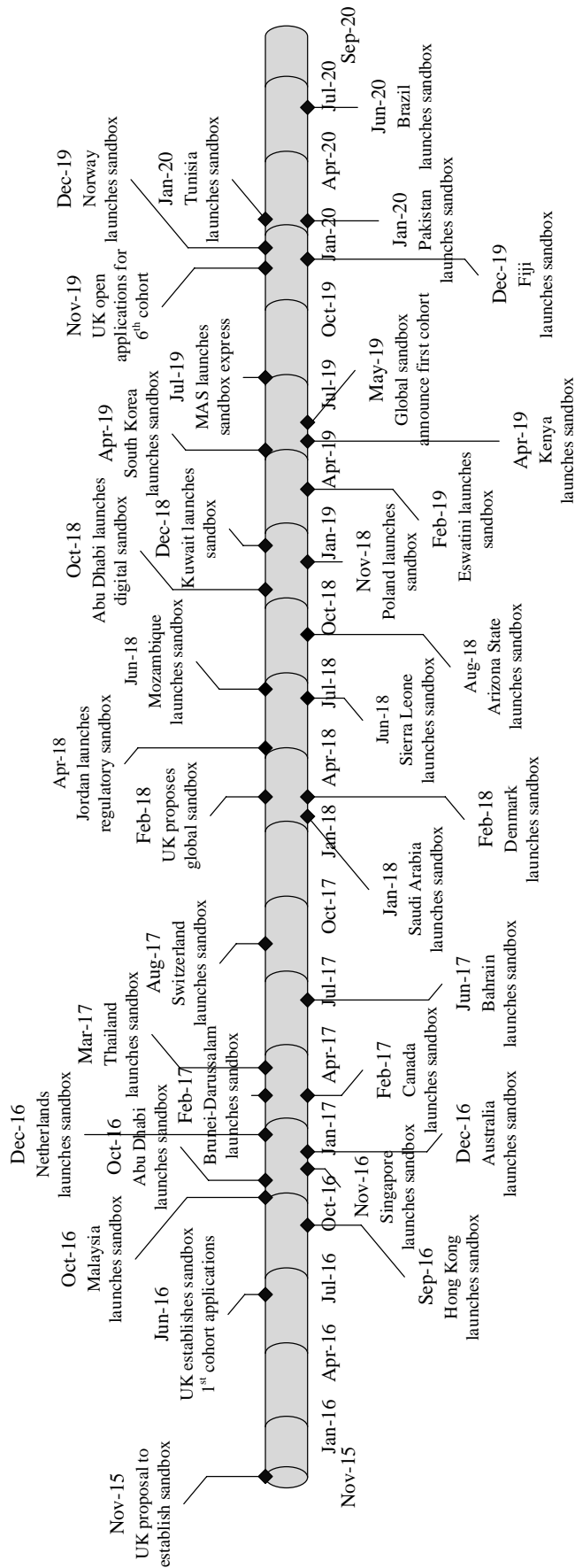
Figure 2.1: Timeline of sandboxes launched, compiled from CGAP repository (private access) and Ringe and Ruof (2018).

Given that this study is industry-specific, it is important to link it with conversations promoting incubator specialisation that provide tailored support services to new ventures operating in various industries, including sector-specific know-how and networks (e.g., Grimaldi & Grandi, 2005; Schwartz & Hornych, 2008). Although there is some evidence of generic business incubators and accelerators operating in the financial sector (e.g., Pauwels et al., 2016), research exploring FinTech-specialised incubation models remains scarce (Gazel & Schwienbacher, 2020). With this in mind, regulatory sandboxes have not yet been introduced as support organisations in the incubation literature despite having the objective of supporting FinTech newcomers. While it may be argued that knowledge from incubation studies can be generalised to the FinTech context, certain key differences – including the non-traditional role of regulators providing legal support services and licensing exemptions – raise questions about how readily existing knowledge can be applied to the FinTech context. Grounded against these gaps, the activities of regulatory sandboxes are explored in the present study in comparison to generic and specialised incubation models. The internal activities of regulatory sandboxes are purposefully explored as a first step to understand novel models prior to future investigations, following seminal studies that explored business incubators (Bergek & Norrman, 2008; Campbell, Kendrick, & Samuelson, 1985) and accelerators (Pauwels et al., 2016).

2.2.1 Exploring the activities of regulatory sandboxes

The activity system framework proposed by Zott and Amit (2010) is employed to guide the identification of regulatory sandbox incubation activities in Paper C. Pauwels et al. (2016) also use the activity system framework to investigate how accelerators function. This framework features two design categories: first, design elements describe value creation activities in terms of what activities create value (content), how such activities are linked (structure) and who executes them (governance). Second, design themes represent the key drivers of value creation in the activity model and consist of specific characteristics like novelty, lock-in, complementarity and efficiency (Zott & Amit, 2010). Table 2.1 outlines the activity system framework.

Table 2.1: Activity system design framework, adapted from Zott and Amit (2010).

Design Elements	
Content	*What* activities should be performed?
Structure	*How* should they be linked and sequenced?
Governance	*Who* should perform them, and *where*?
Design Themes	
Novelty	Adopt innovative content, structure or governance.
Lock-in	Build in elements to retain stakeholders like sandbox participants.
Complementarities	Bundle activities to generate more value.
Efficiency	Reorganise activities to reduce transaction costs.

2.2.2 Exploring social interactions in regulatory sandboxes

The incubation literature stresses the importance of interaction in successful incubation (Rice, 2002). For example, Díez-Vial and Montoro-Sánchez (2016) explored how knowledge links with academic institutions enable innovation in science parks and found that firms in such parks can enhance their innovative capacity through knowledge exchange. The authors highlight interactions between firms and universities as a medium to create a trust-based environment in which alliances are developed to facilitate knowledge exchange. In another study, Scillitoe and Chakrabarti (2010) examined how interactions among incubator managers and tenant firms enable support services, finding statistical support for the influence of networking and counselling interactions on learning buyer preferences and technological know-how. There is also research in this literature stream that explores the influence of incubator-incubatee interactions on knowledge sharing, indicating that such interactions may increase incubatees' knowledge of technology and markets (Rubin, Aas, & Stead, 2015). Finally, D. Patton (2014) examined interactions among incubator tenants and incubator staff to evaluate how they enable tenants' absorptive capacity. The findings indicate that incubator-incubatee interactions improve experiential and exploitative learning capacity, which subsequently enables knowledge growth (D. Patton, 2014).

The above observations support claims from studies (e.g., Zetzsche et al., 2017) that report sandboxes as instruments that promote bi-directional knowledge exchange between regulators and market participants. Accordingly, it is through interactions with innovators that regulatory frameworks become more resilient and better informed about financial market dynamics (Bromberg, Godwin, & Ramsay, 2017). In a report published by the Financial Conduct Authority (FCA), the ability to conduct testing in a sandbox was stated to have provided participating firms with a competitive advantage because solutions were validated without having to invest the time and resources needed to acquire licenses (FCA, 2017). From the regulator perspective, sandboxes provide the opportunity to test and learn how different regulatory practices can influence sandbox participants (Arner et al., 2017). From the participants' outlook, innovators gain a better 'understanding of regulatory and supervisory expectations' (ESA, 2019, p. 5). That said, the lack of previous literature on regulatory sandboxes means that an exploratory approach is needed to investigate the social interactions that occur within these instruments and their influence on the practices of both regulators and sandbox participants in order to make scientifically sound contributions.

Using SCT as a theoretical lens in Paper D, the role and influence of knowledge transfer among regulators and sandbox participants is explored to understand the potential influence on their respective practices. This theoretical lens is chosen given that social capital, defined

as a set of relationships for a network actor, 'plays a critical role in the transfer and exchange of network knowledge' (Inkpen & Tsang, 2005, p. 154). Empirical evidence suggests that social interactions facilitate knowledge transfer (e.g., Zahra et al., 2000) and identifies social capital as a crucial intangible asset that provides access to knowledge sources; still, knowledge of the social aspects of incubation remains limited (Scillitoe & Chakrabarti, 2010; Tötterman & Sten, 2005). SCT assumes that network connections provide access to resources through three main dimensions: structural, relational and cognitive (Inkpen & Tsang, 2005; Lee, 2009; Nahapiet & Ghoshal, 1998). The structural dimension focuses on the position of a member in a network characterised by interaction and configuration of ties, connectivity, frequency of contact, density and hierarchy. The relational dimension represents established behaviours such as trust, norms, obligations and expectations that guide the relations of network connections and, as a result, can influence collaboration and knowledge exchange. The cognitive dimension refers to communication aspects including shared goals, culture, language and codes (Inkpen & Tsang, 2005; Lee, 2009; Nahapiet & Ghoshal, 1998). Figure 2.2 presents the framework employed in visual form.
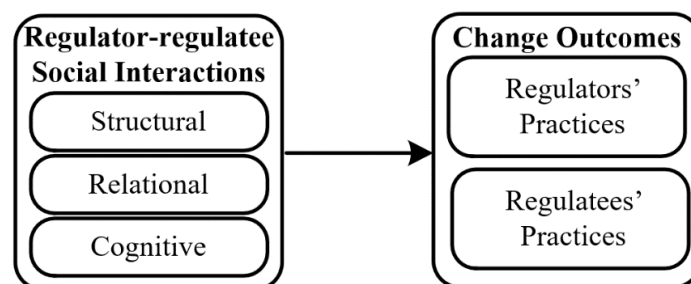
Figure 2.2: Analytical framework (Alaassar et al., 2020).

2.3 Entrepreneurial Ecosystems

Considering the complexity and multi-dimensionality inherent in entrepreneurial activities, several authors (e.g., Audretsch & Kayalar-Erdem, 2005; Shane, 2003) have expressed concern over the scarcity of studies that adopt a holistic approach to entrepreneurship. In this setting, such a holistic approach to entrepreneurship suggests examining entrepreneurial activities that take place within a local context rather than in isolation (Audretsch & Belitski, 2017). To address the lack of a holistic perspective, scholars have borrowed the concept of ecosystems from ecology research and applied it to management scholarship to explore organisations' external environment (Moore, 1993). More recently, the ecosystem approach has been used to investigate additional ecosystems, particularly innovation, entrepreneurial and knowledge ecosystems (Scaringella & Radziwon, 2017).

The concept of EEs is used as a framework to explain social interactions among actors in the entrepreneurship process and local environment (Spigel & Harrison, 2018). Audretsch & Belitski, (2017) define EEs as 'institutional and organisational as well as other systemic factors that interact and influence identification and commercialisation of entrepreneurial opportunities' (p. 1031). EEs are characterised by the presence of educational institutions, supportive policies and infrastructure, industry players, support organisations, a supportive entrepreneurial culture and capital power, all of which impact the creation of local start-ups by facilitating knowledge transfer and resource access (Colombelli, Paolucci, & Ughetto, 2019; Neck, Meyer, Cohen, & Corbett, 2004; Spigel, 2017). Much current EEs research investigates the dynamics between ecosystem actors rather than simply identifying ecosystem elements (Audretsch, Mason, Miles, & O'Connor, 2018; Cao & Shi, 2020; Di Fatta, Caputo, & Dominici, 2018; Ghio et al., 2019). Ecosystem dynamics are conceptualised as interactions that occur between entrepreneurs and ecosystem actors within EEs, often in regard to resource exploration and exploitation.

Although limited empirical research on EEs exists, the bulk of qualitative studies focus on specific geographic locations, overlooking potential industry-specific conditions that may influence entrepreneurial activities (e.g., Scheidgen, 2020; Spigel, 2017). Thus, evidence-based knowledge from empirical investigations cannot necessarily be transferred to emerging digitalised industries like FinTech, EdTech and CleanTech. For example, the rapid growth of market participants in FinTech, the associated systemic risks and legal constraints that emerge, the changing support landscape and the impact of digitalisation on the identification and acquisition of entrepreneurial opportunities are all factors that challenge scholarly understanding of traditional dynamics among ecosystem actors and hinder the generalisability of existing research; this gap is addressed in Paper B.

2.3.1 An EE framework for FinTech ecosystem dynamics

Brown and Mason's (2017) EE taxonomy is employed in Paper B to investigate four ecosystem categories: 1) entrepreneurial actors, implying that entrepreneurs are focal actors and that relational factors mediate entrepreneurship; 2) resource providers, who are actors that facilitate the transfer of various types of resources (financial, industry knowledge, business development); 3) connectors, the mediators supporting access to resources; and 4) entrepreneurial culture, which represents normative aspects. Other prominent EE frameworks (Isenberg, 2011; Spigel, 2017) have also included these actors; however, they have focused either on an ecosystem's composition (Isenberg, 2011) or the relationship between its attributes (Spigel, 2017), whereas Brown and Mason's (2017) conceptualisation

of EEs attempts to capture the full complexity of an ecosystem with regard to interactions among its actors at an individual level. Figure 2.3 outlines the framework employed.
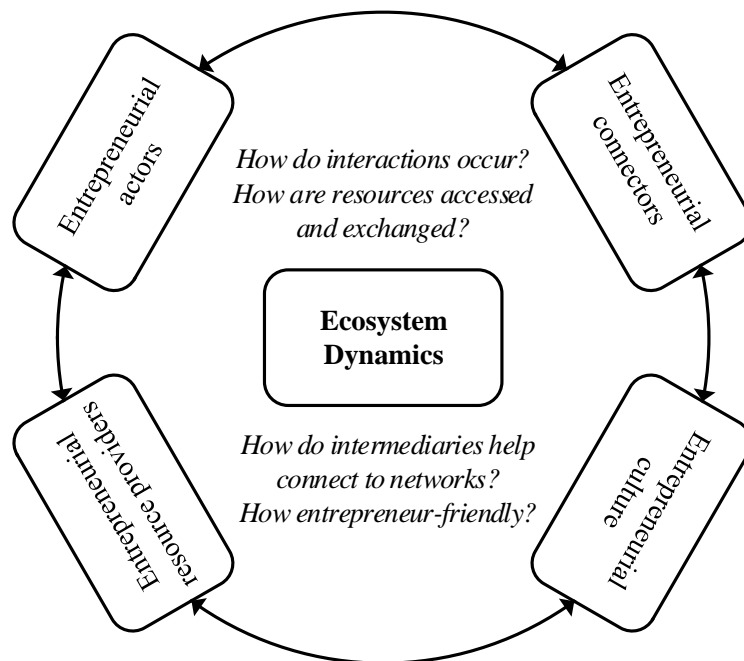
Figure 2.3: EE framework, adapted from Brown and Mason (2017).

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3 Philosophy and Methodology

'The way we think the world is (ontology) influences: what we think can be known about it (epistemology); how we think it can be investigated (methodology and research techniques); the kinds of theories we think can be constructed about it' (Fleetwood, 2005, p. 197). This section presents the selected paradigm, which is a belief system based on ontological, epistemological and methodological assumptions (Guba & Lincoln, 1994), followed by a description of its application to the research conducted.

3.1 Philosophical Position

When considering the philosophical position that is aligned with the researcher's worldview, a careful evaluation of the belief systems was sought from the philosophical continuum, stretching from naive realism at one extreme to relativism at the other (Guba & Lincoln, 1994), with critical realism (CR) positioned in the middle (Järvensivu & Törnroos, 2010). This paradigm-seeking journey resulted in the selection of CR as the belief system that best coincides with the researcher's philosophical stance. Table 3.1 presents a brief comparison of the central philosophical views.

Table 3.1: Comparison of philosophical views, adapted from Järvensivu and Törnroos (2010).

	Naive realism	Critical realism	Relativism
Ontology	Only one true reality exists; universal truth claims apply.	There is a reality; specific local, contingent truth claims apply.	There is no reality beyond subjects.
Epistemology	It is possible to know exactly what this reality is through objective, empirical observations.	It is possible to move closer to local truths through empirical observation, bounded by community-based critique and consensus.	It is possible to form an understanding of a subjective reality through analysis of the subject's account of knowledge.
Methodology	Direct empirical observation.	Empirical observations bounded by subjectivity and community-based critique and consensus.	Analysis of knowledge structures and processes by observing texts.
Research process	Deductive; theory testing.	Abductive; theory generating and testing.	Inductive; theory generating.

3.2 The CR Philosophical Paradigm

CR as a philosophical position originated in the early works of Rom Harré and then Roy Bhaskar in the 1980s as a novel alternative to the realist law-seeking model rooted in natural science and the relativist interpretation-based reductions of social science, challenging the nature of causation; in CR, causation is not established by collecting data of the occurrences of events (Sayer, 2000). Instead, the objective of CR is to provide empirically verified statements of causation by asking how and why a given phenomenon has occurred (Wynn Jr & Williams, 2012).

Ontologically, CR is based on several assumptions about the nature of reality, with 'stratified ontology' being the most distinctive. Unlike other philosophical positions that adopt flat ontologies occupied by either the actual or the empirical, CR proposes a layered reality that differentiates between the real, the actual and the empirical (Bhaskar, 1975). The 'real' level represents the structures, objects and causal powers that exist in the natural or social world, independent of their being empirical objects and us having sufficient understanding of their nature. More importantly, such structures, objects and causal mechanisms have properties that make them susceptible to specific kinds of changes. At the 'actual' level, events and activities occur as a result of causal powers being activated, regardless of those powers can be detected by humans. The 'empirical' level refers to the human perceptions and experiences of the events that occur in the actual level (Sayer, 2000). Using these levels, critical realists can understand the causal mechanisms of social phenomena and their effects. Another noteworthy feature of CR is the use of an open-system perspective to view the complex nature of social reality (Wynn, Jr. & Williams, 2012).

Epistemologically, critical realists derive knowledge claims by using certain epistemological assumptions, of which 'mediated knowledge' and 'explanation' are the most prominent (Wynn, Jr. & Williams, 2012). In CR, scientific knowledge is assumed to have both transitive and intransitive features. The former dimension refers to holders' observations and theories created from scientific inquiry, underscoring that a mismatch between theory and reality is likely to exist, while the latter captures the independent reality that we attempt to explain. Taken together, knowledge is assumed to be mediated by the surrounding social structures and mechanisms; thus, knowledge is 'formed in conjunction with existing social interaction and beliefs along with our own sensory and conceptual interpretations' (Wynn, Jr. & Williams, 2012, p. 793). Explaining the causal powers that are responsible for the generation of an event is the central objective in CR, while depicting that we are prevented from identifying all antecedents of a given outcome by the complexity inherent in open systems. As such, theory generation in the CR paradigm is limited to offering a certain amount of contextual reasoning for the occurrence of a phenomenon embedded in a social reality (Bhaskar, 1975; Wynn, Jr. & Williams, 2012).

Unlike positivism and interpretivism, CR offers a broad range of methods suitable for the research process, conditional on making methodological choices that account for the nature of the study object and the investigation's desired goal. CR denies 'cookbook prescriptions of method which allow one to imagine that one can do research by simply applying them without having a scholarly knowledge of the object of study in question' (Sayer, 2000, p. 19). For this reason, an abductive reasoning logic is commonly employed to create knowledge in

CR by combining a partly theory-driven and partly data-driven approach (Dubois & Gadde, 2002; Järvensivu & Törnroos, 2010; Peirce, 1992).

3.2.1   CR considerations in the present study

The literature on regulatory sandboxes in specific and social aspects of incubation and EEs in a broader sense is scarce, with a limited academic understanding of how and why the regulatory sandbox phenomenon contributes to financial innovation in FinTech start-ups. For this reason, an exploratory qualitative approach was considered a necessary foundation for building explanations of the causal mechanisms of this phenomenon and its associated effects on the practices of innovators and regulators; this approach involved suggesting a set of theoretical propositions. While it may be argued that CR is limited to an explanatory approach to research, there are exploratory accounts in empirical works of prominent CR scholars like Margaret Archer (2003). Thus, this research builds on these contributions by seeking both exploration and explanation. Another important consideration was to ensure the consistent adoption of abduction, a feature that is distinctive of the CR paradigm (Järvensivu & Törnroos, 2010). For this purpose, a thorough adaptation of the Gioia methodology applied was necessary to allow for the alternation between theory, analytical framework, empirical reality and case analysis. A detailed explanation of this adaptation is provided in subsection 3.3.3. That said, even if one were to overlook the philosophical position of the researcher, it is reasonable to argue that other philosophical positions, including positivism and interpretivism, still would not have been appropriate for the research presented here due to the limited literature on regulatory sandboxes and ecosystem dynamics, single case studies, non-longitudinal access to data and the variance-based nature of this study.

3.3   Methodological Choices

The following sections discuss the methodological choices made throughout the research process. For papers B, C and D, a qualitative research design using an exploratory-abductive logic was used to develop explanations in the form of theoretical propositions (Dubois & Gadde, 2002), an approach deemed appropriate in the FinTech context (e.g., Mention, 2020). Whilst an abductive approach is typically used in an exploratory manner in case study research, it is used to facilitate the process of alternating between different sources of data, the frameworks employed and existing knowledge to explain the phenomenon under investigation (Dubois & Gadde, 2002). Table 3.2 outlines the research design for each paper.

Table 3.2: Outline of research design.

	Paper A	Paper B	Paper C	Paper D
Research Objective	Review and synthesis of the literature on innovation facilitators in financial markets	Explore the influence of ecosystem dynamics on FinTech start-ups	Explore the activities of regulatory sandboxes and compare with business incubators and accelerators	Explore the influence of social interactions on the practices of regulators and sandbox participants
Research design	Conceptual	Qualitative design		
Research strategy	Not applicable	Abductive reasoning		
Sampling strategy	Keyword-based and external-article search	Purposive, snowball and criterion sampling	Criterion sampling	Purposive and criterion sampling
Data collection	41 papers from Web of Science and 5 papers from Scopus and Google Scholar.	Primary data from 19 semi-structured interviews with ecosystem actors in Singapore	Global sample of 39 archival documents from 5 leading regulatory sandbox web pages	Primary data from 16 semi-structured interviews with global sample of regulators and regulatees
Data analysis	Content analysis	Modified Gioia method, facilitated with NVivo Pro 12		

3.3.1 Sampling strategy

Paper A employed keyword-based and external-article search strategies, followed by a review of the titles, abstracts and keywords of the identified articles to ensure relevance to the research question. Following this, 46 research papers were prepared for analysis, as outlined in Table 3.3. Paper B followed purposive, criterion and snowball sampling strategies to ensure a purposeful selection of participants in Singapore's FinTech EE (M. Q. Patton, 1990). To limit the sample size of recruited participants, the following criteria were applied: ongoing engagement in the financial market of Singapore as an entrepreneurial actor, entrepreneurial resource provider or entrepreneurial connector. As for snowball sampling, this was employed on an ongoing basis after the commencement of interviews and brought the total of interviews to 19. The social media platform, LinkedIn, played a major role in the recruitment of participants for Papers B and D. Singapore was carefully chosen for its distinctive FinTech context, which is ranked third globally behind the United Kingdom and the United States (Findexable, 2020). Singapore features the dual role of the Monetary Authority of Singapore (MAS), which functions as both a regulator and innovation catalyst with several initiatives including the Singapore FinTech festival (the world's largest), the API Exchange (APIX) that enables collaboration among FinTechs and incumbents and Sandbox Express, which fast-tracks participants to the testing stage.

Table 3.3: Search and selection, Paper A.

#	Search Strings in Web of Science	Search	Selection
1	(incubat* OR accelerat* OR instrument* OR mechanism* OR initiativ* OR hub* OR framework*) AND 'financial innovat*'	335	28
2	(incubat* OR accelerat* OR instrument* OR mechanism* OR initiativ* OR hub* OR framework*) AND (fintech OR 'financial technology')	185	16
Total		520	44
Total accessible			41
Additional contributions (reputable authors sourced from Scopus/Google Scholar)			5
Total # of papers for analysis			46

As for Paper C, a criterion sampling logic was employed from the different strategies for purposefully choosing cases, ensuring case selection based on predefined criteria (M. Q. Patton, 1990). The criteria were 1) public-led regulatory sandboxes, 2) regulatory sandboxes operating by 2016 and 3) the availability of adequate documentation online. Only five regulatory sandboxes worldwide fulfilled these selection criteria at the time of sampling; 39 archival documents were retrieved, and data analysis commenced thereafter. Finally, Paper D both followed purposive and criterion sampling strategies to recruit participants for primary data collection (M. Q. Patton, 1990). A global sample of regulators and sandbox participants (regulatees) was recruited, and a sampling criterion strategy was employed to facilitate selection; regulators were selected based on their current operation of a regulatory sandbox with a minimum of one participant, while regulatees were chosen based on their participation status, either current or within the preceding three years. In total, 15 regulatory sandboxes and 87 sandbox participants met the selection criteria, which led to 16 successful interviews (see the overview in Alaassar et al., 2020).

3.3.2 Data collection

For Paper A, 41 research papers were retrieved from Web of Science (WoS), and five more were selected as important contributions that were only identifiable from Google Scholar and Scopus. In addition, 39 archival documents comprising 459 pages were collected from 5 leading regulatory sandboxes around the globe for Paper C. Table 3.4 provides descriptive data of the selected cases. The documents included regulatory guides, consultation papers, information sheets and press releases published on the web pages of the sandboxes included in the sample. Once retrieved, all documents were uploaded to the NVivo Pro 12 data analysis software package in preparation for analysis.

Table 3.4: Descriptive data of certain regulatory sandboxes (Alaassar, Mention, & Aas, Paper C).

Jurisdiction	Launch	Approach	Exemptions granted	Duration of testing	Number of documents per sandbox
Australian Securities and Investments Commission (ASIC)	12/2016	Rolling basis	6	12 months	9
Hong Kong Monetary Authority (HKMA)	09/2016	N/A	46	No maximum time specified	8
Monetary Authority of Singapore (MAS)	11/2016	Rolling basis	8	Upon agreement	4
Abu Dhabi Global Market (ADGM)	11/2016	Cohort-based	26 (3rd cohort)	24 months	12
UK Financial Conduct Authority (FCA)	04/2016	Cohort-based	118 (5th cohort)	3-6 months	6

For Papers B and D, data collection was achieved through semi-structured interviews featuring pre-defined, open-ended questions with an emphasis on capturing interviewees' experiences through examples. This approach, coupled with the use of theoretical frameworks, facilitated data collection and the discovery of variability in participants' experiences. The interviews were all conducted remotely in English and lasted an average of 50 minutes each; interviews were audio taped and transcribed in preparation for further analysis in NVivo. The data analysis procedure for all papers is briefly described below. Table 3.5 and Table 3.6 provide an overview of the interview participants.

Table 3.5: Description of actors retrieved from Alaassar, Mention, and Aas (Paper B).

Participant Code[a]	Role	Age of start-up/ Organisation	Firm type/classification
Ent-1	Founder and Educator	3 years	Blockchain/Crypto
Ent-2	Founder	5 years	Cross-Border Payments
Ent-3	Founder	3 years	Blockchain/Crypto
Ent-4	Co-founder	6 years	Capital Markets
Ent-5	Serial Entrepreneur, Educator, Advisor	1-4 years	Asset Management
Ent-6	Founder, General Secretary (Association)	2 years	Insurance
Ent-7	Former Entrepreneur, Head of Partnerships, Advisor	6 years	Payments
Ent-8	Serial Entrepreneur, Advisor	1-4 years	Blockchain/Crypto
Ent-9	Co-founder, Advisor	1 year	Payments
EC-10	Director of Accelerator	5 years	Corporate Accelerator
EC-11	Managing Partner and Serial Entrepreneur	2 years	Accelerator
EC-12	Program Manager	5 years	Corporate Incubator and Accelerator
EC-13	Manager and Co-Founder, Advisor	5 years	Accelerator
RP-14	Co-Founder, Partner	2 years	Investor – VC
RP-15	Founder, Consultant	<1 year	Consultancy
RP-16	CEO, Founder	2 years	Investor – VC
RP-17	Co-Founder, Partner	4 years	Investor – VC
RP-18	Executive Manager	4 years	Support Association
RP-19	Regulator	N/A	Government Agency

[a] Ent: entrepreneurial actor; EC: entrepreneurial connector; RP: resource provider

Table 3.6: Description of regulators (R) and sandbox participants (SP), retrieved from Alaassar, Mention, and Aas (2020, Paper D).

	Role of Informant	Participant Code	Regulatory Jurisdiction
1	Financial Specialist	R-1	North America
2	Regulator	R-2	North America
3	Senior Regulator	R-3	Europe
4	Senior Regulator	R-4	Oceania
5	Executive Director	R-5	Europe
6	Senior Manager	R-6	MENA
7	FinTech Specialist	R-7	MENA
8	Founder and Policy Manager	SP-1	Europe
9	CEO and Co-founder	SP-2	Europe
10	Executive Manager	SP-3	MENA
11	CEO and Founder	SP-4	Europe
12	CEO and Founder	SP-5	Asia
13	Director of Regulatory and Policy	SP-6	Europe
14	CEO	SP-7	Europe
15	Head of Compliance	SP-8	Asia
16	Vice President Operations	SP-9	North America

3.3.3   Data analysis

For Paper A, the academic studies were analysed using content analysis following a deductive and inductive coding approach (Belderbos, Grabowska, Leten, Kelchtermans, & Ugur, 2017; Tranfield, Denyer, & Smart, 2003). In this setting, a coding scheme was prepared with high-level categories such as descriptive data, innovation facilitation approaches (what and how) and implications; new categories were created during analysis. To facilitate data analysis in Papers B, C and D, the Gioia methodology was used to achieve qualitative rigour (Gioia, Corley, & Hamilton, 2013). While unquestionably helpful for qualitative research, the Gioia methodology follows an inductive, data-driven logic to theory building rather than an abductive one. It was thus necessary to adapt it to an abductive logic; using a theoretical framework (prior to analysis as opposed to inductively grounded theory research) to assist with data collection and data analysis. Even Gioia et al. (2013, p. 21) state the following: 'Upon consulting the literature, the research process might be viewed as transitioning from "inductive" to a form of "abductive" research'. The researcher shares Langley's perspective on induction versus deduction: 'We overemphasize the idea of induction, that we are completely theory free. I actually think that what we are doing is abduction rather than induction. Induction for me implies that you are generalizing from empirical observation, and that there is not really any a priori theory there, which is illusory. I think that to develop a richer understanding of the world, we do need to connect to prior theory' (cited in Gehman et al., 2018, p. 297). Thus, abduction, as perceived by the researcher, has the purpose of discovering new relationships or variables and is closer to 'theory development rather than theory generation' (Dubois & Gadde, 2002, p. 559). While

this might indicate a closer fit with to the Gioia methodology, the abductive approach adopted here has also links with Eisenhardt's method, for instance by obtaining parsimony (Gehman et al., 2018). Overall, this doctoral dissertation is distinct from both Gioia's theory-development and Eisenhardt's theory-generation approaches to qualitative research.

One may then ask, bearing in mind the exploratory, non-longitudinal and variance-based nature of papers B, C and D, which approach is most appropriate to follow to qualitatively develop theory if one is not adhering to Eisenhardt, Gioia or Langley. This question is answered using the abductive, 'systematic combining' approach pioneered by Dubois and Gadde (2002). Systematic combining, a non-linear, non-positivistic approach, requires the researcher to shift back and forth (conceptualised as 'matching') between the analytical framework, existing theory, the empirical world and the analysis to develop new explanations (Dubois & Gadde, 2002). That said, while the contribution of Dubois and Gadde (2002) provides an alternative approach to develop theory, it lacks clarity when it comes to analysing data and presenting findings, which is addressed by adapting the Gioia methodology to an abductive logic before and after data collection. Prior to data collection, this adaptation features the use of theoretical frameworks (Table 2.1, Figure 2.2 and Figure 2.3) as a general starting point to guide collection of empirical data. After data is acquired, the Gioia methodology is adapted in two ways: 1) employing a preliminary coding scheme based on the theoretical frameworks in papers B and C to guide the categorisation process and 2) inverting it to begin analysis with the structural, relational and cognitive dimensions from SCT (in Paper D). In the former approach, additional categories that emerged inductively were also captured and employed, whilst the latter approach discarded categories that had no relation to the employed theoretical lens. While anecdotal, it is cautiously claimed that this adaptation provides an alternative approach to the positivist and interpretivist schools by enhancing qualitative rigour in CR studies that employ abductive logic.

3.4 Research Quality

Thirty-five years ago, two seminal qualitative scholars (Lincoln & Guba, 1985) posed the question: 'How can an inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?' (p. 290). The merits of qualitative work has been debated both within the broader qualitative community and among scholars of different paradigms who offer a wide range of evaluative criteria. Tracy (2010) seeks to address this gap by providing a set of eight universal quality criteria applicable across all belief systems, which is what this research applies as a guiding framework while acknowledging the existing CR methodological contributions to quality evaluation (e.g., Zachariadis, Scott, & Barrett,

2013). Table 3.7 presents the quality criteria with selected means, practices and methods which enabled achieving each criterion, along with a rationale for how this has been obtained in this research (Tracy, 2010).

Table 3.7: Evaluation of quality criteria, following Tracy (2010).

Criteria	Means, practices and methods	Rationale
Worthy topic	Relevant Timely Significant	The phenomenon of regulatory sandboxes is worthy of study as there is little empirical evidence of how it will achieve its goals in a context characterised by increasing market participants, digitalisation and potential risks to consumers, business operations and overall financial stability. This study also questions assumptions about the transferability of knowledge from different contexts by building on reputable contributions that explore new incubation models like accelerators (e.g., Pauwels et al., 2016) or promote incubator specialisation (Schwartz & Hornych, 2008). An ecosystem approach is employed to inform EE research about the influence of ecosystem dynamics on FinTech start-ups (Alvedalen & Boschma, 2017). As a whole, this study explores a novel support instrument and provides explanations of significance to different stakeholders.
Rich rigour	Theoretical constructs; Data and time in the field; Sample(s); Context(s); Data collection and analysis processes	Rigour was achieved by devoting substantial time and effort to become familiar with the theories, revisiting the literature multiple times before, during and after data collection and analysis – or even months later during review processes – thus ensuring a continuous effort to capture theoretical nuances. Similar efforts were allocated to data collection and analysis; though the former was constrained by sample size, new, rare and even unique data was collected from appropriate participants. Transcript accuracy was ensured by recording interviews and applying a two-step transcription procedure. As for data analysis, the Gioia method was employed to achieve qualitative rigour in analysis; data structures were developed illustrating the most important data aggregation steps undertaken during the analytical process, and frequent use of participant quotes was purposefully made to ensure transparency.
Sincerity	Transparency of methods	Transparency is also a mean to sincerity (Tracy, 2010); this was achieved by providing authentic data trails through documented analysis and reporting of findings. The level of participation in the context is one possible consideration of transparency; at an early stage of the research, the researcher participated in FinTech-related events and had six formal pilot interviews with FinTech scholars and experts to gain a better understanding of the context.
Credibility	Thick descriptions; Triangulation;	Contextualised explanations are provided through showing rather than telling when reporting the findings to illustrate the depth of the data. In contrast to other paradigms, opposing and unique views are not discarded but rather worth consideration, as they can provide in-depth understanding and consequently richer explanations of causal forces in CR (Wynn, Jr. & Williams, 2012). Data triangulation (Downward & Mearman, 2007) was employed to collect empirical data from various sources. In Paper B, different perspectives were captured using a heterogenous sample of ecosystem actors located in Singapore, with entrepreneurs representing the largest number of participants, given their important role as focal actors in the EEs literature. In Paper C, this was achieved by retrieving archival data from five regulatory sandboxes, whereas Paper D captured two perspectives: regulators and sandbox participants.
Resonance	Transferability of findings	Consistent with the above descriptions, transferability is achieved by providing rich descriptions, transparency of methods and a narrative writing style.

Significant contribution	Theoretical; Methodological; Practical	Theoretically, the significance of this research lies primarily in 1) synthesising the literature on innovation facilitators and proposing promising areas for future research (Paper A), 2) clarifying the scholarly understanding of the FinTech context and its link to the EEs literature (Paper B), 3) advancing a novel debate on regulatory sandboxes as incubation models in the incubation literature (Paper C) and 4) extending the scholarly understanding of the influence of knowledge exchange on the practices of regulators and sandbox participants at the organisational and tenant levels of analysis (Paper D). Contributions from all four papers are translated into concise theoretical propositions that lay the foundation for future research. Methodologically, the main contribution lies in the application of the Gioia method to CR abductive research. Practically, this study primarily informs financial market entrepreneurs, regulators and policymakers about the causal forces and related effects associated with regulatory sandboxes and FinTech contexts, which could contribute to improving the conduciveness of environments for entrepreneurial activity and the financial stability of markets.
Ethical	Procedural ethics	This research has been subject to strict ethical evaluation and governing processes imposed by one of the affiliated institutions (RMIT University) where data collection was conducted; an ethics application was filed and approved to conduct the empirical studies (see appendix A for ethics approval). Moreover, prior to and during recruiting and interviewing participants, participant information sheets and consent forms were distributed (see appendix B), and a carefully crafted ethical procedure was followed. Additionally, transcriptions were shared with participants after the data collection process requesting approval prior to analysis, giving participants an opportunity to amend and approve their statements. Distribution of executive summaries after submitting Papers B and D to journals was carried out to participants as a form of gratitude, commitment and timely contribution.
Meaningful coherence	The study achieves its objective using suitable methods and logically interconnects the literature, research questions, findings and discussion	The research is aligned with a CR paradigm that consistently applies an exploratory abductive logic across empirical studies, ensuring interconnectedness among all its sections by moving back and forth between the literature, theoretical framework, analysis and context; purposeful actions such as modifying the data analysis approach support the efforts to achieve coherence. Similarly, explanations of causal mechanisms and associated effects are formalised in theoretical propositions, derived from discussions motivated with 'how' and 'why' questions. Thus, following a CR approach has provided important guidelines to facilitate data collection and analysis and refine the explanation of the findings.

Paper B, C and D have all undergone double-blind peer review processes in ABS level 3-ranked journals prior to publication; review processes function as a control measure of quality and validate the academic and practical relevance of manuscripts. As for Paper A, it is currently being prepared for submission to an academic journal. The following sections provide an overview of the key findings from the research papers followed by a discussion of the implications on research and practice.

4 Research Output: Review and Synthesis of the Findings

This section presents the key findings from each paper and discusses emergent commonalities. Paper A, 'Facilitating innovation in FinTech: A review and research agenda', synthesises contemporary literature on innovation facilitators in financial markets, looking at both publicly and privately led initiatives established to promote financial innovation in FinTechs. The results from the analysed studies in the sample reveal that regulatory initiatives, especially regulatory sandboxes, are the most common topic in the literature. Sandboxes are found to have positive implications on FinTech participants by increasing their credibility and access to capital. The scope of regulatory responses, meanwhile, indicates a change from a risk-based to opportunity-based outlook on regulation. In addition, innovator-led and incumbent-led initiatives were identified as relevant in this setting. For innovators, this appeared in assisting with fundraising (e.g., peer-to-peer lending platforms) and regulatory arbitrage. As for incumbents, incubator programs and collaboration strategies were deployed.

Paper B, 'Ecosystem dynamics: exploring the interplay within fintech entrepreneurial ecosystems', adopts an ecosystem view of entrepreneurship to explore the influence of interactions among ecosystem actors on FinTech start-ups. The findings revealed four categories representing the relational perspective, which features interaction and intermediation dynamics, and the cultural perspective, which encompasses ecosystem development and regulatory dynamics. From these findings, five theoretical propositions were derived to explain how and why opportunity identification and resource exploitation are accelerated or inhibited for start-ups in FinTech EEs. First, it is deduced that the presence of institutional voids in ecosystems like regulators' reluctance to accept cryptocurrencies motivates first-comers to pave the way for later arrivals by establishing supportive mechanisms. Second, with entrepreneurs playing a central role in co-creating regulations through their interactions with regulators (e.g., the Payment Service Act), it is plausible to suggest the presence of relational governance practices within FinTech EEs. Third, in the context of bridging incumbents and FinTechs, regulatory authorities were found to govern collaboration initiatives (e.g., APIX), thus demonstrating hierarchical governance. Fourth, FinTech start-ups' access to non-local ecosystems was positively affected by enhanced connectivity through digitalisation and the intermediary role of venture capitalists (VCs) and support organisations. Fifth, the co-location of VCs in incubator programs and collaboration with university researchers were among the strategies employed to compensate for the identified lack of industry and technical knowledge. Additionally, ecosystem actors were found to face a set of obstacles that emerged due to the slow nature of regulatory processes

when acquiring regulatory clarification or seeking access to regulatory initiatives like sandboxes. The implications of these obstacles impact VCs' willingness to invest. As a result, entrepreneurs were found to resort to pragmatic approaches like avoiding regulators, practicing regulatory arbitrage and raising capital through ICO sales or crowdfunding platforms. Talent retention and presence of scammers were also among the barriers identified.

Some of the above findings from Paper B either confirm or extend the existing scholarly understanding of the results identified in Paper A. In terms of regulator-led initiatives, using Singapore as the case provided insights into several regulatory initiatives employed to facilitate innovation, including the regulatory sandbox. In addition to finding evidence confirming that sandboxes do indeed provide a 'stamp of quality', the financial benefit of postponing licensing fees was reported as an advantage for sandbox participants. As for innovator-led approaches, ICOs or crowd-investing and regulatory arbitrage were both found to be frequently employed practices. As an example of bypassing local regulatory requirements, innovators in the cryptocurrency sphere may apply for a financial license in foreign jurisdictions to save time and capital. Finally, with regard to incubator programs by incumbents, it is noteworthy that the findings from Paper B indicate the role of government in financing innovation labs established in banks.

Paper C, 'Exploring a new incubation model for FinTechs: regulatory sandboxes', explored the incubation model of the regulatory sandbox and how it differs from other incubation models at the organisational level. An activity model was generated from the findings, encompassing three design elements that reveal how value-adding activities are conducted – achieving membership, participating and detaching – and one design theme in the form key sources of value creation – improving connectedness. Six theoretical propositions were developed when discussing the activities characterising regulatory sandboxes and comparing these activities with generic and specialised business incubators and accelerators. The first involves design elements; the findings indicate the use of a dynamic tailoring approach to establish boundary conditions when achieving membership. Such powers allow regulators to alter testing conditions during the participation of FinTechs should unprecedented consequences emerge. As such, sandboxes can proactively protect both consumers and FinTech participants. Second, during participation, the activities of supporting and supervising promoted the transfer of knowledge between regulators and participants, thus increasing regulators' understanding of the application of novel technologies and participants' knowledge of regulation and enabling them to create regulatory-compliant solutions. Third, as to detachment from sandboxes, the enforcement of

termination and extension policies indicated the dominance of a risk-based rather than an opportunity-based approach. Fourth, in terms of the identified design theme of improving connectedness, the sources of value creation were found to be associated with themes including novelty (sandbox models evolve with new activities like the Sandbox Express), complementarity (cross-border collaboration among regulators provides FinTechs easier access to international jurisdictions) and efficiency (as a result of enhancing sandbox operations, transaction costs are reduced). These themes improve connectedness among regulators, local regulators and FinTechs, and international regulators and local sandbox participants. Further, the comparison of activities indicated that regulatory sandboxes differ from generic incubators and accelerators by providing regulatory support and mediating access to regulators in both local and foreign jurisdictions. Similar activities were identified when comparing sandboxes to specialised incubation models, while emphasising that regulators provide contemporary FinTech-specific regulatory knowledge due to their frequent interactions and active roles in this landscape.

The findings from Paper C primarily extend the academic understanding of how regulatory sandboxes operate and evolve, confirming the proactive role of regulators in stimulating FinTech innovation. That said, there is a tendency for risk orientations to emerge, which may inhibit testing activities; regulators in Paper C appeared to be more cautious about adopting an opportunity-based outlook than they did in Paper A. Moreover, regulatory initiatives like the Global Sandbox indicate the hierarchical role of authorities in mediating collaboration between regulators and local sandbox participants, extending the opportunities for co-location and access to non-local ecosystems, beyond the ones presented in Paper B. Another notable aspect found in Paper C was the Singapore's Sandbox Express model, which may reduce the time obstacle reported by entrepreneurs in Paper B with regard to swift access to sandboxes. Additionally, Paper C points out supervising and supporting activities during participation as enablers for knowledge exchange, as depicted in the existing literature presented in paper A. This initial explanation of sandboxes as conducive environments for knowledge exchange motivated the subsequent study.

That last article, Paper D, is called 'Exploring how social interactions influence regulators and innovators: the case of regulatory sandboxes' and explored social interactions between regulators and sandbox participants and their impact on their practices. Ten theoretical propositions were derived to contribute to the scholarly understanding of knowledge exchange in the context of regulatory sandboxes at the organisational and tenant levels of analysis. Starting with the impact of social interactions on sandbox participants, the study confirms that participation in sandboxes improved FinTechs' trustworthiness and acceptance

among investors and consumers, enabling them to raise capital and undertake testing. Further, higher interaction frequency was found to affect participants' knowledge of regulations and compliance capabilities. Similarly, social interactions had a positive effect on participants' risk management capabilities due to the transferred knowledge on compliance and operational pitfalls. As a result, sandbox participants were able to build more sustainable and compliant solutions. As for the impact of social interactions on regulators, the study reinforces the vital role of FinTechs in educating regulators about technology-enabled solutions and providing early access to solutions that will meet with compliance standards. Although the intensity of interaction varied during participation, frequent interaction enabled regulators to understand FinTechs' support needs. Instead of legally oriented discussions, regulators were found to have more technical conversations, which facilitated knowledge sharing. Moreover, the study identified a few negative implications. First, in cases where the nature of interaction among regulators and innovators was dominated by one-way communication in terms of reporting testing performance to regulators, sandbox participants gradually become reluctant to share novel insights. Second, inconsistency in expectations inhibited knowledge exchange among both regulators and sandbox participants. This may include achieving underlying key performance indicators for regulators and financial savings for innovators. Finally, the findings indicated regulators' resistance to amend regulations, which negatively affected innovators' testing practices.

The findings from Paper D complement the contribution of previous studies by capturing the implications of sandboxes on FinTech innovation from the perspective of sandbox participants, which has scarcely been previously explored. Compared to those studies that have been conducted, sandboxes were found to provide FinTechs additional advantages beyond the ones identified previously (e.g., improving acceptance by investors and access to cross-border testing) like improving their compliance and risk management capabilities and being able to communicate with regulators using a common (technical) language. That said, disparities in sandbox participants' experiences were also identified, indicating in some cases fewer benefits from participation. In consensus with previous studies, FinTechs operating in blockchain and cryptocurrency segments were found to benefit the least from participating in sandboxes or interacting with regulators. This is mainly due to the lack of regulation and the underlying motive of regulators to monitor the activities of these start-ups. The findings in Paper D illuminate additional inconsistencies in regulatory incentives, revealing that some regulators are not genuinely incentivised to promote novel FinTech solutions. This is evidenced in regulators' unwillingness to amend existing regulations or establish new regulatory frameworks that accommodate the peculiarities of FinTech newcomers. While

these findings must be cautiously interpreted given the limited sample size and the presence of several contingencies (e.g., regulatory mandates, compliance experience of sandbox entrants, participation in early cohorts), it is reasonable to conclude that some jurisdictions deploy sandboxes with the implicit objective of monitoring testing participants' ability to develop compliant solutions. In such cases, sandboxes may not foster FinTech innovation in the desired manner due to the limitations imposed on testing activities.

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5 Implications for Research and Practice

This section presents the overarching contributions made to theory, methodology and practice from this doctoral dissertation; extended contributions for each paper can be read in part II.

5.1 Theoretical Contribution

Overall, this dissertation contributes to the conceptualisation of the regulatory sandbox phenomenon in the incubation literature and the construct of ecosystem dynamics in the EEs literature by providing explanations in the form of theoretical propositions. Financial markets with the presence of sandboxes and FinTech start-ups constitute the context of this contribution. Hence, this theorisation is made at multiple levels of analysis: the tenant (sandbox participant), the organisation (regulatory sandbox) and the ecosystem (FinTech EEs). Fundamentally, this dissertation challenges the assumption that existing incubation theory can be transferred to the study of regulatory sandboxes because of the peculiarities of this underexplored context. While the findings certainly do reveal how FinTech incubation occurs as to the activities of regulatory sandboxes and the impact of knowledge transfer on the practices of sandbox participants, other important lessons at the ecosystem level extend the scholarly understanding of factors affecting financial innovation in FinTech start-ups. Examples include the presence of institutional voids precipitating entrepreneurial actors to create a support ecosystem for novel or unendorsed segments, the dual mandate of the regulator (i.e., regulation and market development) providing a rich variety of innovation initiatives and the role of digitalisation and intermediaries in reducing spatial contingencies. Despite the deduced positive impact of these factors on FinTech start-ups, several obstacles emerged in the form of regulatory shortcomings that led entrepreneurs to adopt pragmatic, non-regulatory approaches to innovation. These findings bridge the incubation and EEs research streams while emphasising that the incubation of FinTech start-ups is contingent on regulatory responses to sustain the safe operation and dissemination of financial innovations within spatial jurisdictions.

Moreover, the key theoretical contributions in the individual papers are synthesised. The studies conducted advance a novel debate on regulatory sandboxes as incubation models, contributing directly to studies that explore how new models function in the incubation literature, as when Campbell et al. (1985) and Bergek and Norrman (2008) explored incubators or Pauwels et al. (2016) explored accelerators. Future research can also benefit from this study to track the emergence of regulatory sandbox models. In acknowledging the scarcity of studies on specialised incubators (Schwartz & Hornych, 2008), important

contributions are made to this stream by comparing the activities of specialised business incubators and accelerators to regulatory sandboxes. Moreover, the studies extend the academic understanding of the influence of knowledge exchange on the practices of regulators and sandbox participants, contributing to the social aspects of incubation in the incubation literature at the organisational and tenant levels of analysis (Scillitoe & Chakrabarti, 2010). At the ecosystem level, contributions are made to the EEs literature by exploring the influence of ecosystem dynamics on entrepreneurial ventures' access to and exploitation of resources in FinTech EEs (Alvedalen & Boschma, 2017; Cao & Shi, 2020). Specific to the FinTech stream of studies, this research clarifies the theoretical relevance of FinTech, bridging this novel area to encompass two literature streams: the incubation and EEs literatures. Relatedly, it contributes to the atheoretical FinTech literature by employing theoretical based approaches (i.e. the EE framework, activity system framework and SCT) to guide the empirical exploration and data analysis (Gazel & Schwienbacher, 2020). Broadly, the explanations deduced from this PhD study also contribute to investigations on financial innovation in FinTech start-ups (Anagnostopoulos, 2018).

5.2   Methodological Contribution

This study relies on abduction as a mode of theorising instead of deductive and inductive accounts (Makadok, Burton, & Barney, 2018). Here, an important methodological contribution is made by modifying the constructivist-inductive Gioia method to fit with a an abductive CR design, allowing the use of a theoretical framework to guide the empirical studies; a detailed explanation of this adaptation is provided in subsection 3.3.3. Without overlooking methodological contributions to CR employing either a data-driven approach using grounded theory (Hoddy, 2019; Maxwell, 2012) or a theory-driven deductive approach (e.g., Fletcher, 2017), the abductive logic employed in this study paves the way for future research to establish a streamlined data collection and analysis procedure to achieve qualitative rigour when following a CR paradigm.

5.3   Contribution to Practice

The output of conducted studies also has important implications for several stakeholders including regulators, policymakers, FinTech entrepreneurs and other ecosystem actors in search of scientific knowledge on the social aspects of incubation and EEs in the FinTech context. The main implications are synthesised below.

Regulators operating sandboxes can benefit from the theoretical propositions in Paper D by understanding how knowledge transferred prior to, during and after sandbox participation affects FinTech firms' practices either positively or negatively; these experiences offer

regulators a starting point when making future operational or strategic changes and may result in significant impact on the performance of the sandbox. Regulators looking to establish a regulatory sandbox may find the propositions suggested in Paper C helpful for understanding the activities inherent in regulatory sandboxes as best practices when setting up their own activities for both protecting financial markets and promoting financial innovation.

While the findings from the studies conducted here do not quantitatively measure the impact of regulatory sandboxes, they provide rich explanations of the role of regulatory sandboxes as support instruments and the role of regulators in governing and supporting market participants. From these findings in Papers C and D, policymakers can become more informed about the observed pitfalls related to either regulatory sandboxes or existing regulatory frameworks with a countereffect on the practices of FinTech participants in order to improve financial market regulatory policies. As for Paper B, policymakers can gain a better understanding of the conditions that inhibit FinTech activity to amend existing or establish new economic policies that contribute positively to the conduciveness of entrepreneurial environments. Since the findings from Paper C are specific to Singapore, policymakers located in other ecosystems should be attentive to variations in local conditions if changes or new approaches are to be considered.

Lastly, FinTech market participants needing business support or regulatory support, an investment buffer or a safe testing environment in local or non-local ecosystems will benefit from the findings of all four studies; enlightening them about the available support initiatives in EEs and highlighting regulatory sandboxes, along with the opportunities and challenges associated with entering that milieu, will allow FinTech entrepreneurs to make better informed decisions when approaching regulators or other ecosystem actors in search of opportunities to exploit. For example, novice FinTech entrepreneurs with limited knowledge of regulatory requirements and financial resources may think they are dependent on collaborating with established financial institutions so that they can use their financial license(s). Eventually, this would weaken the competitive advantage of a FinTech and make it more vulnerable to early acquisition. As an alternative, regulatory sandboxes provide the benefit of testing and validation of novel financial solutions without the need to acquire a financial license, which buys these FinTechs critical time to demonstrate proof of concept and raise funds from investors before applying for a financial license of their own. The Global Sandbox, meanwhile, allows cross-border experimentation to occur in two regulatory jurisdictions.

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6 Limitations and Future Research

All research has limitations that can also provide promising future research opportunities. As this is primarily an exploratory qualitative study of a novel phenomenon operating in the understudied FinTech context, the findings provide a preliminary understanding in the form of theoretical propositions. In total, 21 propositions are offered as steppingstones for future research to further explore, explain and confirm or refine the findings presented here. Given the limitations of the research design adopted, future investigations ought to quantitively examine the impact of regulatory sandboxes on FinTech participants to validate how effective these instruments are and whether they are delivering on their promise of reducing systemic risks and supporting innovation in financial markets, especially given that considerable resources already being allocated to sandbox operations and that their numbers are growing worldwide. Broadly, one important takeaway is to study the supply-demand side of incubation in technology-enabled industries like EdTech and CleanTech. In the case of FinTech, external challenges such as complex regulatory requirements that are often incompatible with enabling technologies and the high compliance costs of acquiring financial licenses have been among the main drivers for the creation of regulatory sandboxes to enable innovation, as initially reported in the literature. Despite the presence of sandboxes and their degree of success, according to the empirical reality as entrepreneurs see it, other issues persist, like the cumbersome nature of regulation, which is inconsistent with the desired speed of innovators battling their way to seize first-mover advantages while requiring swift regulatory clarification. In other words, there is inconsistency between the supply (regulatory sandbox) and demand (sandbox participants) sides; is it caused by the regulation-innovation lag, a lack of resources or regulators' desire to monitor participants' testing activities while learning about the implications of enabling technologies? Thus, understanding the links between the drivers, activities and objectives of the supply-demand side of incubation in digitalised contexts would provide novel knowledge to improve incubation models and help align participants' expectations. Moreover, future EEs research could benefit from exploring the approaches entrepreneurs adopt to overcome the obstacles they face and explore how EEs precipitate entrepreneurs to improve opportunity identification and resource exploitation.

There are also limitations in the individual papers. In Paper A, a systematic literature review approach would commonly be appropriate when the relevant literature is accessible through high-quality databases, but this may not be the case in the study of innovation facilitators in financial markets. Future research should extend the search scope to encompass a wider range of databases and sources that could include non-academic papers. As for Paper B, exploring ecosystem dynamics with a larger sample size and across FinTech ecosystems

with regulatory jurisdictions and mandates that differ from Singapore's would be helpful in understanding the role of the regulator in promoting start-ups. Additionally, given that the findings of this study reveal different ecosystem dynamics specific to unendorsed and novel FinTech segments like blockchain and cryptocurrencies, future investigations could target these segments. Other limitations include the limited number of regulatory sandbox cases studied in Paper C; at the time the study was undertaken, only a few regulatory sandboxes had been in operation, the contemporary state is different with more cases that qualify for investigation. In fact, different regulatory sandbox variants, also called thematic sandboxes, have recently emerged, including the Global Sandbox and Sandbox Express. The former provides a promising avenue for research because it involves cross-border testing of market participants, allowing researchers to explore multiple contexts in a single investigation, while the latter is designed to fast-track participants to the testing stage. Many regulatory sandboxes are being established in developing economies with the purpose of promoting financial inclusion of unbanked individuals; these sandboxes are often co-created or facilitated with the engagement of an international regulator or observer organisation. Thus, future studies could conduct a comparative study unveiling regulatory sandboxes in both developed and developing economies. Drawing on the exploration conducted in Paper D and the findings it yielded, future research could explore knowledge transfer in thematic sandboxes such as the Global Sandbox. Broadly, the research presented in this dissertation did not adopt an evolutionary approach but rather explored the activities of regulatory sandboxes and the related social interactions at a given point in time. Hence, future research could adopt a longitudinal perspective.

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Appendices

Appendix A: Ethics Approval

RMIT UNIVERSITY

Deputy Pro Vice-Chancellor
(Research & Innovation)
College of Business

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Australia

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Notice of Approval

Date:	21 January 2019
Project number:	21904
Project title:	*Knowledge Sharing and Value Creation: how do regulators enable innovation and how do innovators enable regulation?*
Risk classification:	Low Risk
Chief Investigator:	Prof Anne-Laure Mention
Student Investigator:	Mr Ahmad Alaasar
Other Investigator:	Prof Tor Helge Aas
Project Approved:	**From: 19 January To: 31 December 2021**

Terms of approval:

Responsibilities of the principal investigator
It is the responsibility of the principal investigator to ensure that all other investigators and staff on a project are aware of the terms of approval and to ensure that the project is conducted as approved by BCHEAN. Approval is only valid while the investigator holds a position at RMIT University.

1. *Amendments*
   Approval must be sought from BCHEAN to amend any aspect of a project including approved documents. To apply for an amendment submit a request for amendment form to the BCHEAN secretary. This form is available on the Human Research Ethics Committee (HREC) website. Amendments must not be implemented without first gaining approval from BCHEAN.
2. *Adverse events*
   You should notify BCHEAN immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
3. *Participant Information and Consent Form (PICF)*
   The PICF must be distributed to all research participants, where relevant, and the consent form is to be retained and stored by the investigator. The PICF must contain the RMIT University logo and a complaints clause including the above project number.
4. *Annual reports*
   Continued approval of this project is dependent on the submission of an annual report.
5. *Final report*
   A final report must be provided at the conclusion of the project. BCHEAN must be notified if the project is discontinued before the expected date of completion.
6. *Monitoring*
   Projects may be subject to an audit or any other form of monitoring by BCHEAN at any time.
7. *Retention and storage of data*
   The investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Regards,

Dr Christopher Cheong
Chairperson
RMIT BCHEAN

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Appendix B: Participant Information Sheet and Consent Form

Title	Knowledge Sharing and Value Creation: how do regulators enable innovation and how do innovators enable regulation?
Chief Investigator/Senior Supervisor	Professor Anne-Laure Mention
Associate Investigators	Prof. Tor Helge Aas and Mr Ahmad Alaassar

What does my participation involve?

1 Introduction

You are invited to take part in this research project, which is titled 'Knowledge Sharing and Value Creation: how do regulators enable innovation and how do innovators enable regulation?'. Your details were obtained from LinkedIn or regulatory sandbox website.

This Participant Information Sheet/Consent Form informs you about the research project. It explains the processes involved with taking part. Knowing what is involved will help you decide if you want to take part in the research. Please read this information carefully.

Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether or not to take part, you might want to talk about it with a relative or friend.

Participation in this research is voluntary.

If you decide you want to take part in this research project, you will be asked to sign the consent form section. By signing it you are telling us that you:

- Understand what you have read in the information and the consent forms
- Consent to take part in the research project

Upon signing and participation, you will be given a copy of this Participant Information Sheet and Consent Form (either in-person or via email).

2 What is the purpose of this research?

With a pace of change in the world accelerating around us, technology has ramped up competition, leading the financial industry towards disruption, via the emergence of disruptive technology-enabled business models, constantly forcing legacy financial institutions to clarify their strategies, develop new capabilities and transform their cultures. This research project brings multiple global insights to shed light on the role of regulators and innovators interactions in fostering knowledge exchange and value creation within the financial service industry.

The results of this research will be used by the researcher Mr. Ahmad Alaassar to obtain a PhD degree.

This research is being conducted in collaboration with Associate Professor Tor Helge Aas from the University of Agder.

3 What does participation in this research involve?

If you decide to participate in the research, you are requested to:

- Provide a signed consent form before the interview (in-person or via email to the researchers)
- Participate in the interview process via Skype or telephone (expected to take 60 minutes)

Interview will include questions on the processes, structure, priorities and procedures of regulatory sandbox in enabling innovation.

There are no direct costs for participating in this research project and, no reimbursement or incentives are offered to any participants of this research.

4 Do I have to take part in this research project?

Participation in any research project is voluntary. If you do not wish to answer a question during the interview, you may skip it and go to the next question, or you may stop immediately. You may also refuse to answer any questions that you do not wish to answer during the interview.

Unless you say that you want us to keep them, any recordings will be erased and information you have provided will not be included in the study results.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with the researchers or with RMIT University.

5 What are the possible benefits of taking part?

We cannot guarantee or promise that you receive any benefits from this research; however, you may appreciate the contribution to knowledge in enabling innovation and entrepreneurship within financial services.

6 What are the risks and disadvantages of taking part?

There are no immediate or foreseeable risks in taking part in this research apart from some time commitment.

Nonetheless, you may feel that some of the questions we ask are stressful or upsetting. If you do not wish to answer a question, you may skip it and go to the next question, or you may stop immediately. If you become upset or distressed as a result of your

participation in the research project, members of the research team will be able to discuss appropriate support for you.

7 What if I withdraw from this research project?

If you do consent to participate, you may withdraw at any time. If you decide to withdraw from the project, please notify a member of the research team. You have the right to have any unprocessed data withdrawn and destroyed, providing it can be reliably identified.

8 What happens when the research project ends?

At the end of the research project, should you request, a summary of the research findings will be provided to you. As appropriate, we will endeavour to provide interim summary of the progress. The final summary will be provided electronically to your email, on or after completion of the project. The expected completion date of the research project is 31 January 2021. You will be asked to provide your contact details to facilitate this part of the process.

9 What will happen to information about me?

Any information obtained in connection with this research project will be presented such that you and your institute's identity will remain confidential in publications and other research outputs. We will use coded interviewee indicators (i.e. Interviewee 1, Interviewee 2, etc) and coded firm indicators (Firm A, Firm B, etc.) in all published material related to this research. All recordings and documentation will be imported to the secure drive on University server where it will be stored securely for at least five years. During this time, data may be used for development of research outputs such as journal articles, conference papers, thought leadership papers, presentations and to inform teaching practice.

In accordance with relevant Australian and/or Victorian privacy and other relevant laws, you have the right to request access to the information about you that is collected and stored by the research team. You also have the right to request that any information with which you disagree be corrected. Please inform the research team member Mr. Ahmad Alaassar if you would like to access your information.

Any information that you provide can be disclosed only if (1) it protects you to others from harm, and (2) if specifically allowed by law, and (3) you provide the researchers with written permission. Any information obtained for the purpose of this research project that can identify you will be treated as confidential and securely stored.

10 Who is organising and funding the research?

This research project is being conducted PhD student Ahmad Alaassar affiliated to RMIT University and the University of Agder (Norway), Professor Anne-Laure Mention at RMIT University and Associate Professor Tor Helge Aas at the University of Agder, Norway. The research has no external funding.

11 Who has reviewed the research project?

The RMIT University Human Research Ethics Committee has approved this research project. This project will be carried out according to the *National Statement on Ethical Conduct in Human Research* (2007). This statement has been developed to protect the interests of people who agree to participate in human research studies.

12 Further information and who to contact

If you want any further information concerning this project, you can contact the researcher on:

Name	**Professor Anne-Laure Mention**
Position	Chief investigator
Telephone	+(61 3) 9925 5358
Email	Anne-laure.mention@rmit.edu.au
Name	**Dr Tor Helge Aas**
Position	Associate Professor
Telephone	+47 99092927
Email	tor.h.aas@uia.no
Name	**Mr Ahmad Alaassar**
Position	Higher Degree Research candidate
Telephone	+(61 3) 9925 5358
Email	ahmad.s.m.alaassar@rmit.edu.au

13 Complaints

Should you have any concerns or questions about this research project, which you do not wish to discuss with the researchers listed in this document, then you may contact:

Reviewing HREC name	RMIT University
HREC Secretary	Peter Burke
Telephone	03 9925 2251
Email	human.ethics@rmit.edu.au
Mailing address	Research Ethics Co-ordinator Research Integrity Governance and Systems RMIT University GPO Box 2476 MELBOURNE VIC 3001

Consent Form

Title	Knowledge Sharing and Value Creation: how do regulators enable innovation and how do innovators enable regulation?
Chief Investigator/Senior Supervisor	Professor Anne-Laure Mention
Associate Investigators	Dr Tor Helge Aas and Mr Ahmad Alaassar

Acknowledgement by Participant

➢ I have read and understood the Participant Information Sheet.

➢ I understand the purposes, procedures and risks of the research described in the project.

➢ I have had an opportunity to ask questions and I am satisfied with the answers I have received.

➢ I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my relationship with RMIT.

➢ I understand that I can keep the information form and the consent form for my records.

➢ I understand that signing this consent form will imply my informed consent to participate in this research project.

Participant's Consent

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Researcher[†]

I have given a written explanation of the research project, its procedures and risks and I believe that the participant has reasonable information for making an informed consent to participant in this research.

Name of Researcher (please print) _____

Signature _____ Date _____

Note: All parties signing the consent section must date their own signature.

A photocopy of this consent form will be made available to you after it has been signed by all parties.

Part II: Individual Papers

Paper A

Facilitating Innovation in FinTech: A Review and Research Agenda

Ahmad Alaassar, Anne-Laure Mention, Tor Helge Aas

Abstract

The purpose of this paper is to carry out content analyses on the existing literature to investigate the knowledge state of innovation facilitators adopted to promote FinTech start-ups in financial markets. In total, 46 papers were analysed in the NVivo software package. Three categories of innovation facilitators emerged from the literature capturing the perspective of regulators, innovators and incumbents. Each of the identified initiatives is defined and its processes and implications described. Most initiatives were led by regulators, revealing a regulatory strategy change from risk-based to opportunity-based regulation, with regulatory sandboxes being the most commonly adopted instrument. Based on our results, we discuss several important observations and propose avenues for future research. This paper contributes to the financial innovation and FinTech research literature streams.

Keywords: Financial innovation, FinTech, Innovation facilitators, Systematic literature review, Research agenda

Paper B

Ecosystem Dynamics: exploring the interplay within fintech entrepreneurial ecosystems

Ahmad Alaassar, Anne-Laure Mention, Tor Helge Aas

Abstract Scholars and practitioners continue to recognize the crucial role of entrepreneurial ecosystems (EEs) in creating a conducive environment for productive entrepreneurship. Although EEs are fundamentally interaction systems of hierarchically independent yet mutually dependent actors, few studies have investigated how interactions among ecosystem actors drive the entrepreneurial process. Seeking to address this gap, this paper explores how ecosystem actor interactions influence new ventures in the financial technology (fintech) EE of Singapore. Guided by an EE framework and the use of an exploratory-abductive approach, empirical data from semi-structured interviews is collected and analyzed. The findings reveal four categories representing both the relational perspective, which features interaction and intermediation dynamics, and the cultural perspective, which encompasses ecosystem development and regulatory dynamics. These categories help explain how and why opportunity identification and resource exploitation are accelerated or inhibited for entrepreneurs in fintech EEs. The present study provides valuable contributions to scholars and practitioners interested in EEs and contributes to the academic understanding of the emerging fintech phenomenon.

1 Introduction

The concept of entrepreneurial ecosystems (EEs) has gained extensive attention in recent years (Malecki 2018; Roundy 2016; Spigel and Harrison 2018) due to its explanatory power, which combines social, institutional, and relational aspects (Brown and Mason 2017). However, the growing focus on EEs has caused many unexplored and underexplored areas to emerge, so scholars have called for theoretical and empirical studies to help fill gaps in the literature (Audretsch et al. 2018; Brown and Mason 2017; Spigel 2017; Stam 2015). For example, scholars have stressed the need to explore ecosystem dynamics, conceptualized as interactions that occur among entrepreneurs and ecosystem actors, by adopting a network approach (e.g., Alvedalen and Boschma 2017; Brown and Mason 2017; Motoyama and

Knowlton 2017). Existing studies focus on the causal relations between individual ecosystem actors or EEs as a whole and entrepreneurial output but remain relatively silent on how interactions between different ecosystem actors contribute to new venture creation (Alvedalen and Boschma 2017; Stam 2015). In response, the present study employs Brown and Mason's (2017) taxonomy to investigate four ecosystem categories: entrepreneurial actors, resource providers, connectors, and entrepreneurial culture. Other prominent EE frameworks (e.g., Isenberg 2011; Spigel 2017) have included these elements; however, they have focused either on an ecosystem's composition (Isenberg 2011) or relationships between ecosystem attributes (Spigel 2017). Conversely, Brown and Mason's (2017) conceptualization attempts to capture the full complexity of EEs through their underlying dynamics.

Traditionally, empirical investigations (e.g., Audretsch and Belitski 2017; Liguori et al. 2019; Neck et al. 2004; Spigel 2017) have primarily viewed EEs from the entrepreneur's perspective. At the same time, scholars have argued that entrepreneurship is not an independent act but one that takes place in a society of interrelated actors (Stam 2015) who might not be directly related to entrepreneurial ventures. This may include established firms, universities, public institutions, and capital providers (Isenberg 2010). As such, EEs are interaction systems that consist of hierarchically independent yet mutually dependent ecosystem actors (Autio 2016). It is further argued that the role of these actors is downplayed in EE studies; for instance, Brown and Mason (2017) state that established organizations play a vital role in ecosystems because they attract human resources, incubate startups, and usually serve as first customers. For these reasons, scholars have called for studies to explore the interplay among other actors in the external environment (Cavallo et al. 2018; Ghio et al. 2019; Nicotra et al. 2018). In addition, recent studies (e.g., Motoyama and Knowlton 2017, Neumeyer et al. 2019) have begun exploring multiple perspectives, empirically investigating stakeholders like investors, government actors, incubator managers, and academics. Building on these efforts, we investigate the dynamics between entrepreneurs and ecosystem actors in EEs. Thus, we go beyond typical empirical investigations in the EE literature to explore the experiences of a diverse set of ecosystem actors with profound influence on the success—or failure—of entrepreneurship.

Not all context-specific knowledge can be readily transferred to other contexts due to its distinctive characteristics; hence, we may assume that ecosystem dynamics in certain industry-specific EEs are different compared to other contexts (Autio et al. 2014). Building on this argument, we focus our empirical investigation on the financial industry, which has been profoundly impacted by digitalization, and look particularly at the financial technology

(fintech[1]) phenomenon. In addition to the effect of digitalization on the identification and acquisition of entrepreneurial opportunities (Autio et al. 2018), fintech is characterized by the proliferation of newcomers, financial stability risks (Anagnostopoulos 2018; Li et al. 2020; Magnuson 2018), and changes in the regulatory environment (Arner et al. 2015). These characteristics challenge and reshape the existing dynamics among ecosystem actors (Gazel and Schwienbacher 2020; Haddad and Hornuf 2019; Hornuf et al. 2020).

The present exploratory study addresses the following research question (RQ): *How are ecosystem dynamics accelerating or inhibiting new ventures in fintech EEs?* We answer this RQ through an empirical investigation of the fintech EE[2] of Singapore, which has recently emerged as a leading fintech hub and is now ranked third globally behind the United Kingdom and the United States (Findexable 2020). The Monetary Authority of Singapore (MAS) reported the presence of 1100 fintech firms in 2019, compared to fewer than 100 in 2016 (MAS 2020b). Additionally, 2019 saw the value of investment deals more than double to US$861 million, with 40% of the capital raised by digital payment fintechs (Accenture 2020). These achievements are no accident, as Singapore has cultivated a favorable climate for fintech, with MAS functioning as both regulator and innovation catalyst, giving it a first mover advantage in Asia and around the world. Despite this growth, little academic attention has been paid to Singapore, unlike other fintech EEs such as the United Kingdom and China (Lin 2019).

Methodologically, we answer the RQ through a qualitative research design employing an exploratory-abductive approach (Dubois and Gadde 2002) as a steppingstone to propose theoretical propositions. In-depth semi-structured interviews are conducted with a diverse set of fintech ecosystem actors in Singapore. For data analysis, the Gioia method (Gioia et al. 2013) is coupled with systematic combining (Dubois and Gadde 2002), following a non-linear, non-positivistic approach to theory generation.

Through this study, we extend the existing knowledge of EEs by offering a set of theoretical propositions on the dynamics of fintech ecosystems, thus responding to numerous calls for empirical studies (e.g., Audretsch et al. 2018; Spigel 2017). We also extend the scholarly understanding of how the fintech context is linked to the EE literature stream (Lee and Shin 2018). Additionally, by employing Brown and Mason's (2017) EE framework, the

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[1] While some studies have investigated selected fintech innovations like equity-based crowdfunding and its related regulatory environment (Vismara 2016) or ecosystem (Cummings et al. 2020), we explore fintech as a collective phenomenon encompassing different financial innovations (Gazel and Schwienbacher 2020; Haddad and Hornuf 2019; Hornuf et al. 2020).

[2] While acknowledging that EEs are characterized as nested geographies hosting smaller ecosystems inside larger ones (e.g., Brown and Mason, 2017), we elect to conceptualize the EE as a single ecosystem, following similar investigations of the fintech ecosystem (e.g., Lee and Shin 2018; Palmié et al. 2019).

present study contributes to the emerging fintech phenomenon, which remains underexamined and anecdotal in management research (Puschmann 2017). Last, this study contributes to practice by informing entrepreneurs about opportunities to access networks and exploit resources; practical implications for policymakers are also identified.

The paper is structured as follows: in the next section, we briefly introduce the concept of EEs and establish fintech as an industry-specific ecosystem. We then review the theoretical approach adopted and the EE framework that guides the empirical investigation. A case description is accompanied by an explanation of the research process before the empirical findings are presented. The discussion section suggests theoretical propositions, discusses the obstacles within the fintech EE and describes the implications of this study for both theory and practice; a brief conclusion follows.

2 Theoretical Background

2.1 Entrepreneurial ecosystems

Acs et al. (2017), among others, position the EE concept within the strategy literature, linking it directly to ecosystem concepts that first included business ecosystems (Moore 1993). The EE concept differs from prior literature (e.g., national and regional innovation systems) by its emphasis on entrepreneurs as focal actors and on the social, institutional, and relational aspects of ecosystem actors (Brown and Mason 2017; Nicotra et al. 2018; Stam 2015). It is used as a framework to explain social interactions among actors in the entrepreneurship process and local environment (Spigel and Harrison 2018). Audretsch and Belitski (2017) define EEs as "institutional and organizational as well as other systemic factors that interact and influence identification and commercialization of entrepreneurial opportunities" (p. 1031). The authors refer to EEs as geographically bounded cities like Boston, characterized by the presence of supportive academic institutions, policies and infrastructure, industry actors, support organizations, entrepreneurial culture, and investment power (Audretsch and Belitski 2017). All these elements influence the creation of local ventures by facilitating knowledge sharing and access to resources (Colombelli et al. 2019; Neck et al. 2004; Spigel 2017). EE scholars are currently investigating the dynamics among ecosystem actors rather than simply identifying the role played by ecosystem elements in entrepreneurial activity (Audretsch et al. 2018; Di Fatta et al. 2018; Ghio et al. 2019).

Qualitative investigations of EEs have examined geographical locations rather than specific industries (McAdam et al. 2019; Scheidgen 2020; Spigel 2017). For instance, Spigel (2017) explores new ventures operating in various industries in the ecosystems of Calgary and Waterloo in Canada. While these studies provide valuable contributions to our

knowledge of EEs, their findings are not industry specific. That said, it is not a given that all knowledge from empirical investigations of EEs can be generalized across industries because of differences in the characteristics of each sector. Hence, we may assume that the role of ecosystem actors in certain industry-specific EEs differs in other contexts like digitalized industries (Autio et al. 2018). Digitalization in this setting reduces "the dependency of new ventures on cluster-specific spatial affordances for entrepreneurial opportunities, while also alleviating some of the spatial constraints of opportunity pursuit and enabling new ventures to experiment with and discover business models that exploit opportunities external to the cluster" (Autio et al. 2018, p. 80). On this basis, we narrow our investigation to the financial sector due to the proliferation of market participants, associated risks to financial stability, changes in the regulatory environment, and other contextual conditions such as access to infrastructure, talent, and capital. Taken together, these factors challenge the existing dynamics among key ecosystem actors and consequently the creation and growth of new fintech ventures (Gazel and Schwienbacher 2020; Hornuf et al. 2020; Svensson et al. 2019). The next section describes the complex fintech landscape.

2.1.1 Fintech EEs

According to Autio et al. (2018), digitalization affects both the type of entrepreneurial opportunities being formed and how such opportunities are sought by founders. Hence, the digital economy provides numerous opportunities for newcomers to innovate and potentially challenge established institutions in the targeted sectors (Gazel and Schwienbacher 2020). The financial sector offers a good example of how digitalization has enabled fintech newcomers to aggressively penetrate the market, forcing traditional financial institutions (FIs) to become more open to market engagement through strategic alliances or incubation programs (Hornuf et al. 2020). According to PwC, 88% of incumbents are concerned about losing revenue to fintech entrants, whereas 82% expect an increase in partnerships with fintechs in the next 3 to 5 years (PwC 2017). Changes in financial market dynamics are considerably recent to this context which has traditionally been characterized by low innovation levels (Beck et al. 2016), creating a void between research and practice due to the lack of empirical data exploring the fintech phenomenon (Anagnostopoulos 2018). This is not to overlook academic contributions on niche fintech segments such as initial coin offerings (ICOs) or crowdfunding (e.g., Adhami et al. 2018; Vismara 2016). Rather, there is a need for more studies that explore fintech as a phenomenon capturing a broader range of technology-powered financial service providers (e.g., Gazel and Schwienbacher 2020; Haddad and Hornuf 2019; Hornuf et al. 2020). This is particularly important when fintech innovations (e.g., crowdfunding or ICOs) complement the growth of other fintech segments

in ways like raising capital. While fintech is about not only new ventures but also traditional FIs and technology firms, this study focuses on startups due to their economic impact and disruptive innovations (Palmié et al. 2019). Hence, we use the term "fintech EEs" to represent new ventures and entrepreneurs as focal actors in the financial industry endeavoring to deliver "new business models, applications, processes or products" (Financial Stability Board 2017, p. 7).

It is important to study the fintech phenomenon, given the increasing numbers of market participants across diverse segments like digital payments, wealth management, crowdfunding, lending, capital market, and insurance (Lee and Shin 2018). Accenture has reported that, since 2005, fintech providers have captured a third of total global banking revenues (Accenture 2018). A more recent report enumerates the presence of 90 fintech unicorns[3] globally by early 2020 with an aggregated value of approximately US$500 billion (Crunchbase 2020). Over the past decade, global investment in fintech grew roughly ninefold, with US$43 billion invested in 2019 compared to US$5 billion in 2010 (Crunchbase 2020). Financial regulation scholarship has commonly depicted traditional FIs as the primary drivers of instability and systemic risk to economies (Magnuson 2018). This argument may no longer be the only valid explanation in light of the increased market penetration of fintech newcomers that decentralize and automate financial services in new ways that lead to three main challenges (Anagnostopoulos 2018; Li et al. 2020; Magnuson 2018). First, fintechs are more vulnerable to external market shocks, either because adequate stress-testing may have not been carried out in drastic situations (Anagnostopoulos 2018) or due to a lack of industry experience and understanding of financial regulations (Philippon 2016). Second, regulators can scarcely monitor the activities of fintech firms due to their exponential developmental pace. Alibaba's Yu'E Bao (a fund management fintech) illustrates how rapidly fintech firms can grow, surpassing JP Morgan's US fund to become, in a mere nine months, the world's largest market fund. In this scenario, the Chinese regulator's passive approach would have been inadequate to identify and interfere in the event of systemic threats (Anagnostopoulos 2018). Aside from the need to keep up with fintechs, regulators must also acquire critical expertise to sustain quality supervision (Boot et al. 2021). Third, fintechs are incentivized to adopt non-cooperative behaviors, partly due to ambition to become a frontrunner and achieve short-term gains, but also because most fintech investors are venture capitalists who demand accelerated growth (Magnuson 2018). Additionally, such hastiness can raise questions about the integrity of fintechs; Thakor (2020) presented instances of overlending and scandals from P2P lending platforms that lead to

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[3] A unicorn is a privately held startup valued at more than US$1 billion.

investors departing as well as negative effects on market stability. Taken together, these challenges may mean that fintech firms pose greater systemic risk concerns than established FIs (see Magnuson 2018 for an overview). Not only this, a recent empirical investigation showed that risk spillovers from fintechs to established FIs are positively correlated with the systemic risk of FIs (Li et al. 2020).

In addition to the above characteristics that distinguish the fintech context from others, the role of regulators has been subject to extensive discussions due to regulation's double-edged sword: regulatory intervention can either impede or support innovation (Alaassar et al. 2020; Cumming and Schwienbacher 2018; Haddad and Hornuf 2019). For example, regulations may not support the different and unbundled way fintechs operate in; lenders and borrowers are instantly matched in crowdfunding platforms powered by Big Data analytics, in contrast to bank loans based on long-term relationships (Navaretti et al. 2017). Adding to this complex scenario, fintech newcomers may lack crucial knowledge of regulatory frameworks to navigate through this space (Arner et al. 2015). Furthermore, enabling technologies allow the delivery of financial services to underserved users and unbanked individuals, which affects existing value networks and may pressure FIs to down-scale or relocate due to lower demand (Anagnostopoulos 2018).

Based on the above, we may argue that rules of the game in financial markets have changed; new fintech players have emerged alongside a supportive ecosystem in the external environment (Block et al. 2018). For example, academic institutions have begun to establish educational programs to upskill talent (Kursh and Gold 2016). Support organizations are creating accelerator programs and co-working spaces (Arner et al. 2015; Block et al. 2018). Financial market regulators have introduced new initiatives like regulatory sandboxes[4] and innovation hubs (Jenik and Lauer 2017; Zetzsche et al. 2017). Whereas, capital providers have ensured the availability of funds (Haddad and Hornuf 2019). Other fintech ecosystem actors include technology firms, government institutions, and traditional FIs (Lee and Shin 2018). While comparing fintech EEs to other ecosystems is beyond the scope of this study, we acknowledge that financial markets share similarities with other industries like the energy sector or pharmaceuticals in terms of stringent regulations and use of enabling technologies. However, we argue that industry-specific characteristics like the increase of market participants coupled with the ability to scale rapidly, large amounts of raised capital, and impact on financial stability, make the fintech context relevant for dedicated research. Within this vibrant environment, ecosystem actors interact to access resources and exploit

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[4] "Regulatory sandboxes grant licensing exemptions to participants so that they can test their solutions for a set period of time, subject to conditions imposed by regulators in each jurisdiction" (Alaassar et al. 2020, p. 1, extending Arner et al. 2015; Zetzsche et al. 2017).

opportunities, thereby transforming the status quo of the ecosystem dynamics in financial markets. That said, given that the fintech literature remains in its nascency (Gazel and Schwienbacher 2020), there remains a lack of evidence-based research that explores the dynamics of fintech EEs, a gap that the present study seeks to fill. Figure 1 visualizes the salient features of fintech EEs within broader EEs.

2.2 Conceptualizing ecosystem dynamics

Entrepreneurial dynamics commonly refers to the lifecycle of startups: creation, growth, and stability or exit (Kazanjian 1988). The existing entrepreneurship literature (e.g., Gartner 1985) argues that interaction among actors in the external context may impact entrepreneurial dynamics. For instance, Grimaldi and Grandi (2005) investigated the influence of interaction among incubators and incubatees on entrepreneurial creation dynamics, while Pena (2004) examined the growth dynamics resulting from such interactions. More recently, Alaassar et al. (2020) explored the impact of interactions on the practices of fintech startups and regulators in the context of regulatory sandboxes. However, none of these studies use an ecosystem perspective to capture the role of other actors (Cavallo et al. 2018). Neck et al. (2004) conducted one of the first studies to investigate the interactions of founders with multiple actors in entrepreneurial systems; they conclude that regional entrepreneurial activity is influenced by the collective effort of ecosystem actors. In this literature stream, Spigel (2017) argues that successful EEs should not necessarily be determined based on high rates of entrepreneurship but rather by how interactions among ecosystem actors foster entrepreneurial activity. That said, existing research has largely focused on identifying what defines ecosystems in terms of actors and factors that impact entrepreneurial activity while overlooking relational factors that explain how ecosystem elements interact (Alvedalen and Boschma 2017; Ghio et al. 2019; Stam 2015). On one hand, the literature assumes that interactions among entrepreneurs can inspire newcomers to start a business with exemplary role models and provide direct business support through mentorship (Brown and Mason 2017). On the other, interactions among ecosystem actors have been highlighted as crucial to fostering collaboration with local entrepreneurs and providing them access to resources (Feld 2012). An empirical investigation of EEs in St. Louis, Missouri, supports this finding, indicating that "the way in which entrepreneurs interact and form relationships, leading to support, learning, and growth, was substantially influenced by the way support organizations interacted and by the way the support that they offered was structured" (Motoyama and Knowlton 2017, p. 27). It can thus be argued that entrepreneurial dynamics is at the core of understanding how ecosystems succeed in creating a supportive environment for

entrepreneurship (Stam 2015). On this basis, following Cao and Shi (2020), we conceptualize ecosystem dynamics as interactions that occur among entrepreneurs and ecosystem actors.

Entrepreneurial Ecosystems
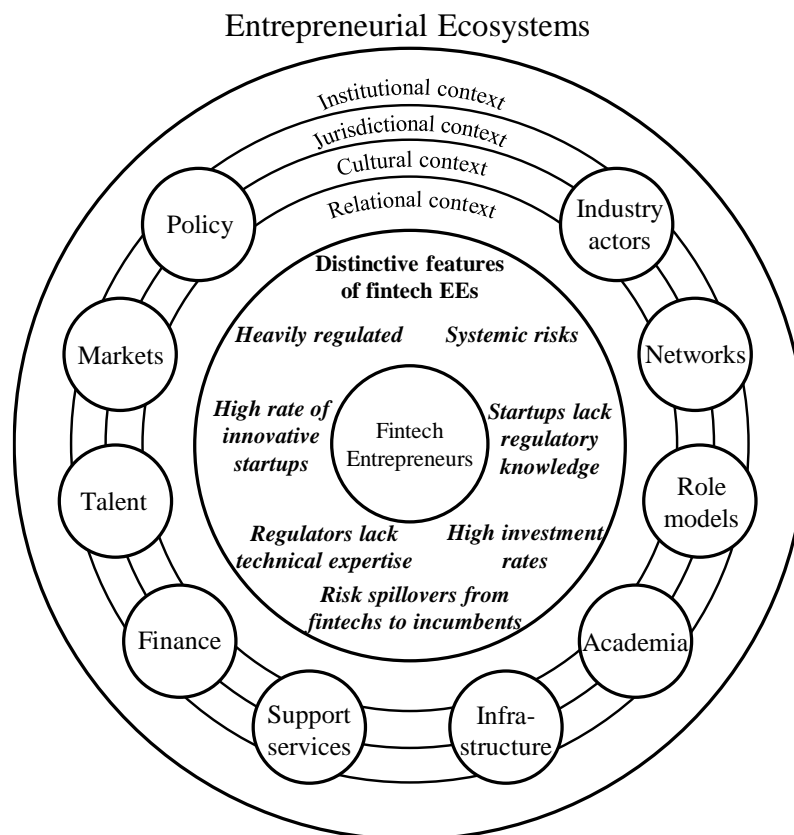
Fig. 4 The distinctive features of fintech EEs; outer circle adapted from Isenberg (2011) and Spigel (2017).

2.3 Theoretical approach

A network approach is employed to guide the empirical investigation in this research, emphasizing the importance of the relational view to entrepreneurship to enable founders to access resources in the external environment (Aldrich and Zimmer 1986). This approach is characterized by the relations among network actors, which can be in the form of communicating information, exchanging services, or, in a normative sense, expectations and obligations (Aldrich and Zimmer 1986). Given the qualitative nature of this work, a metaphorical analysis is conducted to explore the relationships between ecosystem actors rather than an analytical assessment that quantitatively measures network structures, a distinction introduced by Bergenholtz and Waldstrøm (2011). Metaphorical studies imply the presence of diverse social interactions among network actors (e.g., Santoro and Chakrabarti 2002), while analytical studies approach networks in a more formal manner, examining particular social structures through, for instance, social network analysis (e.g., Díez-Vial and Montoro-Sánchez 2016).

2.3.1 EE framework

Most cited EE frameworks include Isenberg (2011) and Spigel (2017). Isenberg (2011) reports that successful ecosystems are influenced by six domains: a supportive culture, enabling policies, access to sufficient capital, availability of a talent pool, accessible markets, and a diversified set of support organizations and infrastructure. Spigel (2017) develops and empirically investigates a framework comprised of three main attributes that play key roles in the early development of new ventures. These attributes consist of cultural (common norms and values), social (networks to ensure resource acquisition and knowledge flow), and material (tangible elements including policy and governance). While both frameworks involve similar domains, they differ in their emphasis on the composition of ecosystems (Isenberg 2011) or the relationships among an ecosystem's attributes (Spigel 2017). Using these frameworks as a starting point, the present study adopts the conceptualization offered by Brown and Mason (2017) because it attempts to capture the full complexity of ecosystems by investigating the underlying dynamics of four coordinative categories. These include entrepreneurial actors, resource providers, connectors, and entrepreneurial culture. In this study, we use this conceptualization to assist with data collection and data analysis, guiding the exploration of variance that emerges empirically in each category. Each category is described below, and Figure 2 presents the research model.

Entrepreneurial actors are widely considered by scholars to be focal actors in EE frameworks (Isenberg 2011; Spigel 2017; Stam 2015). While the concept of EEs may imply that relational factors mediate entrepreneurial activity in the local context, Brown and Mason (2017) argue that recognition needs to be given to non-local interactions that occur between founders and external actors. The role of entrepreneurial actors is crucial for the growth of ecosystems because interactions among entrepreneurs positively impact the perceptions of individuals toward entrepreneurship through spillover effects like the transfer of knowledge, startup spirit, and other resources. This process is referred to as entrepreneurial recycling and can involve entrepreneurial actors who function as serial entrepreneurs, intermediaries, advisors, mentors, and board members. Relatedly, this process may foster investment in local EEs as entrepreneurs re-invest in newcomers following successful exits (Brown and Mason 2017). That said, the availability of knowledgeable entrepreneurs in an ecosystem is also linked to the presence and quality of universities and research institutions, which can raise the level of competence for entrepreneurial actors (Neck et al. 2004; Nicotra et al. 2018). Additionally, the generation of academic spin-offs is increasingly cited as a key role of local universities (e.g., Meoli et al. 2019).

Entrepreneurial resource providers facilitate the transfer of resources into growing firms by providing sources of financing, support structures, and public sector services (Brown and Mason 2017). Specifically, financial capital providers may include traditional banks, VCs, business angels, and alternative funding sources like microfinance, crowdfunding, and P2P lending (Bruton et al. 2015). As for support structures, these commonly take the form of incubation models such as business incubators and accelerators (Mian et al. 2016) that enable startups through mentoring, co-working spaces, access to networks, capital, knowledge and so on (Bøllingtoft and Ulhøi 2005). Lastly, public sector intervention in ecosystems is an important measure to combat market entry barriers such as regulation and access to capital. The creation of regional venture capital funds that facilitate business angel networks and indirect support of incubation models is a commonly employed solution (Mason 2009). Additionally, policymakers may enable entrepreneurs' practices by eliminating inhibiting policies or easing regulations (Nicotra et al. 2018).

Entrepreneurial connectors support EEs by mediating relationships, connecting entrepreneurs to ecosystem actors like investors, industry partners, and mentors. Thus, founders overcome the resource deficiencies that inhibit their access to financial and knowledge capital; accordingly, new venture creation is facilitated (Brown and Mason 2017; Sullivan and Ford 2014). Entrepreneurial connectors can also be former founders and serial entrepreneurs or organizations and programs funded by industry or the state (Brown and Mason 2017).

Entrepreneurial culture is conceptualized as norms, attitudes, and contributions regarding entrepreneurship at the societal level (Brown and Mason 2017; Isenberg 2011). The literature stresses the importance of a positive entrepreneurial culture in supporting social capital in EEs because it fosters the relationships between entrepreneurs and other ecosystem actors (Nicotra et al. 2018). These relationships attract ambitious entrepreneurs and thus lead to a higher number of startups scaling into larger firms that are either acquired or undertake an initial public offering (Brown and Mason 2017; Saxenian 1996). However, EEs can also have a culture that inhibits entrepreneurs simply because entrepreneurship is not valued or is perceived negatively by a society (Isenberg 2011).
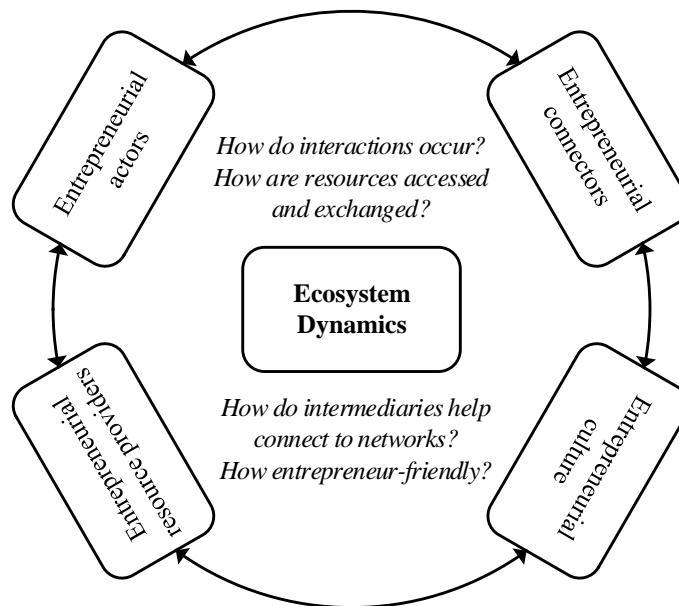
Fig. 2 Exploring ecosystem dynamics; adapted from Brown and Mason (2017)

3 Method

We rely on a qualitative research design using an exploratory-abductive approach (Dubois and Gadde 2002) to develop new explanations in the form of theoretical propositions. This approach is well suited to studying a new phenomenon with limited knowledge and to facilitate "theory development rather than theory generation" (Dubois and Gadde 2002, p. 559). An exploratory approach using in-depth interviews with multiple stakeholders has also been deemed necessary in the fintech context (e.g., Mention 2020).

3.1 Case description

We deliberately selected Singapore as our empirical case to investigate ecosystem dynamics. Singapore is a high-income, entirely urban country of more than 5.6 million people with high internet connectivity (82.1%) and per capita cell phone (1.5) rates (Medici 2019). It ranks second in the world for ease of doing business and fourth for starting a business (World Bank Group 2020) and is well-recognized as a global hub where east meets west, fostering a unique business culture (Suseno and Standing 2018). Singapore's financial market is the world's fifth most competitive financial center, according to the Global Financial Centre Index (Morris et al. 2020), and second globally in digital competitiveness in the IMD Digital Competitiveness Ranking (Bris and Cabolis 2020). Specific to fintech EEs, the Findexable Global Fintech Index ranked Singapore as third behind the United Kingdom and the United States (Findexable 2020). We further extend our case description to discuss how Singapore enjoys a commanding lead in the fintech race, creates a conducive environment for fintechs, and fosters international collaboration.

Singapore has recently emerged as a leading fintech hub, having pioneered several initiatives. First, the API Exchange (APIX) is an open-architecture platform to help FIs discover fintechs and allow FIs and fintechs to collaboratively design and run experiments. Second, the Singapore FinTech Festival (SFF), the world's largest fintech event, fosters connection and collaboration, with 60,000 attendees in 2019. Third, Sandbox Express, a support instrument to fast-track testing activities (unlike the mainstream regulatory sandbox with longer approval times; MAS 2020b). These initiatives are in addition to publicly funded grants to support business development at the national and international levels, the creation of innovation labs, and the adoption of enabling technologies (Lin 2019; MAS 2020a). On the regulatory front, MAS has also made key legislative changes to enable fintech innovations, including the Payment Services Act, which regulates payment systems and service providers like digital payment tokens (MAS 2020d).

Singapore sustains a fintech-conducive EE in two main ways. The first is creating platforms to connect fintechs to local and non-local ecosystems, each serving a specific objective. The ASEAN Financial Innovation Network is a regional initiative to help FIs and fintechs through platforms like APIX. Business sans Borders is a transnational innovation platform for small- and medium-sized enterprises. The Singapore FinTech Association is a non-profit organization that facilitates collaboration among stakeholders in the fintech ecosystem. Moreover, the FinTech Research Platform is an investment and partnership space that connects investors and FIs to fintechs (Lin 2019; MAS 2020b). The second way Singapore provides a fintech-friendly EE is by fostering cooperation with international counterparts. As of Q2 2020, MAS had signed 33 agreements to promote innovation in financial markets through information sharing, referrals and joint projects (MAS 2020c).

3.2 Sampling

This study used purposive and snowball sampling procedures to recruit interviewees and achieved triangulation by investigating the perspectives of different ecosystem actors (Patton 1990). Our selection criteria consisted of (1) being currently engaged as an entrepreneurial actor (e.g., founder, role model, serial entrepreneur), resource provider (e.g., investor, advisor, regulator, researcher), or connector (e.g., incubator manager, former founder) in the financial market industry with respect to any fintech segment, and (2) being based in Singapore. Using these criteria, a list of the best-funded fintech startups was established using CrunchBase. Support organizations, VCs, and other relevant ecosystem actors were identified through online searches, including an online talent portal available through the Singapore FinTech Association. More than 125 eligible participants were contacted through

LinkedIn; further interactions occurred with 38 participants. Ongoing interviews were then conducted upon participant agreement, and snowball sampling was used to recruit additional interviewees. Using this approach, a total of 19 interviews were conducted. The participants comprised of nine entrepreneurs, six support organization managers, three VCs, and one regulator. Most participants had multiple roles in fintech EEs (both local and non-local), including mentor, investor, and educator. Table 1 provides an overview of the participants.

Table 1 Description of participants

Participant Code[a]	Role	Age of startup/ organization	Firm type/classification	Offering/ Industry focus
Ent-1	Founder and Educator	3 years	Blockchain/Crypto	Builds business solutions powered by blockchain.
Ent-2	Founder	5 years	Cross-Border Payments	International remittance to more than 60 countries.
Ent-3	Founder	3 years	Blockchain/Crypto	Develops blockchain-powered devices for transactions.
Ent-4	Co-founder	6 years	Capital Markets	Cloud-based independent investment research network.
Ent-5	Serial Entrepreneur, Educator, Advisor	1–4 years	Asset Management	Platform provider to issue, manage, and trade tokenized securities.
Ent-6	Founder, General Secretary (association)	2 years	Insurance	Digital platform supporting the insurance cycle.
Ent-7	Former Entrepreneur, Head of Partnerships, Advisor	6 years	Payments	Provides a retail banking platform.
Ent-8	Serial Entrepreneur, Advisor	1–4 years	Blockchain/Crypto	A cryptocurrency exchange platform.
Ent-9	Co-founder, Advisor	1 year	Payments	Cross-border consumer know your customer.
EC-10	Director of Accelerator	5 years	Corporate Accelerator	Accelerator for fintechs.
EC-11	Managing Partner and Serial Entrepreneur	2 years	Accelerator	Accelerator for blockchain fintechs.
EC-12	Program Manager	5 years	Corporate Incubator and Accelerator	Support programs for fintechs.
EC-13	Manager and Co-Founder, Advisor	5 years	Accelerator	Technology accelerator.
RP-14	Co-Founder, Partner	2 years	Investor – VC	Invests in early-stage, technology-centric startups.
RP-15	Founder, Consultant	<1 year	Consultancy	Business support services for tech firms.
RP-16	CEO, Founder	2 years	Investor – VC	Cybersecurity venture capital manager.
RP-17	Co-Founder, Partner	4 years	Investor – VC	Investment in Deep Tech and AI startups.
RP-18	Executive Manager	4 years	Support Association	Supports development of the fintech industry.
RP-19	Regulator	N/A	Government Agency	Financial market.

[a] Ent: entrepreneurial actor; EC: entrepreneurial connector; RP: resource provider

3.3 Data collection and analysis

The interviews, which lasted an average of 50 minutes, were conducted remotely through Skype (8 of 19 were video calls) between January and March 2020 and followed a semi-structured format. Recorded calls were transcribed and prepared for analysis. Since different ecosystem actors participated, the interview guide was adapted to explore each participant perspective. Open-ended questions that focused on exploring participants' current and previous experiences of the ecosystem were posed to participants, including how the fintech

EE looked to them, which ecosystem actors they interact(ed) with, and how they access(ed) networks and exploit(ed) resources (Figure 1). Additionally, the interviews explored the relationships among ecosystem actors and their influence on practices like networking, financing, supporting, and connecting.

For data analysis, we combined the Gioia method, which provides a two-step process to achieve systematic data reduction (Gioia et al. 2013), with an abductive approach that keeps prior research in the frame and enables an analytical framework to guide the analysis and confront theory (Dubois and Gadde 2002). As such, a process of systematic alternation between the framework, the literature, empirical data, and the case analysis was carried out (Dubois and Gadde 2002). For the first round of coding, which resulted in 1st order concepts, we started with the preconceptions of the EE framework (Brown and Mason 2017). Thus, we began coding with a preliminary scheme to explore categories that describe the role of each actor's perspective with respect to his or her interactions with other ecosystem actors, access to networks and resources, and perceived attitudes and norms. As we progressed, additional categories emerged inductively; more patterns were then identified, and categories were distilled as presented. Hence, this round of analysis resembles a combination of data-driven and theory-driven approaches. For the second round of coding, abstract themes that describe ecosystem dynamics were created, which required shifting back and forth between the literature and analysis (Dubois and Gadde 2002). Once relationships were established and relevant concepts connected, we considered the possibility of further distilling the 2nd order themes into aggregated dimensions (Gioia et al. 2013). The NVivo 12 software package was used to facilitate the analytical procedure (Gaur and Kumar 2018).

4 Findings

In this section, we report the findings that emerged from the analysis of interview data to explore the influence of ecosystem dynamics on startups in Singapore. The findings reflect the perspective of entrepreneurial actors, resource providers, and connectors. Figure 3 outlines how the data was processed into aggregated dimensions that capture the relational and cultural perspectives.
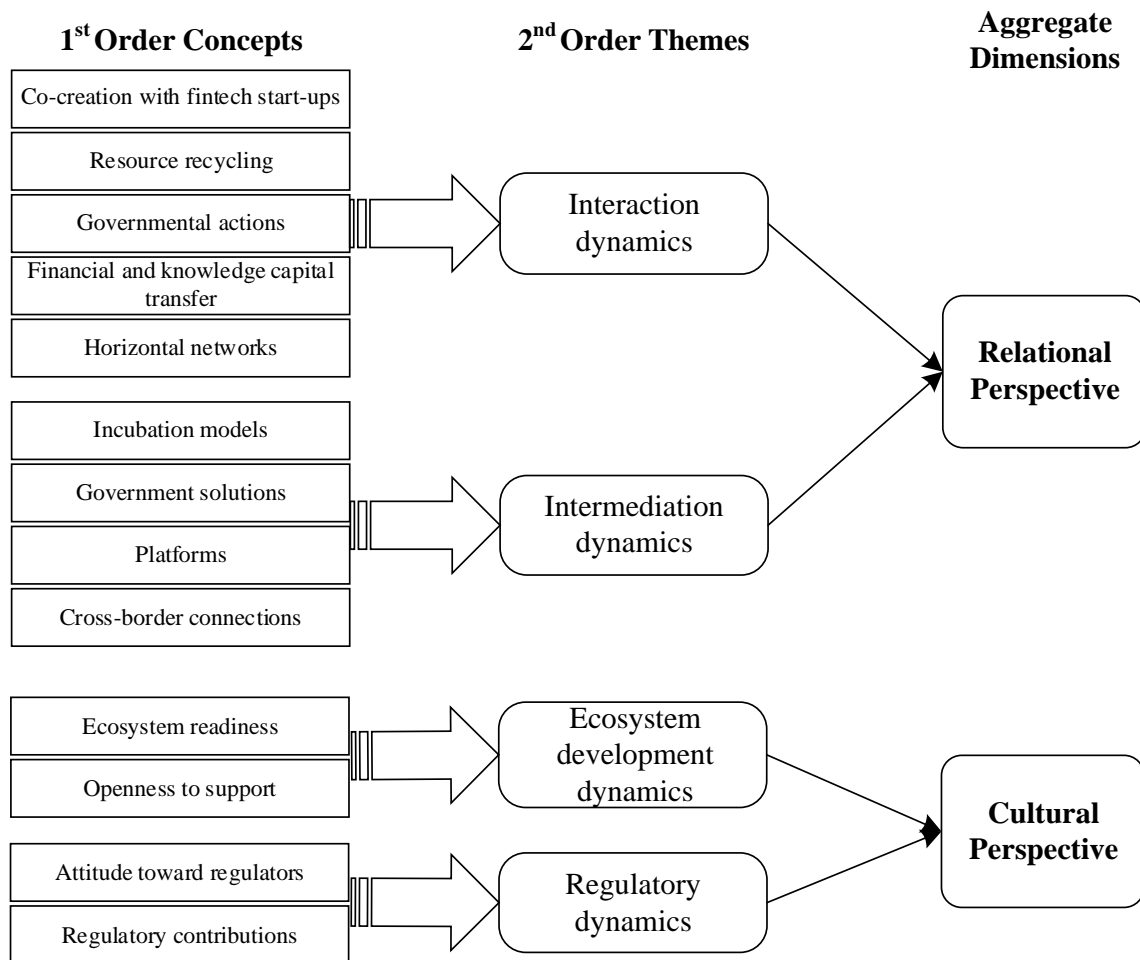
Fig. 3 Data structure, compiled by the authors

4.1 Relational perspective

4.1.1 Interaction dynamics

Our analysis of the perspectives of entrepreneurial actors captured two categories in which social interactions occur and create value in Singapore's fintech EE: (1) co-creation with fintech startups and (2) resource recycling.[5] From the perspective of all ecosystem actors, two categories captured the role of (3) governmental actions and (4) financial and knowledge capital transfer in enabling (or impeding) interaction dynamics. Additionally, an interaction pattern of (5) horizontal networks was common to all perspectives that emerged from the data.

In terms of fintech startup co-creation, the data suggests that fintechs work together through formal or informal agreements to access market data or integrate solutions from other players to provide a holistic solution. For example, one interviewee said, "they [a Hong

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[5] This is similar to entrepreneurial recycling that involves reusing of resources by entrepreneurs (Brown and Mason 2017), yet different as it is not solely exit-centric and focused on a geographical location.

Kong-based bank] wanted to build a digital bank. They selected us to be the core banking technology. Over the last two years, 43 different vendors and partners have contributed towards delivering the end product. We had to work with a payment processor provider [a UK-based fintech startup] to deliver the end state's architecture. We now have a partnership credential with that provider that we use when approaching other banks" (Ent-7). Our findings also reveal that established startups leverage other channels like local accelerators to connect with early-stage fintechs for assistance with technology utilization or development of proof of concept (PoC). Notably, the founders we interviewed had multiple roles in the ecosystem, such as mentorship in support associations or platforms. Through these engagements, entrepreneurs can benefit in different ways, including potential partnerships and access to data. Our findings revealed that fintech startups are willing to work with emerging fintechs that provide niche solutions to unregulated segments of financial markets that are growing rapidly but lack the support of resource providers and the endorsement of regulators. For example, one entrepreneur said, "we have two clients that are fintech firms setting up as private exchanges, competing with actors like the SG [Singapore] Exchange and the London Stock Exchange to facilitate active trade in unlisted startups on an exchange. Through our network of analysts, we help by providing research on unlisted companies, which also isn't easy to come across" (Ent-4).

For the second category, resource recycling, we found that fintech startups can play a central role in circulating resources within financial markets; this view surfaced with respect to banks and FIs that either integrate fintech solutions or use their efficient infrastructures. A startup interviewee reported that "one of our partnering banks uses our remittance infrastructure to improve remittance service for their bank customers" (Ent-2). Another fintech startup operating in the capital market space to provide a platform for independent research analysts shared its important ecosystem role of increasing the visibility of corporates to investors: "Through our partnership with the SG Exchange, we provide the corporates with the ability to access the platform, their listed corporates, be discovered by analysts, and get invested in by the investors. Again, there's a shared interest. And we have a commercial relationship with the SG Exchange, which recently became a small investor in us" (Ent-4). Another and even more interesting perspective emerging from the data describes the contribution of entrepreneurial actors to the regulatory change process: "What you read there [on MAS] is basically what our community is telling MAS as to how they should tackle emergent fintech issues. For example, over an 18-month period, we had discussions with MAS through workshops where we were teaching them what bitcoin and crypto are and what's happening in its underlying world. The outcome of these discussions was the Payment

Services Act" (Ent-8). In terms of talent, we also found evidence indicating that smaller fintech startups face difficulty in retaining talent. One interviewee said, "when banks want to get their latest payments app built, they engage consulting firms like Accenture that will then go to win that contract by telling the bank that they've got many people with FinTech experience; they get those people by tearing out developers working in a fintech. The fintech sector is relatively young; that makes the ecosystem less capable of retaining [talent]" (Ent-4).

Further, our analysis revealed the role of governmental actions in supporting fintech innovators. A common view among interviewees was the leading role played by MAS in providing this support through active engagement with the fintech community. One entrepreneur said, "I discussed with MAS the possibility of running a thought leadership series on moving core banking onto the cloud, and they're willing to facilitate a roundtable to have participants from the industry come together to discuss this" (Ent-7). Looking more closely at these engagements, another interviewee expressed the time-intensive nature of pursuing regulatory clarification: "The senior executives at MAS are very interested in what we're doing, looking to push us forward and drive new ideas, but the reality of dealing with the regulators has been somewhat more step by step in nature, meeting different teams and departments within the regulatory authority" (Ent-6). We also found that regulators leverage other channels to engage with fintech startups; one of the interviewed incubator managers said that "MAS would connect with startups through incubators like ours; during the program phase, they would organize and attend different sessions, providing information on the offered infrastructure solutions or covering aspects like how to access regulatory sandboxes" (EC-12). Our findings also revealed the role of other governmental authorities in addition to MAS, as one interviewee noted: "A year after inception we started exploring development grants. We connected with Enterprise Singapore and received a grant from them for innovation and R&D. The agency also connected us with potential clients" (Ent-1).

For the fourth category, financial and knowledge capital transfer, the data provides insights into the role of VCs, business angels, and mentors. Some of the startups we interviewed shared their experiences in fundraising before fintech gained the attention of VCs. One entrepreneur said, "as we were trying to run a new kind of network in the capital market space in 2014, there wasn't a lot of early-stage formalized VCs; business angels were the only ones present to back us with some equity funding. Then, within a year, we were able to start to tap into those early-stage VCs, and that ecosystem started to kick off. It's firms like Wavemaker and Jungle Ventures who have backed us" (Ent-4). Another recurring view surfaced from incubation model actors with respect to connecting startups to VCs: "We have

to be very convinced about the startup itself before we take it in or connect it to our own network in terms of funding possibilities. If we take the startup to a selected VC, they expect us to have done the required due diligence, that we're convinced the startup has all the ingredients for possible success" (EC-13). A similar perspective was shared by one of the interviewed VCs, illuminating the interaction dynamics at the evaluation stage: "The due diligence process takes a bit longer because we want to ensure that we feel comfortable with the people establishing the startups; we want to spend some time to see how they behave, to know what their values are, and to learn whether their values are aligned with ours. How emotionally resilient are they? Do we think they've got the skills to be a successful CEO? And so on" (RP-16). From a mentoring perspective, many interviewees felt that VCs play a major role in providing active non-financial support by giving startups access effectively for free to their in-house expertise. At a strategic level, it was reported that VCs provide industry-specific knowledge, assist with go-to-market strategies, and help startups identify potential pitfalls in their value propositions. That said, startups may also access knowledge capital through traditional mentors that are commonly provided as part of an incubation model program or through support associations and platforms. One incubator manager said, "mentors enrich our capabilities and support offering; those are the experts that we don't have internally. For example, we don't have an investment banker as part of the core team, so this is something we can tap into through mentors. We reach out to our mentor networks that can then really give startups honest feedback and field insights on a voluntary basis; we don't have any paid partnerships with mentors" (EC-12).

For the fifth category, horizontal networks, our evidence uncovered how ecosystem actors interact through a variety of events and channels. All interviewees applauded the efforts of the government and MAS in making Singapore's financial market a global networking hub, with the SFF cited as an inclusive arena for connecting key stakeholders. Although this may be true, our interviewees also indicated the presence of abundant amateur actors and scammers in the ecosystem. In addition to the SFF, some interviewees reported that hackathons were a good avenue to meet VCs, accelerators, and like-minded entrepreneurs, while others said they connected with non-local clients through events held outside Singapore. One interviewee said, "I started building the InsurTech community here in Singapore and, with a few other people, founded and ran some of the earlier conferences in 2016 and 2017. I am also the founder and general secretary of an insurance association that has around 2,000 insurance buyers across Asia. Through that, I'm well networked into the community of insurers, brokers, and other technology firms" (Ent-6). As to virtual networking platforms, the common view of LinkedIn among entrepreneurs was captured by

one founder: "LinkedIn is essentially my CRM [customer relationship management] system and one of my key tools for building my network. I currently have more than 10,000 global contacts that have been built up over my entire career, all of which would be financial services folks. If I need to reach out to a company, I'll search the name of the company and there's a very good chance that I already know someone at the management level, either directly or one degree away, which allows me to have the right conversations with the right people" (Ent-7). As evidence of how entrepreneurs leverage multiple roles in the ecosystem, another interviewee had the advantage of accessing clients and achieving credibility through affiliation with a fintech network: "AFTA [Asia Fintech Angels] provide me with opportunities to meet vetted fintechs, which helps me cut through the noise and work out who I should be talking with to provide my services" (RP-15). We also found evidence indicating that a VC firm mobilizes its mentoring position and co-location in an entrepreneurial hub to select investees, giving it the opportunity to interact closely with startups and determine whether there is something unique that can be scaled up. This happens by first observing the startups at an early stage, while being screened to access an accelerator program, and then interacting with them as mentors throughout acceleration that spans across three months.

4.1.2 Intermediation dynamics

As for mediating access to networks and critical resources, three categories emerged from the analyzed data describing the role of a selected actor or channel in connecting entrepreneurs within local ecosystems. These include (1) incubation models, (2) government solutions, and (3) platforms. Another prominent category revealed how (4) cross-border connections mediate access to non-local ecosystems.

For the first category, our findings showed that incubation models like business incubators and accelerators play an intermediary role among ecosystem actors and fintech entrepreneurs. Thus, directly connecting tenants to ecosystem actors, hosting networking events, or working with VCs that look for startups with a particular profile. A common view highlighted by incubation model actors was their ability to make the right connections, which saves entrepreneurs valuable time. One accelerator manager said, "being able to connect our tenants with the right person provides massive support, because nobody wants to take time off their busy schedule to find out who the right person is. We have corporate advisors working directly with startups to help with integration, because many corporates could be using legacy systems, providing technical support and industry insights. This saves a lot of trial and error for startups" (EC-11). The same interviewee was asked to provide an example

of a use case reflecting this intermediary role: "We introduced one of our tenants to the government technical house GovTech, which helped solve bottlenecks in the technical process. Through our corporate networks, we have also connected that startup with multiple corporates, resulting in a six-digit deal. We also helped them raise $4–5 million by introducing them to our network of VCs" (EC-11). Hackathons emerged again as a networking mechanism, this time from the incubator perspective: "Our corporates demand hackathons because they give greater visibility to individuals or fintech startups unfamiliar to banks; they are a great way to recruit for the corporates" (EC-12). We also found, from the perspective of VCs, strong relations with incubation models to drive the top of the VC deal flow funnel, as one interviewee said: "We have built our own global networks of accelerators. We review many entrepreneurs from them and, when we like a very early-stage technology startup, we initiate direct discussions. And we now find it easy to do it without being present in that geography" (RP-17). Notably, this finding differs from our previously presented evidence showing how VCs benefit from their local presence in entrepreneurial hubs to interact with potential investees by highlighting how non-local ecosystem dynamics also allow VCs to exploit incubation model networks to find investees.

As to government-led solutions, the data revealed the intermediary role played by MAS, GovTech, and Enterprise Singapore in the fintech EE. One of the MAS infrastructure solutions, APIX, was mentioned by several interviewees, with two divergent discourses emerging. The first expressed the importance of this solution: "APIX helps FIs and startups to connect. It solves the problem of the long PoC process and asymmetric information that a startup faces when engaging with FIs" (RP-18). Although this may be true for some actors, a second view reflected reservations about APIX, as one entrepreneur put it: "I don't think that signing up to it [APIX] is incredibly valuable because the ecosystem is small right now. And what this platform solves is essentially a discoverability issue. It's not difficult to find companies now because of digital networks. Another issue is the quality ranking of application programming interfaces (APIs); it's kind of arbitrary and opaque" (Ent-7). Our findings also revealed the common use of MyInfo, a GovTech data sharing service that simplifies the onboarding of new users. One interviewee said, "we were one of the early adopters of MyInfo, which allows individuals to easily do cross-border payments as part of our KYC [know-your-customer] process; once they log in, they can authorize the disclosure of their personal information to us" (Ent-2). The intermediary role of another agency, Enterprise Singapore, the startup support arm of the government, also became clear. According to one encounter related by an entrepreneur, Enterprise Singapore connected his

startup to local hospitals and healthcare providers and directed it to access public funding opportunities.

Our evidence revealed the emergence of platforms as a third category that enables intermediation. Two main perspectives were expressed: the role of APIs as technology intermediary platforms and support organizations that provide a platform for networking. The proliferation of API technology arose in discussions of intermediary solutions, as one entrepreneur put it: "Previously, banks were one-stop shops providing various financial services through a special infrastructure including their own processors, data lakes, and servers. However, with the advent of API technology—which we call an un-bundling of the banks—what is now happening is the re-bundling of the banks through APIs; this way, we plug into a bank's system to extract or access data through real-time algorithms. This can be achieved without having to build new infrastructures" (Ent-7). While the APIX platform presented in the above concept rests on the application of API technology to facilitate interaction among fintechs and FIs, it is also distinct by being a cross-border, government-led solution. Moreover, our findings show evidence of support associations acting as platform leaders, facilitating collaboration among entrepreneurs and ecosystem resource providers through a variety of solutions that includes providing access to VC databases exclusive to its members. One manager said, "we have a non-public database of 150 VCs based in Singapore; we segregate them by preferred startup stage for investment to perform good matching" (RP-18). Some interviewees even shared positive experiences in co-working spaces, which could be a conducive platform for networking and resource sharing. While these platforms may have enabled most fintech segments, our findings revealed that other types such as cryptocurrencies have not benefited from advantages like access to finance because they operated in an unregulated environment. Relatedly, one of the entrepreneurs indicated that the advent of ICOs as an alternative finance source changed this situation, giving crypto fintechs the opportunity to access capital while bypassing traditional intermediaries like VCs, support organizations, and FIs.

The fourth category, cross-border connections, reflects the mediating role of actors like VCs, Enterprise Singapore, and incubation models in connecting entrepreneurs to global networks. The most common view emerging from the data was that VCs play a substantial role in helping startups access networks and resources in other parts of the world, a theme expressed by both entrepreneurs and incubation model actors. For example, one entrepreneur said, "we are backed by Vertex Venture and Fullerton Financial holdings, who are well connected with the Ministry of Finance in Malaysia; they helped us access the regulatory jurisdiction by expediting the financial license application since we were one of the earliest

cross-border payment fintechs" (Ent-2). The same founder also said that they were currently seeking VCs in Latin America to access regulatory and incumbent networks in that region. The government agency Enterprise Singapore was also commonly discussed among fintechs, with one entrepreneur noting that "we were able to obtain support from them [Enterprise Singapore], not just in the form of grants, but in the form of having physical people on the ground across the world, who guided us in terms of accounting access, legal support, office space; their support was there for us at a very early startup stage" (Ent-4). Another government initiative that arose was the SFF event, which serves as a channel to connect with non-local ecosystem networks like VCs and potential partners. We also found evidence indicating that incubation models leverage their global presence to provide local entrepreneurs with access to foreign networks. Along these lines, one VC shared his experience of using external networks to scout for investment projects: "There are two parts to this relationship: first, we access academics from the University of Waikato, University of Queensland, and La Trobe University for their cybersecurity expertise, to help us with technical due diligence. Second, 10% of our fund is allocated toward commercialization projects with university researchers who might be onto a good idea, which we identify through this relationship" (RP-16).

4.2 Cultural perspective

4.2.1 Ecosystem development dynamics

Two categories emerged from the cultural perspective: (1) ecosystem readiness and (2) openness to support.

For the first category, the empirical findings revealed two recurring views related to the preparedness of ecosystem actors. One perspective that emerged from entrepreneurs reflected the stage of fintech in retrospect, as one participant put it: "Early-stage conferences in 2014 and 2015 were very conceptual. There was a lot of talk on AI [artificial intelligence] with little to no action; nobody knew what we mean by this, what specific solution this is, what problem this is solving, and who the customers are. Fast forward to today; everyone feels a lot more confident that they could see where and how the innovation needs to happen and why it's going to win or lose" (Ent-4). On the cryptocurrencies and blockchain side, it was reported that before 2017 only a few participants attended events and conferences; however, with rising bitcoin prices, that all changed. The presence of entrepreneurial role models as early drivers of the cryptocurrency and blockchain ecosystem is notable in this setting. Our findings indicate that only a handful of individuals were active in this segment prior to 2017, hosting workshops and conferences; one of these individuals is the founder

and managing director of the cryptocurrency association in Singapore that has growing global importance. Further, we found evidence indicating that entrepreneurs played an important role in educating ecosystem actors including VCs, who at earlier stages were less convinced about the need for disruption, the identified problems and solutions, market size, and so on. This required layer of education was reported to be more crucial for fintechs operating in segments outside the digital payment space. Regarding this issue, one VC said, "many of the VC providers lack the necessary expertise in the cyber area to do a sufficiently thorough due diligence of the opportunities. They tend to be conservative and stay away. That's a big factor in why there hasn't been as much money flowing into cybersecurity startups" (RP-16). Beyond the problem of a potential lack of knowledge, another VC pointed out the issue of poor exit rates for over US$100 million in Singapore in comparison to established ecosystems like London or New York. According to the VC, not exiting at that threshold will make it difficult to justify an investment from an economic point of view. The second view, interestingly, draws on the experience of a non-local incubator who accessed the fintech ecosystem in Singapore to find that actual readiness deviates from external perceptions: "Before we decided to come to Singapore, we'd done our research and had built our network; Singapore looked more mature on the outside, but we soon learned that their digital infrastructure and mindset is not ready. Even though everybody speaks about fintech and they seem to know what they're talking about, as soon as we have more in-depth discussions, we realize no, they are not at a point where we can apply our own model that we've created in Switzerland. A lot of the banks that we've encountered here still believe that they can pull it off on their own. If they have an innovation lab, they think that's enough. The banks here have this very internal focus, which stops them from seeing the challenges that they are facing. Even when collaborating with startups, it's on a very ad hoc basis and with an unstructured process" (EC-12). Importantly, this finding contrasts with the retrieved evidence from locally established incubation models who did not disclose similar concerns about the technical or cultural readiness of FIs.

As for the second category, openness to support emerged from our data to indicate a vibrant scene with ecosystem actors open to connecting and sharing their experiences. These views arose in different perspectives, including VCs and support organizations. For example, one VC said, "on a voluntary basis we would help very early-stage startups; for instance, we provided a female founder of a technology business with mentorship: just acting as professional coaches, bouncing ideas back and forth, suggesting ways to go about things" (RP-16). Another aspect that was mentioned is the presence of government-backed organizations like SG Innovate that organize talks that are free of charge. Even from the

perspective of entrepreneurial actors, we found evidence that may indicate an openness to engage: "In our view, everything is interconnected, and the solution has to be holistic, and you're not going to get that on your own. We engage our solution with many other players, whether they're disruptors or those that are to be disrupted" (Ent-4). That said, our findings also indicated banks' reluctance to collaborate with fintechs, though this view varies from country to another. For example, one of the cross-border payment firms still face resistance from incumbents: "Some banks think that by supporting fintech its putting risk on their whole operations and on their compliance; we do come across banking or FI partners that would suddenly cease operations" (Ent-2). Relatedly, we found that some fintech segments like cryptocurrency providers are unable to access normal banking services. One of the interviewees operating this type of fintech said, "it's impossible to open a bank account to cover the normal operation of a business because banks are still being threatened by cryptocurrency projects" (Ent-8). Moreover, our findings revealed a support orientation favoring business-to-business (B2B) fintechs, from the perspective of both support organizations and VCs. One interviewee said, "we prefer B2B fintechs because these founders would usually have worked in a FI, have identified a particular problem area and have the deep domain knowledge that's required to successfully navigate the entire market" (EC-10). One VC added, "we find it easier to define the conditions for success in B2B providers because they tend not to be a winner-take-all approach" (RP-17). Along the lines of providing advantages to selected fintech businesses, our findings also reveal differential willingness to support fintechs practicing regulatory arbitrage, non-employment of local talent, or compliance with other policies, all of which limit opportunities to access local ecosystem resources. These findings are elaborated in our discussion of regulatory dynamics.

4.2.2 Regulatory dynamics

As to regulatory dynamics, our findings fell into two categories, predominantly capturing entrepreneurial actors' perspectives: (1) attitude toward regulators and (2) regulatory contributions.

For the first category, our empirical evidence revealed views about regulators that emerged largely from foreign entrepreneurs based in Singapore, one of whom said, "I am convinced that every fintech will say the same thing: the less interaction you have with the regulator, the better. It is unlikely they understand exactly what it is you're doing. Startups are likely to be faced with a whole bunch of regulation, interpretation, and case law based on businesses that have existed a long time before theirs did and based on an ecosystem which looked completely different. For example, the ease of dissemination of information globally

via a platform like ours is not addressed in most financial regulation" (Ent-4). The absence of uniformity between regulators was a consistent pattern; these views concur with the highlighted evidence on the role of governmental actions in supporting fintech innovators, though from the relational perspective. For example, there is misalignment between the C-level executives who strongly advocate for fintech and the other regulatory officers with whom startups will interact with once they approach MAS: "[The officers] don't care about any of that stuff that those 20 people talk about. They've got a lot of paperwork to fill in, rules and regulations to follow, putting you in the wrong boxes, trying to make you apply for different things" (Ent-4). Talking about the same issue, another interviewee said, "it took me 15 months to get into the regulatory sandbox. It was still a time-consuming process, and I know the senior management at MAS would like to make that faster" (Ent-6). Another important point is that certain areas are more regulated than others, which may create prohibitively high hurdles, as one interviewee put it: "If you move into areas like wealth or asset management, it becomes very expensive: one thing is paying the license fee, but you also need to have two employees who are Singaporean with at least five years of experience" (Ent-5). The same entrepreneur added that fundraising in these areas is difficult, as investors would normally want to see at least some revenues generated prior to making any investments, and it is impossible to generate revenues without a license. When asked about how to overcome regulatory barriers, entrepreneurs emphasized a pragmatic approach to dodge regulators, including the creation of safe regulatory covers and careful selection of the regulatory jurisdiction in which to operate. For example, one entrepreneur said, "we try to do international arbitrage; getting an asset management license in Switzerland is much easier than in Singapore, despite the fact that we are sitting here" (Ent-5). More interestingly, our findings indicate that foreigners establishing a business need to have an inside director who is a Singaporean citizen or permanent resident: "If you found a startup company and you tried to do it bootstrapped, you will not be able to get a work permit for yourself; this can be a showstopper for incorporating in Singapore. That's why we incorporated it in London. Now, we are looking to enter an accelerator program to be in a better position to raise capital; however, we may not qualify as we are not incorporated here" (Ent-5). Another possible implication of this issue emerged from a VC: "We've not been able to access any of the support offered by the development arm for fund managers because we're not Singaporean enough, even though we are incorporated here, which makes us ineligible for many other support programs" (RP-16).

As for the second category, regulatory contributions were found to have a positive impact on a culture conducive to entrepreneurial actors and the fintech EE more broadly. The

regulator said that MAS, unlike other regulatory authorities, has a market development objective and thus has a dual role focused on both regulation and innovation. Recent contributions such as the Payments Service Act surfaced among interviewees operating in the cryptocurrency space, as highlighted under resource recycling in regard to entrepreneur–regulator collaboration during this process of regulatory change. This finding, however, indicates how such regulatory intervention is perceived by entrepreneurial actors; one entrepreneur said that "the new act is a big leap forward because new regulatory frameworks state what you can do under which circumstances" (Ent-5). Another recurring contribution was the regulatory sandbox; a primary benefit of this mechanism was allowing participants to waive a large investment in financial licenses until the end of their exemption periods (if they opt to proceed). One VC told us that "the sandbox provides a safe harbor to launch and allows us to de-risk some of the more innovative financial products and be able to launch them without necessarily fearing that the regulator will wake up one day and pull the plug" (RP-14). Relatedly, one of the entrepreneurs criticized the role of regulatory sandboxes in driving innovation, stating that regulators spontaneously launched sandboxes overlooking how they should operate: "I don't think they did it well enough. But then, I wouldn't expect a regulator to do that, because regulators aren't innovators. They're policy people" (Ent-7). That said, we found evidence of supportive top-level regulators demonstrating commitment to improving financial markets by confronting incumbents. One entrepreneur said, "a MAS fintech officer recently posted, 'No more PoC for free,' which reflects what startups very often have to deal with when engaging with banks" (Ent-5).

5 Discussion and Implications

In addition to the findings presented above, we discuss a few important observations from which our theoretical propositions are derived; we then devote a section to present the main barriers ecosystem actors face, followed by the implications of this study.

Given that fintech is an emerging phenomenon, some unregulated segments like blockchain and cryptocurrencies face unequal acceptance from ecosystem actors like banks, VCs, and regulators. Under these ecosystem conditions, our empirical evidence indicates that these institutional voids give rise to the formation of a new ecosystem spearheaded by entrepreneurial role models. In turn, this enables novel fintech segments to grow, as indicated by one of the interviewed early affiliates in the blockchain and cryptocurrency community. In line with the previous EE literature (e.g., Goswami et al. 2018; Kuratko et al. 2017), it may be deduced that the entrepreneurial commitment of earlier fintech affiliates creates value in EEs. Such value creation not only constitute of helping newcomers to access existing

resources but also and more importantly by acting as catalysts to establish the key building blocks of an ecosystem. This may include a support association that provides mentorship and acts as an intermediary between ecosystem actors like regulators and FIs. Thus, allowing fintech entrants to exploit opportunities and contribute to system-level outcomes such as business model innovations (Autio et al. 2018; Cao and Shi 2020). We can further postulate that the presence of institutional voids causes early entrepreneurial affiliates in novel fintech segments to create a support ecosystem, thus accelerating entrepreneurial identification and exploitation of opportunities in fintech EEs. We therefore suggest that

P1: Institutional voids precipitate first-comer members to create supportive ecosystems, facilitating efficient access to and exploitation of resources for forth comer startups.

Another important observation is that entrepreneurs play a central role in shaping future fintech regulations through their interactions with regulators. For example, the Payment Services Act was reported to have been co-created with entrepreneurial actors. While we recognize that the important role of the government in Singapore's fintech EE goes beyond traditional support like financing R&D and controlling market demand (Doblinger et al. 2019), our findings lead us to postulate the existence of a relational rather than a hierarchical governance model (see Colombelli et al. 2019 for an overview). As such, entrepreneurs drive the interaction dynamics of collaboration. This view is also supported by the presence of different social clusters contingent on the fintech segment, with a specialized support infrastructure built around them. For example, we found that blockchain and cryptocurrency startups have support associations and incubation models offering specialized services, which confirms the fundamental feature of EEs as smaller ecosystems located inside larger ones (Brown and Mason 2017). While this finding is well supported in the literature, our study confirms the presence of nested geographies in digitalized industries. Our findings further demonstrate the hierarchical governance of the government through MAS, this time in regard to intermediary solutions; it functions as a centralized infrastructure solution provider to govern the intermediary dynamics of collaboration[6] between fintechs and incumbents. While this may be expected, given the fundamental role of regulators in securing financial markets against systemic risks, our findings suggest that MAS has incentivized banks and FIs to open their own innovation labs in the past two years. Resultantly, indicating that almost all banks in Singapore now have their own labs. Similarly, intermediary platforms like APIX were established to promote collaboration among incumbents and newcomers. These efforts represent the dual role of this regulator, which is focused on both regulation

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[6] That is, presence of explicit patterns of authority to regulate and manage.

and innovation. However, this orientation may disfavor business-to-consumer (B2C) fintechs in the EE and thus weaken competition in financial markets, which is currently an unexplored topic in the literature; recent contributions have focused on collaboration among—rather than competition between—banks and fintechs (Hornuf et al. 2020). Based on the above discussion, we suggest the following propositions

P2a: Entrepreneurs drive the interaction dynamics of collaboration in fintech EEs, contributing positively to the co-creation of fintech-friendly regulations and support infrastructures.

P2b: The dual role of the regulator ensures the governance of intermediary dynamics between ecosystem actors, affecting the development of fintech innovations.

Another heavily debated aspect of EE research is spatial boundedness; common explanations of EEs propose the need for close geographic proximity with ecosystem actors to foster localized interactions and knowledge flow (Brown and Mason 2017). However, digitalization has been argued to reduce such spatial contingencies (Autio et al. 2018). Our findings confirm that founders are able to access new markets and opportunities remotely, though this is often found to be facilitated by intermediaries like VCs and government agencies or platforms like APIs. Similarly, our findings reveal that VCs not only play the role of financial and knowledge capital providers but also mediate access to non-local networks, including regulatory authorities. In so doing, they may help fintechs overcome a primary cause of failure by successfully deploying their solutions beyond national boundaries (Mention 2020). This latter function of VCs is merely explored in the existing management literature (Clayton et al. 2018) and merits much more detailed study. Notably, our findings also indicate that VCs discover potential investees without having to be present in the same geography, thanks to digitalization and connectedness to local actors like incubators and accelerators. On this basis, it may be deduced that

P3: Digitalization and the presence of localized intermediary actors positively affect entrepreneurial actors' accessibility to non-local ecosystems, which drives opportunity exploitation.

Moreover, foreign entrepreneurs residing in Singapore shared their view of regulators, emphasizing a bureaucratic and entrepreneurial-unfriendly system, due to factors like unfavorable labor market regulations and fear of incurring high compliance costs, which may drive entrepreneurs to other jurisdictions. Such regulatory arbitrage emerged from our evidence and is consistent with the literature (Cumming and Schwienbacher 2018). These findings may also be associated with studies indicating that jurisdictions with stronger

regulatory enforcement have lower VC investments in fintechs (e.g., Cumming and Schwienbacher 2018). While our findings cannot confirm a relationship between investment levels and regulatory enforcement in Singapore, they do indicate another reason for lower investments; namely, the lack of VCs' technical and industry knowledge. As a result, VCs ability to conduct appropriate due diligence is affected, especially in novel fintech segments. This perspective may contradict earlier findings in the literature that acknowledge VCs for their investment decision-making abilities (e.g., Nahata 2008). However, a closer look at the literature (e.g., Cumming and Schwienbacher 2018) reveals that VCs operating in smaller financial centers with fewer exit opportunities are more likely to be inexperienced and as such may not be capable of conducting rigorous due diligence. We argue that this is not necessarily the case for Singapore, given its strong fintech presence.[7] Other possible explanations are the existence of immature VCs during boom periods (Cumming and Schwienbacher 2018); however, this would explain higher investment rates rather than the contrary. Nevertheless, it is still unclear why VCs may lack the required knowledge to perform due diligence and then invest in novel fintech segments; this is a promising avenue for future research. More importantly, our findings also indicated the role of the fintech EE in moderating VCs' possible lack of critical knowledge. Specifically, we found evidence of how a VC firm mobilizes their mentoring position and co-location in an accelerator to interact with potential investment candidates over a longer period of time to assess the characteristics and features of the entrepreneurial team, along with the solution. In this regard, the same VC also reported utilizing multiple non-local ecosystem university institutions to conduct technical due diligence. We therefore suggest that

P4: VCs' lack of industry and technical knowledge of novel fintech segments can be compensated for through co-location to enable interaction with potential investees and collaboration with ecosystem actors to assist with due diligence.

In our proposed model of fintech EEs[8] (Figure 4), we illustrate the interplay between ecosystem actors—entrepreneurial actors, resource providers, and connectors—and the identified types of dynamics—interaction, intermediation, ecosystem development, and regulatory—through the theoretical propositions depicted. For example, the arrow marked

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[7] According to Startup Genome (2019), Singapore had a FinTech exit value growth of 127.7%, compared with a global average of 90.6% between 2013–2014 and 2017–2018.

[8] This model extends Brown and Mason's (2017) framework by unpacking the underlying dynamics specific to fintech EEs. Since entrepreneurial culture was found to be a common attribute, it is distinctively categorized from the other ecosystem actors and positioned as an aggregate dimension encompassing ecosystem development and regulatory dynamics. Also note that the relational and cultural perspectives are positioned as illustrated following the order of the presented findings.

P1 in Figure 4 denotes the influence of entrepreneurial fintech affiliates on ecosystem development dynamics; the other propositions are indicated by the other arrows.
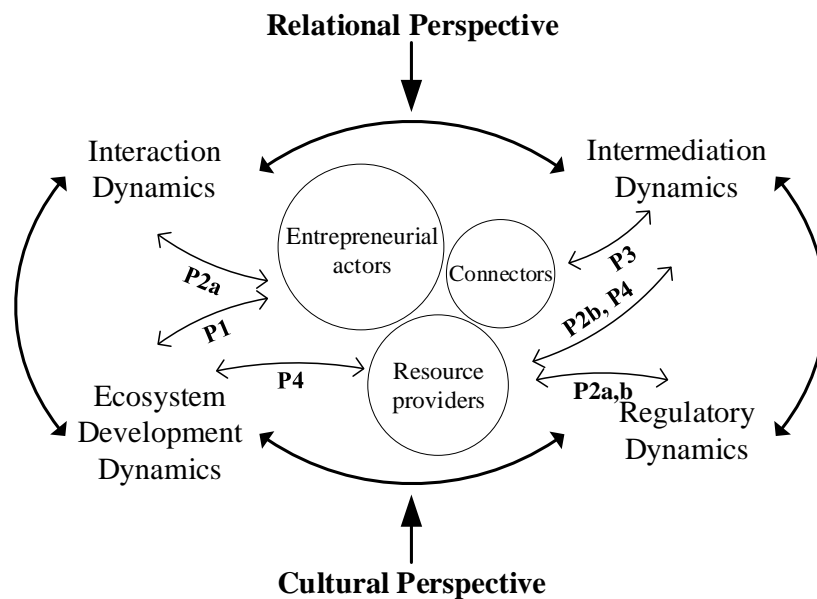

Fig. 4 A model of ecosystem dynamics in fintech EEs

5.1 Obstacles within the fintech EE

We devote this section to discussing the obstacles that ecosystem actors face and how these may challenge the efforts of supporting new ventures in fintech EEs. Starting with the regulatory barriers that constituted an important part of our findings, we found that cumbersome regulatory processes could impede fintechs from gaining swift access to regulator-led support instruments like regulatory sandboxes and receiving regulatory clarification. These barriers may cause fintechs to lose first-mover advantages, become visible on the monitoring radar of regulators, or even be compelled to apply for a financial license. They may not only affect fintech newcomers but may also have negative repercussions on other market participants. For instance, VCs could be less willing to invest in fintechs as they are not capable of generating revenue or executing a PoC prior to obtaining a financial license. While this is understandable from an investor's point of view, it may be fatal for fintechs because a financial license is a regulatory prerequisite for operating in the market. One may argue then that fintech firms can attempt to access regulatory sandboxes or cooperate with a financial license holder like a FI to comply with these requirements, which is certainly plausible. However, those who are not able to access support instruments or collaborate with FIs because they operate in unregulated environments may find themselves in a paradoxical situation. Our findings revealed that fintech market participants overcome such regulatory challenges by following the motto "keep one's distance from regulators" and practicing regulatory arbitrage. As for capital-raising constraints, our findings showed that

novel fintech segments are using alternative funding approaches like ICOs or (equity-based) crowdfunding platforms to access critical capital. Other obstacles included retention of talent and presence of amateur actors and scammers in the fintech ecosystem, both of which may send negative signals to ecosystem actors indicating prematurity and longer time to market. Resultantly, making fintechs less attractive for supportive regulatory intervention, VC investment, or cooperation with FIs.

5.2 Theoretical implications

Our study has important implications for theory. We contribute to the literature by (1) facilitating the theorization of ecosystem dynamics and its influence on startups through theoretical propositions, (2) linking EEs to fintech research, and (3) promoting the use of theoretically grounded approaches when investigating EEs. Thus, we add to the growing debate in the EE research stream (Audretsch et al. 2018; Brown and Mason 2017; Ghio et al. 2019; Motoyama and Knowlton 2017; Spigel 2017) and on fintechs (Gazel and Schwienbacher 2020; Hornuf et al. 2020; Svensson et al. 2019).

While we acknowledge that our theoretical propositions are derived from idiosyncratic, single case findings of a unique jurisdictional and institutional context, we argue that common elements may be transferable, with appropriate caution, to other empirical contexts and theoretical domains. Characterized by digital and spatial affordances (Autio et al. 2018), the case of fintech EEs is particularly suited to explain how digitally enabled EEs overcome spatial barriers. For example, our findings reveal how alternative financing sources like ICOs assist blockchain and cryptocurrency fintech startups in accessing capital that is otherwise difficult to access due to the identified EE contingencies. Relatedly, digital technologies like APIs were found to have a central role in alleviating intermediation-related constraints. Other ecosystem actors like support organizations were also found to have a prominent role in connecting non-local VCs to promising candidates, which broadens funding possibilities for entrepreneurial ventures. Taken together, these findings may contribute to research investigating how other ecosystems with digital and spatial characteristics allow startups to benefit from the exploitation of entrepreneurial opportunities that occur beyond local ecosystems (Cavallo et al. 2018; Nambisan et al. 2019). Relatedly, these findings contribute to other literature streams, including entrepreneurial finance, that investigate alternative funding approaches like ICOs and equity-based crowdfunding (Block et al. 2018; Hornuf and Schwienbacher 2017; Vismara 2016) by explaining how underlying ecosystem mechanisms such as regulatory and intermediary constraints precipitate unregulated fintech segments to seek alternative financing sources.

This study also provides insightful lessons for scholars looking to investigate other fintech contexts in which regulatory contributions are critical to facilitate the creation and scaling of new ventures. That said, the role of regulators may vary greatly depending on the regulatory mandates adopted in each jurisdiction, as these may determine whether regulators have a market development objective to support innovation or simply a regulatory mandate to monitor market participants. In Singapore, despite regulators' having the dual objective of regulating and supporting innovation, we found several barriers to innovation that lead ecosystem actors to adopt alternative approaches, such as international arbitrage, avoidance of regulators, and capital raising through ICOs. Relatedly, we found evidence indicating a support orientation favoring B2B fintech segments given the identified government support to FIs and establishment of digital platforms like APIX to enable cooperation. While not undermining the crucial role of regulators, these observations indicate that transferability to other fintech contexts with either a regulatory mandate or a dual role is uncertain and must be carefully investigated in future scholarship.

5.3 Implications for practice

For practitioners, this study is significant for a variety of ecosystem actors, including founders, investors, incubation model managers, regulators, and policymakers. For example, we inform entrepreneurs about using intermediaries to access financial and knowledge capital, which can enable opportunity discovery and resource acquisition in both local and non-local ecosystems. Entrepreneurs can also benefit from the pragmatic measures that entrepreneurial actors in certain fintech segments have employed to circumvent regulatory barriers or access capital from alternative funding sources. As for policymakers, our study provides a starting point for potential improvements in regulatory and incentive policies to promote a conducive environment for fintech and ensure more balanced resource allocation to support ecosystem actors. The high cost associated with financial licenses may inhibit fintech startups' access to critical VC capital and drive newcomers to other jurisdictions. In addition, policymakers may want to reconsider existing support orientation policies favoring B2B fintech firms to promote more market competition.

6 Conclusion

The EE approach has recently emerged to investigate the influence of a geographically bounded context on entrepreneurial activity (Colombelli et al. 2019). Despite the extant literature providing certain contributions regarding the driving forces behind successful EEs (Cao and Shi 2020; Ghio et al. 2019; Spigel 2017), there is still little empirical evidence on ecosystem dynamics. Additionally, with digitalization affecting almost every industry,

opportunity recognition and resource acquisition may change (Autio et al. 2018); it is thus important to investigate how these changes impact newcomers. Our study aimed to fill this gap by exploring the influence of ecosystem dynamics on new ventures in the financial industry, guided by an EE framework (Brown and Mason 2017). Through this investigation, four distinctive categories emerged: interaction and intermediation dynamics from the relational perspective and ecosystem development and regulatory dynamics from the cultural perspective. Taken together, these dynamics explain how entrepreneurial opportunity identification and resource exploitation can be either accelerated or inhibited in fintech EEs.

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Paper C

Published in Technovation

Exploring a New Incubation Model for FinTechs: Regulatory Sandboxes

Ahmad Alaassar, Anne-Laure Mention, Tor Helge Aas

Abstract

Research on incubation models indicates that incubators and accelerators are crucial catalysts for the development of start-ups. To facilitate start-ups in financial markets, several regulatory authorities have adopted a new incubation model called a 'regulatory sandbox'. Regulatory sandboxes enable eligible applicants to test their technology-enabled financial solutions for a certain period of time (subject to conditions the regulator imposes). As such, these instruments allow innovation while preventing severe instability in financial markets caused by systemic risk. Despite their importance, management research has devoted little attention to studying how sandboxes operate as a new incubation model. In our abductive study, we adopt the activity system framework and a qualitative analysis approach to investigate the activities of five leading sandboxes and compare them with the activities of other incubation models. The data analysis yielded an activity model with three design elements (achieving membership, participating and detaching) and one design theme (improving connectedness). Thus, sandboxes are characterized by providing regulatory guidance and facilitating access to testing across international jurisdictions, distinguishing them from both generic and specialized incubation models. Our primary contribution to the incubation literature is extending the knowledge of a unique incubation model through a set of theoretical propositions.

Keywords: Financial technology (FinTech); Regulatory sandbox; Incubation models; Business incubators; Business accelerators; Activity system framework

1 Introduction

Business incubators (BIs) and accelerators can play a vital role in facilitating start-ups' entrepreneurial activity, enterprises that often have constrained resources and a high failure rate (Peters et al., 2004). Certain industries, including financial markets, energy and pharmaceuticals, face additional barriers to innovation due to regulatory constraints that vary across jurisdictions, inhibiting entrepreneurial firms (Blind, 2012; Hornuf and Schwienbacher, 2017). To overcome such barriers, governments offer sector-specific BIs and accelerators, providing access to resources that significantly lower validation costs and

time to market (see Doblinger et al., 2019; Grifantini, 2015; Michael and Pearce, 2009). For instance, the US government founded the National Incubator Initiative of Clean Energy (NIICE) to consolidate the efforts of cleantech BIs and accelerators through a knowledge exchange platform (DOE, 2018). In financial markets, regulatory authorities have set up several initiatives, including regulatory sandboxes and innovation hubs, to engage and support financial technology (FinTech) start-ups (ESMA, 2019; UNSGSA et al., 2019). These examples illustrate an increasing focus on supporting sector-specific incubator organizations to foster novelty in regulated sectors. Scholars such as Stayton and Mangematin (2019) hold that individualized investigation of these industries is necessary due to their peculiarities (e.g., regulatory environment), making each relevant for dedicated research. Thus, we investigate regulatory sandboxes as important support instruments for FinTech start-ups in financial markets by following recent contributions investigating this sector (Gazel and Schwienbacher, 2020; Haddad and Hornuf, 2018; Laidroo and Avarmaa, 2019).

Using digital technologies such as artificial intelligence, blockchain and big data analytics, FinTech start-ups develop, test and deliver a wide range of innovative financial services (FS) like digital payment solutions, securing them new opportunities and disrupting the course of traditional banking (Lee and Shin, 2018). However, FinTech start-ups face barriers to development due to the high cost of compliance and a lack of regulatory knowledge (Arner et al., 2015; Haddad and Hornuf, 2018; IOSCO, 2017; UNSGSA et al., 2019), potentially leading to firm failure and disruption in financial markets (Pai, 2017). In response, regulatory authorities from numerous countries including the US, the UK, Singapore and Australia have taken an active stance to find appropriate regulatory solutions that stimulate innovation, improve market competition and ensure financial market stability (Arner et al., 2016; Fan, 2017; Jenik and Lauer, 2017). One of the first, in 2016, the UK's Financial Conduct Authority (FCA) established a regulatory sandbox to achieve these objectives (Fan, 2017; Zetzsche et al., 2017). These are environments free from legal consequences in which FinTech firms can test and validate their business models without draining their resources by attempting to obtain traditional financial licenses (Teigland et al., 2018). Following the UK's lead, other governments have hurried to design and establish sandboxes. On a global basis, recent reports indicate that over 50 jurisdictions have either announced or already operate a sandbox (see UNSGSA et al., 2019 for an overview).

With the rapid increase in the number of FinTech market participants, regulators face challenges in designing and operating regulatory instruments in a context conventionally characterized by command-and-control regulatory approaches (Mangano, 2018). Creating

and operating sandboxes is crucial from the perspective of regulators, given their role in stimulating financial innovations and reducing disruptions in financial markets. That said, there remains a lack of academic research shedding empirical light on how regulatory sandboxes operate from a management perspective, with most research addressing exclusively legal issues (Arner et al., 2017; Bromberg et al., 2017; Zetzsche et al., 2017). We fill this gap by exploring the activities of this novel support instrument to establish a knowledge-based foundation that will foster advancements in regulatory sandboxes. An activity refers to involved actors' engagement to achieve an overarching objective (Zott and Amit, 2010). When adapted to the incubation setting, this represents activities such as training conducted during selection, business support and mediation (Bergek and Norrman, 2008). Following Pauwels et al.'s (2016) investigation of accelerators, we explore activities instead of other dimensions as a foundation that must precede future investigations dealing with performance.

Viewed broadly, BIs, accelerators and regulatory sandboxes all reduce the high failure rates associated with new venture creation (Aerts et al., 2007). However, BIs provide a wider range of services to support firm entry into different industries than sandboxes, which have thus far focused on FS in selected categories like banking, insurance and investment management (ESMA, 2019). In addition, regulatory sandboxes have certain distinctive characteristics: the prominent role of regulators, being led by public institutions, providing licensing exemptions and regulatory support services that pilot novel innovations without systemic risk (Arner et al., 2017; Magnuson, 2018; UNSGSA et al., 2019; Zetzsche et al., 2017). We thus argue that, due to the specific characteristics of regulatory sandboxes, one cannot blithely assume that the knowledge from the incubation literature necessarily applies to regulatory sandboxes.

The study aims, by exploring and identifying the activities that characterize the incubation model of regulatory sandboxes, to find out 'How are the activities of regulatory sandboxes different compared with the activities of BIs and accelerators?' To answer this research question (RQ), we first analyze the secondary data of archival documents (e.g., regulatory guides, consultation papers) from five regulatory sandboxes in leading financial centres using the activity system framework (Zott and Amit, 2010). We then discuss the differences of sandboxes in relation to the incubation literature, guided by the incubation model activities of generic (Bergek and Norrman, 2008) and specialized (Schwartz and Hornych, 2008) BIs and accelerators. We thus contribute to both the incubation literature and to practice by exploring a new incubation model that has gained the attention of stakeholders in the FinTech space. Broadly, we contribute to the emerging FinTech literature, which remains

insufficiently theorized and lacks the needed scholarly and practitioner attention (Gazel and Schwienbacher, 2020; Gimpel et al., 2018; Puschmann, 2017).

The remainder of the paper is structured as follows: we begin with a theoretical background reviewing the literature on incubation models and present the research framework. We outline the research process in the methods section and explore the empirical results from the cases in the findings section. The discussion section offers propositions and addresses theoretical and practical implications. We close with concluding remarks and future research avenues.

2 Theoretical Background

In this section, we first offer an overview of the characteristics of FinTech ventures. We then review incubator configuration studies that focus on the activities of BIs and accelerators, followed by a review of regulatory sandboxes and their relevance for FinTech start-ups. We further justify why this study is needed by conceptualizing the case of regulatory sandboxes in contrast to BIs and accelerators. Finally, we present the activity system framework guiding our empirical investigation.

2.1 Characteristics of FinTechs

FinTech has been broadly defined as 'technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services' (FSB, 2017, p. 7). The emergence of FinTech is traceable to the aftermath of the 2008–2009 financial crisis; it was led by start-ups and technology firms delivering FS using digital technologies and data-driven solutions (Arner et al., 2017; Jenik and Lauer, 2017; Lee and Shin, 2018). The FinTech movement is characterized by digital infrastructures and interfaces, unlike traditional financial institutions that still operate legacy IT systems that, in some cases, are more than 38 years old (CBInsights, 2018; Gozman et al., 2018). That said, incumbents benefit from access to large customer bases, the ability to predict changes in markets based on extensive industry experience and knowledge of banking regulations; by contrast, FinTech newcomers have the advantage of building efficient systems from the beginning (Philippon, 2016).

We focus on FinTech start-ups that, in addition to being constrained in terms of resources, may lack sufficient knowledge of the relevant regulatory frameworks (e.g., Arner et al., 2015; IOSCO, 2017; Peters et al., 2004). FinTech start-ups target specific market segments by offering customized services based on technologically innovative solutions (Gozman et al.,

2018). Haddad and Hornuf (2018) demonstrate that determinants like technological infrastructure, talent pool, venture capital and supportive regulatory initiatives have positive impacts on the formation of FinTech start-ups.

The lack of legacy systems and relatively lower level of organizational complexity enable FinTech start-ups to be more responsive and radically innovate FS (Hornuf et al., 2020). However, the novel application of enabling technologies to deliver FS presents compliance-specific challenges that are different than those incumbents face. For instance, activities on crowdfunding platforms (i.e., getting funds from the crowd based on big data analytics rather than long-term relationships, like in the banking sector) require different banking regulations to be enforced (Navaretti et al., 2017). Taken together, these factors indicate an urgent need to support FinTech start-ups in financial markets; however, there is scarce scientific research on how support instruments foster FinTech novelties.

2.2 Incubation models

An incubation model is a support institution that enables the survival and development of new ventures through the provision of entrepreneurial support services (Pauwels et al., 2016). Such support services (i.e., activities) are further identified as one of the main components in incubation research capturing incubators' operations (Baraldi and Havenvid, 2016). However, the incubation literature (e.g., Bergek and Norrman, 2008) denotes that identifying how and in what ways incubator support activities are provided has received little academic attention.

2.2.1 Business incubators

In a generic sense, technology BIs represent support organizations like accelerators, science parks, innovation offices and industrial parks (Bøllingtoft, 2012; Cohen, 2013; Löfsten and Lindelöf, 2002; Mian et al., 2016). BIs first became popular in the 1980s; their offerings have been evolving ever since (Bruneel et al., 2012). According to Hackett and Dilts (2004, p. 57), a BI is a 'shared office-space facility that seeks to provide its incubatees with a strategic, value-adding intervention system of monitoring and business assistance. This system controls and links resources with the objective of facilitating the successful new venture development of the incubatees while simultaneously containing the cost of their potential failure'. More precisely, BIs facilitate entrepreneurial ventures by providing business support services, access to physical facilities and networking opportunities (Mian et al., 2016).

Campbell et al. (1985) made the first attempt to conceptualize how incubators operate to illuminate their internal activities. They delineate four such activities: identification of business needs, selection and monitoring, access to capital investment and network access. Through these activities, incubation models create value for their tenants (Campbell et al., 1985). Bergek and Norrman (2008) examine how incubator practices differ from one another and propose an incubator model framework including selection, business support and mediation as the most distinctive activities. Selection concerns the assessment criteria employed when evaluating a start-up's entry into the incubator. Business support refers to services like start-up development training, mentorship, legal and patent services, financial services and marketing and advertising services provided during the incubation process. Mediation refers tenants' ability to access external resources to facilitate development, especially when the incubator lacks the required expertise (Bergek and Norrman, 2008; Hausberg and Korreck, 2018).

2.2.2 Business accelerators

Business accelerators are commonly characterized as short-term and cohort-based programs (Cohen, 2013; Hausberg and Korreck, 2018). In a study exploring accelerators, Pauwels et al. (2016) argue that accelerators have four distinct features: 1) not being designed for the long-term provision of support services and physical facilities, 2) generally offering pre-seed funding in return for ownership shares, 3) geared toward angel investors rather than venture capitalists and 4) providing intensive short-term training and business development support to prepare start-ups for investment.

To explore the incubation model of accelerators, Pauwels et al. (2016) adopt the activity system framework to identify design elements that characterize the activities of accelerators on the one hand and design themes that emerge from particular types of accelerators on the other. The design elements include 1) a 'program package' that consists of offered services (mentoring, training, investment opportunities, physical facilities); 2) a 'strategic focus' that highlights whether accelerators are focused on a specific industry or geographical location; 3) a 'selection process' that represents screening activities like in-person presentations and third-party screening services; 4) a 'funding structure' that considers revenue streams supporting the accelerator operation, which can be private, public or self-generated and 5) 'alumni relations', which represent networking activities with graduated participants and a post-accelerator program. They also identified three distinct themes that characterize accelerator models: the ecosystem builder, the deal-flow maker and the welfare stimulator (Pauwels et al., 2016).

2.2.3 Regulatory sandboxes: A new incubation model for FinTech start-ups

Regulatory sandboxes grant time-limited licensing exemptions to eligible FinTechs to test their solutions, as subject to imposed regulatory conditions in each jurisdiction (Arner et al., 2016; Zetzsche et al., 2017). These instruments are initiated by public-based institutions with a regulatory or monetary function (Bromberg et al., 2017) and commonly established following public consultation processes in which ecosystem stakeholders are engaged to help shape sandbox activities (CCAF, 2018). Fan (2017) stresses that sandboxes do not eliminate the risk of business failure – a determinant of innovation – rather, they reduce the consequences of testing on consumers and financial market stability. Hence, sandboxes reduce systemic risk[9] (Magnuson, 2018).

2.2.4 Complementing existing knowledge: Regulatory sandboxes vs incubation models?

While incubation studies have reported positive implications of BIs and accelerators for start-ups in a variety of sectors, it is less clear whether emerging FinTech start-ups can benefit from incubation models in the same way. This is due to generic and diffuse investigations that either overlook specialized incubators, study a broad sample of incubation models and start-ups or capture a time period irrelevant to the FinTech phenomenon. For instance, Aerts et al.'s (2007) investigation of European incubators' screening practices showed that 44% (sample N = 107) of the incubators specialized in the financial sector, but their sample was collected in 2003, long before the rise of FinTechs. Among recent studies confirming that incubation models significantly lower FinTechs' risk of failure, Gazel and Schwienbacher (2020) examine a sample of BIs and accelerators; however, they do so without explicitly targeting the impact of support activities. Regarding accelerators, while Pauwels et al. (2016) indeed study one FinTech accelerator, their findings are combined with other sector-specific accelerators, making it difficult to distinguish how the FinTech accelerator operates. That said, it is important to acknowledge that prior investigations, although not specific to incubation activities conducted to enable FinTech start-ups, do provide relevant insights for our study, including common activities. However, we argue that the differences in this relatively young context (including high compliance costs and regulatory challenges) intertwined with regulators' and FinTechs' characteristics call for different types of incubation activities to support innovation. This is in line with previous arguments in incubation research promoting incubator specialization and providing sector-specific support services (Grimaldi

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[9]According to Magnuson (2018), scholarship on financial stability has traditionally assumed that large financial institutions are the primary source of systemic risk and threat to the overall economy. In this study, we adopt Magnuson's view, arguing that smaller financial actors like FinTechs enabled by certain abilities (e.g., digital technologies) may constitute systemic risk issues greater than established financial institutions.

and Grandi, 2005; Schwartz and Hornych, 2008; Vanderstraeten and Matthyssens, 2012). Some of the advantages of sector-specific BIs that Schwartz and Hornych (2008) highlight are 1) specialized facilities, 2) sector-specific know-how and networks, 3) a collaborative co-working environment and 4) intangible image effects.

Regarding the literature on sandboxes, we deduce that certain characteristics distinguish regulatory sandboxes from existing BIs and accelerators: regulatory authorities' uncommon intervention of supporting innovation, periodic licensing exemptions allowing FinTech novelty-testing and regulators' roles in providing knowledge about regulatory frameworks. Thus, on the one hand, due to these specific characteristics, evidence on incubation activities that is not industry-specific may not be entirely transferable to the study of regulatory sandboxes. On the other hand, sector-specific knowledge falls short in terms of investigating the unique incubation activities of FinTech start-ups, with the exception of some studies investigating how FinTechs benefit from corporate BIs or accelerators in terms of access to customer base, knowledge of banking regulations and access to financial licenses (e.g., Hornuf et al., 2020). While these benefits can certainly encourage FinTechs to cooperate with or even be acquired by incumbents, they disadvantage other start-ups and limit market competition, as newcomers may not find support instruments that are independent from incumbents. It is thus crucial to illuminate the role of regulatory sandboxes in promoting start-ups in financial markets. On this basis, we investigate the incubation activities of sandboxes and provide an evidence-based comparison of the activities of sandboxes to both generic and sector-specific BIs and accelerators. To guide this comparison, we use the generic incubation activities of selection, business support and mediation (Bergek and Norrman, 2008) and the sector-specific incubation activities of specialized facilities and sector-specific know-how and networks (Schwartz and Hornych, 2008).

2.3 The activity system: A framework to study incubation activities

Like Pauwels et al. (2016), we argue that the activity system model Zott and Amit (2010) suggest is – through identifying its main design elements and themes – an appropriate framework to study how incubation models operate and differ from other existing models. Introduced to assist firms in designing their business models, the framework encourages the focal organization to adopt a holistic approach rather than partial optimization when designing the system of activities required to create, deliver and capture value by the focal organization and its stakeholders. It also suggests how the focal organization is embedded in its ecosystem through the structure of interactions with network actors (Zott and Amit, 2010).

The activity theory championed by Vygotsky (1978) attempts to explain the connections among individual actions in society; here, any activity includes human action and interaction toward achieving a specific goal (Zott and Amit, 2010). From that starting point, the authors conceptualize organizational activity 'as the engagement of human, physical and/or capital resources of any party to the business model (the focal organization, end customers, etc.) to serve a specific purpose toward the fulfilment of the overall objective' (Zott and Amit, 2010, p. 217).

The activity system framework is divided into two design parameters (see Table 1). First, design elements describe the architecture of an activity system featuring activities carried out to create value, how these activities are connected and by whom they are performed. The second parameter represents design themes that describe the sources of value creation in the activity system, distinguished by the extent to which an activity system is coordinated and connected through certain themes like novelty, lock-in, complementarities and efficiency. Apple's introduction of iPod and iTunes is a good example of a design theme reflecting novelty in content, structure and governance (Zott and Amit, 2010). While both design parameters fundamentally describe activities, the design elements are concerned with how value-adding activities are conducted, whereas design themes focus on identifying the key sources of value creation.

We adapt the activity system framework to our study to facilitate data analysis when exploring the design parameters that characterize regulatory sandboxes and subsequently understand how value is created and captured for sandboxes as focal organizations.

Table 1
An activity system design framework (adapted from Zott and Amit, 2010)

Design Elements	
Content	*What* activities should be performed?
Structure	*How* should they be linked and sequenced?
Governance	*Who* should perform them, and *where*?
Design Themes	
Novelty	Adopt innovative content, structure or governance
Lock-in	Build in elements to retain stakeholders like sandbox participants
Complementarities	Bundle activities to generate more value
Efficiency	Reorganize activities to reduce transaction costs

3 Method

We employ a qualitative research design to identify the activities that characterize sandboxes and to address the RQ 'How are the activities of regulatory sandboxes different compared with the activities of BIs and accelerators?'; we use an abductive approach to explore and develop new explanations through systematic combining (Dubois and Gadde, 2002). Systematic combining facilitates the process of alternating between different data

sources, theoretical frameworks and existing knowledge to explain the phenomenon under study (Dubois and Gadde, 2002). We chose this approach because the regulatory sandbox model is in a nascent stage with limited academic evidence, necessitating an exploration of the empirical phenomenon, even while being informed about prior research. Our data collection included secondary data comprising archival documents retrieved from five leading regulatory sandbox webpages. This type of data has proven valuable in several studies of related phenomena in different sectors (e.g., Wang and Hajli, 2017), including FinTech (e.g., Gozman and Willcocks, 2019). Additionally, archival research provides accessibility to enough online documents from a range of sources to enable analysis of the phenomenon in multiple locations.

3.1 Sampling

We executed case selection using the following parameters: first, we focused on public-led regulatory sandboxes because only regulatory and monetary authorities have the power to provide licensing exemptions, which is an integral characteristic of a regulatory sandbox. Second, given the novelty of the sandbox model – with only six founded in 2016 (Zetzsche et al., 2017) – we included only regulatory sandboxes that were operating by 2016 to capture information-rich cases featuring the most highly developed sandboxes[10]. This is particularly important because sandboxes serve as a testing arena for both regulators and innovators, enabling knowledge exchange and dissemination in the form of reports (FCA, 2017). Finally, the regulatory sandboxes had to have an adequate number of documents published online to enable our investigation of the activities they conducted.

Using the above sampling procedure, five of the six sandboxes established in 2016 qualified for selection; we excluded Bank Negara Malaysia due to a lack of online documents. Although limited in size, this sample represents the only active cases (operational with use cases) that provide sufficient variation and meaning to illuminate the studied incubation activities of sandboxes, thus ensuring an adequate qualitative sample (Cleary et al., 2014). However, a recent survey of innovation facilitators covering 28 countries reported that sandboxes were the most commonly adopted instrument by regulators worldwide (Jenik

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[10] As of March 2018, 17 regulatory sandboxes were operating in the UK, Hong Kong, Malaysia, Singapore, Abu Dhabi, Australia, Mauritius, the Netherlands, Indonesia, Brunei Darussalam, Canada, Thailand, Bahrain, Switzerland, Saudi Arabia, Denmark and the US state of Arizona (Ringe and Ruof, 2018). The majority of established regulatory sandboxes had either not received applicants or had no graduated participants at the time of data collection (October 2018–February 2019).

and Sharmista, 2019)[11], indicating that sandboxes cover most of the world's regulator-led initiatives in the field.

3.2 Data collection

The final sample consisted of 459 pages of secondary data from regulatory sandboxes in Australia, Hong Kong, Singapore, the United Arab Emirates (UAE) and the UK and was collected between October 2018 and February 2019. As of April 2019, 204 FinTech firms (including start-ups, licensed financial institutions and technology providers) have been granted access to these sandboxes since their establishment in 2016. As an example of the proportion of start-ups, 80% of the first two cohorts in the FCA sandbox were FinTech start-ups (FCA, 2017). Table 2 outlines the key characteristics of the selected cases; their timeline highlights are presented in Figure 1. In total, we retrieved 39 archival documents (see Appendix 1 for a full list) – including regulatory guides, consultation papers, reports, information sheets and press releases – to explore sandboxes' design elements and themes.

Table 2
Descriptive data of selected sandboxes (compiled by the authors)

Jurisdiction	Launch	Approach	Exemptions granted	Duration of testing	Number of docs per sandbox
Australian Securities and Investments Commission (ASIC)	Dec. 2016	Rolling basis	6	12 months	9
Hong Kong Monetary Authority (HKMA)	Sept. 2016	N/A	46	No maximum time specified	8
Monetary Authority of Singapore (MAS)	Nov. 2016	Rolling basis	8	Upon agreement	4
Abu Dhabi Global Market (ADGM)	Nov. 2016	Cohort-based	26 (3rd cohort)	24 months	12
UK Financial Conduct Authority (FCA)	Apr. 2016	Cohort-based	118 (5th cohort)	3–6 months	6

3.3 Data analysis

We followed the Gioia methodology to achieve a qualitatively rigorous data analysis process, extracting aggregated dimensions from 1st-order coding and 2nd-order themes (Gioia et al., 2013). While this method of analysis typically follows an inductive approach, we rely on an abductive approach that informs us about prior research and enables our use of a theoretical framework to guide the analysis (Dubois and Gadde, 2002, 2014). Gioia et al. (2013, p. 21) support this approach: '[upon] consulting the literature, the research process might be viewed as transitioning from "inductive" to a form of "abductive" research'.

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[11] Innovation facilitators overseen by regulators included (by percentage): regulatory sandboxes (35%), innovation hubs (26%), internal innovation facilitators (15%), accelerators (13%) and other facilitation (11%). The data presented are from a survey by the Consultative Group to Assist the Poor (CGAP) and the World Bank Group (Jenik and Sharmista, 2019).

Similarly, our process of systematic combining comprised a shifting back and forth between the secondary data, the activity system framework and the relevant literature.
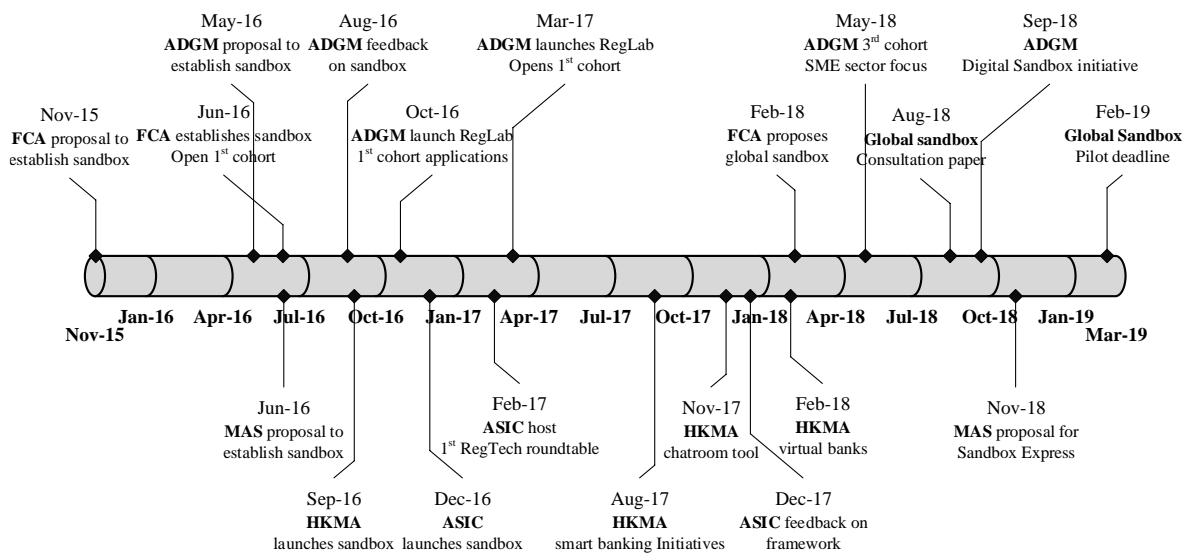

Figure 1: Timeline of regulatory sandboxes (compiled by the authors using secondary data from regulators' online content).

Guided by the activity system framework (Zott and Amit, 2010), the coding process commenced with an initial coding scheme to explore categories describing the activities of design elements or design themes, as mentioned in Table 1. Like Zott and Amit (2010), we assume the design elements and themes to be independent, though they could be interdependent. Despite the coding process being highly iterative, design elements, including what activities create value, how activities are connected and who performs these activities, were identifiable in the earlier stages of coding. In contrast, we created design theme categories toward the end of this round of analysis, as we depended upon first achieving an overview of established design element activities. This enabled us to consider whether the created categories could instead be related to design themes representing the activity system's main value creation drivers, characterized by novelty, lock-in, complementarities or efficiency. In the first round of coding, we labelled categories with terms based on phrases from analyzed documents. In the second round of coding, we created abstract themes that described activities of design elements and themes. Finally, we generated aggregated dimensions representing the design elements and themes of regulatory sandboxes based on patterns established in the previous round. We used NVivo to facilitate the analytical procedure (Gaur and Kumar, 2018). Figure 2 outlines the data structure (how we processed the raw data into codes, themes and aggregated dimensions).

4 Findings

Here, we report the key findings from our archival document analysis to explore the activities that characterize regulatory sandboxes, in which we captured four aggregated dimensions that represented their design elements and themes (Figure 2). Using regulatory sandboxes as the unit of analysis, the findings reflect regulators' perspectives, including their feedback and observations about FinTechs. This section remains at the level of empirical evidence by introducing the aggregated dimensions of regulatory sandboxes, with the subsequent section discussing these findings in relation to the activity system framework and incubation literature.

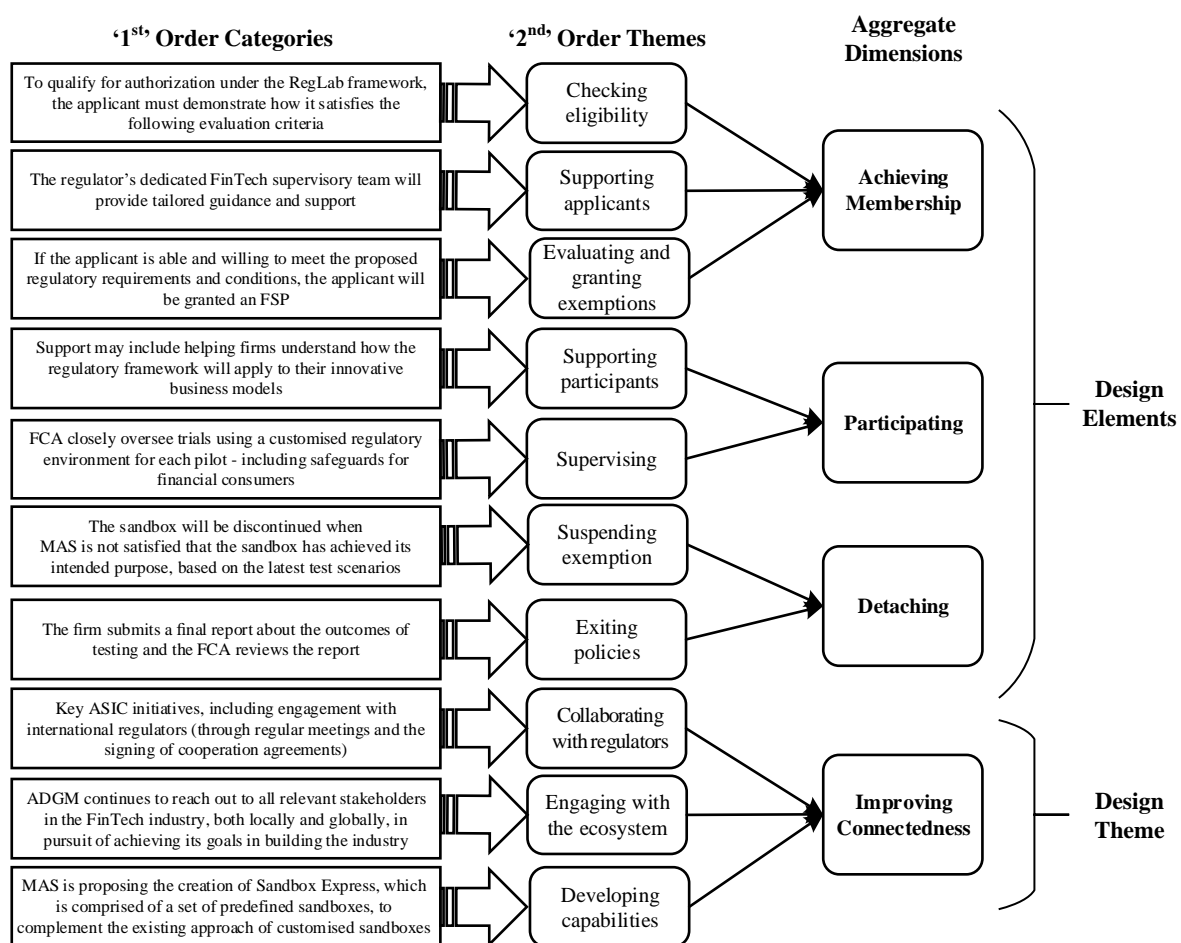Figure 2: Activities of regulatory sandboxes (compiled by the authors).

4.1 Design elements: How value-adding activities are conducted

4.1.1 Achieving membership

Our findings suggest that achieving membership consisted of early-stage activities through which regulatory sandbox staff interacted with potential participants to check eligibility, support applicants and evaluate and grant exemption requests.

Checking the eligibility of those interested in FinTech solutions is among the first activities that most regulators conduct as a condition of offering further support and to establish eligibility for a formal application. If applicants meet the relevant criteria, a case officer is assigned to provide informal assistance as the start-up attempts to achieve membership. The sandbox in Hong Kong uses a different approach; here, interested parties can file their applications directly. In a departure from other sandbox activities, the Australian Securities and Investments Commission (ASIC) has an automated licensing exemption for limited services, which allows eligible firms to rely on relief without having to complete a formal application. This approach is highlighted in ASIC's RG257 document: 'You [the market participant] do not need to apply to obtain the benefit of the fintech licensing exemption. If you meet the eligibility requirements and follow the conditions set out in the relevant instrument, you are legally entitled to rely on the exemption for 12 months' (ASIC, 2017c, p. 14). However, ASIC does require applicants to send a written notice and provide information about the business model and the background of the individuals involved (ASIC, 2017c). Although regulators have different requirements, the eligibility criteria generally require applicants to 1) provide a product or service that fits into the FS industry, 2) offer an innovation that is either unique or solves an existing problem more effectively, 3) benefit consumers, 4) demonstrate a need for licensing relief and 5) show individual and firm readiness.

In general, most regulators encourage all types of FinTech firms to apply to the sandbox, even if they already possess a financial license. For example, the first two cohorts the FCA hosted consisted of approximately 80% start-ups, 10% small- and medium-sized enterprises (SMEs) and 10% large firms, including HSBC and Lloyds Banking Group (FCA, 2017). By contrast, to be eligible for the financial exemption ASIC provides, participants may not already hold an Australian financial license (ASIC, 2017c). The Hong Kong Monetary Authority (HKMA) began with the opposite approach – when it was established, only incumbents were eligible to access it, and required that technology firms, including new businesses, collaborate with financial institutions to enter the sandbox (HKMA, 2016). However, one year after its launch, the HKMA (2017) announced multiple initiatives to enhance its sandbox to which FinTech start-ups were permitted access.

Supporting applicants is the next activity we identified in the regulatory sandboxes we assessed. Regulators describe this support as informal guidance provided through an assigned case officer to help applicants navigate the regulatory framework. During this activity, case officers also discuss any compliance issues that arise and may waive or modify the regulatory boundaries to be applied when testing in the sandbox (Abu Dhabi Global Market [ADGM],

2016b). For example, the Monetary Authority of Singapore (MAS) reports that participants receive their first response within 21 days after submission. At this point, regulators and innovators exchange knowledge about the regulatory system and business model. This exchange is made possible through the tailoring approach, which begins early in the incubation model and continues through the completion of an innovator's participation in the sandbox (MAS, 2016). Due to the uncertain nature of expected testing, which may necessitate modifying the sandbox parameters, the tailoring approach also reserves the regulator's right to impose additional requirements (FCA, 2017):

> The Regulator will work with the applicant to determine the specific regulatory requirements and conditions (including test parameters and control boundaries) to be applied to the FinTech solution in question. The applicant will then assess if it is able to meet these requirements.… If the applicant is able and willing to meet the proposed regulatory requirements and conditions, the applicant will be granted an FSP [financial services permission] to carry on the Regulated Activity. (ADGM, 2016b, p. 8)

Evaluating and granting exemptions is the final activity before participants can formally commence testing in the sandbox. Through previous interactions with FinTech service providers, regulators would already have collected the required documentation and could thus begin assessing applicants against a set of authorization requirements (such as testing plans with defined testing scenarios and outcomes) accompanied by risk mitigation and exit strategies (FCA, 2015): 'sufficient safeguards are put in place to mitigate potential harm during and after testing' (FCA, 2017, p. 5). Evaluation times were not reported due to the complexity of assessment (MAS, 2016). Examples of boundary conditions are number of clients, transaction amounts, testing periods and additional limitations specific to each regulatory framework (ADGM, 2016b). Finally, MAS (2016) indicates that applicants may also be rejected if they fail to meet sandbox objectives or assessment criteria.

4.1.2 Participating

Our findings further reveal that, while FinTechs were participating, regulators generally engaged in supervisory activities to ensure that participants operated within the set boundary conditions. However, some regulators do provide supporting activities in the form of regulatory guidance and support services to assist sandbox participants during the enrolment period (ADGM, 2016b; ASIC, 2017c; FCA, 2015). For example, the FCA uses case officers to provide guidance and support during the testing period to help innovators understand how regulatory requirements apply in practice (FCA, 2015):

Each firm's case officer works with them [sandbox participants] to develop a test and facilitates engagement with subject matter experts from across the FCA. Direct feedback from [participating] firms… indicates that this aspect of the sandbox programme is valuable in helping them to understand how the regulatory framework applies to them, accelerating their route to market and reducing expenditure on external regulatory consultants. (FCA, 2017, p. 5)

Other regulators provide additional support services. ADGM notes that sandbox participants can access physical facilities: 'FinTech Participants can hold regular showcases and progress updates on their FinTech solutions to their target group of investors and clients. FinTech Participants may also make use of the auditorium facility in the ADGM Building (subject to availability) to conduct these presentations' (ADGM, 2016a, p. 7). Additionally, ADGM arranges workshops and seminars to allow FinTech participants to present their services to a variety of stakeholders (ADGM, 2016a).

Supervisory activities reflect the observational role of regulators, who employ monitoring activities to ensure that sandbox participants follow regulatory frameworks. For instance, regulators may engage with participants to ensure that testing remains within the initially established regulatory boundaries and conditions (ADGM, 2016b). Using supervisory technology like RegTech (i.e., enabling technology that enhances regulatory processes), regulators can supervise testing activities in real time (ADGM, 2018). Additionally, regulators reserve the right to redefine the testing environment's boundary conditions based on observed risks, which may vary with external factors (MAS, 2016).

4.1.3 Detaching

Our findings suggest that detaching begins toward the end of exemption periods, and that certain policies apply. Exemption periods vary from three months to two years. In general, sandboxes allow participants to either extend validity for further testing, complete testing and apply for a full-fledged license or elect not to proceed upon completion of the exemption period. Additionally, MAS reports that participants can lose access if they fail to comply with the boundary conditions or mitigate risk exposure. For example, MAS may terminate testing if 'a flaw has been discovered in the financial service under experimentation where the risks posed to customers or the financial system outweigh the benefits of the financial service under experimentation, and the sandbox entity acknowledges that the flaw cannot be resolved within the duration of the sandbox' (MAS, 2016, p. 7). Optimally, regulators want sandbox participants to apply for financial licenses prior to completion in order to continue operating immediately after exit and subsequently enable competition in the real-world FS market

(ASIC, 2017c). Further, our findings reveal that regulators exercise a restricted extension policy and demand that participants terminate operation at the end of validity periods unless an extension or financial license is granted (ASIC, 2017c): '. . . the validity period of the authorisation granted . . . may be extended in exceptional circumstances only, determined at the Regulator's discretion on a case-by-case basis' (ADGM, 2016b, p. 6). Finally, as part of their exit policies, regulators require testing firms to submit a completion report summarizing the results they achieved and outlining further steps (FCA, 2015).

4.2 Design theme: Key sources of value creation

4.2.1 Improving connectedness

Since the introduction of sandboxes in 2016, most regulatory authorities have followed in the FCA's footsteps, adopting comparable activities with the mission of promoting market competition and innovation in the FS industry. However, our findings indicate that dominant value creation drivers have emerged from regulators with the objective of improving connectedness in FinTech ecosystems.

Collaborating with regulators through cross-border cooperation agreements is carried out not only to enable knowledge exchange among regulators but also to facilitate testing across international jurisdictions and allow foreign FinTech firms to access domestic FS markets. For example, the FCA, ADGM and ASIC have all reported signing agreements with regulators across international jurisdictions:

> These [cross-border cooperation] agreements establish a framework for information sharing relating to innovation in financial services, including emerging market trends and regulatory issues arising from the growth in innovation. A number of these agreements also enable ASIC to refer Australian fintech businesses to other regulators' fintech assistance programs-and vice versa. (ASIC, 2107a, p. 10)

Along these lines, in February 2018, the FCA initiated a proposal to establish a Global Sandbox. The rationale was to create a community of regulators, promote collaboration and knowledge exchange among regulators and offer FinTech firms opportunities for testing across international jurisdictions, reducing their time to overseas markets. Shortly afterward, the Global Financial Innovation Network (GFIN, 2018) was established by 11 jurisdictions, including ADGM, ASIC, FCA, HKMA and MAS. As of February 2019, 25 regulatory jurisdictions and four observing organizations were part of the GFIN network (FCA, 2019).

Engaging with the ecosystem is another activity regulators have adopted to interact with innovators and learn from collaborations with external stakeholders; however, the extent of

interaction varies from one jurisdiction to another. In some cases, like Singapore, these interactions have supported regulators' efforts to set up a new model: 'Through engagements with players in the FinTech ecosystem, MAS has identified certain regulated activities where pre-defined sandboxes could be reasonably constructed' (MAS, 2018, p. 4). Although the tailoring approach regulators commonly adopt provides opportunities to promote testing and validating solutions, regulators in Singapore emphasize that this approach increases the time it takes to process applicants into the sandbox (MAS, 2018). Thus, MAS (2018) proposed eliminating the tailoring approach for certain types of FinTech firms – including insurance brokerage, recognized market operators and remittance – through the Sandbox Express. This initiative streamlined achieving membership by creating pre-defined sandboxes: 'The current [sandbox] approach . . . requires an extensive review of each application as each sandbox is customised. . . . We have learned along the way that for certain types of regulated activity, the risks can potentially be well managed within certain specific boundaries' (MAS, 2018, p. 4).

Developing capabilities is another activity that regulators adopt to enhance support services and the overall incubation model of their regulatory sandboxes. For instance, the ADGM announced its Digital Sandbox after observing the challenges FinTech newcomers faced (e.g., access to data and international markets) and experiencing the challenge of integrating innovative FinTech solutions into incumbents' legacy systems (ADGM, 2018). On this basis, the Digital Sandbox was established to enable sandbox participants to connect with local and non-local financial institutions to digitally test their solutions in a collaborative environment using synthetic data hosted on cloud-based servers. Through this regulated collaborative space, regulators at ADGM (2018) postulate cost-efficiency and scalability benefits to both sandbox participants and traditional financial institutions.

5 Discussion and implications

An existing stream of incubation research has identified how incubation activities vary between different incubation models like accelerators (e.g., Pauwels et al., 2016) and technological BIs (e.g., Rubin et al., 2015). We extend this research stream by providing systematic empirical evidence on how the nascent sector-specific incubation model of regulatory sandboxes operates and is distinct from other incubation models. Specifically, we apply the activity system framework (Zott and Amit, 2010) to explore the activities of sandbox models. We then compare sandbox activities with generic and specialized incubation models (Bergek and Norrman, 2008; Schwartz and Hornych, 2008). In doing so, academics can gain insights into how incubation models may require different designs in

specific industries to promote innovation, thereby depicting the limitations of transferability and the need for dedicated research. Moreover, regulators currently operating or considering setting up sandboxes can benefit from our proposed findings to enhance or design appropriate activities for sandbox participants. FinTech start-ups can also determine whether the support services offered in sandboxes meet their needs. Given the exploratory nature of this study, we derive theoretical propositions as conclusions from the discussed findings to help drive future research. Further, we suggest both theoretical and practical implications for different stakeholders.

5.1 Activities characterizing the incubation model of regulatory sandboxes

We identify various activities that characterize regulatory sandboxes: proactively protecting financial systems, tailoring testing environments, granting exemptions, providing regulatory guidance and using a risk-based approach to evaluate FinTech participants. Additionally, value creation drivers that promote access to international jurisdictions, seamless entry to pre-defined sandboxes and collaboration with financial institutions emerged from the analyzed data. We discuss the main characteristics in detail throughout this section.

5.1.1 Achieving membership

The content of achieving membership constitutes the activities of checking eligibility, supporting applicants and evaluating and granting exemptions. We observe that these activities follow a specific sequence (structure): firstly, including an initial eligibility check, followed by assigning a case officer, suggesting sandbox boundaries and lastly offering access to testing. As for governance, while these activities are greatly dependent upon regulators managing them, sandbox applicants play an important role in performing these activities by approaching regulators, complying with the application requirements and co-developing testing conditions by establishing sufficient protection mechanisms.

The idea that regulators are offering proactive protection is due not only to engagement with FinTechs and monitoring participants but also to the tailoring approach (content) that regulators perform prior to achieving membership. In practice, this means that regulators work with applicants early on to tailor the best testing plan for each participant. Relatedly, our findings indicate that regulatory sandboxes have the necessary regulatory power to provide licensing reliefs and establish the boundary conditions of exemptions to fit the needs of each FinTech firm. Regulators may also use these significant powers to alter boundary conditions during participation or even to cease testing activities (such as when they observe a greater impact on clients). We may thus deduce that regulatory powers enable regulators to

manage and perform the identified activities in regulatory sandboxes. Taken together, a tailoring approach and regulatory powers allow regulatory sandboxes to build risk-appropriate testing environments for FinTech participants and proactively safeguard financial systems. These activities can be attributed to the increasing number of market participants and the vital need for regulators to oversee financial markets. Theoretically, these findings are consistent with Magnuson's (2018), who argues that FinTechs constitute greater systemic risk threats than established incumbents as they are '. . . more vulnerable to adverse economic shocks, less transparent to regulators, and more likely to encourage excessively risky behavior by market participants' (Magnuson, 2018, p. 1167). In line with this discussion, we offer:

P1a: Regulatory sandboxes proactively protect financial markets using a dynamic tailoring approach and by exerting regulatory powers.

5.1.2 Participating

The activities performed during participating consist of supporting and supervising participants (content) – unlike achieving membership, these are conducted in a parallel sequence (structure). Notably, the scope of performed activities may vary from one regulatory jurisdiction to another, possibly due to imposed mandates and availability of resources. In terms of governance, both activities are predominantly performed by assigned case officers (regulators) with the aim of supporting newcomers in their regulatory endeavours as well as monitoring them to ensure that potential risks remain contained. Thus, our findings imply that regulators inherently operate with two functions focusing on the regulation and innovation of FinTechs, with information being exchanged and access to internal regulatory expertise provided (as highlighted in the FCA example). These observations support and further explain studies (e.g., Zetzsche et al., 2017) that describe regulatory sandboxes as promoting bi-directional knowledge exchange between regulators and FinTech participants. Specifically, regulator–innovator engagement benefits regulators by providing insights into 'innovations and the opportunities and risks they present' while offering innovators a better 'understanding of regulatory and supervisory expectations' (ESMA, 2019, p. 5).

On this basis, we postulate that knowledge-sharing within sandboxes increases regulators' understanding of the application of novel technologies and participants' knowledge of financial regulation, enabling them to create regulatory-compliant solutions. This bridges the lag between regulatory frameworks and new technologies in financial markets (IOSCO, 2017). Based on this discussion, we offer:

P1b: Regulatory sandboxes enable the transfer of regulatory and technological knowledge between regulators and FinTech participants.

5.1.3 Detaching

The content of detaching represents two activities: suspending exemptions and enforcing exiting policies. Testing activities within regulatory sandboxes may cease either during participation or when the exemption granted expires; in either case, these are linked (structure) to prior or subsequent activities like providing regulators with a completion test report after termination and applying/receiving an extension or a financial license. Our findings also reveal that regulators closely monitor these activities, evaluating whether the unforeseen risks that emerge during testing can be mitigated and determining next steps if the participant fails to comply with the testing parameters. Although the data indicate that sandbox participants can apply to extend the exemption periods, regulators adopt a strict yet unclear extension policy. One possible explanation for these findings is that regulators are driven by a risk-based approach when evaluating participants' testing outputs – to a great extent, this explanation is supported by their consistent actions to safeguard financial markets. However, this prompts the question of how regulatory sandboxes are changing the risk-averse and highly regulated climate in financial markets in ways that may inhibit FinTech novelties when a test-and-learn approach to innovation is not effectively supported. Allen (2019) provides an extended discussion on this issue, arguing that a strict trial termination policy is required in the context of regulatory sandboxes even if this impedes innovation. The author emphasizes sandboxes as a training ground primarily for regulators. Along these lines, we suggest that:

P1c: Regulatory sandboxes adopt a consistent risk-based approach that can constrain FinTechs' freedom to test solutions.

5.1.4 Improving connectedness

We further discuss a source of value creation in the activity system that emerged as a common design theme for all the investigated jurisdictions: improving connectedness. Unlike design elements in which activities encompass all three dimensions (content, structure and governance), the source of value creation in design themes could be described in either one or more of the following themes: novelty, lock-in, complementarities and efficiency (Zott and Amit, 2010).

Our findings indicate that regulatory authorities have established cooperation agreements as well as participated in a dedicated initiative, the Global Sandbox, to promote knowledge

transfer among all the investigated jurisdictions and enable testing across international jurisdictions for market participants. This initiative is an example of regulators co-creating new activities and ways of linking and managing such activities (novelty). They are thus improving connectedness first among regulators and second among international regulators and foreign sandbox participants. This can further be associated with the theme of complementarities – they create value for FinTech participants by testing FS across multiple jurisdictions with possibly different frameworks and receive support from foreign regulators (instead of running independent sandbox processes). Similarly, regulators share best practices around emergent issues associated with monitoring FinTech participants and protecting financial markets. Singapore's Sandbox Express initiative is novel in content, structure and governance, providing a different model to achieve membership and reducing time-to-testing for participants. We argue that this model reduces transaction costs for regulators because the activities are standardized (i.e., efficiency). Evidence from ADGM's case features another initiative regulators have taken to improve connectedness, this time between FinTech participants and incumbents. The Digital Sandbox is the first to adopt such an activity, representing a novelty-centred theme. This latter finding presents an alternative platform for FinTechs to take advantage of banks' financial licenses; thus, we view it in relation to recent studies that consider the role of FinTech corporate incubators in facilitating these collaborations (Block et al., 2018). For example, Hornuf et al. (2020) investigate various types of bank–FinTech alliances and find that they are most often based on product-related collaboration.

These initiatives indicate different forms of improving connectedness in financial markets as a result of collaborating with regulators, engaging with the ecosystem and developing capabilities. For instance, cooperation among regulators in the Global Sandbox may indicate that legal authorities face common regulatory challenges from FinTech participants and would benefit from sharing experiences related to enabling technologies. There might be additional urgency to collaborate, as regulatory frameworks may vary from one jurisdiction to another, making emergent issues different in each context – at least to some extent. Given that financial trade is inherently global, another explanation could be that sandbox participants would likely express the need to extend their operations across different regulatory jurisdictions. Taken together, these cases show how regulators shape their activity system design in response to prevailing needs, thus creating new value for regulators and FinTech participants. We therefore offer the following proposition:

P1d: The sources of regulatory sandboxes' value creation can be associated with overriding themes such as novelty, complementarity and efficiency.

5.2 Comparing regulatory sandboxes' activities with other incubation models

Generic incubation models like BIs and accelerators commonly provide programs that offer support services, access to physical facilities and networking opportunities, all under general selection and exit policies (Bøllingtoft, 2012; Bruneel, et al., 2012; Cohen, 2013; Hausberg and Korreck, 2018; Rubin et al., 2015). By contrast, specialized incubation models provide specifically designed services and access to sector-specific knowledge and networks (Schwartz and Hornych, 2008). Conversely, our findings indicate other service offerings, which leads us to argue that both generic and specialized BIs and accelerators are inherently different from regulatory sandboxes because of the specifics of the activities conducted. Identifying these differences provides important opportunities for research and practice to understand which specific incubation activities enable regulatory sandboxes to support FinTech start-ups. We now discuss these similarities and differences using the frameworks developed for generic (Bergek and Norrman, 2008) and specialized (Schwartz and Hornych, 2008) incubator models.

5.2.1 Activities of generic incubation models vs regulatory sandboxes

Regarding the selection practices for BIs and accelerators, the incubator literature reports using different strategies that vary by incubator focus (industry), organization type (for-profit vs non-profit) and incubation model (such as incubators or accelerators) (Hausberg and Korreck, 2018). Bergek and Norrman (2008, p. 24) classify selection strategies of incubator models into a 2 x 2 matrix framework representing 'idea-focused' and 'entrepreneur-focused' categories on one the hand and 'picking-the-winners' and 'survival-of-the-fittest' categories on the other hand. As for accelerators, selection is focused on finding entrepreneurial teams rather than individual founders (Pauwels et al., 2016). Similarly, our findings reveal that sandboxes check applicant's eligibility at an early stage, considering aspects like individual characteristics, concept readiness and having an innovative solution. We thus argue that BIs and accelerators and regulatory sandboxes conduct similar selection activities. However, we identify important differences. For example, the firm type during tenant selection varies – innovative start-ups are often eligible to access incubator and accelerator programs (Hausberg and Korreck, 2018), whereas sandboxes often focus on selecting a diverse set of ventures including FinTech start-ups, corporates and technology firms. Moreover, we found regulators use a case-by-case tailoring approach, which contrasts with the more streamlined programs that accelerators provide (Hausberg and Korreck, 2018; Pauwels et al., 2016). Sandboxes often have the necessary regulatory power to adapt testing parameters to each FinTech firm, whereas we see no studies that indicate whether BIs and

accelerators have the authority to grant exemptions or adjust regulatory framework conditions (one exception could be specialized BIs and accelerators led by regulatory authorities such as the Bank of England [Laidroo and Avarmaa, 2019]).

Moving forward, we discuss business support during participation. In the case of sandboxes, FinTech participants are mainly offered regulatory guidance. For BIs and accelerators, regulatory support is primarily accomplished through legal advice services that an external network of law firms generally provide (Merrifield, 1987; Pauwels et al., 2016). Although specialized lawyers may well be familiar with regulatory frameworks, we argue that regulators are more competent regarding regulatory frameworks, possess legal authority and are more knowledgeable about technological developments, as they regularly interact with market participants. Thus, we assume that regulatory sandboxes have more competence in offering regulatory support than BIs and accelerators.

Further, we observe similarities in both duration and program approach (cohort-based or on a rolling basis). Specifically, prior research shows that accelerators often have cohort-based programs that last six months (Pauwels et al., 2016), whereas incubator programs offer ongoing support services for longer (ranging from three to five years) (Bergek and Norrman, 2008; Hausberg and Korreck, 2018). Comparatively, sandboxes admit applicants using either a cohort-based approach or on a rolling basis; they provide validity periods lasting from three months to two years with the opportunity to extend. While there are similarities, our findings reveal that each incubation model has its own duration period that, we argue, is determined by its objective. Specifically, sandboxes encourage tenants to apply for financial licenses during the validity period in order to transition to full-fledged, real-world operations once their exemptions end. BIs have a similar purpose – they want tenants to become self-sufficient so they can undertake business development activities after graduation (Rubin et al., 2015). However, an important factor that may determine validity periods in sandboxes is the discovery of risks during testing that, if not adequately mitigated, may lead to participant suspension. In contrast, the incubation literature does not report exit or discontinuation policies that focus on consumer risk exposure; the concern here is the risk of business failure (e.g., Schwartz, 2009).

Beside the identified similarities and differences, business support like training, mentoring, supervising and access to funding networks are not distinctive features of regulatory sandboxes, although there are a few exceptions (e.g., ADGM's sandbox). However, when looking at monitoring, our findings suggest that regulators supervise participant activities to ensure regulatory compliance. Notably, some regulators reserve the

right to impose changes to the agreed-upon parameters due to unforeseen changes. By comparison, in BIs and accelerators, monitoring incubatees' performance is undertaken to understand tenant needs in order to develop measures that will facilitate their growth (e.g., Hackett and Dilts, 2004). Along these lines, our findings reveal that sandbox models like the Global Sandbox, Sandbox Express and Digital Sandbox enable FinTech novelties in a distinctive manner (e.g., providing access to international jurisdictions). That said, caution must be applied in interpretation, given the lack of longitudinal investigation.

Finally, we discuss differences in mediation. In this setting, an important role of incubators is to act as an intermediary that connects tenants to networks to access resources when they lack the required expertise (Bergek and Norrman, 2008). Our findings suggest that regulatory sandboxes play a mediating role; however, instead of mediating between sandbox participants and external actors to access resources like technical or industry knowledge, technology or capital, regulators facilitate access to other regulators either in the home country or internationally (FCA, 2019). By contrast, the extant incubation literature does not feature studies indicating whether BIs and accelerators collaborate with international regulatory authorities in a similar manner. Bergek and Norrman (2008) report that network mediation by BIs can either be limited to specific regions or expand to an international scope. Based on this discussion, we propose that:

P2a: Regulatory sandboxes differ from generic BIs and accelerators by providing regulatory guidance and mediating access to international jurisdictions.

5.2.2 Activities of specialized incubation models vs regulatory sandboxes

Departing from the benefits of specialized incubators (Schwartz and Hornych, 2008), we compare our findings with the activities of FinTech-specialized incubation models discussed in the literature.

Starting with specialized facilities, our findings generally do not indicate that sandboxes offer access to such facilities. This does not apply to ADGM's sandbox, which provides participants with access to synthetic data for testing and physical facilities such as meeting rooms. In contrast, the limited literature discussing FinTech-specific incubation models indicates that FinTechs may benefit from mentorship, access to customer bases, knowledge of banking regulations and access to financial licenses when partnering with incumbents or achieving membership in a corporate BIs (e.g., Hornuf et al., 2020; Sinha, 2017). We further argue that neither regulators nor financial banking incubators have the knowledge needed to support FinTech participants in the face of complex technological and legal challenges. Put another way, regulators may lack technical knowledge, whereas corporate BIs and

accelerators may fall short of regulatory knowledge – banking regulations may not always apply to FinTechs, whose novel application of enabling technologies may require different regulatory frameworks (Navaretti et al., 2017). In addition, when considering networks, regulators and corporate incubation models have access to dissimilar networks, each providing different advantages. For example, sandboxes provide access to regulators in international jurisdictions. Lastly, as to collaborative engagements among incubatees and image effects as additional benefits from sector-specific incubators, our findings regarding regulatory sandboxes do not illuminate these aspects; further empirical investigation is required to explore how these benefits unfold.

Overall, when comparing regulatory sandboxes to specialized incubator models that largely represent corporate BIs and accelerators in the reviewed literature, our findings lead us to argue that FinTechs would benefit from the ability to operate freely in local and international jurisdictions independent of a parent company, as in the case with corporate BIs and accelerators. Hence, we offer the following proposition:

P2b: Regulatory sandboxes differ from specialized BIs and accelerators by increasing FinTechs' flexibility to operate and providing FinTech-specific regulatory knowledge.

Table 3 summarizes the activities of BIs and accelerators and regulatory sandboxes.

Table 3
Summary of the compared activities between BIs and accelerators and regulatory sandboxes (compiled by the authors)

Incubation Model Activities	BIs and Accelerators	Regulatory Sandboxes
Generic (Bergek and Norrman, 2008)		
Selection	Selective, dependent on incubator focus, organization type and incubation model	Selective, unified eligibility criteria, tailoring approach coupled with exertion of regulatory powers, regulatory guidance and progress monitoring
Business support	Training, mentoring, financial resources like seed-funding in accelerators, progress monitoring	
Mediation	Access to networks (e.g., investors)	Access to local and non-local regulatory networks
Specialized (Schwartz and Hornych, 2008)		
Specialized facilities	Testing facilities (e.g., testing data)	Testing facilities rarely provided (except in ADGM's case)
Sector-specific know-how and network	Technology and industry knowledge, access to industry networks	Regulatory knowledge, access to local and non-local regulators

5.3 Theoretical implications

Our key contribution is to advance a novel debate on regulatory sandboxes as support organizations and establish an evidence-based foundation in the incubation literature by providing explanations in the form of theoretical propositions. Our investigation of regulatory sandboxes is novel due to the lack of academic studies exploring sandboxes from

a management perspective, with most research adopting a legal perspective (e.g., Arner et al., 2016; Zetzsche et al., 2017). We use an exploratory approach to understand the activities that characterize sandboxes and to explore how these activities differ from those associated with other incubation models; this is in line with studies exploring accelerators' activities (e.g., Pauwels et al., 2016) and the benefits of sector-specific BIs on new venture creation (e.g., Gazel and Schwienbacher, 2020; Schwartz and Hornych, 2008).

Our findings support the assumption that sandboxes provide contemporary regulatory guidance and facilitate access to testing across international jurisdictions – such activities are rare or non-existent in generic and specialized BIs and accelerators (Bergek and Norrman, 2008; Schwartz and Hornych, 2008). Additionally, we found that the tailoring approach and regulatory powers were central prior to participation, supporting regulators in their efforts to proactively protect financial markets against systemic risks. Once granted access to license-free testing (participating), ongoing conversations among regulators and sandbox participants were depicted as conducive to exchanging regulatory and technological knowledge. Moreover, our findings related to detaching reflected a risk-based rather than innovation-based approach; although this might be imperative to contain risks, it could limit the testing bandwidth for FinTech innovations. Finally, a source of value creation, improving connectedness, resembled regulatory jurisdictions' efforts in innovating sandbox models, either establishing new models like the Global Sandbox or improving existing ones. These findings are an impetus to more scientific research that investigates regulatory sandboxes' impact on fostering novelties.

Beyond the incubation literature, this study contributes to the entrepreneurial finance literature that has recently begun debating the role of new players, such as incubation models, in assisting FinTechs raise capital (Block et al., 2018). Within this literature stream, regulatory sandboxes have a positive influence on sandbox participants' ability to access capital, as regulatory costs and uncertainty are reduced (compared to FinTechs that do not access sandboxes) (Alaassar et al., 2020; Cornelli et al., 2020; Goo and Heo, 2020). We thus contribute to this growing stream of studies by elucidating how regulatory sandboxes fundamentally operate and provide regulatory guidance. Similarly, implications can be drawn for research discussing the influence of sandboxes on FinTech ecosystems (e.g., Buckley et al., 2020; Mention 2019). Our study provides insights relevant to the spatial boundaries of FinTech ecosystems, as sandbox participants may have easier access to international jurisdictions.

Other important contributions we make include using the activity system framework (Zott and Amit, 2010) to explore novel incubation models, following seminal investigations by Pauwels et al. (2016). In doing so, we respond to calls by incubation scholars to employ theoretically based approaches when investigating incubation models' activities (Bruneel et al., 2012). We employed the activity system framework to investigate the value-creating activities of regulatory sandboxes and to identify value-creation drivers that emerge from the studied cases. By using this theoretical framework, we also contribute to the broader FinTech phenomenon that remains under-theorized and lacking in sufficient scholarly attention (Gimpel et al., 2018; Puschmann, 2017). Moreover, through this lens, we extend the scholarly understanding of regulatory intervention, building on recent FinTech studies that confirm supportive regulatory initiatives have a positive impact on firm formation (Haddad and Hornuf, 2019).

5.4 Implications for practice

Our research has important implications for different stakeholders on the FinTech scene, particularly regulators, policy-makers and innovators. Through this study, we inform regulators with established regulatory sandboxes about the similarities inherent in the activities of regulatory sandboxes, BIs and accelerators. This can help regulators develop more effective supervisory approaches by sourcing evidence-based knowledge from the established incubation literature stream. Additionally, we shed light on the presence of a predominant risk-based approach that may impede innovation testing – a more balanced approach could be devised to grant FinTechs flexible testing conditions. Active risk-gauging and innovation-friendlier thresholds would then be necessary. This is crucial to help regulators in their quest to offer effective support for novelties. As for regulatory authorities that are considering setting up a regulatory sandbox or improving established sandboxes, we provide a starting point that details the main activities undertaken by the world's most developed sandboxes. We also present a value creation driver that regulators employ. Introducing regulatory sandboxes to these jurisdictions can reduce the technology–regulation (knowledge) lag and help regulators to safeguard their financial markets.

From a policy perspective, this study is important, given the emergence of FinTechs and the need to find more effective regulatory approaches while ensuring the existence of business environments that are conducive to attracting FinTech ventures. Specifically, the identified differences in activities between sandboxes and incubation models (e.g., providing regulatory guidance, mediating access to international jurisdictions and increasing FinTechs' independence) are benefits that policy-makers can leverage to establish hospitable

environments for FinTechs. Our study informs policy-makers about the diversity in sandbox models arising from differences in their mandates and the need for this support instrument, with its unique service offering that contrasts with other incubation model services. Policy-makers in jurisdictions with established sandboxes would also benefit from the provided insights, better equipping them to formulate or amend risk protection and innovation support policies.

Finally, we inform FinTech innovators about the opportunities that sandboxes can offer, which include receiving regulatory guidance and access to testing opportunities across international jurisdictions. Additionally, regulatory sandboxes allow FinTech start-ups to avoid having to partner with banks simply to obtain financial licensing, as they can test and validate their solutions without a license and thus have a better chance of raising capital and attracting investors during the validity period. Hence, this study informs FinTechs about the flexibility of operating freely without committing to larger organizations when accessing regulatory sandboxes. More broadly, the design elements detail the activities conducted in sandboxes, giving FinTech newcomers an easy introduction to regulators' requirements from initial conversations to final reporting.

6 Conclusions

Regulatory sandboxes play an important role in stimulating entrepreneurial and innovative activity among FinTechs. However, previous research on this novel support instrument provides limited insight into its activities. Hence, we explored the activities that characterize regulatory sandboxes in order to discuss how these instruments differ compared to generic and specialized BIs and accelerators. Initially, our findings suggested that regulatory sandboxes operated in a similar manner. However, when investigating the nature of sandbox activities, we found differences that resembled in providing regulatory guidance, facilitating testing across international jurisdictions and offering FinTechs flexibility to operate in financial markets. On this basis, we have derived a set of theoretical propositions to guide future research exploring incubation models, including regulatory sandboxes.

6.1 Limitations and future research

No research is without limitations. In this final section, we suggest a future research agenda to extend the scholarship on regulatory sandboxes. In addition to the following suggestions, the propositions we put forward serve as a promising basis for future research. First, the empirical part of this paper is based on archival data sourced from webpages. Although this approach offers advantages like accessibility to documents from multiple sources, it also has drawbacks such as limited details and a lack of insights into practical

examples. This limitation provides opportunities for future scholarly work to collect primary data that is richer and focuses on practical experiences. Second, our sample was restricted to five leading regulatory sandboxes established in 2016. With the rapid increase in the number of sandboxes, we encourage future research to expand the sample size under investigation. Our findings revealed distinct regulatory sandbox models, allowing future investigations to focus on certain models rather than analyzing a heterogenous sample. Third, we explored sandboxes from the perspective of regulators, as the sample comprised documents issued by regulatory officials. To gain a deeper understanding of the incubation model of regulatory sandboxes, we urge future research to conduct a multi-perspective analysis, using our propositions as a starting point. Lastly, there is abundant room for future research to link the study of regulatory sandboxes to other streams beyond the incubation literature stream – for instance, to managing innovation collaborations or networks.

Acknowledgements

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Appendix 1: List of Archival Documents

Name	Pages	Codes
ADGM CP 2	14	7
ADGM CP 3	11	7
ADGM CP3 Annex A	3	2
ADGM CP3 Annex A_2	10	3
ADGM CP3 Annex B	13	4
ADGM CP3 Annex C	2	2
ADGM Digital Sandbox	3	4
ADGM Regulatory Laboratory Guidance	12	14
ADGM Sandbox Infographic	4	9
ADGM Welcomes 3rd Cohort with SME Focus	2	3
ADGM-Press-Release-3rd-Cohort	5	4
ADGM-Regulatory-Sandbox-Process	4	4
ASIC CP260	2	2
ASIC CP297	14	4
ASIC Government Proposal for New and Improved Sandbox	4	2
ASIC Licensing Exemption Infographic 1	1	2
ASIC Press Release	2	5
ASIC Report 508 Response to CP	20	4
ASIC Report 523 on RegTech	26	11
ASIC Report 543 Response to ASIC Report on RegTech	20	7
ASIC RG257	38	12
FCA Lessons-Learned-Report	21	8
FCA Press Release Cohort 4	5	3
FCA Regulatory Sandbox	23	11
FCA Regulatory Sandbox – Cohort 2	3	3
FCA Regulatory Sandbox – Cohort 3	3	4
FCA Sandbox-Testing-Parameters	1	6
HKMA CP Authorization of Virtual Banks	7	4
HKMA Fintech Supervisory Sandbox (FSS) webpage	4	6
HKMA Innovation Hub Release Letter	3	4
HKMA Press Release – A New Era of Smart Banking	2	4
HKMA Press Release – Fintech Supervisory Chatroom	2	3
HKMA Regulatory Sandbox Release Letter	3	2
HKMA Speech by the Deputy Chief Executive on RegTech	5	9
Hong Kong Launch Regulatory Sandbox Article	6	6
MAS CP005 on Regulatory Sandbox	19	4
MAS CP015 on Sandbox Express	14	4
MAS Regulatory Sandbox Guidelines	18	10
MAS Response to CP	110	8
Total	**459**	**211**

Paper D

Published in Technological Forecasting and Social change

Exploring how social interactions influence regulators and innovators: The case of regulatory sandboxes

Ahmad Alaassar, Anne-Laure Mention, Tor Helge Aas

Abstract Like incubators, regulatory sandboxes constitute a prominent mechanism to enable entrepreneurial activities that guide financial technology (FinTech) firms through regulatory frameworks in the financial industry. Because they are new, there is a lack of research on regulatory sandboxes; most studies have investigated legal aspects while overlooking the management perspective. To address this gap, this paper builds on incubation research studies to explore how social interactions within regulatory sandboxes influence the practices of regulators and regulatees, using social capital theory. An exploratory-abductive approach is adopted, using data collected from 16 semi-structured interviews. The findings indicate that regulator-regulatee social interactions increase the legitimacy, risk management capabilities, and knowledge of regulatory frameworks among regulatees and, as to regulators, increase their understanding of regulatory constraints and potential risks in enabling technologies, better inform them of regulatees' support needs, and offer them early access to regulatory innovations. The findings also reveal that the practices of regulators and regulatees may be negatively affected due to lowered trust and discrepancies in expectations and underlying goals. This research contributes to the incubation literature by focusing on the micro and meso levels of knowledge exchange and the entrepreneurial finance literature by promoting the role of incubation models.

1 Introduction

As enabling technologies like artificial intelligence, blockchain, and Big Data analytics have revolutionized industries including financial markets (e.g., Diaz-Rainey et al., 2015; Palmié et al., 2019), debates on the role of new players in supporting entrepreneurial financial technology (FinTech) firms in raising capital have emerged (Block et al., 2018). For instance, one stream of research has focused on investigating the influence of regulation on both traditional (e.g., Cumming and Schwienbacher, 2018) and non-traditional funding forms (e.g., Hornuf and Schwienbacher, 2017). Notably, non-traditional financing alternatives like crowdfunding (i.e. raising capital from the crowd) may not necessarily be aligned with

existing banking regulations (Navaretti et al., 2017), giving rise to legal issues and the need for regulatory change (Cumming, Johan, & Pant, 2019). In addition, attributable regulatory challenges appear to be barriers for FinTech firms due to the high cost of compliance and the consequences of non-compliance, a lack of regulatory knowledge, and legal uncertainty (Arner et al., 2015; Appaya and Jenik, 2019; Haddad and Hornuf, 2019; IOSCO, 2017; UNSGSA et al., 2019; Zilgalvis, 2014). As a result of these challenges, regulators have noted the urgent need to find new approaches to regulate financial markets and promote innovation (Jenik and Lauer, 2017). Among different safeguards, this study focuses on regulatory sandboxes as both a support and a policy instrument (Borrás and Edquist, 2013) adopted by regulators to stimulate innovation and competition while achieving broader goals like the stability of financial markets. Fundamentally, regulatory sandboxes grant licensing exemptions to participants so that they can test their solutions for a set period of time, subject to conditions imposed by regulators in each jurisdiction (Arner et al., 2016; Zetzsche et al., 2017).

Zetzsche et al. (2017) claim that regulatory sandboxes promote bi-directional knowledge exchange between regulators and market participants; it is through interactions with innovators that regulatory frameworks become more resilient and informed about financial market dynamics (Bromberg et al., 2017). In the present study, social interaction is described as a required mechanism for resource and knowledge transfer (Inkpen and Tsang, 2005). From a regulator's perspective, sandboxes provide an opportunity to test and learn how different regulatory practices influence participants (Arner et al., 2017), while participating innovators gain a greater "understanding of regulatory and supervisory expectations" (ESA, 2019, p. 5). These findings indicate that regulatory sandboxes influence both regulation and innovation. However, considering the novel nature of this instrument, there is lack of in-depth academic and non-academic management research on policy instruments (Martin, 2016), which may be due to the ad hoc nature of policy intervention (Patanakul and Pinto, 2014). Innovation management research has rarely investigated aspects of technological transformation in capital markets (Diaz-Rainey et al., 2015). We thus know little about how social interactions among regulators and innovators participating in regulatory sandboxes influence practices of regulators or regulatees. Accordingly, we still lack evidence regarding how sandboxes may enable FinTech firms in the entrepreneurial finance setting. To help address these gaps, we focus our research on the incubation stage—defined as a validation process to test developed ideas in the marketplace—instead of idea generation or scaling (O'Reilly and Binns, 2019) to conduct a qualitative study that systematically explores regulator-regulatee social interactions in the context of regulatory sandboxes.

This problem is important to investigate for the following reasons. First, fundraising for entrepreneurial ventures is gaining greater attention among policymakers at different levels (Block et al., 2018). Internationally, bans on novel fundraising forms like initial coin offerings (ICOs) cause spillover effects that hamper the diffusion of ICOs across countries, as financial trade inherently crosses borders, thus requiring an orchestrated regulatory approach (Bellavatis et al., 2019). Second, the economic impact of the FinTech phenomenon is growing significantly, with FinTech providers already having seized one-third of total banking revenues globally (Accenture, 2018). Third, FinTech initiatives and opportunities are continuously growing, and there is a pressing need for regulators to develop effective approaches like regulatory sandboxes to stimulate innovation while still ensuring financial market stability. Over 50 regulatory authorities worldwide have either established or announced a regulatory sandbox (see the overview in UNSGSA et al., 2019). Along these lines, regulators have started to modify current sandbox models, offering additional programs or changing current practices. For example, the Monetary Authority of Singapore (MAS) has recently launched Sandbox Express, while the Global Sandbox initiative is undergoing a cross-border pilot phase with eight FinTech participants (FCA, 2019a; MAS, 2019). Finally, neither regulators nor innovators necessarily know how FinTech innovations can comply with regulations in a heavily regulated industry; there is thus a need for a collaborative platform that facilitates experimentation and knowledge exchange regarding new solutions that comply with regulatory frameworks. We ground the importance of this study in these reasons, emphasizing the lack of knowledge on how regulatory sandboxes function in different contexts, how the relevant actors interact, how such social interactions influence innovation and regulation, and whether sandboxes deliver on the promise of fostering innovation.

Regulatory sandboxes as support instruments share similar objectives with incubation models like business incubators and accelerators, such as promoting innovative businesses through the provision of support services, and are currently being debated as new players in the entrepreneurial finance literature (Block et al., 2018). This study builds on the extant incubation literature, an emerging stream that investigates the role of support institutions and individual actors in the technology transfer process at the micro and meso levels (Cunningham and O'Reilly, 2018; Tsai et al., 2009). Specifically, we connect this research to conversations investigating the outcome of different interaction activities on enabling successful incubation (Bøllingtoft and Ulhøi, 2005; Díez-Vial and Montoro-Sánchez, 2016; Patton, 2014; Peters et al., 2004; Rice, 2002; Rubin et al., 2015; Scillitoe and Chakrabarti, 2010). For instance, from the perspective of tenants, Scillitoe and Chakrabarti (2010)

examine the influence of interactions among start-ups and incubator managers that enable knowledge sharing on business and technical support for new ventures. Similarly, Rubin et al. (2015) explore knowledge sharing among different incubator stakeholders, while Peters et al. (2004) investigate the impact of interactions on the incubation process from the perspective of incubator managers. These studies all find that incubator-incubatee interactions have a profound impact on the success of the incubation process by improving incubator practices and tenants' knowledge or capabilities. However, findings from incubation studies may not be readily transferable to the sandbox context due to its distinctive characteristics, including the fundamental role of regulators in protecting the stability of financial markets. The underlying question in the present study is thus whether regulator-regulatee social interactions can yield similar impacts in the context of regulatory sandboxes.

The objective of this study is to explore the following research question: How can regulator-regulatee social interactions influence practices of regulators and regulatees? To answer it, we use social capital theory (SCT) as a lens to understand regulator-regulatee interactions, mainly because knowledge transfer requires social interaction (Inkpen and Tsang, 2005; Zahra et al., 2000). With this study, we contribute to the incubation research stream by extending existing conversations on the influence of social interactions on entrepreneurial and innovative activities through theoretical propositions, offering opportunities for future research and implications for regulators and practitioners. Moreover, this study contributes to our understanding of novel technology transfer mechanisms such as regulatory sandboxes and the role of individual actors like regulators in facilitating those processes (Cunningham and O'Reilly, 2018). We thus extend contributions to recent studies in the entrepreneurial finance literature (e.g., Block et al., 2018; Cumming, Deloof et al., 2019) that highlight the growing importance of incubation models in bridging start-ups with funding sources. We also contribute to the FinTech literature, which has been criticized for being under-theorized, by discussing our findings in relation to SCT (Gai et al., 2018; Gimpel et al., 2018; Puschmann, 2017).

The paper begins by defining the FinTech phenomenon and regulatory sandboxes, followed by reviewing the relationship between regulation and innovation. We then review the literature on interaction activities in incubation studies and justify the use of our theoretical lens. A description of the qualitative research method is provided before we present the empirical findings and discuss them in relation to the theoretical lens. Finally, concluding remarks are presented, along with the main implications for research and practice, study limitations, and suggestions for future research.

2 Theoretical Background

2.1 The FinTech phenomenon and regulatory sandboxes

The present study understands FinTech as "technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services" (FSB, 2017, p. 7). While the use of technologies to provide financial services is hardly new, recent FinTech developments after the global financial crisis in 2008 are characterized by the use of enabling technologies by newcomers and by new services offered in both developed and developing markets (see an overview by Arner et al., 2017; Palmié et al., 2019). Gomber et al. (2017) propose a three-dimensional framework for synthesizing the FinTech literature. The first dimension represents business functions that include business-to-business and business-to-consumer models offering financial services across industries such as financing and insurance. FinTech firms can be divided into six solution areas: payment, wealth management, crowdfunding, lending, capital market, and insurance (Lee and Shin, 2018). The second dimension refers to enabling technologies like blockchain and artificial intelligence that support operational elements. The third dimension highlights firm types and encompasses start-ups, technology firms, and traditional banking institutions (Gomber et al., 2017).

Prior research has discussed the emergence of the financial service sector as resulting from the integration of disruptive technologies, indicating a more proactive role for regulators due to the increase in market participants and the need to find more effective regulatory approaches (Arner et al., 2017). Among the approaches commonly adopted by regulatory authorities, regulatory sandboxes and innovation hubs have gained the most attention (Appaya and Jenik, 2019; Arner et al., 2017; ESA, 2019). This engagement challenges the conventional role of government in fostering entrepreneurial activity (Doblinger et al., 2019). We narrow this study to focus on regulatory sandboxes, given the attention they have received and their rapid growth from their establishment in the UK in 2016 to more than 50 regulatory authorities that either operate or have announced a regulatory sandbox (FCA, 2017; UNSGSA et al., 2019). Regulatory sandboxes are novel types of customized support and policy instruments that provide eligible FinTech market participants, including start-ups, technology firms, and incumbents, with licensing exemptions to allow business model experimentation without exhausting firm resources (Teigland et al., 2018). These instruments are often initiated and operated by a government's executive branch, with a regulatory or monetary authority at either the state or national level; they are usually established following

public consultation to engage ecosystem stakeholders, with regulators welcoming feedback from the public (FCA, 2015). The literature distinguishes between three types of innovation policy instruments: regulatory, economic and financial, and soft instruments (see the overview by Borrás and Edquist, 2013). Thus, we may claim that regulatory sandboxes are purposive regulatory instruments that have the ultimate purpose of protecting consumers from potential risks and financial markets from systemic risks (Borrás and Edquist, 2013; Magnuson, 2018) while protecting sandbox participants against financial losses arising from violating protections laws (Lee and Shin, 2018).

Although regulatory sandboxes have gained attention among financial market participants, what a regulatory sandbox is and what can be achieved during participation are open questions. In a recent report, after three years of operating a regulatory sandbox, De Nederlandsche Bank (DNB) and the Dutch Authority for the Financial Markets (AFM) state that participants might have the misconception that regulatory sandboxes offer a legal free experimental space, which may cause confusion among market participants (DNB and AFM, 2019). Additionally, a survey by the Consultative Group to Assist the Poor (CGAP) and the World Bank Group report that a lack of human resources and technical knowledge were the greatest constraining factors preventing regulators from promoting innovation in financial markets, even as some jurisdictions had committed substantial human resources to operate regulatory sandboxes (Appaya and Jenik, 2019). Furthermore, when enabling technologies are applied in novel ways like cryptocurrency payments, regulators openly state that supervisory rules can be unclear for both participants and regulators (DNB and AFM, 2019). These limitations may explain why jurisdictions like Singapore (three sandbox participants) and Australia (seven) have lower numbers. Notably, despite low participation and acknowledged drawbacks, regulatory authorities in developed economies have not given up; rather, they have made improvements to attract more applicants. For instance, MAS launched the Sandbox Express to streamline the application process. An estimate of 522 market participants applied to sandboxes around the globe, with 200 being accepted (Appaya and Jenik, 2019). Despite the increasing importance of these instruments from the perspective of regulators and market participants, this phenomenon has remained largely ignored among researchers, particularly in management research.

2.2 Relationship between regulation and innovation

This section reviews what we know about the relationship between regulation and the management of innovation in financial services. This is important to consider because FinTechs have disrupted the strategies, organizational capabilities, and culture of traditional

financial institutions through the innovative application of enabling technologies. However, as financial markets are highly regulated, the role of regulators is more prominent than in other sectors, requiring regulatory authorities to strengthen their understanding of FinTech-related technologies to facilitate innovation instead of impeding it (Mention, 2019). In addition to having regulators reconsider their governing mechanisms, market participants need to operate and comply with regulatory frameworks in novel ways (Milian et al., 2019). Hence, technological transformation cannot be viewed in isolation from regulation, which can either enable or impede change in capital markets (Diaz-Rainey et al., 2015).

Several studies have focused on regulatory changes in financial markets due to increased FinTech participation (Mazzucato, 2013; Ng and Tang, 2016; Tapiero, 2014; Weihuan et al., 2015). For example, Hornuf and Schwienbacher (2017) explore the impact of securities regulation on crowdfunding in different jurisdictions, arguing that leaner and better tailored regulations are required to support equity crowdfunding, which affects the creation and growth of small businesses. All these studies attest to the positive influence of regulatory practices on innovative activities (Patanakul and Pinto, 2014). Haddad and Hornuf (2019), for example, confirm that regulations in the form of compliance and administrative burdens have a significant impact on the growth of entrepreneurial FinTech firms. However, regulatory intervention can have a negative impact on innovation by inhibiting productivity or market entry (Cumming and Schwienbacher, 2018; Patanakul and Pinto, 2014).

In the same manner that regulatory intervention influences innovative activity, the potential influence of FinTech innovators on regulators has also been discussed (Arner et al., 2017; Zetzsche et al., 2017). Specifically, regulators can acquire knowledge of different business models and gain a better understanding of technological elements (Zetzsche et al., 2017). This knowledge can facilitate changes to regulatory policies (FCA, 2017). Regulators' engagement with FinTech innovators provides insights into the complex risks, key opportunities, and current and future challenges associated with FinTech innovations (ESA, 2019). These findings imply that innovators influence regulators, which in turn leads to changes in regulatory mechanisms. The main barriers hindering regulators from offering sufficient support to innovation were identified as a lack of human resources, regulatory constraints, and gaps in technical knowledge (Appaya and Jenik, 2019). We thus argue that innovators can influence regulators' technical knowledge and improve their ability to respond to innovation. However, there is currently no systematic evidence in the literature that provides detailed insight into how regulatory practices change as a result of social interactions with FinTech innovators—or vice versa—which is what we explore in this empirical study.

2.3 Interaction in incubation studies

Business incubators commonly share the purpose of promoting new firm creation, entrepreneurship, and innovation (Hackett and Dilts, 2004; Theodoraki et al., 2018). They "have become a popular policy option and economic development intervention tool" (Lasrado et al., 2016, p. 205) and have recently been recognized as new players in the entrepreneurial finance arena, apart from venture capitalists or business angles, by providing support in the form of access to networks or other value-added services (e.g., Block et al., 2018; Cumming, Werth, & Zhang, 2019). Prior incubation literature emphasizes the prominent role of social interaction to promote successful incubation (Bøllingtoft and Ulhøi, 2005; Díez-Vial and Montoro-Sánchez, 2016; Patton, 2014; Rice, 2002; Rubin et al., 2015; Scillitoe and Chakrabarti, 2010).

Incubation studies have not only investigated interactions among incubator staff and tenants but have also extended the discussion to include a diverse set of stakeholders in different networks, including interactions between universities and industry (Alexander et al., 2018; Santoro and Chakrabarti, 2002), universities and start-ups (van Stijn et al., 2018), and universities and spinoffs (Soetanto and van Geenhuizen, 2019). Such interactions provide access to tangible and intangible resources like physical, social, and financial capital, knowledge, and legitimacy (van Weele et al., 2017). Along similar lines, studies have employed the construct of engagement to represent access to resources in dyadic settings (Perkmann et al., 2013).

The extant literature provides evidence on the influence of interactions. For instance, using the theoretical lens of absorptive capacity and a social network approach, Díez-Vial and Montoro-Sánchez (2016) examine how ties among research centers and co-located firms influence innovative activity in science parks and confirm that knowledge sharing among these actors significantly promotes firms' innovative capability. Specifically, they find that formal and informal interactions contribute to creating a trust-based environment in which partnerships evolve to foster knowledge sharing. In a similar study using absorptive capacity theory to look at university incubators, Patton (2014) explores incubator-incubatee interactions to assess their influence on founders' knowledge acquisition; his findings confirm that such interactions enable iterative dialogue which subsequently stimulates absorptive capacity. In another stream of research that employs SCT, Bøllingtoft and Ulhøi (2005) explore mechanisms that facilitate networking in "network incubators" as novel incubator models that are distinct from the traditional model. Their findings suggest that trust

is an underlying mechanism between individuals and agents in network incubators in enabling networking and cooperative interactions (Bøllingtoft and Ulhøi, 2005).

We thus find in the literature widespread agreement on the influence of interaction among incubators and tenants in different incubation models. The construct of social interaction is selected as an appropriate lens to explore activities that occur in regulatory sandboxes on the basis of findings that propose sandboxes as a testing arena for regulators and innovators (Arner et al., 2017) that allows those involved to exchange knowledge (Zetzsche et al., 2017). Other fields of study, such as organizational learning, also confirm the positive influence of regulator-regulatee interactions, suggesting that they allow "regulators and organizations to exchange knowledge and information regarding best practices within the industry, discuss potential refinements to operating procedures, and collectively diagnose and troubleshoot problems within organizational routines" (Desai, 2016, p. 639). Specific to incubation studies, Peters et al. (2004) investigate tenants' influence on the incubation process, reporting that incubator managers learn about the needs of their tenants through interaction, enabling them to redesign their processes and incubation services appropriately.

In the incubation literature, despite some research that examines industry-specific business accelerators focused on financial markets (e.g., Pauwels et al., 2016), there is a lack of management research that explores social interactions with actors like public agencies, investors, and larger organizations (Baraldi and Havenvid, 2016). Pauwels et al.'s (2016) investigation of the incubation model of accelerators in Europe includes a single FinTech support instrument (the FinTech Innovation Lab) in its sample of 13 accelerators. However, that accelerator is driven by an industry actor and is thus a poor comparison for publicly led regulatory sandboxes. On this basis, we argue that existing evidence on interaction activities in incubation studies provides only limited insights due to the distinctive characteristics of regulatory sandboxes, such as the role of regulators to monitor and enable innovation, being governed by regulatory authorities, offering licensing reliefs, and regulatory support, and other contextual factors that have different levels of influence on regulator-regulatee social interactions.

2.4 Regulator-regulatee social interactions

For this study, we conceptualize regulator-regulatee social interactions as an enabling activity among regulators and sandbox participants that affects both groups and their practices (Nonaka, 1994; Zott and Amit, 2010). Regulators' practices include the assessing, monitoring, and supervising that are undertaken during social interactions with regulatees or other stakeholders in the sandbox context. These activities may influence regulators'

knowledge and understanding of enabling technologies. To support this view, we find evidence that a lack of technical knowledge is a barrier for regulators in effectively supporting innovation (Appaya and Jenik, 2019). In addition, we have found that regulatory sandbox initiatives have evolved since their establishment as a result of lessons learned (FCA, 2017), which has led to the enhancement of regulatory sandboxes in several jurisdictions including Abu Dhabi's Digital Sandbox and Singapore's Sandbox Express (Duff, 2019). We may argue that these changes have occurred due to regulator-regulatee social interactions that have improved regulators' practices. For the second construct, we define practices of regulatees as testing and validation activities of financial solutions in which FinTech innovators engage with domestic or international regulators to develop innovative and legally compliant solutions in the context of regulatory sandboxes. As a result of regulator-regulatee social interactions, we may argue that sandbox participants develop their knowledge and capability base.

2.5 Theoretical lens for understanding regulator-regulatee interactions

To gain a deeper understanding of regulator-regulatee social interactions and support our discussion section, this paper employs SCT. This theoretical lens is selected given that social capital, understood as a set of relationships for a network actor, "plays a critical role in the transfer and exchange of network knowledge" (Inkpen and Tsang, 2005, p. 154) across different analytical levels, including the individual, the organization, and the broader society (Eveleens et al., 2017). More importantly, empirical evidence suggests that knowledge transfer is facilitated by social interaction (e.g., Zahra et al., 2000). Another reason for selecting this lens is that social capital has been identified in incubation studies as an important intangible form of capital that gives access to knowledge sources; however, there is limited knowledge of the social aspects of incubation (Scillitoe and Chakrabarti, 2010; Tötterman and Sten, 2005). Nonetheless, SCT is commonly applied to investigate the impact of social capital dimensions in other relevant settings like university-industry collaboration (Al-Tabbaa and Ankrah, 2016; Grzegorczyk, 2019) and enablers of innovation capabilities (Camps and Marques, 2014).

The underlying assumption in SCT is that network connections provide access to resources encompassing three main dimensions: structural, relational, and cognitive (Inkpen and Tsang, 2005; Lee, 2009; Nahapiet and Ghoshal, 1998), thus contributing to the actor's knowledge, value creation, and performance (Eveleens et al., 2017; Tsai and Ghoshal, 1998). The structural dimension refers to the position of an actor in a network characterized by network interaction and configuration in terms of ties, connectivity, density, frequency of

contact, and hierarchy. The relational dimension reflects normative behaviors and includes aspects like trust, norms, obligations, and expectations to guide network connections. Establishing norms and building trust-based relationships are important factors in creating a conducive environment for collaboration and knowledge exchange. Finally, the cognitive dimension relates to the communication context and includes shared goals, culture, language, and codes. This includes having a common understanding of desired outcomes, beliefs, and narratives of best practices, along with sharing knowledge through common language and codes (Inkpen and Tsang, 2005; Lee, 2009; Nahapiet and Ghoshal, 1998). The cognitive dimension thus promotes value creation by enhancing knowledge transfer and firm capabilities among network actors (Theodoraki et al., 2018).

Building on Inkpen and Tsang's (2005) conceptualization of social interactions as a locus for knowledge exchange, this study empirically explores the underlying role of network knowledge transfer in changing the practices of regulators and regulatees as outcomes. To achieve this, we employ the three dimensions of SCT: structural, relational, and cognitive. Figure 1 outlines our preliminary analytical framework that guides this study.
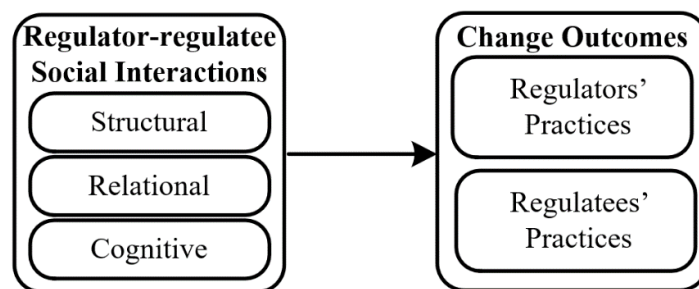

Figure 1: Preliminary analytical framework.

3 Research Design

We adopted a qualitative research design in the form of an exploratory-abductive approach (Dubois and Gadde, 2002; Dubois and Gadde 2014) to develop new explanations through theoretical propositions. This approach was selected as it is well-suited to study a new phenomenon with limited academic knowledge and to discover new theoretical relationships (Dubois and Gadde, 2002).

3.1 Sampling

A purposive sampling procedure was applied to recruit participants associated with regulatory sandboxes in different locations (Patton, 1990). We aimed to sample (1) regulatory sandboxes that were operating and had at least one participant, whether currently enrolled or graduated, and (2) sandbox participants that were either engaged in a sandbox when we conducted the study or had been so in the previous three years. These selection

criteria were used to determine the suitability of regulatory sandboxes, regulators, and sandbox participants based on information provided on regulatory sandbox webpages. A total of 15 regulatory sandboxes were identified as relevant, including the UK Financial Conduct Authority (FCA), Abu Dhabi Global Market (ADGM), MAS, Hong Kong Monetary Authority (HKMA), and Bank Negara Malaysia (BNM). All the regulators identified were contacted using the email addresses provided on their websites. Of the regulatory authorities we contacted, nine responded to seek additional information. Following several email correspondences and in some cases multiple phone calls, six regulators from five jurisdictions agreed to be interviewed. Additionally, one financial specialist from a global observer organization actively involved in the regulatory sandbox scene agreed to participate. In general, the interviewees were proposed by the regulatory authorities and had different roles; Table 1 outlines the interviewed regulators.

	Role of Informant	Participant Code	Regulatory Jurisdiction	Launch Year of Sandbox
1	Financial Specialist	R-1	North America	-*
2	Regulator	R-2	North America	2017
3	Senior Regulator	R-3	Europe	2017
4	Senior Regulator	R-4	Oceania	2016
5	Executive Director	R-5	Europe	2018
6	Senior Manager	R-6	Asia (MENA)	2017
7	FinTech Specialist	R-7	Asia (MENA)	2017

*Global observatory organization; MENA: Middle East and North Africa

Table 1: Description of Regulators.

As for sandbox participants, most regulators provide the names of participating firms on their websites. Using this as a starting point, LinkedIn searches and profile screening were undertaken to identify and contact informants who met the selection criteria. Additionally, we manually searched for informants with roles like (co-)founders, CEOs, and compliance managers of firms participating in sandboxes: start-ups, technology firms, and financial institutions. A total of 87 sandbox participants were contacted through LinkedIn's mailing feature; further communication was made through personal email with 22 sandbox participants who expressed interest and requested additional details. Eventually, nine informants agreed to participate, with the remainder either declining due to limited capacity or failing to reply further. In sum, the selection approach led to interviews between November 2018 and September 2019 with 16 participants (9 regulates, 6 regulators, and a single financial specialist) residing on 4 continents and associated with 11 regulatory jurisdictions. Table 2 provides an overview of the regulatees.

	Role of Informant	Participant Code	Fintech Classification	Regulatory Jurisdiction	Phase in Sandbox
1	Founder and Policy Manager	SP-1	Insurance	Europe	Operation
2	CEO and Co-founder	SP-2	Payment	Europe	Graduated
3	Executive Manager	SP-3	Payment	Asia (MENA)	Operation
4	CEO and Founder	SP-4	Insurance	Europe	Graduated
5	CEO and Founder	SP-5	Insurance	Asia	Operation
6	Director of Regulatory and Policy	SP-6	Other – identity	Europe	Graduated
7	CEO	SP-7	Lending	Europe	Operation
8	Head of Compliance	SP-8	Payment	Asia	Graduated
9	Vice President Operations	SP-9	Capital market	North America	Operation

Table 2: Description of Regulatees (sandbox participants).

3.2 Data Collection

For data collection, the interviews followed a semi-structured format, conducted via Skype calls (6 of 16 were video calls) that lasted approximately 40–60 minutes each and were recorded. All interviews were conducted in English, with transcripts developed from the recordings. Since different stakeholders were involved, the pre-defined set of open-ended questions was adapted to explore experiences from the perspectives of both regulators and regulatees. In general, the questions focused on understanding the nature, purpose, and frequency of the social interactions that occur at different stages and how such interactions have influenced practices of either regulators or regulatees or both. These stages begin with social interactions prior to testing, interactions during testing, and interactions after graduation from the sandbox. The interview guides for both regulators and sandbox participants are attached in Appendix B.

3.3 Data Analysis

For data analysis, we followed the Gioia method in part; in its original form, it provides a two-step process of systematic reduction of categories with 1st order concepts and 2nd order themes that are more abstract, followed by aggregated dimensions (Gioia et al., 2013). However, since this study adopts an abductive rather than an inductive approach—informing us about prior research while relying on a theoretical framework to guide further analysis—we inverted the data analysis procedure described by Gioia et al. (2013) to begin with the SCT dimensions. However, the abductive approach, unlike deductive and inductive reasoning, facilitates the process of systematic combining that requires the researcher to alternate between the empirical reality, literature, and theoretical framework (Dubois and Gadde, 2002; Dubois and Gadde, 2014). Thus, using the SCT as a lens for analysis, we began by considering whether relevant theoretical concepts commonly related to the structural, relational, and cognitive dimensions could be connected to the categories that emerged from

the coded data to provide a certain level of understanding. This represents the first round of coding (1st order concepts), a continuous process that varied throughout data analysis. For the second round of coding that resulted in 2nd order themes, we coded emergent themes from the interview data to create new categories, while shifting between the data, theoretical framework, and analysis (Dubois and Gadde, 2002). As we progressed through the data, more patterns were identified, and categories were distilled. Further, we refined the last set of categories, labelling them with terms based primarily on theoretical constructs from SCT. Accordingly, we continually evaluated whether the categories acquired could be related to theoretical concepts that are either nascent or well-established in the SCT literature. In a final procedure, we cross-referenced the theoretical concepts against the SCT dimensions, which were also labelled aggregate dimensions (Gioia et al., 2013). Triangulation was achieved by analyzing multiple perspectives (Patton, 1990). NVivo 12 was used to facilitate the analytical procedure (Gaur and Kumar, 2018).

4 Findings and Discussion

In this section, we present the key findings that emerged from the analyzed data in the context of regulatory sandboxes. We further discuss the research question—How can regulator-regulatee social interactions influence practices of regulators and regulatees?—with respect to the SCT dimensions. Based on this discussion, theoretical propositions are offered as suggestions for future research. Figure 2 illustrates the data structure that was established from the analysis. Also attached in Appendix A is a table that outlines the concepts and themes, supported by illustrative quotes that emerged from the data analysis.

4.1 Structural Dimension

4.1.1 Network ties

In regard to how actors are related in the networks explored, two categories emerged from the interview data: i) regulatees' and regulators' partnerships and ii) regulator-regulatees' follow-up post sandbox exit.

For the first category, our findings indicated that regulatees have access to either formal or informal networks to obtain information or access to specific resources. These networks are established for a variety of purposes, including partnering to strengthen operational aspects or service base, community engagement, and establishing ties with the regulators. We also found evidence that regulators can either directly or indirectly influence regulatees' network ties. Directly, this is reported to happen through email introductions to cross-border regulators; indirectly, it can occur by improving the legitimacy of regulatees through press

releases or when regulators showcase a sandbox participant as a case study during presentations to external audiences, all of which attracts more investors and facilitates access to other network ties. The following quote supports this finding: "By being in a sandbox, investors look at us in a friendlier way as it provides some assurance and guidance which helps with the fundraising process and reassures customers of the quality of our offering, hence having the 'stamp of approval,' from the regulator" (Sandbox participant [SP]-4). Theoretically, these findings reflect how social capital established in the regulatory sandbox context can help regulatees access external networks because they appear more trustworthy, thus reducing network entry barriers and influencing the order of social exchange (Nahapiet and Ghoshal, 1998). These findings accord with those observed in the existing incubation literature, which indicate that incubators provide intangible resources like added legitimacy (Bruneel et al., 2012; Tötterman and Sten, 2005). Hence, with respect to the regulatory sandbox context, these findings deepen our understanding of how regulators support sandbox participants in their validation efforts as they gain legitimacy and acceptance, making them more attractive for both investors and consumers. This is particularly important for certain types of FinTech firms such as blockchain-based crypto funds because they are generally less trusted by regulators and thus less appealing to investors.
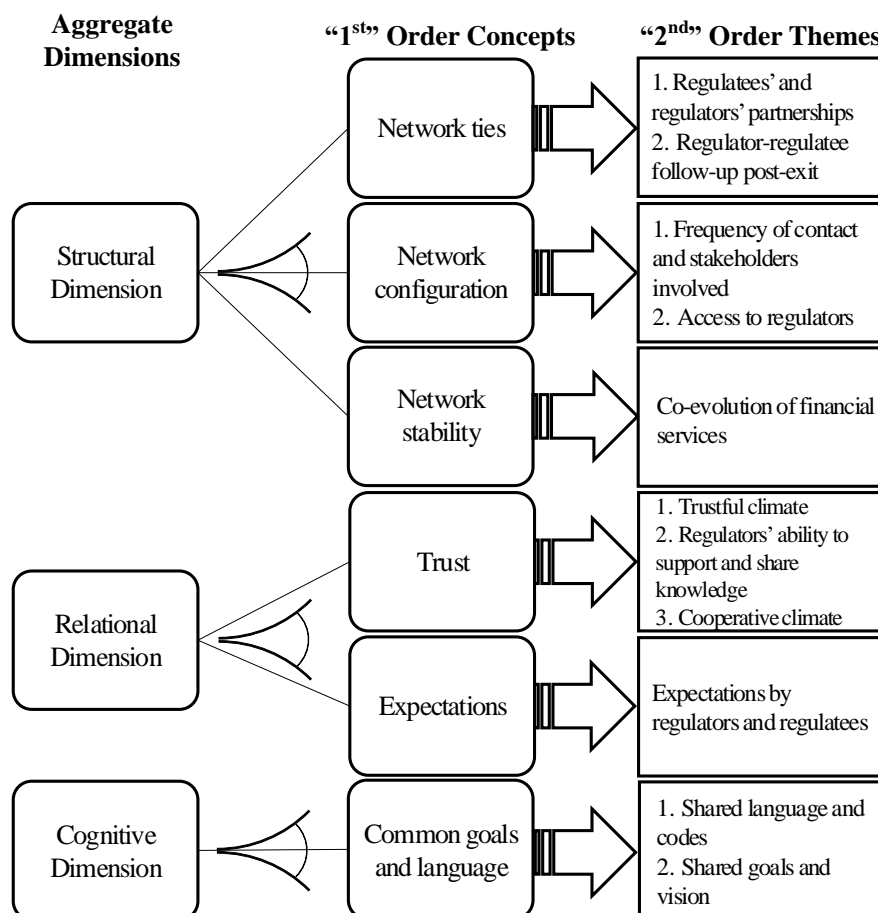

Figure 2: Data structure.

Regulators also reported diverse formal ties with other regulators operating internally in different departments within the broader regulatory jurisdiction to discuss existing rules as a result of issues arising during their interactions with regulatees. This is reflected in the following: "We [regulators] involve the ministry of finance, and we also contact the European Commission, European Banking Authority, or European Securities and Markets Authority, to highlight if certain technologies used in a certain way that some type of rules might not be sufficient or that they did not fit very well to these new situations, that they might not be proportionate in certain ways" (Regulator [R]-3). These findings are significant to the overall study because they describe how regulators exchange knowledge about new technologies.

The second category, regulator-regulatees' follow-up post-exit, represent an ongoing relationship in which regulatees benefit from access to regulatory advice and networking opportunities with both domestic and international regulators through cross-border collaboration agreements, allowing regulators to refer sandbox participants to other regulatory jurisdictions. From the regulatee perspective, this is reflected in the following: "Upon approving us with the full licensing, they [regulators] have been very cooperative assisting us with diverse reporting. They assisted us in a very positive manner, answering emails or phone calls in a timely manner. This also applies to all the regulatory departments that we dealt with. Also, along the way, we are required to report any incidents that happened in the company" (SP-8). At first, this finding seemed to contradict the suggestion in previous studies (e.g., Tötterman and Sten, 2005) that social relationships post-incubation gradually disappear, which is clearly not the case in the regulatory sandbox setting, where the longest relationship was reported to have lasted more than two years after exiting the sandbox. That said, one possible explanation for this finding is that relationships continue due to perceived mutual benefits and responsibilities. For instance, regulators might want to keep an eye on the activities of nascent market participants, as regulators are fundamentally responsible for the stability of financial markets. We found support for this explanation in the analyzed data, which indicated the importance of regulators' continuing their engagement to monitor regulatee activities. One interviewed regulator put it as follows: "What we're trying to do is, because during the testing period, we have continuous relationship, and during that period, the firm is restricted for example with the number of clients, number of transactions, and value of transactions that they can take. Once we give them the unrestricted license, they're open to do everything else, we don't just let them go without any supervision. We try to still do some sort of continuous update, continuous meetings, to see how the firm is adapting with

scaling up in their business" (R-6). Based on the above discussion, we suggest these two propositions:

P1a: Regulator-regulatee social interactions increase regulatees' legitimacy among investors and consumers, thus positively affecting their validation practices.

P1b: Knowledge exchanged during regulator-regulatee interactions increases regulators' understanding of the legal constraints and risks arising from enabling technologies, resultantly improving monitoring practices.

4.1.2 Network configuration

As to interaction patterns between network actors, two categories emerged from the data: i) frequency of contact and stakeholders involved and ii) access to regulators in financial markets.

In general, as a means of communication, most regulator-regulatee social interactions occur remotely, via email and the telephone, although some participants reported that regulators host face-to-face meetings or visit market participants at their offices. These engagements are for reporting, monitoring, guidance, or follow-up purposes on a routine or ad hoc basis and vary from case to case, depending on the approaches adopted in a given regulatory jurisdiction. The multiple facets of engagement with diverse sets of regulators were also made clear, with one respondent stating that, "we were meeting with different people on the regulator side, the innovation team, and the AML [anti-money laundering] compliance team" (SP-2).

In terms of frequency of contact and stakeholders involved, the analyzed data suggested that interaction frequency varied widely, depending on a regulatee's testing progress, its FinTech classification, and—most importantly—which regulator was involved. For instance, we found evidence that proactive regulators would contact a regulatee on a weekly basis for follow-up conversations. In another case, conversations occurred once every quarter; there, the FinTech participant was testing a cryptocurrency fund. Interestingly, four regulators operating in other jurisdictions highlighted that they would normally closely monitor this type of FinTech due to the risks and consequences associated with cryptocurrency. Confirming that these interactions could vary in purpose as noted above, one regulatee reported the following: "Much of our engagements are for monitoring and following-up, and little or no guidance. We do bi-monthly reports on progress, on sales, on technology developments, etc. We give feedback to [the regulator] on how that's gone. Then intermittently we will have meetings with them" (SP-5). Another experience from a

graduated sandbox participant reflects a more dynamic relationship with the regulator: "We submitted a very limited sheet of information … twice a month, and we also had 30 minutes call every two weeks just checking in on how things were going. However, towards the end we even moved these calls to a monthly catch up, because there was not that much happening in terms of customer traction" (SP-4). Building on this, from a regulatory perspective more clarity is provided about the frequency of social interaction and how it changes during the regulatory sandbox process: "Our interaction with the firm will be very high leading up to an issuance but might tailor off at the end of an issuance while they work on any findings from that activity, and then we'll ramp up again. So, the way in which we approach the testing period is not standardized. There are key components, for example around AML [anti-money laundering] requirements, KYC [know your customer] and everything related to financial crime compliance that we take very seriously and monitor throughout, and then there will be certain components that will be tailored throughout the period" (R-7).

With reference to previous research, we now present a possible explanation for the above findings. From the SCT literature, we know that frequent and close interactions enable knowledge sharing and relationship building (e.g., Tsai and Ghoshal, 1998). While this study is unable to clearly demonstrate whether trustworthiness between regulators and regulatees increases over time, we found from the analyzed data that, in cases with more frequent and direct interactions, regulatees perceived their engagements with regulators more positively than those who had fewer interactions. Frequent interactions may create stronger ties that allow regulators to understand regulatees' needs and challenges and enable regulatees to learn more about regulation and possible pitfalls to be avoided. These findings confirm and extend prior incubation work (Rice, 2002; Scillitoe and Chakrabarti, 2010).

For the second category of access to regulators in financial markets, we found that regulatees reported ease of contact with local regulators, whether prior to acceptance or after graduation. In the former case, regulatees reported positive reception and encouragement when they engaged with the regulator to understand the various regulations that they would need to observe and to understand the regulator's appetite for engagement. In addition, regulatees reported meeting regulators at industry conferences or FinTech-related events. Interestingly, most regulators reported the existence of multiple points of engagement that market participants could use to interact with the regulator, emphasizing that regulatory sandboxes are only one part of the overall regime. For instance, one regulator stated, "we are the regulator, but there's also [another] authority, and they run an accelerator program, and there's one other accelerator program that operates out of that authority. We engage with both of them. We also have a quite far-ranging internal innovation program; it looks at how

we as a regulator can facilitate the wider ecosystem, not just by looking at regulated entities and not just through working as a sandbox" (R-7). Moreover, the empirical findings suggest that most participants at some point during the testing or immediately after graduation would initiate conversations with regulators in other countries. The findings presented here are consistent with seminal social capital research (e.g., Nahapiet and Ghoshal, 1998) indicating that the number of channels determines the time and expenses associated with gathering information. Building on this, a possible explanation for these findings may be due to financial market innovators having high level of contact and access to these networks from diverse points, which means better accessibility and easier knowledge sharing. However, we further argue that, with the increase in market participants, resource constraints will limit the ability of regulators to provide timely support, which could encourage market participants to find more accessible networks elsewhere. We found support for this explanation in the data, as one regulatee put it: "At the end, we decided actually … [to] go through a regulatory partner to basically rent a license … helping us in terms of regulations, how to do compliance" (SP-7). It can thus be suggested that:

P2: The frequency of regulator-regulatee interactions positively affects regulators' understanding of regulatees' support needs and regulatees' understanding of regulatory frameworks.

4.1.3 Network stability

With respect to changes in networks, the findings fell into a single category: the co-evolution of financial markets. The findings suggest that regulator-regulatee social interactions contribute to regulators' and regulatees' understanding of how new technologies function and how they fit into or link with existing regulations. Additionally, engagement between regulators and ecosystem actors revealed the role of regulatory sandboxes in ecosystem building, which could result in broader changes to legal systems and financial market stability. Based on comments from a graduated FinTech start-up that shared its role in changing regulations, our findings suggest the transformation of existing regulatory frameworks and related policies. According to the informant, a change in regulation was required to overcome obstacles that arose when the firm wanted to extend its operations across multiple jurisdictions, including Vietnam and Japan: "In the case of Japan, we developed a new mechanism that is electronic for identity verification. We presented a proposal for them [the regulator], to consider it equivalent to the current method [prescription based, specifying 'how' regulations should be achieved rather than 'what' in the case of countries like the UK]. We needed both the police and the regulator to agree. To achieve that

infusion of that new technique into the current setting, they [the regulator] created a regulatory sandbox to allow that to be tested. But the regulatory sandbox formation required a new law. That was prepared, and we were consulted several times on preparation of that new law. So, that required a different type of change; it required a new law" (SP-2). Conversely, we learned of cases in which the regulators were less willing to make regulatory changes. According to one regulatee, "there are a lot of regulatory rule books that were written decades ago, which are in part outdated and could use a refresh, but they [regulators] don't do that easily … instead they [regulators] are writing up a report every now and then highlighting lessons learned" (SP-4). Notably, however, our findings suggest more powerful implications for regulators from sandbox participants: "We were telling them [the regulator], for us to be effective and for you to be effective in achieving your goals … we need you to talk to other regulators. Play cross-border scenarios. Because trade is cross border. So, we need to define the rules of engagement with other regulators. It took a while, but they set up a global sandbox; this is the example of how they [regulators] evolve based on the feedback they get from the industry" (SP-2).

Moreover, all informants stated that they learn about technology, regulatory frameworks, and the risks involved, providing growth opportunities to financial markets. Specifically, these social interactions allow regulators that are not up to date on technological developments to understand the risks and opportunities associated with new technologies. For instance, one informant stated, "the officials on the regulator side are all experienced people … in the sense that they are quite old and very confined to the normal way of transferring money of what they have been auditing of all these bricks-and-mortar companies. When it comes to us being a sandbox player, they learned how we try to conduct a transaction without having to see the customer via face-to-face, and what departments and skillset we have in the company to make sure a seamless process can be done.… They [the regulators] can't see this in the bricks-and-mortar companies" (SP-8). Our findings show that regulators benefit from interactions in diverse ways: "We are able to see how this technology affects preexisting business models.… That allows us to become comfortable and to assess what risks are emerging and which are diminishing, because typically what we tend to find is that if you come out and you're using smart contracts, that use of smart contracts means that maybe there's less of a legal risk or an execution risk on certain activities, but equally, then there's a new operational risk because you have to account for the smart contract technology and how that works. We look at how that shifts the risks that the market would be exposed to. This allows us to have firsthand knowledge that helps inform our policies going forward" (R-7).

Further, our evidence indicates that regulatory sandboxes operate as a catalyst for the development of both local and non-local ecosystems. Locally, regulators engage with ecosystem actors like academic institutions, industry partners, and FinTech hubs to design and develop new approaches that facilitate sandbox practices. An example of engagement with academic institutions is reflected by one regulator: "We have a strong relationship with the Technical University … to work on certain blockchain experiments … these experiments show how and what the technical barriers or the incapability of blockchains still are. So that helps us with our technical knowledge on these topics" (R-3). Notably, these engagements can also lead to the creation of regulatory roadmaps and legal requirements as a way to cope with the novel application of enabling technologies. For instance, one regulator from the MENA region said that crowdfunding regulation frameworks and requirements were recently developed for investment-, equity- and loan-based crowdfunding platforms, after engaging members of the FinTech ecosystem that operate in this niche area to understand their market needs and strive to meet them. Another regulator added that "what a lot of the time will happen is that we give additional guidance; let's say I have 50 requests from market participants, and they all look very similar. What we will do is provide additional information sheets or develop policy in a particular area, for instance on cryptocurrencies. Simultaneously, we might update our existing public guidance based on advice questions received" (R-4). Our findings also reveal regulators' engagement with non-local ecosystem actors, as is demonstrated in the following statement: "We are very active in the international regulatory sphere. We sit on the Coordination Group, which is the board of GFIN [a global sandbox initiative] ... and we are involved in cross-border testing. We also do bilateral work with developed and emerging economics to discuss how our regulatory sandbox experience has been and share thoughts on different challenges that we're facing with FinTechs or solutions we've found" (R-7).

In reviewing the social capital literature, little evidence was found on network stability. That said, prior research indicates that higher degrees of network instability (i.e., changes in membership) might constrain social capital creation opportunities (Inkpen and Tsang, 2005). In regulatory jurisdictions that have established new regulations or initiatives like the Global Sandbox, we may argue that networks are highly stable because actors are joining the network, which increases rather than limits networking opportunities. For instance, when the Global Sandbox was proposed in mid-2018, 11 regulatory jurisdictions were involved. A few months later, after its establishment, the number of members in regulatory and observer roles had more than doubled; as of mid-2019, the network had 38 members. In addition, eight global sandbox participants are part of a cross-border pilot project (FCA, 2019b). More

broadly, we may also argue based on the analyzed data that, given the level of regulators' commitment to stimulate innovation, regulator-regulatee networks are stable, offering opportunities for social interaction, as barriers to network entry are lowered through supportive policies and regulatory instruments. In addition, our findings demonstrate how regulators' engagement with ecosystem actors like sandbox participants, industry actors, and international regulators enables them to develop more effective approaches for the FinTech community, to become more informed about risks associated with new technologies, and to craft ways to change existing frameworks or create new ones. Regulatory sandboxes thus play an important role in nurturing local and non-local FinTech ecosystems. However, as the FinTech phenomenon remains in its nascent stages, there is insufficient evidence regarding how the stability of these networks will evolve, which provides opportunities for future research. Based on the discussion above, we offer the following proposition:

P3a: Regulator-regulatee interactions positively affect regulators' access to regulatory innovations.

4.2 Relational Dimension

4.2.1 Trust

As to regulators' and regulatees' willingness to share knowledge during their interactions, three categories emerged from the analyzed data: i) trustful climate, ii) regulators' ability to support, and iii) share knowledge and cooperative climate.

For the first category, the empirical findings reveal that the regulator-regulatee relationship may be trust-based, allowing sandbox participants to test their business models without fear of sanction. We found support for this statement in the following: "We're able to test out any kind of system, but we are not bound to be fined or imprisonment because we are meant to make mistakes" (SP-8). Building on this, we found another example in which regulators entrusted sandbox participants with freedom in testing and partner selection: "It's more a sense of they're saying, here's the framework that you all should operate in, now get techy and get on with it, rather than specifically handholding to particular types of solutions, processes or encouraging certain collaborations" (SP-5). Surprisingly, another regulatee shared concerns about the regulator sharing knowledge with other sandbox participants: "They probably shared our advice with other asset managers who've come to them. We've been the longest in this field, so a lot of it is that they have gone through a whole bunch of information from us" (SP-9).

Our findings do not consistently show support for trust among regulators and regulatees or a willingness among regulatees to share knowledge. One informant felt less encouraged to share information with regulators because they might pass it on to other sandbox participants. As it is important to bear in mind the possible bias in this response, we found other instances that indicated how regulators were able to pave new paths based on gained knowledge. For example, one participant said, "our case manager … got promoted as a result of successful testing with us. He then started a series of blockchain projects with other start-ups.… He understood enough, he learned enough, he was trusted enough because we succeeded in creating a trusted process" (PS-2). Put differently, such evidence may suggest that regulators might share best practices with future sandbox participants. At first, these findings appeared to accord with McAdam and Marlow (2007), who found privacy issues like theft of intellectual property and consequent secretive behavior to emerge in business incubator networks. However, incubation studies (e.g., McAdam and Marlow, 2007; Tötterman and Sten, 2005) have not previously demonstrated that incubator staff are perceived as less trustworthy by incubatees; on the contrary, tenants are normally willing to share information with and receive support from incubators. Given this contrast, our empirical findings are unexpected and may have profound importance for the issue of trust among regulators and regulatees and its effect on knowledge sharing (e.g., Inkpen and Tsang, 2005). Another possible explanation for these findings is that regulatees are more prone to become secretive and reluctant to share knowledge when they are unable to benefit from regulators. We thus suggest the following:

P4a: Asymmetrical regulator-regulatee interactions negatively affect regulatees' willingness to share best practices.

For the second category of regulator support, the evidence reveals cases of the regulator's ability to support market participants through legal or non-legal actions, which reflects the commitment of regulators. We first explore the role of the regulator from the perspective of sandbox participants. Our findings suggest that regulators employ a diverse set of tools to support market participants. For instance, one regulatee said, "they have a tool called informal student. As part of the sandbox, we can send them a copy of questions and request informal information, some guidance from an expert. And that's really helpful because we didn't know or didn't consider a couple of things in our risk management on how to treat customers, which at the end really improved our technology" (SP-7). More interestingly, we found that, because regulators are experienced with regulating traditional financial market participants, they are able to support sandbox participants by identifying gaps and providing regulatory nudges in advance, which helps regulatees avoid both compliance and operational

issues later on. According to a regulator, these interactions are win-win situations, as the regulatee is developing risk mitigation and the regulators are gaining learning experience. Financial benefits also emerged from the analyzed data; for instance, one regulatee said, "the sandbox period allows me to waive the full broking license investment until the end of the sandbox period when we can either put that money in by then, if I've got the right level investors" (SP-5). Along these lines, several regulators indicated that sandbox participants are also able to reduce current and future operational costs because more sustainable businesses are created thanks to the support provided by regulators and the ability to experiment in the sandbox.

The social capital literature (e.g., Nahapiet and Ghoshal, 1998) holds that network actors offer access to resources; our findings show that most regulatees have received legal and non-legal support that assisted their FinTech firms, possibly giving them an advantage over actors in other networks. Specifically, we found support that regulators provide nudges on operational and compliance issues that improves participants' risk management, which in turn allows regulatees to reduce their expenses and improve the sustainability of their businesses. However, it remains unclear how direct ties with regulators provide regulatees with unique resources that may not be accessible outside regulatory sandboxes, as we received contradictory accounts from two informants, who noted that the disadvantages in terms of longer time to market and lack of regulatory support outweighed the possible advantages from regulators in different jurisdictions. There may be several reasons for this difference in views, including variations in regulatory mandates in different jurisdictions, a lack of technical know-how among regulators, and regulatees' differences in expectations and knowledge of regulations. Consistent with our findings, we offer the following proposition:

P4b: Regulator-regulatee interactions positively affect regulatees' risk management capabilities.

As to the third category, a cooperative climate is found in regulator-regulatee networks. From the perspective of regulatees, our evidence reveals how sandbox participants promote collaboration among several stakeholders: "We've been part of bringing together quite a few industry bodies to look at digital identity. We've encouraged the FinTech delivery panel, Open Identity Exchange, Department of Culture, Media and Sports, and government digital services to come together and collaborate" (SP-6). We also found evidence suggesting that sandbox participants are encouraged by regulators to collaborate and share knowledge: "We were requested [by the regulator] to share our journey to companies in the sandbox in a recent

FinTech symposium, which was organized by the Central Bank. We were called upon to talk about how we graduated, what are the difficulties that we went through, how we mitigated all these issues, and how we graduated" (SP-8). Interestingly, the same participant shared the experience of bringing in two partners to support a technical solution; the regulators, based on this learning experience, became convinced that other market participants should consider these new cost-effective providers. Another aspect worth mentioning is regulatory engagement with the FinTech community, where regulators seek knowledge from market actors and other regulators, as an example of regulators' collaborative approach to develop new policies: "When we started developing policy materials, we did have post interactions with members of the society, companies that were specifically dealing in this area, in order to ensure that what we're developing is fit for that purpose. These companies had a say in how the regime can be created. Of course, we do our own benchmarking, we see what other regulators are doing, and we put certain rules in place, but we also take into consideration the market in our jurisdiction; what do they have to say about it, and then if necessary where we see it is suitable" (R-6).

The above findings indicate that cooperative behavior emerge when trust exists, making network actors more willing to engage in social exchange (e.g., Tsai and Ghoshal, 1998). Specifically, our empirical findings reveal cooperative interactions between regulators and diverse stakeholders, which illustrates their willingness to engage in social exchange to learn about market needs. We believe that such cooperative behavior has profound meaning for the level of trustworthiness among regulators and network members. Previous studies also support this interpretation (e.g., Nahapiet and Ghoshal, 1998). The findings also show an association between the relational and cognitive dimensions; prior research reports a similar association, but it links having a shared vision and common values to the level of perceived trust (e.g., Tsai and Ghoshal, 1998). In our scenario, by contrast, shared narratives are related to levels of trust and transparency, so our findings have discrepancies with the extant literature examining interactions between social capital dimensions (e.g., Al-Tabbaa and Ankrah, 2016). We thus suggest the following:

P4c: Regulators' encouragement of graduated sandbox participants to share narratives to current participants positively affects knowledge sharing among regulatees.

4.2.2 Expectations

Within the relational dimension, the analysis also shows evidence of expectations from regulators and regulatees. A single category emerged: expectations of regulators and regulatees.

Regulators expect that sandbox participants will conduct the tests they set out to do, indicating that regulators may have questions about the suitability of the sandbox for some participants. This is articulated in the following: "We had to quite hard-sell [the regulator] that we want to drive these things forward, but the reality has been that it's quite hard for us to deliver these things. The [regulator] is scrutinizing us quite closely to see whether we can, whether we will … we need to be able to show that we're doing some of these things. Otherwise it questions our suitability for the sandbox in the eyes of the [regulator]" (SP-5). We also found evidence suggesting that regulatees expect regulators to lack knowledge of the technologies they adopt: "The habits of the compliance officers don't change overnight, despite the regulator saying that they do adopt and review new technologies, they take a risk-based approach. But it still takes time. That's why for us the sandbox was a good value. Because it was part in education process towards the regulator" (SP-6). Notably, as one informant stated, during the testing period, "the regulators performed an audit on compliance to see how the process has been taken toward the customer, how does it process, what are the reports we've done, and how the risk assessment takes place. Post the audit, the regulators highlighted several gaps that needed to be addressed to be able to get the full-license bandwidth. The regulators also provided recommendations" (SP-8). Another important experience shared by a regulatee reflects a performance-driven culture among regulators: "You can feel that the underlying KPIs [key performance indicators] for the regulators are much more driven by how many companies can get through. They accepted us at the end, obviously, only because we do machine learning for credit risk assessments in a way that nobody had done it before. So, they just want to tick all these boxes and at the end have a big summary that can be press-released" (SP-7).

Our findings consistently indicate that regulators' expectations revolved around clarifying expectations, meeting time targets, and maintaining a regulatory focus. For instance, one regulator reported the following: "We commit the time and we do very extensive presentations for them that explain what it means to be regulated, how regulators work, what our objectives are, what we're looking for, and to make it absolutely clear to them that our job is to make sure that their risks are accounted for and that we are meeting our regulatory objectives by allowing them to test" (R-7). The same regulator added: "We found that the cohort approach is not just about resourcing on our side, but it's about setting expectations and timelines for the firms. It's also partially about driving the firms. And that's in recognition of the fact that the firms are typically start-ups that come in, they have a sort of dual purpose; they want to become regulated, but mainly they want to make money by getting their product out to the market. And when they're going through that, they typically will go

out into the market and try to sell the product already—or the idea—and get investors, and they can sometimes not have as much focus on the regulatory side" (R-7). The analyzed data also reveal regulators' expectations as to satisfying requirements, emphasizing that most entrepreneurs provide insufficient detail about what they are doing, in which case the regulator has to seek further clarification.

The above findings indicate that both regulators and regulatees develop expectations during their social interactions that might affect their trust levels and consequent motivation to exchange knowledge, as has been reported in the literature (e.g., Coleman, 1988; Nahapiet and Ghoshal, 1998). For instance, we found empirical evidence that regulators might conduct unplanned audits, which may support the view that regulators are less than fully confident that regulatees will act in accordance with regulators' expectations and norms. While this could have negatively influenced the relationship between regulators and regulatees, the latter group did not perceive it as negative. On the contrary, they were satisfied to receive recommendations from regulators that helped them become more compliant with regulatory frameworks. In this case, it may thus be suggested that regulators and regulatees established stronger bonds that positively influenced the relational dimension. Furthermore, the empirical evidence describes how regulators define their expectations to ensure that future obligations are met, which is consistent with earlier studies (e.g., Nahapiet and Ghoshal, 1998). However, we also found evidence that regulators are not necessarily motivated to understand regulatees' needs and wants; rather, they seek to satisfy their own goals, which reveals an opportunistic attitude. Similarly, regulators reported opportunistic behavior by sandbox participants who may have been preoccupied by financial outcomes. We thus suggest the following:

P5: The existence of tacit goals negatively affects knowledge sharing and practices for both regulators and regulatees.

4.3 Cognitive Dimension

4.3.1 Common goals and language

Lastly, the analyzed data revealed perceptions about how regulators and regulatees work towards shared goals with a common understanding. Specifically, two categories emerged: i) common goals and vision and ii) common language and codes.

For the first category, our findings reveal that regulators in certain jurisdictions may share a similar vision with FinTech firms, whereas other regulators may be pressured to follow, specifically in crypto networks: "Over time, as other countries innovate, the regulatory

arbitrage creates an interesting pressure on other countries. So, when smaller countries like Malta and others start thinking out of the box and creating regulatory frameworks suitable for crypto, it has a big change in a world of finance, operating now out of Malta and generating revenue in taxes and seemingly operating within the white side of the market, instead of pushing everything to the gray or dark in the market" (SP-2). Similarly, we found evidence of regulatees working with regulators and a diverse group of governmental bodies to achieve common goals like a better understanding of how digital identity can help in innovation. This is articulated in the following quote: "The interesting thing with the [regulator] was that they are fully aware that identity and digital identity goes across every sector of the economy. So, that they knew that a lot of their fellow regulators and other sectors—be that Information Commission, Bureau of Film Classification Department, Culture of Media and Sport, Competition and Markets Authority—had strands on identity. And digital identity was a fundamental game changer across many different sectors" (SP-6). We also found an example indicating regulators' motivation to network with a sandbox participant sharing a vision of improving financial markets by disrupting the way traditional financial providers function: "They [the regulators] wanted to eliminate having many branches because it poses lots of risks in terms of exposure to fraud by employees (and robbery as well). So, the regulators were eager to get us to come up with this system to disrupt the money services business so that they will be able to operate without having branches. That was the fundamental wish by the regulator" (SP-8). Conversely, one sandbox participant stated that regulators provide "guidance not to violate existing legal framework and regulatory rules … regulators advised us to frame what we were going to test in a way that changes best practices but does not require changing the regulations, because we were supposed to work within the existing regulatory framework" (SP-2).

The above findings may be argued to agree with previous research that found "shared goals represent the degree to which network members share a common understanding and approach to the achievement of network tasks and outcomes" (Inkpen and Tsang, 2005, p. 153). However, our findings deepen the understanding of social aspects in the incubation literature, which remains limited (e.g., Scillitoe and Chakrabarti, 2010). The examples of regulators and regulatees working together on common goals like digital identity or eliminating branches in financial markets demonstrate how common goals can shape network interactions. Unexpectedly, however, we found evidence of regulators who were not willing to change and develop regulations; instead, they asked regulatees to frame their testing activities within existing regulations. This finding shows conflicting goals among regulators, given that regulatory sandboxes' very reason for existence is to allow eligible

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market participants to test new business models that are not necessarily compliant with existing regulations. This raises a troubling question: if regulatees are not able to test innovative solutions that can later be employed in real-world financial markets, then how are regulators promoting innovation when they overlook lessons learned from regulatees' testing experiences? This might signal an underlying lack of willingness among regulators to change the existing framework. Although this contradictory finding may result from differences in regulatory mandates or conflicting intentions of establishing regulatory sandboxes without forcing change upon regulatory systems, the same participant (SP-2) also reported that regulators in other jurisdictions like Vietnam and Japan had indeed made changes in existing regulations. As a result, we offer the following:

P6a: Regulators' unwillingness to make regulatory changes negatively affects regulatees' testing maneuverability.

As for the second category of common language and codes, our findings provide an example of how regulators support market participants by confirming and interpreting existing legal frameworks: "In Vietnam, we said to the regulator, 'We will submit a number of questions on the way we understand your legal system, can you answer those questions for us? … They provided all the legal interpretation. Basically, legal opinion for us.… They said, 'In this paragraph in this particular law we can do this but not this because of this legal statute, you can do this but not this' and other things. That allowed us to understand the system, adjust our processes, submit a different proposal to them" (SP-2). Another example of how regulators ensure that sandbox participants understand them is by finding a common language: "We try to enter those conversations from a technical point of view, rather than just focusing on the legal aspects. If we just start with the legal aspect, the conversations will be quite complicated because the regulatory framework in certain ways is very restrictive and you don't get them to the essence of how things technically work" (R-3). This approach is presented by regulators as an enabler of learning experiences for sandbox participants. The above findings extend evidence from other studies to the incubation literature stream in which shared language is described as an enabler for accessing information (e.g., Nahapiet and Ghoshal, 1998). Specifically, the findings reveal the role of regulators in establishing a shared language. This has profound meaning in the context of regulatory sandboxes, as regulatees may not have a legal background or knowledge of regulatory frameworks, which might make it challenging for them to interact effectively with regulators. On this basis, we suggest the following:

P6b: Regulators' ability to create conversations that use a common language positively affects knowledge sharing between regulators and regulatees.

5 Concluding Comments

Regulatory sandboxes have a prominent role in supporting entrepreneurship and innovation in the FinTech context. However, given the novelty of the sandbox concept, there is a lack of research on the social aspects of regulators and regulatees. Through the theoretical lens of SCT and with reference to the prior incubation literature, this paper explores the influence of interactions among regulators and sandbox participants on the practices of both regulators and regulatees. On one hand, this study has shown that regulator-regulatee social interactions increase regulatees' legitimacy, risk management capabilities, and familiarity with regulatory frameworks, all of which may positively influence regulatee practices. It was also shown that regulators benefit from these interactions by increasing their understanding of regulatory constraints and the potential risks from enabling technologies, better informing them of regulatees' support needs, and by offering them early access to regulatory innovations. These advantages will in turn promote financial markets that welcome innovation while protecting stability. On the other hand, less positive discoveries were made in our empirical investigation. For example, we found that regulatees may anticipate regulators as less trustworthy, making them reluctant to share information. Additionally, regulatees might be discouraged from innovating if regulators limit their testing practices to the boundaries of existing regulatory systems. Taken together, these findings provide additional evidence with respect to importance of the social dimensions of incubation, illuminating social interactions among regulators and FinTech innovators in the context of financial markets, which is heavily regulated because financial stability is nothing less than crucial. Thus, providing interesting insights of a niche but worthwhile topic.

5.1 Theoretical and practical implications

Overall, this study provides important implications for both research and practice by exploring how regulators support FinTech innovators, particularly with respect to testing and validation practices that are essential at the incubation stage. Thus, we inform regulators and FinTech innovators about win-win situations. At the meso and micro levels, this study contributes to the growing debate in the incubation literature on the role of technology transfer instruments (e.g., Cunningham and O'Reilly, 2018; Grzegorczyk, 2019; Tsai et al., 2009), including regulatory sandboxes, through which the role of individual actors like regulators is to support FinTech innovators while also paying close attention to their practices. Along these lines, the findings of this study provide novel insights that deepen our

understanding of how knowledge exchange takes place among regulators and regulatees in regulatory sandboxes, a context characterized by escalating numbers of market participants and increasing focus on financial innovation and technological transformation (Diaz-Rainey et al., 2015; Palmié et al., 2019). These interactions inform regulators about the use of enabling technologies and new ways of complying with regulatory frameworks, both of which enable regulators and policymakers to develop financial markets that reflect the latest technological and economic developments. This study also builds on contributions in the extant incubation literature by advancing our understanding of the social capital dimensions that facilitate incubation efforts in the context of FinTech. We further contribute to recent management studies confirming that supportive regulatory initiatives have a positive impact on firm formation (Haddad and Hornuf, 2019), emphasizing the role of financial regulators (Lee and Shin, 2018). We also contribute to the emerging FinTech literature, which has been criticized for lacking a theoretical basis, by conceiving our study and discussing our findings through the lens of SCT (Gai et al., 2018; Gimpel et al., 2018; Puschmann, 2017).

Additionally, we contribute to the growing academic debate about entrepreneurial finance (e.g., Block et al., 2018; Cumming, Deloof et al., 2019; Cumming, Johan et al., 2019; Cumming and Schwienbacher, 2018) by elucidating the potential of regulatory sandboxes to help innovative FinTech ventures raise capital in two important ways. First, social interactions in regulatory sandboxes enable the supply side of entrepreneurial finance by providing FinTech participants with regulatory knowledge and, in some instances, creating new regulatory frameworks and requirements to facilitate crowdfunding platforms. These regulatory changes may encourage greater access to capital through financing approaches like crowdfunding platforms and ICOs. Additionally, regulators can better protect market participants from problems like financial fraud. Second, our empirical investigation reveals how regulatory sandboxes provide intangible resources that have important financial implications. This includes providing regulatees with the following: 1) a quality seal, making them more attractive to investors and consumers; 2) hints on operational and compliance issues that support them in developing operationally and legally sustainable businesses; and 3) enough time to postpone making a significant investment at an early stage, since regulatory sandboxes provide exemptions from financial licenses.

5.2 Limitations and future research

There is no research without limitations. In this last section, we suggest a future research agenda to extend the scholarship on regulatory sandboxes. As the current investigation was limited in terms of sample size and context, we suggest theoretical propositions that future

research can investigate to examine the significance of highlighted relationships and make generalizations that apply to the incubation and entrepreneurial finance literatures. Additionally, the increasing number of regulatory sandboxes around the globe raises the crucial question of how effective these instruments are, given the financial and human resources allocated to their operation. Hence, future studies can investigate whether the presence of regulatory sandboxes in a given jurisdiction (or group of jurisdictions) increases the amounts of risk and venture capital or other funding sources over jurisdictions without a regulatory sandbox. That said, this study only investigated social interactions that occur within established regulatory sandboxes, limiting the empirical investigation to one of many important regulatory change stages that typically unfold when setting up these instruments. These may include 1) calls for input (public consultations), 2) engagement with industry actors and/or international regulators through roundtable discussions, and 3) responses in the form of published regulatory guides. There is thus ample room for further research, particularly to investigate how social interactions differ across the regulatory change stages from a longitudinal perspective, both nationally and across jurisdictions, as advocated by Cumming, Johan, and Pant (2019).

Acknowledgements

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Appendix

Appendix A - Illustrative quotes of SCT

Aggregated Dimensions	1st Order Concepts	2nd Order Themes	Illustrative Quotes
Structural Dimension	Network ties	Regulatees' and regulators' partnerships	"we partner with universities and with a regulatory partner apart from investors or mentors who help us." (SP-7).
		Regulator-regulatees' follow-up post exit	"in addition to having unofficial alumni calls every two months, there are also times when I need something from the regulators as we are being approached frequently by insurance companies across the globe asking if we could bring our services to country X or Y? And very often I would write the [home country] regulator to ask … can you please make the introduction?" And then comes a friendly warm introduction from the [regulator]." (SP-4).

	Network configuration	Frequency of contact and stakeholders involved	"We actually met a number of times with them [the regulator], where we presented progress on how testing was going on, what parameters we were testing, what were our preliminary results, we demonstrated the product to them as it was being used by the consumers. We were also meeting with different people on the regulator side, e.g., the innovation team, the AML compliance legal people." (SP-2).
		Access to regulators	"What I find during our interaction with people who want to access the sandbox to do some sort of testing is that they may not be able to use the sandbox, however within the established or open relationship with them, we can give them some regulatory nudges, where they can potentially take a commercial solution that would work." (R-4).
	Network stability	Co-evolution of financial services	"In Vietnam, the legal framework that exists today requires paper-based signature, which is done remotely. So, we have to adjust our innovation in a way that would allow finger-based signature on screen, accompanied with a paper-based signature in the branch. This certification of identity then creates a significant enough record that would allow it to be used later on in engagement with the same financial institution or others. For that, the Vietnamese Central Bank needed to issue a circular, not a change in the regulation, but change in the regulatory application for this to happen." (SP-2).
Relational Dimension	Trust	Trustful climate	"the most fruitful advantage for a sandbox license was that we're able to test out any kind of system, we are not bound to be fined or imprisonment because we are meant to mistake. Along the way, there's a lot of mistakes that have happened, but we are not being fined because of that." (SP-8).
		Regulators ability to support and share knowledge	"the firms that come into the sandbox will have less mature risk management systems, and we do provide them with waivers and modifications to the preexisting rules, that allow firms flexibility in how they mitigate the risk. For example, they can outsource certain things, or combine certain functions into one in recognition of the fact that they are a new start-up. But the risk still needs to be managed." (R-7).
		Co-operative climate	"We managed to collaborate with a system provider from the UK to do electronic KYC through the system. To get Central Bank regulators convinced … we had a few rounds of tests and then they requested to come with a full-fledged presentation of how that provider is working in the back-end." (SP-8).
	Expectations	Expectations by regulators and regulatees	"we often have to go back and ask for some clarity. An example might be providing financial advice, but we can't work out their system, is it general or personal advice or the other alternative which is more common in the advice space or is that they are collecting a lot of information? they [regulatee] say they are only providing general advice, but it's clearly not general advice. There's a bit of an expectations gap, and sometimes it takes a bit longer to bring them across the line and say, well, you collected a lot of information." (R-4).
			"the habits of the compliance officers don't change overnight, despite the regulator saying that they do adopt and review new technologies, they take a risk-based approach. But, it still takes time. That's was why for us the Sandbox was a good value. Because it was part in education process towards the regulator." (SP-6).
Cognitive Dimension	Common goals and language	Shared language and codes	"we get firsthand sort of knowledge of exactly how that technology works. So typically, during the testing period, we work very closely with firms and we sit in on tests and we often will look through the backend.

	Sometimes we'll even go through the code and do audits. We will crawl all over the new technology. For us it's excellent because we get to understand what's coming out into our market." (R-7).
Shared goals and vision	"I don't think the FCA was dramatically nervous about how the sandbox would work in practice, they had a rough idea and they decided to go for it and test it and tweak it. That's were, I think, the most benefits of a sandbox are, just doing something, trying it, maybe failing but learning from the failure, and working towards the optimal framework." (R-1).

Table: Concepts and categories that emerged from the data analysis.

Appendix B – Interview guides

Interview guide: Regulators

1. Please tell us about your background and current role.
2. Please tell us about the recent changes in the regulatory sandbox practices.
3. Based on examples, please tell us how regulators engage stakeholders from the fintech community to shape regulatory sandbox practices? Who are the main actors, what is their role, if there are any obstacles regulators face?
4. Based on examples, please describe the interactions that occur in sandboxes with innovators prior to acceptance? What are the obstacles regulators face during such interactions? How long are the periods prior to acceptance?
5. Once a fintech has started testing in the sandbox, please describe how and for what purpose do regulators interact with sandbox participants, using examples.
6. Based on examples, please describe what knowledge/ideas are exchanged in the interactions between regulators and sandbox participants?
7. Can you please, based on examples, describe instances of regulator-regulatee interactions that have influenced the way regulators work?
8. Please describe instances of regulator-regulatee interactions that have possibly influenced sandbox participants directly or indirectly?
9. After graduation/exit of participants, please describe the nature of interaction with graduated participants?
10. According to your view, what are the advantages that sandbox participants may provide regulators? Similarly, what are the advantages that regulators provide to sandbox participants?

Interview guide: Sandbox participants

1. Please tell us briefly about your background and current role in your FinTech firm.
2. Please tell us about your previous/current journey in/out of a regulatory sandbox (Why regulatory sandbox to begin with?)
3. Can you, based on examples, describe interactions that occur with regulators, prior to accessing the sandbox/start validity period?

4. Please describe how and for what purpose has your FinTech interacted with regulators, or vice versa, after accessing (i.e. during testing) the sandbox?

5. Can you please describe an example in which knowledge/ideas were exchanged in the interactions with regulators and how was this of support in testing and validating your business model?

6. After graduation/exit, please describe whether your FinTech interacts with regulators and for eventually what purpose?

7. Lastly, according to your view, what are the advantages that sandbox participants may provide regulators? Similarly, what are the advantages that regulators provide to sandbox participants?

8. If you think back at your experience: how has your knowledge developed?