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Entrepreneurial Ecosystem Mechanisms

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Abstract:

Entrepreneurial ecosystems have developed from a powerful idea and concept into a transdisciplinary research program, increasing our understanding into entrepreneurship-led development and providing actionable knowledge for improving the conditions for entrepreneurship and development. In this paper we take stock of the progress to date and synthesize the findings of 181 empirical scientific entrepreneurial ecosystem studies with a systematic literature review. We organized the review around five key mechanisms that explain the nature and development of entrepreneurial ecosystems: (1) interdependence of its elements, (2) upward causation explaining entrepreneurial ecosystem outputs and (3) outcomes, (4) downward causation and path dependence, and (5) inter-ecosystem links. We summarize the findings and outline opportunities for research and discuss policy implications in the light of a transdisciplinary entrepreneurial ecosystem research program.

This paper is of interest for scholars of all academic disciplines that provide knowledge that is relevant for the understanding of entrepreneurial ecosystems, entrepreneurship and entrepreneurship-led development, but also for all stakeholders involved in the development of entrepreneurial ecosystems.

Keywords:

Entrepreneurship; Entrepreneurial ecosystems; Causal mechanisms; Economic development

JEL codes:

L25, L26, M13, O18, R11, R58

1. Introduction

The concept of entrepreneurial ecosystems has gained enormous popularity within research, policy, and business practitioner fields over the last decade. Indeed, half of the ten most cited papers in entrepreneurship over the past five years are on entrepreneurial ecosystems (García-Lillo et al., 2023). The idea — that there is a particular arrangement of actors and factors within a region or country that promotes entrepreneurship that acts as an engine of economic growth — was quickly adopted by governments and non-governmental organizations such as the United Nations (UNCTAD, 2010), the World Economic Forum (World Economic Forum, 2014), the OECD (Mason & Brown, 2014), the European Commission (European Commission, 2014), the Kauffman Foundation (Bell-Masterson & Stangler, 2015), and the World Bank (Mulas, Mingos & Applebaum, 2015), and commercial organizations including Startup Genome (Startup Genome, 2012) and StartupBlink (StartupBlink, 2014). This policy excitement led to a situation where research is led by policy rather than policy being guided by rigorous academic research (Stam, 2015; Stam & Spiegel, 2018). Even within the academic literature, the concept of entrepreneurial ecosystems is mainly used metaphorically with unclear relationships to other theories of innovation, entrepreneurship, and (regional) economic development (Alvedalen & Boschma, 2017; O'Connor et al., 2018, Scaringella & Radziwon, 2018; Stam, 2015), and confusion with related business concepts including innovation ecosystems (Adner & Kapoor, 2010) and business ecosystems (Moore, 1993) that aim to explain firm performance with ecosystem approaches.

Although entrepreneurial ecosystems quickly achieved ‘buzzword’ status within research and policy communities and the implementation of ecosystem policies quickly outpaced their research foundation (Stam, 2015; Autio et al., 2018), the basic ideas underlying the entrepreneurial ecosystem concept are grounded in strong research traditions.

Current thinking on entrepreneurial ecosystems can be seen as the result of developments in several related literatures: entrepreneurship context (Autio et al., 2014; Welter, 2011), high-growth entrepreneurship (Autio & Rannikko, 2016; Henrekson & Johansson, 2008), industrial clusters (Delgado et al., 2010; Rocha, 2004; Rocha & Sternberg, 2005), regional innovation systems (Cooke, 2007; Sternberg, 2007; Ylinenpää, 2004), and entrepreneurial environments (Gnyawali & Fogel, 1994; Van de Ven, 1993). The entrepreneurial ecosystem approach synthesizes these often disconnected literatures and opens up new research questions and avenues for investigating economic policy issues as well as more fundamental social science questions such as the relationship between structure and agency in modern capitalism (Spigel, 2020). Moreover, entrepreneurial ecosystems emphasize the role of ‘place’ and provide a lens for understanding regional economic transformation through entrepreneurial action (Audretsch, 2015; Feldman & Lowe, 2018; O’Connor et al., 2018). We define an entrepreneurial ecosystem as a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory (cf. Stam, 2015; Stam & Spigel, 2018; Stam & Van de Ven, 2021).

Given the extent of policy and research interest in entrepreneurial ecosystems it is important to critically reflect on what work has been done and what knowledge has accumulated about the contextual nature of the entrepreneurship process. In this paper we structure and synthesize the field of entrepreneurial ecosystem studies with a focus on the empirical evidence of the underlying causal mechanisms. Uncovering causal mechanisms is fundamental for understanding change in society in general (Elster, 1989; Sayer, 1992), and entrepreneurship and innovation in particular (Van Burg & Romme, 2014; Hedström & Wennberg, 2017). Uncovering causal mechanisms is not only fundamental for understanding how entrepreneurial economies work, but also for improving them with an entrepreneurial ecosystem approach.

Building on the work by Wurth et al. (2022)¹, we first define some key academic ‘tools’, which underpin our analysis: concept, framework, model, theory, and mechanisms. We start with the general notion of entrepreneurial ecosystems. The concept of entrepreneurial ecosystem is an abstracted idea of a real-world phenomenon. We identify, categorize, and organize the factors deemed most relevant to understanding entrepreneurial ecosystems: a framework (cf. the entrepreneurial ecosystem frameworks of Isenberg, 2010; Spigel, 2017 and Stam, 2015). This framework provides the foundations for a model, in which the specific functional relationships among particular variables or indicators are hypothesized to operate in some well-defined set of conditions. These hypotheses can be derived from or organized through theories, which are different ways to talk about causal mechanisms explaining development and change (cf. Hedström & Wennberg, 2017; Van de Ven & Poole, 1995). We conceptualize five causal mechanisms that are grounded in earlier work by Wurth et al. (2022), namely (1) interdependencies between ecosystem elements, (2) the link between entrepreneurial ecosystems and entrepreneurial outputs and (3) wider socio-economic development, (4) downward causation, and (5) links and flows of ideas, people, and resources between different entrepreneurial ecosystems.

We use a systematic literature review to synthesize empirical studies on the causal relationships among the ecosystem elements and how they are linked to outputs and outcomes (Webster & Watson, 2002). The goal is to develop a comprehensive and mechanism-based understanding of the entrepreneurial ecosystem concept and how it can contribute to entrepreneurship and economic development policy and our wider understanding of the contextual nature of entrepreneurship. This is an instrumental step in building a coherent research community around entrepreneurial ecosystems that would allow

¹ This paper builds on, extends, and updates Spigel (2020) and Wurth et al. (2022).

for the accumulation and development of scientific and practical knowledge. It is also an invitation for replication and extension studies, and for novel questions and approaches.

While recent reviews of the entrepreneurial ecosystem literature (e.g., Cao & Shi, 2020; Garavan et al., 2019; Hakala et al., 2020; Nicotra et al., 2018; Maroufkhani et al., 2018) have sought to bring together this rapidly shifting field, we advance on these works in two key ways (cf. Wurth et al., 2022). First, we embrace a broad literature covering the entirety of the entrepreneurial ecosystem concept, rather than specialties such as ecosystems in emerging economies or specific domains. Second, we draw on this literature to identify the empirical evidence for the five casual mechanisms, which link the contexts in which entrepreneurship takes place with specific outcomes such as firm growth, innovation, and increases in overall welfare.

We discuss the implications of the results of our review in light of existing research agendas as opposed to developing a new one. In line with the aim of the review, our goal is to synthesize existing work. This is crucial for the credibility of the entrepreneurial ecosystem concept and its future within academic research and policy and business practice more broadly.

2. The Entrepreneurial Ecosystems Approach

2.1 The Origins of the Entrepreneurial Ecosystem Concept

The core idea of entrepreneurial ecosystems, that there are forces outside a firm but contained within a territory that affect an entrepreneurial firm's ability to innovate and grow, is not novel. The ecosystems literature builds on long-standing intellectual traditions ranging from industrial districts and clusters to innovation systems and urban economics (Acs et al., 2017; Brown & Mawson, 2019; Malecki, 2018; Schäfer & Henn, 2018). The early

roots of the entrepreneurial ecosystem idea dates back a century to Alfred Marshall (1920), who studied the factors that stimulated the productivity of firms in certain territories, so-called industrial districts. Subsequent work has built on the notion of Marshallian industrial districts (cf. Krugman, 1991; Markusen, 1996), first with the early work on national systems of innovation (Freeman, 1995; Lundvall, 1992), learning regions (Keeble et al., 1999; Malmberg & Maskell, 2002) the Triple Helix (Leydesdorff & Etzkowitz, 1996) and then with the larger literatures on regional clusters (Delgado, Porter & Stern, 2016; Porter, 1998, 2000) and regional innovation systems (Cooke, 2001; Cooke, Uranga & Etxebarria, 1997). Malecki (2018) locates the modern origins of the concept to the early 1990s through work by Bahrami and Evans (1995) and entrepreneurial infrastructure (Van de Ven, 1993), though the core concept can be even traced to earlier discussions of entrepreneurial climates in the 1970s (Cooper, 1973). While these approaches have divergent goals, methodologies and epistemological views of how the economy works, they are united by the central idea that there are factors outside an organization but within a territory which contribute to firm-level innovation, productivity, and competitive advantage (Spigel & Harrison, 2018).

- - - Insert Figure 1 Around Here - - -

As shown in Figure 1, there are five key research areas that inform the core ideas of entrepreneurial ecosystem (Spigel, 2020). First, due to its focus on productive entrepreneurship, contemporary entrepreneurial ecosystems work is heavily influenced by research on one of the most used proxies for productive entrepreneurship, namely *high-growth firms*. This literature is crucial because it establishes that while firms who grow rapidly make up only small portion of the overall firm population, they are fundamentally different from their lower-growth peers (Demir et al 2017). Empirically, high growth firms

are often defined as those that grow by 20% or more, year over year, for three years. But more important than the formal definition is an understanding about why certain firms are able to grow faster than others. Sustained rapid growth is not a random outcome from a homogeneous pool of ventures, “but is associated with specific firm attributes, behaviours, strategies, and decisions.” (Barringer et al., 2005 p. 665). The personal characteristics of a founder, such as their education, levels of ambition, and risk tolerance, will affect the ability of a firm to grow, as well do attributes of a firm such as its industry, resources, absorptive capacity, and flexibility (Hermans et al., 2015). Crucially, though limited in numbers these high growth firms are estimated to produce the majority of new jobs in most modern economies, making them a key economic development priority (Mason and Brown, 2014). This literature both establishes the *raison d'être* for research on entrepreneurial ecosystems — the promotion of high growth firms as an economic development strategy — and provides key insights into the types of support that these firms need to grow.

The entrepreneurial ecosystems concept is also deeply informed by work on *context*. Theories of context seek to embed the study of a focal phenomenon, such as the prevalence of different types of entrepreneurship, within the overlapping influence of social, economic, and political contexts. This view differs from more positivist and reductive forms of research that seek to control away contextual factors with the goal of producing generalizable findings that transcend temporal, social or political boundaries (Ucbasaran et al. 2001). This means that the entrepreneurial context literature presages a shift away from producing universal laws of entrepreneurship but instead examines how entrepreneurial processes, practices, and outcomes emerge from their contextual environment (Zahra et al., 2014). Within the entrepreneurship literature, this approach has been driven by the work of Welter (2011) and Baker (Baker and Welter, 2018; 2020). They draw specific attention to the ‘where’ context: the geography of entrepreneurial activity. Beyond obvious place-based factors such as the

presence of financial and human capital, and specific policies like taxes or property rights, entrepreneurial cultures and informal institutions develop in places that help constitute the meaning and values of entrepreneurship. This leads to a varied geography of not just the quantity of entrepreneurship — how many and what type of firms are created — but also of the nature of the entrepreneurship process itself.

Entrepreneurial ecosystems research is fundamentally contextual, concerned with understanding the impact of localized contexts on the entrepreneurship process and understanding how these contexts develop and the mechanisms through which their influence is enacted. Context informs ecosystems research in two ways. First, it emphasizes that geographic context has a profound influence on the nature of the entrepreneurship. The characteristics of a place, from its formal institutions and support mechanisms to its industrial specialization or diversification to its local culture, will all affect the nature and course of the entrepreneurship process. This is one of the key arguments of ecosystems research: that place matters for entrepreneurship. Second, it suggests that contexts are interlinked, with place-based and global contexts influencing each other, altering the overall influence on the firm (Autio et al., 2014)

The social theory of *embeddedness* links notions of geographic context with entrepreneurial action. One of the most important social theories of the 20th century, embeddedness refers to how people and organizations become entangled in complex networks of social relationships that both enable and constrain their potential actions (Granovetter 1985; 2017). Entrepreneurship exhibits a great deal of territorial embeddedness, where important structures are rooted in particular places (Oinas, 1997; Hess, 2004; Dahl and Sorenson 2009). For entrepreneurs, their social networks (Schutjens and Völker, 2010) and key resources like capital (Christensen 2007) and business advisors (Mole and Capelleras 2017) are generally place-based. Consequently, if they are to access these and other

resources, entrepreneurs must abide by local norms of behavior and action. While entrepreneurs can and do violate these norms, such behavior might result in being excluded from local networks, making them unable to build up the reciprocal trust required to get the resources and support needed (De Clercq and Voronov 2009; Jammaers and Williams, 2021). They must become and act as part of their local community and are thus embedded in local logics of entrepreneurship. This makes the local cultural, political, and economic structures and norms of a place an influential context affecting the practices, actions, and futures of entrepreneurs.

If embeddedness and context show how and why local factors are a key influence on entrepreneurship, then the literature on clusters and regional innovation systems provide the key logic about why proximity between entrepreneurs in an ecosystem can contribute to even faster growth for all firms involved. Cluster research investigates how co-location between similar or different firms increases their productivity (Maskell 2001) while the regional innovation systems research shows how knowledge spillovers and networks between nearby firms and universities promote innovation (Cooke 2001). But despite their differences, these two theories provide the intellectual foundations for what ecosystems are and how they work. Both push our attention away from the firm or founder in isolation and towards the broader geographic environment it exists within for understanding the source of sustainable competitiveness.

The central insight of both these literatures is that firm competitiveness is enhanced through proximity with other firms or other organizations like universities (Sternberg, 2007; Ylinenpää, 2004). While some of this competitiveness comes from the shared resources and building a pool of talented workers (Glaser and Kerr, 2009), other advantages accrue from informal knowledge spillovers. Discussions between entrepreneurs and managers, movement of employees between firms, and even casual observation spreads knowledge about new

market developments, strategies, and technologies. These so-called Jacobs externalities help in the development of new products by combining complementary knowledge and insights from a variety of markets (Beaudry and Schiffauerova 2009).

By far the most diffuse literature informing the entrepreneurial ecosystems literature is *entrepreneurial environments*. This research comes from a diverse disciplinary background ranging from economic geography to sociology to political science and strategic management. It could be equally called entrepreneurial systems (Neck et al. 2004), infrastructure (Van de Ven 1993), milieu (Ritsilä 1999) or clusters (Delgado et al. 2010). But it is unified by an interest in what causes higher levels of entrepreneurship than can be explained by traditional factor endowments such as capital, labour, and innovation (Malecki, 2009; 2018). This field provides a conceptual and empirical basis for understanding the role of more ephemeral forces such as culture and history in supporting (or preventing) high-growth entrepreneurship in a region. Entrepreneurial environments can be thought of as the intangible aspects of a place that affect the supply of entrepreneurs and their ability to thrive. Of these intangible factors, this literature identified local cultural outlooks as crucial for supporting innovative, high-growth entrepreneurship (Spigel, 2017b).

2.2 Advances in Entrepreneurial Ecosystem Thinking

Early academic work on entrepreneurial ecosystems by Stam (2015), Spigel (2017) and others used the research domains discussed above to make three interlinked claims. First, drawing on context, embeddedness, and entrepreneurial environments, they argued that there are specific localized configurations of actors, institutions, networks, and cultural outlooks that can support (high-growth) entrepreneurs and that the region, rather than the nation, is the appropriate spatial scale to understand these influences. These influences are not discrete but are linked to each, with the actions of entrepreneurs affecting them and them affecting each

other. Second, through research on high-growth entrepreneurship it argues that the support needs of high-growth firms is fundamentally different than those needed by lower-growth firms. This means that the way these firms draw on local resources and how they in turn influence their broader economy and society are different than both small firms but also larger companies. Finally, drawing on research from the clusters and regional innovation systems literature, the ecosystems literature argues that interactions between entrepreneurs and other actors leads to increased competitiveness due to their ability to share resources, knowledge, and insight. This has the potential to create a virtuous cycle in which success in creates new resources for future entrepreneurs.

But the ecosystems concept is more than just a combination of insights from prior research. The field makes two major advancement on these prior literatures. First, entrepreneurial ecosystems place entrepreneurs at the core of the research agenda rather than as a peripheral factor in a larger economic system. Ecosystems represents an embrace of the agency of entrepreneurs and other entrepreneurial actors to construct their own networks and support frameworks. Entrepreneurs are key actors in the construction of the support networks that catalyze high-growth entrepreneurship. The interactions between entrepreneurs help provide support for growth that is often not (effectively and efficiently) supplied by the market nor through government interventions. This gives entrepreneurs the power to transform their own contexts, irrespective of other constraints placed on them.

Situating entrepreneurs at the center of research agendas allows for a closer examination of the interdependencies that affect new value creation at the firm level and in the broader economy. This narrower focus allows for more precise investigations into what types of organizational attributes and regional factors support scalable entrepreneurial endeavors. This focus on the entrepreneur allows ecosystems research to engage with a fundamental question of social science: the relationships between individual agency and

social and economic structures in modern capitalism (Stam, 2015; 2016; Stam & Welter, 2021). Research on the entrepreneurial ecosystem prioritizes the role of entrepreneurs as organizational, innovation and community leaders. This highlights their ability to disrupt existing structures and create new paths based on their individual characteristics and circumstances. Other actors in an ecosystem, such as investors, officials and workers, can also determine how they operate within an entrepreneurial ecosystems. This includes leverage gained from structures outside the local ecosystem, such as supply chains, platforms or clusters (Auerswald & Dani, 2017). The implication of this idea of the entrepreneur-led ecosystem is that the causal mechanisms driving the evolution of regional entrepreneurial ecosystems may not be the same as for other territorial innovation models (Gilbert, 2016; 2017).

Second, there is an explicit focus on the interdependencies between the different elements that constitute the ecosystem. Thus, rather than examining one particular type of actors (e.g., investors) or context (local cultural norms) on entrepreneurial action, ecosystems research takes a more holistic approach that looks to understand how these elements mutually constitute and reproduce each other over time. This has drawn on theories from evolutionary economic geography (Schmutzler et al., 2021; Stam, 2010) and complex adaptive systems (Auerswald & Dani, 2017; 2022; Carayannis et al., 2022; Han et al. 2020; Haarhaus et al., 2020; Roundy et al., 2018) to theorize the interactions between different actors, institutions, and contexts. The examination of different configures of actors and factors is a fertile field that allows new insights into the effectiveness (and ineffectiveness) of policies and public interventions and draws attention to the variegated role of context (cf. Cherubini Alves et al. 2021; Schrijvers et al. 2021). For example, ecosystem approaches suggest that the impact of a singular support program can only be studied through understanding the program's place in a wider network of entrepreneurial support (Spigel, 2016). However, at the same time, it is

important to retain the central role of entrepreneurs' agency within this study. High-growth entrepreneurship is not the outcome of a specific arrangement of programs and policies but rather these networks of support programs create a context in which high-growth entrepreneurship can potentially thrive.

Entrepreneurial ecosystems thus represent a renewed interest in localized conditions for entrepreneurship combined with a focus on the ability of entrepreneurs to create and transform their own contexts. This has contributed to a vibrant research landscape fueled by both a legacy of diverse research traditions and new policies introduced in diverse settings around the world.

Indeed, some even argue that entrepreneurial ecosystem policy is the 'New Industrial Policy' needed to avoid economic stagnation (Startup Genome, 2020). However, there is a need to critically evaluate this new research and policies in order to understand what has been learnt and what blind spots and gaps remain. In the remainder of the paper, we systematically review the extant literature on entrepreneurial ecosystems and evaluate the dominant themes and approaches.

3. A Conceptual Perspective on Entrepreneurial Ecosystem Mechanisms

Despite its growth, one of the major weaknesses of the ecosystem literature is the lack of evidence into casual mechanisms that connect the structure and resources of the ecosystem itself with the actions of individual entrepreneurs. This makes identifying potential causal mechanisms and developing a multi-level understanding of ecosystems a priority (Alvedalen & Boschma, 2017). In the following, we expand upon the early work by Wurth et al. (2022). For the identification of the causal mechanisms in entrepreneurial ecosystems we use the framework by Stam (2015) and Stam and Van de Ven (2021) to guide our analysis with the aim of linking empirical reality to the entrepreneurial ecosystem approach, in order to better

understand entrepreneurial economies (Thurik et al., 2013). This entrepreneurial ecosystem framework is implicitly based on a (critical) realist methodology, postulating that there is a reality independent of the human mind, but that scientific research is able to perceive events that reflect changes in reality, which are produced by underlying causes (Sayer, 1992; Van de Ven, 2007). In particular, we consider the intra-layer causation among the ecosystem elements (interdependence of elements); the upward causation — how the elements lead to outputs and outcomes; and downward causation and feedback from outputs and outcomes shape the entrepreneurial ecosystems and its elements (cf. Stam & Van de Ven, 2021). Lastly, we include the interaction between different ecosystems and the flow of resources and between them (see Figure 2), treating entrepreneurial ecosystems explicitly as open systems.

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Upward causation reveals how the fundamental causes of new value creation are mediated by intermediate causes, while downward causation shows how outcomes and outputs of the system over time also feed back into system conditions. Intra-layer causal relations refer to the interaction of the different elements within the ecosystem. The links between ecosystems have been largely neglected in the literature and are partially caused by the ambiguity around the spatial boundary of ecosystems.

This approach corresponds to a complex systems perspective of the economy, in which economic agents experiment and interact at the micro level to form a constantly evolving system. Many of these experiments fail, but some succeed and create wealth for society (Beinhocker, 2006). Economic development does not happen by itself: it takes entrepreneurs to create new value that then circulates throughout the economy (Fayolle, 2007; Schumpeter, 1934). This new value creation is an emergent property of a complex system of economic agents and their interactions: the entrepreneurial ecosystem.

Entrepreneurs can structurally change the economy and society, as evidenced by new sets of technologies, institutions and organizational arrangements (Arthur, 2013; Feldman, 2014). The (regional) economy cannot be separated from the agents and institutions that it is made of but is a result of a “constantly developing set of technological innovations, institutions, and arrangements that draw forth further innovations, institutions and arrangements” (Arthur, 2013, p. 1). Therefore, entrepreneurship is simultaneously the result of and the mediator of evolution (Day, 1987). Entrepreneurial behavior as an output is enabled by the system, while the new value created, and potential structural change as an outcome of the system is mediated by entrepreneurship.

This outcome is an emergent property of the system and redefines the nature of the system through feedback effects. Such feedback effects mean that the system and its outputs should not be interpreted as a one-way relation, as the current state of the system might be affected by previous outcomes. This comes close to the statistics issue of simultaneity, which “arises when one or more of the explanatory variables is jointly determined with the dependent variable [...]” (Wooldridge, 2013, p. 530), which is a well-known cause of endogeneity problems. However, in dynamic systems analysis this is not a problem to be evaded, but an inherent characteristic of system dynamics.

These five mechanisms present the highest level of aggregation in a system of nested mechanisms, meaning that they consist of several more specific mechanisms and processes. This links to the issue of the ‘effects’ that are caused by these mechanisms. While any mechanism or process requires causality to develop *explanations* (Hedström & Wennberg, 2017), this does not necessarily determine a specific outcome. Hedstrom & Ylikoski (2010, p. 50) illustrate this using the example of a roulette table, which does not have different mechanisms for individual pockets but one mechanism that can lead to 37 different results. In the case of entrepreneurial ecosystems, the interdependence between elements does not

guarantee a specific evolution of elements. Similarly, entrepreneurial ecosystems and the many configurations in which they exist can lead to a variety of types of entrepreneurial outputs. We further conceptualize the five main mechanisms in light of this in the following.

3.1 Interdependencies within Entrepreneurial Ecosystems

In its most basic form, market-based economic systems are composed of interdependent actors representing supply and demand. To understand economic development, however, we need to look beyond these traded interdependencies and also examine the untraded interdependencies between actors that explain the different performance of economic systems (Dosi, 1988; Lawson, 1999; Storper, 1995). Untraded interdependencies include complementarities between actors and resources as well as information flows that do not fully correspond to commodity flows (Richardson, 1972; Teece, 1986, 1998; Tripsas, 1997). They represent a structured set of externalities, which is a collective good of groups of actors within an economy and is usually internalized within individual firms, both independently and interdependently of their network position (Bunker Whittington et al. 2009). Due to its inherent connectivity, non-linearity and openness, a complex system offers limited functional decomposability (Martin & Sunley, 2007), indicating that the overall functioning of the entrepreneurial ecosystem cannot be inferred from knowledge of its elements, but requires knowledge of how these elements are interrelated. In other words, the pattern must emerge from the process rather than the process from the pattern.

A distinction among these elements must be made between actors and factors (Stam, 2015; 2023). Factors include the structural features of entrepreneurial ecosystems, for example physical and digital infrastructures, institutions, and the supply of capital. Actors can be the organizations and individuals that make up the elements of entrepreneurial ecosystems,

for example the individuals taking leadership roles, people that embody human capital, and investors. Equally as important as the interactions between actors and factors, if not more, are the interactions among actors. These interactions are central in the network element of entrepreneurial ecosystems. But, these interactions can also lead to the formation of a core group in the entrepreneurial ecosystem: a startup community. This community is a “group of people that – through their interactions, attitudes, interests, goals, sense of purpose, shared identity, fellowship, collective accountability, and stewardship of place – are fundamentally committed to helping entrepreneurs succeed” (Feld & Hathaway 2020, p. 78) that actively influences the entrepreneurial ecosystem.

Entrepreneurial ecosystems, in turn, play a critical role in shaping entrepreneurial agency, providing the resources, incentives, and opportunities that enable individual entrepreneurs to pursue their goals and aspirations, and ultimately driving economic growth and development in a particular region. While some elements are more important than others at different levels of aggregation, it is the interplay between the entrepreneurial communities and the wider elements of the ecosystem that supports or constraints entrepreneurs.

3.2 Entrepreneurial Ecosystems and Entrepreneurial Outputs

In an entrepreneurial economy, the engine of overall performance is widely distributed among a variety of innovative firms and start-ups rather than dependent on a few large players (Audretsch & Thurik, 2001; Thurik, Stam & Audretsch, 2013). Ecosystems provide the context for emergence and growth of startups. Depending on their level of maturity and configuration of their elements, they are said to produce not only different levels of output but also different types of output (Brown & Mason, 2017). Entrepreneurship research, and entrepreneurial ecosystem research in particular, has in recent years overly concentrated on ‘gazelles’ or ‘unicorns’ and those companies with venture capital

investments, despite these being extremely rare outcomes (Aldrich & Ruef, 2018; Welter et al., 2017).

One of the defining features of entrepreneurial ecosystem research, especially early work, has been a focus on productive entrepreneurship. Productive entrepreneurship has been defined as “any entrepreneurial activity that contributes directly or indirectly to net output of the economy or to the capacity to produce additional output” (Baumol, 1990, p. 30). This form of entrepreneurship is associated with new job creation and increases in the overall productivity of an economy. Productive entrepreneurship is often measured as (young) high growth firms, but should not be limited or equated to this particular empirical proxy (Davidsson, 2004; Stam 2015). There is a considerable amount of entrepreneurial ecosystem studies that focus on types of entrepreneurship that do not necessarily belong to the category of high growth firms. Examples include ecosystems of social entrepreneurs (Thompson, Purdy & Ventresca, 2017) and creative entrepreneurs (Loots et al., 2020) that can have indirect positive effects on the aggregate economy. This also indicates the need for a larger concept of productive entrepreneurship which includes social and ecological value creation alongside commercial value. Indeed, might also imagine other ecosystems that support non-productive or even destructive entrepreneurship (Baumol, 1990), such as ecosystems of lobbyists in Washington D.C. or Brussels (Sobel, 2008) or the mafia in Southern Italy (Gambetta, 1993).

This raises a new question: do entrepreneurship ecosystems enable all forms and stages of entrepreneurship similarly, or do different types of entrepreneurship need different types (configurations) of entrepreneurial ecosystems? Some authors argue for a set of generic elements that positively influence productive entrepreneurship in general, e.g. physical and institutional infrastructures. Others argue that certain types of entrepreneurs or entrepreneurship are affected differently by entrepreneurial ecosystems than other types.

Examples include individual attributes such as gender (e.g. Hechavarría & Ingram, 2019; Sperber & Linder 2019), and firm-level attributes such as being active in the retail or biotech sector (Auerswald & Dani, 2017).

3.3 Entrepreneurial Ecosystems and Wider Socio-Economic Outcomes

The links between ecosystems and their outputs and outcomes cannot be separated, as productive entrepreneurship (in whatever form) as the output fosters ‘aggregate value creation’ and economic development (in a wider sense) as the outcome (Carree & Thurik, 2010; Stam, 2015; Wennekers & Thurik, 1999). We define entrepreneurship-led economic development as structural changes to the economy and its ‘social and institutional fabric’ (Acemoglu, 2012) that goes beyond GDP and productivity growth or higher employment rates. Further relevant aspects include resilience to economic shocks at the local or regional level (Duran & Fratesi, 2023; Iacobucci & Perugini, 2021) and other dimensions of well-being, quality of life, and inequality (e.g., Zahra & Wright, 2016).

In this context, the types of entrepreneurship and variety of outputs that entrepreneurial ecosystems produce play a key role. Entrepreneurial activities in the broader sense come with a ‘social multiplier’ (Zahra & Wright, 2016). Social entrepreneurs, for example, “provide a distributed mechanism for society to identify neglected problems with positive externalities, develop innovative solutions to address them and, often, change institutional arrangements so that the externality becomes visible and is internalized by other societal actors” (Santos, 2012, p. 348). In this way, ecosystems can also act as a catalyst for social movements transforming existing and growing new industries (Lounsbury et al., 2003).

This mechanism cannot be separated from the previous one, as entrepreneurship is the means for creating value (financial, societal, and environmental, among others) across

different levels of aggregation and, therefore, economic development (e.g., Carree & Thurik, 2010; Vedula et al., 2022). Rather, they are complimentary.

3.4 Downward Causation and Path-Dependencies

Entrepreneurial ecosystems, like economies as a whole, are subject to path dependencies. The concept of path dependency goes back to the work by David (1988) and Arthur (1989) and “can be used to offer an understanding of why some optional developments are followed, or intentionally chosen, over others [...] path dependence conditions, but does not determine, a specific outcome” (Henning, Stam & Wenting, 2013, p. 1350). It is this recursive continuous process of interaction between ecosystems (context), processes, and their outputs and outcomes that shape the ecosystem and the conditions for entrepreneurs (Aldrich & Martinez, 2001).

Downward causation can take many forms as an enabler of path dependencies. Conceptually, both are integral parts of entrepreneurial ecosystems (e.g., Stam, 2015). Path dependency manifests itself in institutions, which can be characterized as ‘the carriers of history’ (David, 1994), and a spiky resource landscape. A prominent example of the regional institutions is the ‘pay it forward’ culture of Silicon Valley that developed over decades and is a distinct feature of that ecosystem (Wagemans & Schram, 2021).

The spiky landscape is the result of various other processes and mechanisms. Probably the most common form is entrepreneurial recycling, in which successful entrepreneurs “use their newly acquired wealth, allied to the experience they have accumulated, to engage in other entrepreneurial activities, notably starting new business ventures and investing in other businesses as business angels or venture capitalists” (Mason & Harrison, 2006, p. 55). Related to this is the concept of ‘serial entrepreneurship’ or a

‘renascent entrepreneur’, i.e. those entrepreneurs that exited a previous business and start a new one (Stam, Audretsch & Meijaard, 2008).

The path-dependency in entrepreneurial ecosystems is also affected by the industries that are present in a particular territory (Neffke et al., 2011). From a policy perspective, the ‘smart specialization’ approach aims to capitalize on path dependencies by building on the existing strengths in a region (cf. Balland et al., 2018). Entrepreneurial ecosystems, however, are seen to be unique by enabling cross-fertilization between industries and the sharing of business model innovation and structural knowledge, particularly in the digital context (Autio et al., 2018). This provides a means of path-breaking behavior, which is crucial for regional economies to not get locked in to unproductive or even destructive paths (Isaksen, 2015). Particularly in more peripheral regions, external investments or policy interventions are often required to initiate these processes (Brekke, 2015).

Entrepreneurial ecosystems, therefore, are a means to operationalize different dimensions of context (Welter, 2011) and ‘multiscalar institutional environments’ through their nestedness (MacKinnon et al., 2019). Entrepreneurial ecosystems combine the regional and supra-regional conditions with place-based legacies and, as a result, enable or constrain entrepreneurial behavior.

3.5 Inter-Ecosystem Links

The entrepreneurial ecosystem literature is dominated by a focus on the endogenous dynamics within specific territories rather than multi-scalar studies (Alvedalen & Boschma, 2017). Some entrepreneurial ecosystems rise to become hubs for entrepreneurial activity and attract people, ideas, and resources. Related to path-dependencies, this migration of talent and resources is a key driver behind the dynamics of entrepreneurial ecosystems and the resulting spiky landscape in terms of research and innovation (e.g., Balland, et al., 2018; Balland &

Rigby, 2017) and entrepreneurial activities (e.g., Brown & Mason, 2017; Kuechle, 2014; Sorenson & Audia, 2000), and the financial resources that support them (Bruton et al., 2002; Startup Genome, 2020). Based on research on the impact of social capital (e.g., Florin et al., 2003), entrepreneurs migrate to join these ecosystems and get access to resources that are available to support their growth.

There is conceptual and empirical uncertainty around where the boundaries of entrepreneurial ecosystems are. While policy makers typically refer to (their) jurisdictions, practitioners often refer to more or less spatially bounded communities (e.g., Feld, 2012; Feld & Hathaway, 2020). Academic work mostly uses a regional approach to entrepreneurial ecosystems without a consistent definition of ‘region’ and fewer applications of the ecosystem concept at national levels (e.g., Wurth et al., 2022). However, there is also work on sub-ecosystems based on different industries within a region (e.g., Loots et al., 2020; Spigel, 2022) and related to coworking spaces (Orel et al., 2022), communities of practice (Cuntz & Peuckert, 2023), and education hubs (Knight, 2013) that all attract talent and facilitates links within and between ecosystems.

This also opens up research on transnational entrepreneurs (Schäfer & Henn, 2018) and transnational entrepreneurial ecosystems (Velt et al., 2020). Transnational entrepreneurs (Portes, Haller & Guarnizo, 2002; Schäfer & Henn, 2018) and returnee entrepreneurs (Saxenian, 2006; Kenney et al., 2013;) form one of the largest groups in some of the most vibrant ecosystems. Such entrepreneurs are often key actors in their ecosystem and by keeping ties with their country of origin and, therefore, other ecosystems. In this way, they take on the role of modern middlemen who “transcend the multiple institutional environments in which they are embedded” (Terjesen & Elam, 2009, p. 1093). From a knowledge spillover perspective, they “are capable of overcoming the sensitivity to distance usually associated with knowledge spillovers” (Sternberg, 2007, p. 658).

In Silicon Valley, for example, it was the highly educated and skilled Asian immigrants who actively supported the growth of the ecosystem by becoming entrepreneurs and helping facilitate interactions with their home countries, which opened up new markets and opportunities (Saxenian, 2002). However, such populations are not necessarily critical in the early stages of entrepreneurial ecosystem development, i.e. ‘nascent ecosystems’ (Spigel & Harrison, 2018) or the ‘birth’ phase (Mack & Mayer, 2016). This phase is usually driven by local entrepreneurs and regional policy makers through a combination of bottom-up and top-down processes. However, these migrant entrepreneurs may play key roles in developing emergent ecosystems in their places of origin if they return and take on the dual role of both experienced entrepreneur and investor (Yi et al., 2021). Investors, like other ecosystem actors, have to adapt to their new ecosystem though, and must balance this with bringing change and leveraging past experiences and practices (Bruton et al., 2002).

There has been comparatively less work on the spillover effects between neighboring ecosystems’ R&D activities, infrastructure and their economic performance (Bronzini & Piselli, 2009). Furthermore, predominantly in ICT and other technology-based sectors, many scale-ups either provide a platform themselves or are based on other platform or innovation ecosystems (Cennamo, 2021; Cutolo & Kenney, 2021; Nambisan & Baron, 2013). Supra-regional and global linkages are important, both to prevent lock-ins from path-dependency and to maintain a high level of innovativeness (Malecki, 2018; Mason & Brown, 2014; Sternberg, 2007). With implications for regional and national policy (e.g., immigration) as well as entrepreneurial practice and ecosystem ‘governance’, the main question is how these mutually beneficial links and transregional and -national entrepreneurs can be attracted, supported, and integrated into the ecosystem. We will review the empirical literature in light of these five overarching mechanisms and synthesize the empirical evidence.

4. Methodology

4.1 Identification of Relevant Papers

For our systematic analysis of the entrepreneurial ecosystem literature we applied the same multi-stage process as Wurth et al. (2022). In the initial stage we searched all databases from Web of Science and Scopus for a comprehensive overview of the published literature (Frank & Hatak, 2014; Martín-Martín et al., 2018; Webster & Watson, 2002). We only used journal papers and excluded book chapters and conference papers to avoid including multiple publications based on the same research. We focused exclusively on the entrepreneurial ecosystem concept, which differs from other applications of ecosystems in the management literature in terms of (1) the focus on specific types of entrepreneurship, and (2) the specific territorial boundaries that are placed on the entrepreneurial ecosystem, usually a city, a region, or a nation (Scaringella & Radziwon, 2018). We conceptualize entrepreneurial ecosystems at the regional level, but also acknowledge that ecosystems are situated within national systems and institutions. They are also not homogenous themselves and are made up of different clusters and communities. Therefore, we look include the application of ecosystems across all levels of aggregation to further understand the nestedness of ecosystems and how this relates to the main mechanisms behind their dynamics. We performed a topic search (title, abstract, keywords) with the following keywords: “entrep* ecosystem*” (1,036 results Web of Science Core Collection / 1,091 Scopus), “startup ecosystem*” (56/74), “start-up ecosystem*” (41/53), “entrep* system*” (70/90), and “system* of entrep*” (55/70). Using a topic search enables the required breadth at this stage of the literature search. The result is an initial sample of 1,497 journal articles.²

² Search date: 22 December 2022

In the second stage, we used the Scimago Journal Rankings and extracted the top quartile journals of the 2021 edition from the subject areas ‘Business, Management and Accounting’ and ‘Economics, Econometrics and Finance’ as well as the subcategories ‘Geography, Planning and Development’, ‘Urban Studies’, and ‘Social Sciences Miscellaneous’ from the ‘Social Sciences’ subject area. This step aimed to balance the breadth and depth of our review. Including journals from business, strategy, and management to economics, geography, and urban studies allows the inclusion of a wide variety of perspectives on entrepreneurial ecosystems and the territorial context for entrepreneurship. In doing so, this stage also excluded the publications in non-relevant disciplines such as health or robotics. Including only the top quartile of journals limits the depth of the review but ensures a high level of scientific quality. The result was a list of 924 journals, with 115 being represented in our initial sample. We have removed the journal Sustainability from this list due to the recent ranking as a ‘predatory’ journal.³ This leaves us with an intermediate sample of 533 articles from 114 journals.

In the third stage, we undertook an in-depth reading of all the remaining papers. Our goal was to be as inclusive as possible, identifying all empirical articles that use the entrepreneurial ecosystems concept and deal substantially with the phenomenon. We excluded 113 articles that did not include original, empirical research. These include editorials, call for papers, review papers, methodological, and theoretical/conceptual papers. We focused on empirical research to understand what we know about how ecosystems work compared to insights based purely on logic in theoretical work. We reviewed the empirical literature based on a commonly accepted framework (e.g., Maroufkhani et al., 2018; Nicotra et al., 2018), which allows us to draw conclusions regarding the mechanisms. Further 86 articles were excluded because they used the ecosystem concept at the organizational level

³ <https://predatoryreports.org/news/f/list-of-all-mdpi-predatory-publications> [accessed 15 March 2023]

(e.g., universities or support organizations) and a further 15 articles were excluded because they do focus on entrepreneurial ecosystems within a particular spatial context (e.g., platforms). These articles did not conform with our ecosystem definition and the systemic nature of ecosystem within a spatial context. We excluded 54 articles because they only used the entrepreneurial ecosystem concept as a label (mostly for regional characteristics or context) and 68 papers that dealt with it in a trivial or marginal way, without any meaningful engagement with the concept. Finally, 16 articles are excluded because they neither used the entrepreneurial ecosystem concept itself nor do they engage with the principles of an ecosystem. This left us with a final sample of 181 articles.

4.2 Content Analysis and Coding

Several review papers on entrepreneurial ecosystems have already been published, many of them organized around analyzing empirical studies of entrepreneurial ecosystems (e.g., Cao & Shi, 2020; Garavan et al., 2019; Hakala et al., 2020; Maroufkhani et al., 2018; Nicotra et al., 2018). Building on the insights from these reviews and the framework presented by Wurth et al. (2022), we take a concept-centered approach to our review (Fisch & Block, 2018). The aim is to produce an empirical evidence-based, transparent, and reproducible review of the literature (Tranfield et al., 2003). We extracted the main findings from the final set of 181 papers and categorized them according to the five causal mechanisms described in Section 3. By synthesizing and learning from insights from a variety of methodological approaches, we draw a comprehensive picture of the current stock of knowledge with regard to how entrepreneurial ecosystems work. We can only establish a clear understanding of how ecosystems work and the causal relationships through synthesizing and scrutinizing the existing body of empirical work, not from individual studies alone. We also consider and reflect on the nature of the conducted research and the

methodologies (i.e., the ‘type of evidence’ produced), without adhering to a strict ‘hierarchy of evidence’ (Tranfield et al., 2003). Other scientific disciplines, especially the fields of medicine and public health (Concato et al., 2000; Davies & Nutley, 1999, Evans, 2003), have a clearer hierarchy and developed higher consensus over time compared to the field of entrepreneurship and management research more broadly (Tranfield et al., 2003).

Fundamentally, this is rooted in a greater variety of ontological and epistemological bases and the resulting need for a wider set of methodological approaches. We discuss the results and implications in Section 5.

4.3 Overview of Relevant Papers

The academic literature on entrepreneurial ecosystems has grown significantly since the mid-2010s (see Figure 3).⁴ This is true for the trend of all unique papers that we identified by searching Scopus and Web of Science as well as when reducing the sample using the top quartile of the Scimago Journal Rankings and our final sample.

- - - Insert Figure 3 Around Here - - -

Figure 4 shows the number of published findings from the final sample according to the five causal mechanisms. The empirical entrepreneurial ecosystem literature is dominated by work on interdependencies between elements of the ecosystem and how entrepreneurial ecosystem are linked to particular outputs (e.g., start-ups, scale-ups/high-growth firms, social entrepreneurship). There is a delay of approximately three years until research linking entrepreneurial ecosystems to socio-economic outcomes more broadly and downward causation and path-dependencies started to gain momentum. However, both streams of research never reached the magnitude of the first two. One explanation is that entrepreneurial

⁴ Nine papers among the 1497 unique papers (eight of which are also in the reduced sample and one is part of the reviewed papers) were already assigned to volumes and issues to be published in 2023, which explains why all three lines have a sharp drop at the end.

ecosystems are predominantly applied at the regional or local level, which makes it hard to draw links to wider socio-economic development. Regarding path-dependencies, a possible explanation might be the lack of longitudinal data that covers both system level outputs or outcomes as well as information about individual elements of the ecosystem and their configuration. This could equally apply to the fifth mechanism, the links between different (regional) ecosystems, that has seen the least attention from academics. We will discuss the current status quo of the research on each mechanism in more detail in the following section.

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5. An Empirical Perspective on Entrepreneurial Ecosystem Mechanisms

Understanding the way in which entrepreneurial ecosystems are studied and are used to study entrepreneurship is a necessary requirement when synthesizing the findings and distilling the causal mechanisms that drive the development of entrepreneurial ecosystems. In the following, we discuss state of the empirical entrepreneurial ecosystem literature.

5.1 Interdependencies within Entrepreneurial Ecosystems

Our review, and particularly the large number of empirical articles that we excluded of the articles using the entrepreneurial ecosystem concept shows that a substantial part of the literature merely utilizes the concept in a metaphorical way. These articles use the concept in name only without appropriately recognizing the fundamental interdependencies between the constituent elements of the ecosystem. Many studies use the ecosystem to introduce the study of geographical contexts of entrepreneurship, but focus on isolated elements as variables ‘explaining’ the prevalence of a particular type of entrepreneurship. There is also a subset of studies that focus on a singular innovation project within in a spatial setting, not looking at the aggregate prevalence of entrepreneurship, nor at the interdependencies in the ecosystem

more broadly. Such metaphorical offer limited contributions towards a consolidated scientific understanding of entrepreneurial ecosystems.

Despite this, the empirical entrepreneurial ecosystem literature is dominated by a focus on interdependence and the link between ecosystems and outputs. The interdependencies within ecosystems often mean that they enable the sharing and circulation of resources (Corradini, 2022; Shi & Shi, 2021). This can be best understood at the regional level as the heterogeneity in the composition of entrepreneurial ecosystems across city-regions and some spatial patterns would not be visible using larger spatial units (Perugini, 2022). In the following, we reflect on the use of the entrepreneurial ecosystem concept across different levels of aggregation, but explicitly supporting a regional perspective on entrepreneurial ecosystems. We also acknowledge that there are sub-systems nested within regional ecosystems and ecosystems themselves are nested in larger national systems of innovation and entrepreneurship and other institutions. An overview of the papers addressing the interdependencies within ecosystems is presented in Table 1.⁵

The dynamics within ecosystems are driven by feedback and non-linear co-evolution between ecosystem elements and the wider socio-economic-historical context (e.g., Bessagnet, Crespo & Vicente, 2021; Bischoff, 2019; Daniel et al., 2022; Eichelberger et al., 2020; Grande et al., 2022; Hubner et al., 2022; Marinelli et al., 2022; Yamamura & Lassalle, 2020). By extension, this means that ecosystems are unique due to their co-evolving elements and historical, cultural, and institutional heritage (Mack & Mayer, 2016) and their configuration and the resulting feedback effects can vary significantly (Spigel, 2017). The non-linear evolution of the entrepreneurial ecosystem can even have contradictory developments within different elements (Radinger-Peer, Sedlacek & Goldstein, 2018).

⁵ Tables 1-5 are extensions of Wurth et al. (2022).

Building on this work, other studies have highlighted that improving the entrepreneurial ecosystem requires addressing the weakest elements or ‘bottlenecks’ (Aliabadi, Ataei & Gholamrezai, 2022; Szerb et al., 2022), but in some cases stronger elements can also compensate for weaker ones (Godley, Morawetz & Soga, 2021). This is rooted in the complex nature of ecosystems (Leendertse, Schrijvers & Stam, 2021; Stephens et al., 2022) and their potentially chaotic evolution (Cloutier & Messeghem, 2022). This has also implications for the governance of ecosystems, which is an iterative process that relies on effective management of relationships, communication ties with local and national agendas and a shared collaborative culture (Knox & Arshed, 2022). This also changes as the ecosystem evolves, and so does the role of different actors (Colombelli, Paolucci & Ughetto, 2019). Entrepreneurial ecosystem evolution depends on both munificence (in the built environment) and the dynamism and behavioral responses of agents in the ecosystem (Johnson, Bock & George, 2019).

These co-evolutionary dynamics are the result of the interactions of individuals and organizations within ecosystems. These interactions are enabled by (predominantly informal) institutions but also constantly co-create them (Lowe & Feldman, 2017; Pocek, 2022). These interactions are not one-off in most cases and represent repeated patterns and behaviors (Feldman & Lowe, 2018). These predominantly endogenous, bottom-up, and time-patterned processes shape the ecosystem (Han et al., 2021; Maysami & Mohammadi Elyasi, 2020; Pushkarskaya et al., 2020; Thompson, Purdy & Ventresca, 2018).

This leads to the role networking as entrepreneurial behavior and the formation of networks and communities within ecosystems (Kömlösi et al., 2022; Thees, Zacher & Eckert, 2020), which can also provide support and resilience during crisis (Kansheba, Marobhe & Wald, 2022). When an industry in a region matures and a cluster emerges, local generic entrepreneurial ecosystem service providers may be bypassed by their local entrepreneurs (Li

et al., 2022). However, gender issues can constrain the bottom-up evolution of ecosystems and women-only networks are not sufficient to improve connectedness and engagement in entrepreneurial activities of women (McAdam, Harrison & Leitch, 2019).

The presence of these actors and factors is not sufficient for ecosystem development. They also need to be connected and interact (Noelia & Rosalia, 2020). More importantly, that involves all actors, not just central ones (Korber, Swail & Krishanasamy, 2022), although central ‘deal-makers’ are essential for fostering connectivity and knowledge spillovers (Pittz, White & Zoller, 2019). Yet actors need to reach legitimacy across three complementary dimensions – institutional, cultural and relational – to make an impact within the ecosystem (Lechner, Delanoë-Gueguen & Gueguen, 2022). The way in which the actors and factors are connected is what makes each ecosystem unique (Neck et al., 2004).

Role models and intermediary organizations (Hannigan et al., 2021) and other ‘champions’ (Roundy, 2019), anchor firms and organizations (Lo & Theodoraki, 2021; Ryan et al., 2021; Sohns & Wójcik, 2020; Stolz, 2022), and key actors more generally (Rocha, Brown & Mawson, 2021) are crucial for creating local buzz, promoting shared visions, and bridging cultural holes, which improves the flow of resources and information. A key role model are entrepreneurs themselves, who shape and contribute to the ecosystem in addition to benefitting from it (Bichler et al., 2022; Cunha, Kastenholz & Carneiro, 2020; Pankov, Schneckenberg & Velamuri, 2021). Particularly successful start-ups (or ‘lighthouses’) play an important role in shaping the cultural, social and material attributes of an ecosystem (Tiba, Van Rijnsoever & Hekkert, 2020). Intermediary organizations, including entrepreneurial support organizations (ESOs; Bergman & McMullen, 2022), in entrepreneurial ecosystems play a significant role in orchestrating collaborations (Goswami, Mitchell & Bhagavatula, 2018; Hernández-Chea et al., 2021; Pustovrh, Rangus & Drnovšek, 2020). However, they usually do not fundamentally address unfavorable institutions and only provide

‘symptomatic’ solutions, therefore new ‘systemic’ support organizations and institutions are needed (Van Weele et al., 2018). Government sponsorship is an effective driver of ecosystem development beyond increasing individual recipient firms’ performance (Motoyama & Knowlton, 2016). Universities also adapt to the state of the entrepreneurial ecosystem and contribute in multiple ways, often beyond their traditional remit of teaching and research (Pugh et al., 2019; Schaeffer & Matt, 2016; Wagner et al., 2019).

The ecosystem concept has been predominantly – and more than for any other mechanisms – applied at the regional level (53 out of 59 studies) when studying the interdependencies of their constituent elements. We can conclude from this section that entrepreneurial ecosystems must be situated not just in their wider economic context but their socio-cultural-historical context as well. Particularly the historical context of places and the role of entrepreneurship and how it is embedded in these wider sociological and demographic processes within the entrepreneurial ecosystem and neighboring ones has not yet been adequate explored (cf. Stam & Welter, 2021). What is missing are multi-level studies that consider multiple levels of (spatial) aggregation and how these levels relate to different actors and factors within ecosystems.

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5.2 Entrepreneurial Ecosystems and Entrepreneurial Outputs

Different entrepreneurial ecosystem configurations lead to different entrepreneurial outputs (Cherubini Alves et al., 2021; Dilli, Elert & Herrmann, 2018; Dionisio, Inácio Júnior & Fischer, 2021; Harms & Groen, 2017; Inacio Junior et al., 2021; Prencipe et al., 2020; Roundy, 2019; Wolff et al., 2022; Xie et al., 2021; Yan & Guan, 2019;). entrepreneurial ecosystems and their outputs are also ‘place sensitive and complex’, where different

configurations can lead to desirable (high-growth) and non-desirable (low-growth) outputs simultaneously (Muñoz et al., 2020). Marginal changes in the initial configurations of entrepreneurial ecosystems can also lead to unexpected, disproportionate changes in the outputs (Haarhaus, Strunk & Liening, 2020). This is linked to the notion that outputs of entrepreneurial ecosystems evolve over time (Buratti et al., 2022).

This is, however, not limited to the overall ecosystem but nested sub-systems or clusters with ecosystems can produce different outputs (Scheidgen, 2021; Spicer & Zhong, 2022). These sub-systems can be based on social capital (Neumeyer, Santos & Morris, 2019), other organizational- and individual-level factors (Neumeyer & Santos, 2018), or centered around digitalization and digital technologies (Cornet, Bonnet & Bourdin, 2022). While they can produce different outputs, they can also provide support across the entrepreneurial ecosystem and, for example, help with internationalization efforts of companies (Theodoraki & Catanzaro, 2022). This kind of clustering is common even in advanced EEs, with few cross-over points between different communities, yet general managerial/entrepreneurial know-how is still important across all subsystems for high-growth firms (Spigel, 2022). This highlights the importance of having ‘connectors’ or ‘dealmakers’ in the ecosystem, who can help connect people and communities that might otherwise develop – or not – in isolation.

The link between entrepreneurial ecosystems and entrepreneurial activity in general, usually proxied by start-up rates, has been examined from different angles. There is support for a general link between ecosystems and the founding of start-ups (Audretsch & Belitski, 2017; Long, Zheng & Qian, 2022; Nylund & Cohen, 2017), and that start-ups perform better and have higher survival rates, particular for first-time founders (Vedula & Kim, 2019). entrepreneurial ecosystems are also seen as a necessary condition to enable start-up creation through collaboration (Cetindamar, Lammers & Zhang, 2020; Guéneau, Chabaud &

Sauvannet, 2022; Jung, Eun & Lee, 2017), even for those associated with universities (Abootorabi et al., 2021; Harrison & Leitch, 2010; Johnson, Bock & George, 2019).

Digital technologies (Zhang, van Gorp & Kievit, 2022), human capital and entrepreneurial absorptive capacity (Qian, Acs & Stough, 2013), and institutions, predominantly informal institutions at the regional level, in combination with a strong ecosystem are linked to higher start-up rates (Audretsch, Lehmann & Seitz, 2019; Bennett, 2021b; Oner & Kunday, 2016; Riaz, Leitão & Cantner, 2022). Policy makers should also consider broader innovation policies and efforts such as smart cities to support entrepreneurship through the entrepreneurial ecosystem (Barba-Sánchez, Arias-Antúnez & Orozco-Barbosa, 2019). Particularly in the tourism sector, which is critical for many rural or peripheral areas, quality of life as an additional aspect of the ecosystem – highlighting the embeddedness in the wider context – supports entrepreneurial activities (Bichler, Kallmuenzer & Peters, 2020).

The entrepreneurial ecosystem concept has traditionally focused on producing high-growth start-ups or scale-ups. Consequently, there is a large body of empirical evidence linking entrepreneurial ecosystems both at the regional and national level to high-growth firms (Acs, Autio & Szerb, 2014; Corrente et al. , 2019; Fotopoulos, 2022; Gueguen, Delanoë-Gueguen & Lechner, 2021; Leendertse, Schrijvers & Stam, 2021; Lux, Macau & Brown, 2020; Mikic, Horvatinovic & Kovac, 2021; Neck et al. , 2004; Noelia & Rosalia, 2020; Stam & Van de Ven, 2021; Vedula & Fitza, 2019).

A well-developed ecosystem is a prerequisite to (smart specialization) industry prioritization because the latter will fail without the entrepreneurial ecosystem being able to nurture high growth ventures (Szerb et al., 2020). The link between largely industry-agnostic entrepreneurial ecosystems and industrial clusters is starting to be explored empirically. Based on a qualitative case study, seven propositions, which open new avenues for

understanding EEs, global value chains, and their interplay in emerging high-tech industries have been proposed to this end (Reis et al., 2022).

Different entrepreneurial ecosystem configurations can lead to different outputs. Consequently, there are similar elements that, in conjunction with a strong ecosystem, support not only start-up activities in general but high-growth entrepreneurship too. These include informal institutions, especially institutional trust (Khlystova, Kalyuzhnova & Belitski, 2022) and economic freedom at the regional level (Bennett, 2021a), and institutions in combination with entrepreneurial talent for developing economies (Mahn & Poblete, 2022). Entrepreneurial ecosystems generally amplify the effectiveness of public and social services by regional governments for supporting opportunity entrepreneurship (Wei, 2022). Digitalisation and the tech industry play a key role for high-quality entrepreneurship (e.g., unicorns) and digital ecosystems might be more useful to explain this than new business creation in general (Torres & Godinho, 2022).

The local presence of research-oriented universities, access to capital, and business concentration are correlated to the emergence of knowledge-intensive entrepreneurship (Fischer, Queiroz & Vonortas, 2018). But universities and their spinouts also depend on the ecosystem. Some ecosystem configurations lead to higher spin-out retention (especially in lower urbanization and localization economies) while others have higher attraction rates (higher localization economies and innovation resources) (Rossi, Baines & Smith, 2021). High information asymmetries can also affect high-tech entrepreneurial ideas based on university knowledge to attract external finance, but this is moderated by other ecosystem elements (Ghio, Guerini & Rossi-Lamastra, 2019).

In emerging economies the gap between productive and unproductive entrepreneurship is mainly caused by the market uncertainty and the perception of political

entrepreneurship and corruption, which links informal and formal institutions (Belitski, Grigore & Bratu, 2021).

The dynamics within and the outputs of entrepreneurial ecosystem are the result of the interplay between structure and agency. Dense ecosystems do not automatically lead to more interactions, but those entrepreneurs who do actively engage and exercise their agency, have a higher rate of survival (especially among high-tech start-ups) (Bandera & Thomas, 2019).

In addition to start-ups and scale-ups (or high-growth entrepreneurship), recent research has broadened the range of entrepreneurial outputs from EEs. Examples include social and sustainability-oriented entrepreneurship (Audretsch, Eichler & Schwarz, 2022; Tiba, Van Rijnsoever & Hekkert, 2021; Woo & Jung, 2022), female entrepreneurship at the regional level (Berger & Kuckertz, 2016; Welsh et al., 2023), frugal and informal entrepreneurship (Igwe et al., 2020), entrepreneurship in the creative industries (Wang & Richardson, 2021), and the creation of knowledge intensive business services (Horváth & Rabetino, 2019).

There is also an emerging body of research that questions the extent to which EEs, or at least many of their elements, impact entrepreneurial activity. Examples include several national-level entrepreneurial ecosystem aspects not having a significant impact on rates of male or female entrepreneurial engagement (Hechavarría & Ingram, 2019), inadequate entrepreneurial ecosystems hindering the development of 'transformative entrepreneurship', i.e. sustainable businesses with societal impact (Egere, Maas & Jones, 2022), and the perception of a weak entrepreneurial ecosystem mitigating (potential) entrepreneurs' ambitions, actions, and opportunities in peripheral regions (Freitas & Kitson, 2018). Even with substantial government support, these challenges remain for innovative entrepreneurs (Biru, Gilbert & Arenius, 2020) and university spin-offs (Civera, Meoli & Vismara, 2019).

Overall, these findings have been mostly derived from applying the ecosystem concept at a regional level (approximately two thirds, with the remaining third of the studies applied at the country level). Quantitative studies dominate within the country-level study of the link between ecosystems and entrepreneurial output. This can partially be explained by the more widespread and longer-term availability of data at the national level. Nevertheless, this neglects the significant intra-country variation and regional concentration of entrepreneurial activity.

The synthesized results for this mechanism should be seen in light of the common practices of academic publishing, where publishing results with no effects is harder than results with either a negative or positive effect. Consequently, these studies represent potentially only a small portion of inconclusive or negative results. However, some of these studies do not account for the interdependencies within ecosystems (e.g., Hechavarría & Ingram, 2019) or study specific outputs (e.g., Biru, Gilbert & Arenius, 2020; Civera, Meoli & Vismara, 2019; Egere, Maas & Jones, 2022). This section has highlighted the variety of outputs that entrepreneurial ecosystems can produce, so negative or inconclusive results do not necessarily mean that the entrepreneurial ecosystem concept does not stand up to empirical scrutiny.

The entrepreneurial ecosystem literature that focuses on different outputs has seen a rise in quantitative and mixed method approaches. Similar to many of the main arguments under the ‘interdependencies’ mechanism, we are looking at a much more solid evidence base for the main arguments supporting the link between entrepreneurial ecosystems and entrepreneurial outputs compared to earlier work by Wurth et al. (2022). This includes the use of longitudinal datasets such as GEM, World Bank, and Eurostat combined with other data sources. Fuzzy set qualitative comparative analysis (fsQCA) has become a prominent approach to the systemness of ecosystems, the analysis of different configurations, and the

effect on entrepreneurial outputs of EEs. However, much of the recent research has effectively produced new ‘cases’ to support existing arguments, albeit in different contexts or ecosystems but there is a lack of pushing the boundaries of what we know about the ways in which entrepreneurial ecosystems produce entrepreneurial outputs.

- - - Insert Table 2 Around Here - - -

5.3 Entrepreneurial Ecosystems and Wider Socio-Economic Outcomes

There is a growing number of papers that study the link between entrepreneurial ecosystems and wider socio-economic outcomes (see Table 3). The nestedness of entrepreneurial ecosystems and the different levels of (spatial) aggregation at which elements of the entrepreneurial ecosystem as well as the outputs and outcomes interact and play out are the main issue underlying this stream of research. For example, studies are highlighting that (predominantly national) ecosystems foster economic growth and more efficient resource allocation due to knowledge spillovers (Acs et al., 2018; Basole, Park & Chao, 2019; González-Serrano et al., 2021; Lafuente, Szerb & Acs, 2016; Lafuente et al., 2019, 2021; Xie, Xie & Martínez-Climent, 2019). Linked to the previous discussion around the outputs of ecosystems, supporting the founding of high-potential start-ups is not enough. With a focus on economic development, ecosystems must support the growth of startups as the quality of entrepreneurship is more relevant than the quantity (Andrews et al., 2022). The knowledge spillover theory of entrepreneurship (cf. Acs et al., 2009) supports our general framework with entrepreneurship as the output of the entrepreneurial ecosystem and as a means for wider economic development (Figure 2).

In addition to the quality of entrepreneurship, the quality or maturity of the entrepreneurial ecosystem also matters, particularly at the regional level (Audretsch & Belitski, 2021; Spilling, 1996). This includes building enabling co-creation and interactions

(Erina, Shatrevich & Gaile-Sarkane, 2017; Grama-Vigouroux et al., 2022) and building resilience (Iacobucci & Perugini, 2021).

Some research has also shown that entrepreneurial ecosystems act as a moderator for the relationship between entrepreneurship and economic development (Content et al., 2020; Szerb et al., 2019). However, another study has shown no moderating effect of entrepreneurial ecosystems on the relation between entrepreneurship and economic growth (Bruns et al., 2017).

Based on a comparative case analysis, Kapturkiewicz (2021) concludes that entrepreneurial ecosystems should not be reduced to standardized measures but evaluated based on their configuration according to the ‘Varieties of EEs’ and within their context and state of development. Early work has emerged that studies the link between entrepreneurial ecosystems and a variety of outputs (as discussed in the previous section) and other outcomes as well. In terms of wider socio-economic benefits, entrepreneurial ecosystems have also been linked to sustainable innovation and addressing grand societal challenges (Khatami et al., 2022; Moggi, Pierce & Bernardi, 2022) and society more broadly (McDaniel et al., 2021; McDaniel, Ge & Yuan, 2022).

Research on the wider outcomes of entrepreneurial ecosystems is dominated by quantitative work (see Table 3). This is partially driven by the increasing availability of longitudinal and panel data that explicitly covers various aspects of entrepreneurship and the environment in which entrepreneurship happens. Disaggregation to regional levels is still lagging national surveys, but there have been significant advances (e.g., REDI, the Regional Entrepreneurship and Development Index). The challenges are 1) finding the right proxies for measuring improvements in aggregate well-being and quality of life beyond GDP growth and 2) applying them and the elements of the entrepreneurial ecosystem at the appropriate level of aggregation (cf. Sternberg, 2022, and the empirical work by Bruns et al., 2017, and

Lafuente, Ács & Szerb, 2021). Further mixed-method approaches can also shed light on the perceived impact of entrepreneurial ecosystems and entrepreneurship in addition to changes in proxy variables for economic development in a broader sense.

There is also a significant in the ratio between region- and country-level applications of the ecosystem concept compared to the previous two mechanisms. A total of thirteen studies uses the region as the level of analysis and nine papers use countries as the level of analysis. When considering wider socio-economic effects of entrepreneurship, this can be difficult to break down to the regional level and many effects are not necessarily limited to a particular region. Nevertheless, we need more research focused on regional ecosystems, how they are situated in and contribute to aggregate wellbeing.

With different entrepreneurial ecosystem configurations leading to different entrepreneurial outputs and different broader socio-economic outcomes, this provides substantial choice regarding resource allocation and incentive structures for policy makers and other ecosystem actors. While innovation-driven entrepreneurship and scale-ups in particular are important for economic growth (cf. Wennekers et al., 2005), increasing the number of self-employed people and general start-up rates can lead to (regional) resilience and flexibility in times of external shocks. For policy makers, this provides substantial choice regarding resource allocation and incentive structures. These choices can range from broader investments in education and human capital development to more specialized investments and policies for supporting scale-ups and the commercialization of research and scientific advancements. Policy makers should always consider prioritizing the bottlenecks in their ecosystem (Acs, Autio & Szerb, 2014; Autio & Levie, 2017). Particularly at the national level, policy makers should try to create favorable conditions in which regional ecosystem with different strengths and weaknesses can flourish in their own ways.

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5.4 Downward Causation and Path-Dependencies

The studies in our review have demonstrated that path dependency and downward causation is an essential part of how entrepreneurial ecosystems evolve over a longer term (see Table 4). A number of papers have demonstrated path dependencies and Matthew effects in regions. Entrepreneurial output feeds back into the regional entrepreneurial ecosystem (Stam & Van de Ven, 2021) and entrepreneurial agents, especially individual (regional) entrepreneurs, drive the evolution and resource dynamics of regional entrepreneurial ecosystems (Shi & Shi, 2021). While this regional entrepreneurial activity has a positive effect on objective institutional performance, it does also negatively affect subjective performance (Meek & Tietz, 2022). High-growth firms and the entrepreneurs leading them typically have a greater impact on the entrepreneurial ecosystem than new ventures in general (Martínez-Fierro, Biedma-Ferrer & Ruiz-Navarro, 2019). Similarly, anchor firms and local institutions play a key role, but there is a risk of entrepreneurial ecosystems becoming overly dependent on these actors (Lorenzen, 2019; Ornston & Camargo, 2022).

A particular process by which entrepreneurial ecosystems experience path dependencies is entrepreneurial recycling. Local institutional structures support recycling and mobility within the ecosystem after external shocks (Spigel & Vinodrai, 2021) and ecosystems facilitate the quality and speed of the re-entry of failed entrepreneurs (Guerrero & Espinoza-Benavides, 2021; Espinoza-Benavides et al., 2021). The effect of the entrepreneurial ecosystem on the re-entry decision of entrepreneurs who experienced business failure is different for males and females (Simmons et al.; 2019). Given the generally high failure rates of start-ups, this is an important finding that calls for attention to

create institutions and structures that help close the gender gap and keep female entrepreneurs in the entrepreneurial ecosystem as founders.

Path-dependencies also manifest themselves in regional economies through the actions of individuals. The state of the entrepreneurial ecosystem affects individual entrepreneurs' behaviors and the effectiveness of policy interventions. This includes location choices of entrepreneurs (Cavallo, Ghezzi & Rossi-Lamastra, 2021; Stephens et al., 2019) and if and at what stage they try to raise angel investment (Lerner et al., 2018). Other entrepreneurial ecosystem actors are influenced in a similar fashion. Universities both depend on their entrepreneurial ecosystem (Elnadi & Gheith, 2021) and need to tailor their external engagement and impact-oriented efforts to the state of the entrepreneurial ecosystem (Nkusi et al., 2020). Other research points towards (path) development of entrepreneurial ecosystems being shaped by foremost public authorities and endogenous initiatives (Radinger-Peer, Sedlacek & Goldstein, 2018), but policy making needs to account for the current state of the entrepreneurial ecosystem and interventions have different effects on involved industrial clusters (Auerswald & Dani, 2017; Brown, Gregson & Mason, 2016; Farinha et al., 2020). Consequently, a policy mix is usually required (Wang et al., 2022) that is harmonized with wider socio-technical-economic policies (Kantis, Federico & García, 2020).

Related to this, gender issues beyond the re-entry of male and female entrepreneurs have been studied (Simmons et al., 2019). Women and men benefit in different ways from entrepreneurial ecosystems and their elements (Birdthistle, Eversole & Walo, 2022; Hechavarría & Ingram, 2019; Sperber & Linder, 2019). This demonstrates how entrepreneurial ecosystems enable particular types of entrepreneurial behavior and how some people have less access to the benefits of their entrepreneurial ecosystem based on their gender and possibly other characteristics.

Understanding path-dependencies requires different methodological approaches. Our review highlights a balance between qualitative and quantitative approaches among studies showing path-dependencies and entrepreneurial recycling, with more quantitative work demonstrating how the state of the ecosystem affects the behavior of entrepreneurs and other entrepreneurial ecosystem actors (see Table 4). Similar to the link between ecosystems and broader socio-economic outcomes, we see the level of analysis being applied at the country level (eleven times) almost as frequently as at the city or regional level (fourteen times). The effects of downward causation are a key driver for why the entrepreneurial landscape at the sub-national level looks spiky and there is a clear need for ecosystem research to further untangle how the effects and regional ramifications of entrepreneurial outputs and outcomes as well as the state of the ecosystem on entrepreneurial behavior.

More generally, the interplay of upward and downward causation shows how entrepreneurship as an output of the system and means for creating aggregate well-being and entrepreneurial behavior at the individual level are influenced by but also shape the ecosystem and the wider context (Autio, 1997). While conceptually appealing, there is still a lack of empirical evidence for whether ecosystems as a whole or in part are subject to path-dependencies or *past-dependencies* (cf. Wurth et al., 2022). Path-dependency is based on non-reversible, non-ergodic processes. An ecosystem subject to past-dependencies is impacted by the past without being overly restrained in terms of alternative trajectories moving forward. This path-elasticity enables a variety of possible developments, which forms part of the rationale for the limited applicability of prescriptive lifecycle models for ecosystems (Brown, Mawson & Rocha, 2023). Both path- and past-dependencies are place-based mechanisms and sensitive to their wider context (Martin & Sunley, 2006), yet we lack an understanding of which dynamic processes in ecosystems fall under each category and how they ultimately interact.

This is where future research and potential methodological innovation is needed. Conceptually, entrepreneurial ecosystems provide a means for enabling cross-fertilization between industries and the sharing of business model innovation and structural knowledge, particularly in the digital context (Autio et al., 2018). However, path-breaking behavior has not yet been properly explored empirically. This is particularly relevant for ‘organizationally thin’ ecosystems and those that do not yet have favorable institutions, which often rely on external investment and policy interventions to initiate change or path renewal (Isaksen, 2015; Tödtling & Trippel, 2005). Mixed method approaches and those that combine a quantitative view of the development of the entrepreneurial ecosystem with methodologies that can trace processes and decision-making can shed new light on how the development of an entrepreneurial ecosystem is co-created and influenced by the current state of the system (e.g., Beach & Pedersen, 2019).

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5.5 Inter-Ecosystem Links

No man is an island, and no entrepreneurial ecosystem is an island. The links between entrepreneurial ecosystems, from neighboring regions to transnational entrepreneurs and investors, are an integral complement to endogenous dynamics within entrepreneurial ecosystems. The empirical literature shows support for the argument that entrepreneurs, other ecosystem actors, and, by extension, ideas, practices, and norms move and migrate between ecosystems and across spatial, cultural, and linguistic barriers (see Table 5). More specifically, entrepreneurial ecosystems within a wider social field are co-created by the circulation of people, resources, and artefacts (Fraiberg, 2017; Schäfer & Henn, 2018).

Transnational entrepreneurs play a key role in creating momentum and initiating institutional change in less-developed entrepreneurial ecosystems (Harima, Harima & Freiling, 2021). Even when returning to their home entrepreneurial ecosystem, they continue to benefit from non-local connections in addition to the embeddedness in their home entrepreneurial ecosystem (Wang et al., 2022). In addition to the impact of transnational entrepreneurs, there are also spillover effects from large metropolitan centers to adjacent peripheral regions (Long, Zheng & Qian, 2022). Through digitalization, entrepreneurial ecosystems can more easily overcome spatial barriers and increase access to resources beyond its boundaries (Alaassar, Mention & Aas, 2022).

Entrepreneurial ecosystems that allow immigrant entrepreneurs to rapidly build a network, get reputational benefits from being located in this entrepreneurial ecosystem, and provide access to a market for experimentation are attractive to immigrant entrepreneurs and conducive to their performance (March-Chordà, Adame-Sánchez & Yagüe-Perales, 2021).

The result is often a bidirectional learning process for both migrant entrepreneurs (both international and domestic) and entrepreneurial ecosystems (see Table 5). Entrepreneurs need to be able to adapt to local norms and institutions (Steinz, Van Rijnsoever & Nauta, 2016). However, entrepreneurs should not cut all ties with their home-country entrepreneurial ecosystem, as this can still have positive effects on their business success abroad (Duan, Kotey & Sandhu, 2021). Keeping these connections limits the potential brain drain for the home entrepreneurial ecosystem (Schmutzler, Andonova & Perez-Lopez, 2001).

Except for the mixed method approach by Schmutzler, Andonova and Perez-Lopez (2001), who combine multilevel logistic regression based on GEM data and a qualitative case study, the remaining studies are based on qualitative studies. This calls for future research that uses novel data sets and advances in 'big data' for studying how entrepreneurs, ideas, and different types of resources circulate between ecosystems. Furthermore, there is also still

a relative lack of empirical studies addressing the role of entrepreneurial ecosystems as domestic hubs for talent and investments. When and how entrepreneurs move within their home country has important implications for policy and support organizations. For example, entrepreneurs might start their business close to home or where they attend or graduated from university but decide to move to a more mature entrepreneurial ecosystem that promises better access to resources that are required for scaling the company. Taken together, research should examine how domestic or even international migration leads to path development and allows entrepreneurial ecosystems to evolve through diversifying (e.g., incorporating a variety of new perspectives, people, and capital) specializing (e.g., scale-ups or social ventures, focusing on particular sectors).

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6. Conclusions

The entrepreneurial ecosystem approach provides an exciting and productive framework for research, policy and entrepreneurial practice. This review sheds light on the breadth of empirical entrepreneurial ecosystem research and the variety methodological approaches as well as the interdisciplinary nature of the research, and the substantial and metaphorical use of the entrepreneurial ecosystem concept. Through this critical review we show that the entrepreneurial ecosystem concept has sparked interdisciplinary discussions and that as a framework it has synthesized a variety of research streams together to generate new research questions about the emergence of entrepreneurial activity.

6.1 Knowledge accumulation beyond fads and fashion

The interest in entrepreneurial ecosystems remains high and has led to a growth in published academic work. This includes both empirical studies as well as conceptual and theoretical papers. With the metaphorical use of the concept, it runs the danger that it will only be a fad that has come into fashion, and will be out of fashion sooner or later, without any accumulation of knowledge.

Is the entrepreneurial ecosystem concept just a fad? Yes, there is an intense and widely shared enthusiasm for the entrepreneurial ecosystem concept, evidenced by the large and growing number of entrepreneurial ecosystem studies and policy initiatives. No, it is not short-lived, since we are already witnessing this continued growth over more than a decade. Has the entrepreneurial ecosystem concept become a fashion, and will it soon be out of fashion? It certainly has become a fashion, and to some degree a superficial fashion, a label to claim academic and policy novelty. Our review has shown that out of the 420 articles in high-quality journals, which claim to have done empirical entrepreneurial ecosystem research, 24 percent (101) did not analyze entrepreneurial ecosystems at a territorial unit of analysis (analyzing an organization or platform as a unit of analysis), and 33 percent just used the entrepreneurial ecosystem concept as a label, using this in a trivial way, as a label for “context” or “collectives”, and not engaging with the principles of complex economic systems. The disappointing conclusion is that the majority (56 percent) of the articles that claim to contribute to the entrepreneurial ecosystem research program with empirical studies, do not live up to these expectations. Echoing the finding of Kirchherr (2023) in the realm of sustainability studies, there is a lot of “scholarly bullshit” in so-called entrepreneurial ecosystem research. This not only does fails to contribute to knowledge accumulation, but even discredits the entrepreneurial ecosystem research program at large.

The good news is that there is a substantial and growing amount of credible entrepreneurial ecosystem research, with a knowledge base of 181 empirical studies in high

quality journals. What can we conclude from this research and how to continue as a transdisciplinary research program? We will answer this in the following paragraphs.

6.2 Empirical evidence on entrepreneurial ecosystem mechanisms

We organized the review around five key mechanisms that explain the nature and development of entrepreneurial ecosystems: (1) interdependence of its elements, upward causation explaining entrepreneurial ecosystem (2) outputs and (3) outcomes, (4) downward causation and path dependence, and (5) inter-ecosystem links.

The empirical entrepreneurial ecosystem literature is dominated by research on interdependencies between entrepreneurial ecosystem elements and on the effect of entrepreneurial ecosystems on entrepreneurial outputs, both mostly within a short time span, or even with only a cross-sectional research design. Entrepreneurial ecosystem research has shown in many ways that there is moderate to strong interdependence between entrepreneurial ecosystem elements, particularly in high-quality entrepreneurial ecosystems. This research uses a variety of methodological approaches but is predominantly based on qualitative research designs. While this large range of studies helps build credibility and confidence in the results through replication, and confirms the complex systems nature of entrepreneurial ecosystems, overall progress has been stalling. We need more relational studies (with qualitative and quantitative research) that address ‘how’ things happen within ecosystems. This requires exploring novel data sources and non-standard methodological tools and approaches that allow us to answer these different questions. For example, social media data or other big data approaches can give valuable insights into how the connectedness and interdependence of actors and factors in entrepreneurial ecosystems. For example, social media data or other big data approaches can give valuable insights into the culture of places and the heritage and perception of entrepreneurial behavior.

One element that receives a lot of attention in practice, but that is highly under researched is leadership. We recommend more in depth and also large-scale research into the nature, quality and roles of leadership in entrepreneurial ecosystems.

The studies on entrepreneurial ecosystems and entrepreneurial outputs most often show positive correlations and effects of entrepreneurial ecosystem quality and different types of outputs, including the prevalence of startups, scale-ups, university spin-offs, and innovative, high-tech and social entrepreneurship. Even though most of these studies are based on rigorous quantitative methods, their causality tests are often weak. Future studies should aim to better test for causality, for example by making use of (quasi) natural experiments, or using more longitudinal data to better disentangle cause and effect.

There is less research on the ultimate welfare outcomes of entrepreneurial ecosystems. The small number of studies on the upward causation between entrepreneurial ecosystems, entrepreneurial outputs and welfare outcomes, show positive direct, or indirect (via entrepreneurial outputs), effects of entrepreneurial ecosystems on traditional macroeconomic outcomes including productivity, gross value added, GDP and employment. There is a paucity of studies analyzing the effects of entrepreneurial ecosystems beyond traditional economic development measures. This is clearly an opportunity for research, and also highly relevant in the light of the promise of entrepreneurship to tackle societal challenges and realize sustainable development.

There is little research on feedback effects of entrepreneurial outputs and welfare outcomes on the subsequent development of entrepreneurial ecosystems. The few (both quantitative and qualitative) studies that have been published show that especially firms that grow and grow to a substantial size are likely to have positive feedback effects on elements of the entrepreneurial ecosystems. Especially so-called entrepreneurial recycling, in which

“retired” entrepreneurs or serial entrepreneurs fulfill roles (investor, role model, network broker, mentor) that enhance the quality of the entrepreneurial ecosystem.

There is least research on inter-ecosystem connections. Most research has (implicitly) treated entrepreneurial ecosystems as closed systems, but no entrepreneurial ecosystem is an island, and should be analyzed as an open system. The small number of studies on inter-ecosystem connections reveal the importance of human capital mobility, labelled as transnational, immigrant or diaspora entrepreneurship. In addition, there is evidence for the importance of inter-ecosystem networks and especially capital flows. Most of the studies are based on qualitative research, which calls for future (quantitative) research that uses novel data sets and advances in ‘big data’ for studying how entrepreneurs, ideas, and different types of resources circulate between ecosystems, within and between countries. The effects of ecosystems as ‘hubs’ within countries or regions and the reciprocal effects on neighboring ecosystems has been largely overlooked in the literature. Studying the links between ecosystems and how they are influenced by and collectively co-create institutions and support is key to understanding the nestedness of ecosystems.

Even though we reviewed a substantial number of 181 empirical studies, which mostly cover at least one of the key mechanisms that explain the nature and development of entrepreneurial ecosystems, in almost all these domains we are just scratching the surface of the empirical evidence needed for fully understanding the nature and development of entrepreneurial ecosystems. More replication and extension studies are needed, and more research is needed to fill the voids in the entrepreneurial ecosystem knowledge base.

Overall, entrepreneurial ecosystem research is very much dominated by authors from and studies in Europe and North-America. Here is a clear opportunity and need for more authorship and studies from other continents, to better understand the nature and development

of entrepreneurial ecosystems in these contexts, and also to build up capacity for engagement between academics and policy practice.

6.3 Policy

Also in the economic policy landscape the label of entrepreneurial ecosystems, and ecosystems more broadly seems to be used as a new “catch all” phrase to legitimize “holistic” policies for stimulating entrepreneurship and innovation in particular places and sectors. However, the usefulness of the ecosystem concept for policymaking depends on an advanced understanding the causal mechanisms discussed in this paper. Without such knowledge, we are left with little besides a cargo cult policymaking based on copying the most prominent features of successful regions.

In addition, we need more policy research to trace the effectiveness and efficiency of entrepreneurial ecosystem policy interventions. This will never be perfect, given the complex system nature of the entrepreneurial ecosystems, and the impossibility of isolating the effects of policy interventions from other influences on the development of entrepreneurial ecosystems and entrepreneurship. An example is the integration of policy and support for predominantly sector-agnostic ecosystems and industry sectors and clusters (e.g., smart specialization approaches to regional development). However, with better data and knowledge about the nature and development of entrepreneurial ecosystems, policy makers and other entrepreneurial ecosystem stakeholders, not the least leaders of entrepreneurial ecosystems, could initiate ex-ante entrepreneurial ecosystem diagnostics, to search for the entrepreneurial ecosystem elements that deserve most policy attention. This could improve the information and knowledge base for stakeholder dialogues about what policies to prioritize. Once this prioritization has taken place, and policy is implemented, we need rigorous monitoring of the development of the entrepreneurial ecosystem and evaluation of

the effectiveness and efficiency of the policies that have been implemented. These context specific knowledge and insights should then be confronted with knowledge from other entrepreneurial ecosystems. In this way academic knowledge and practical knowledge can be combined to enrich the entrepreneurial ecosystem knowledge base. Only in this way can we improve each entrepreneurial ecosystem in its own way, and make the transdisciplinary entrepreneurial ecosystem research program work.

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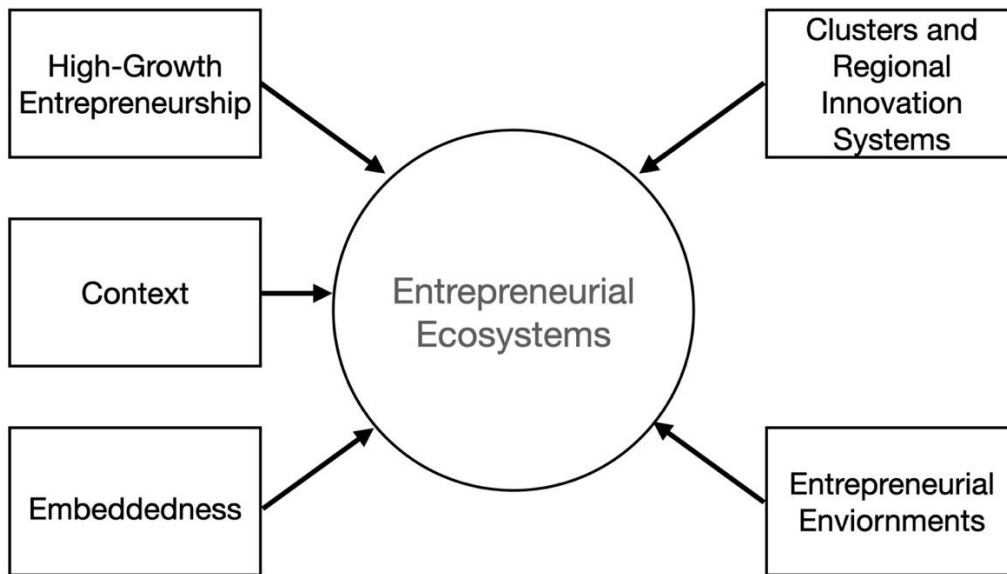


Figure 1: Key influences on entrepreneurial ecosystem theorizing

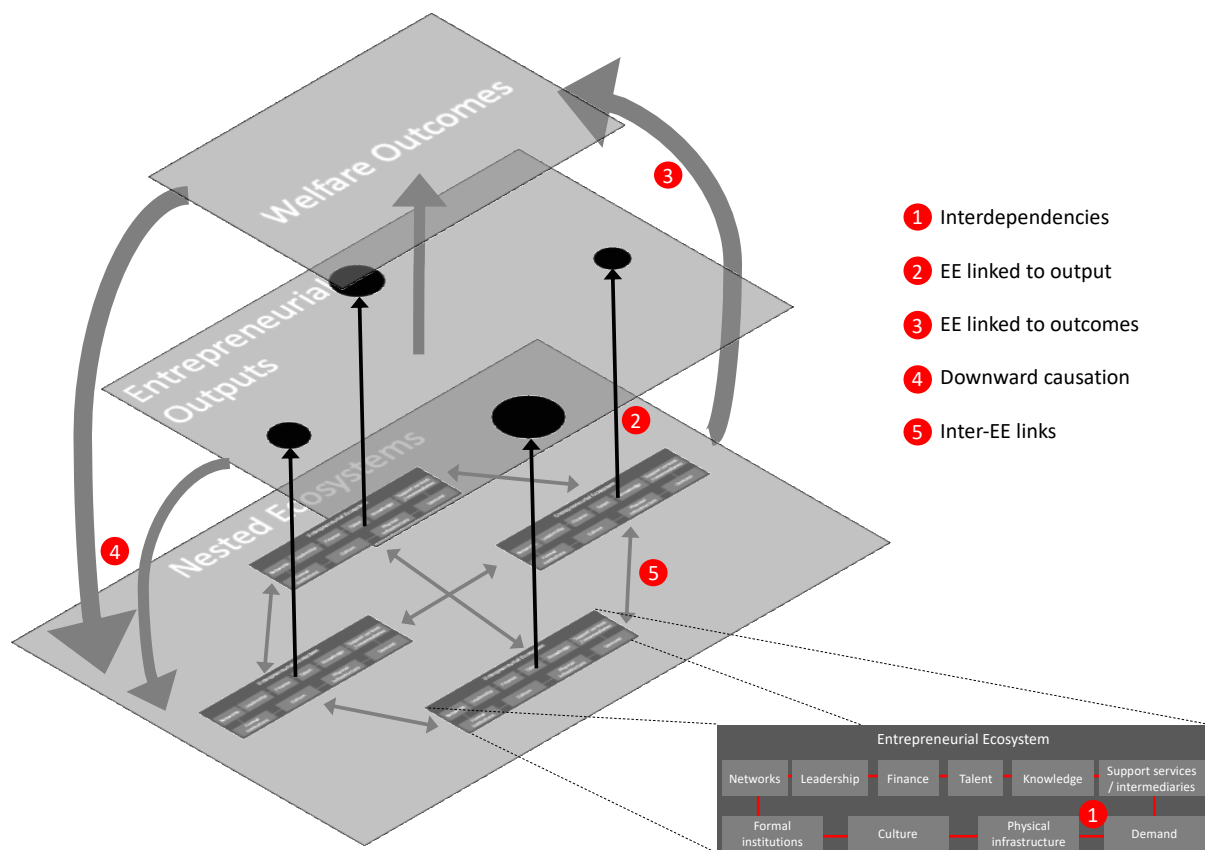


Figure 2: Causal mechanisms in the entrepreneurial ecosystems (Wurth et al., 2022)

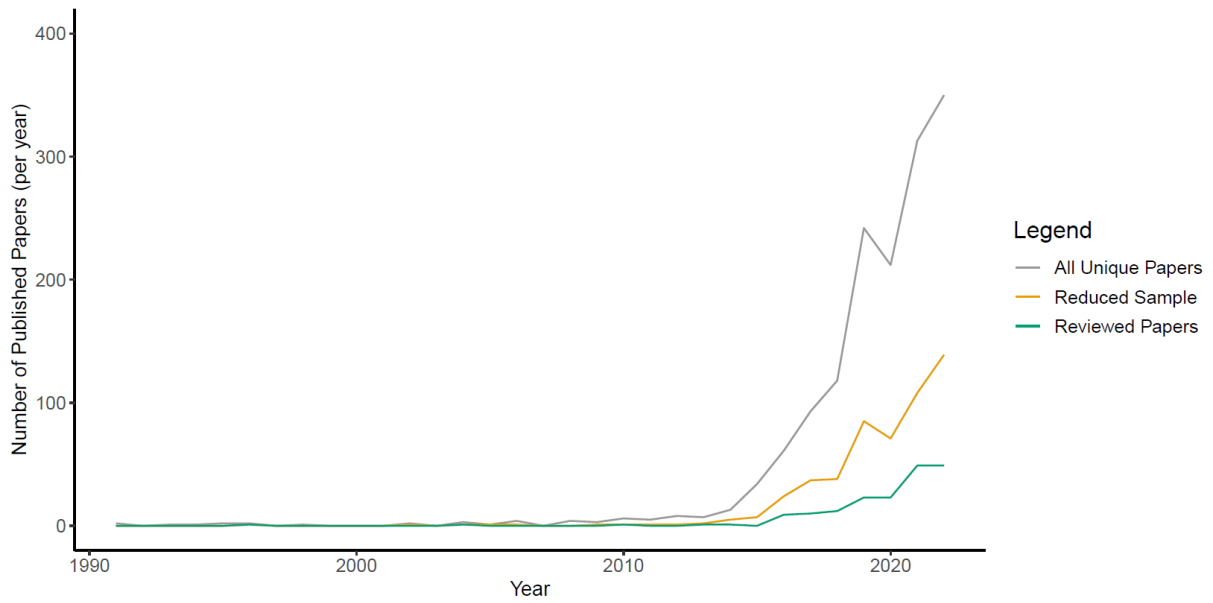


Figure 3: Overview of published papers covered in this review

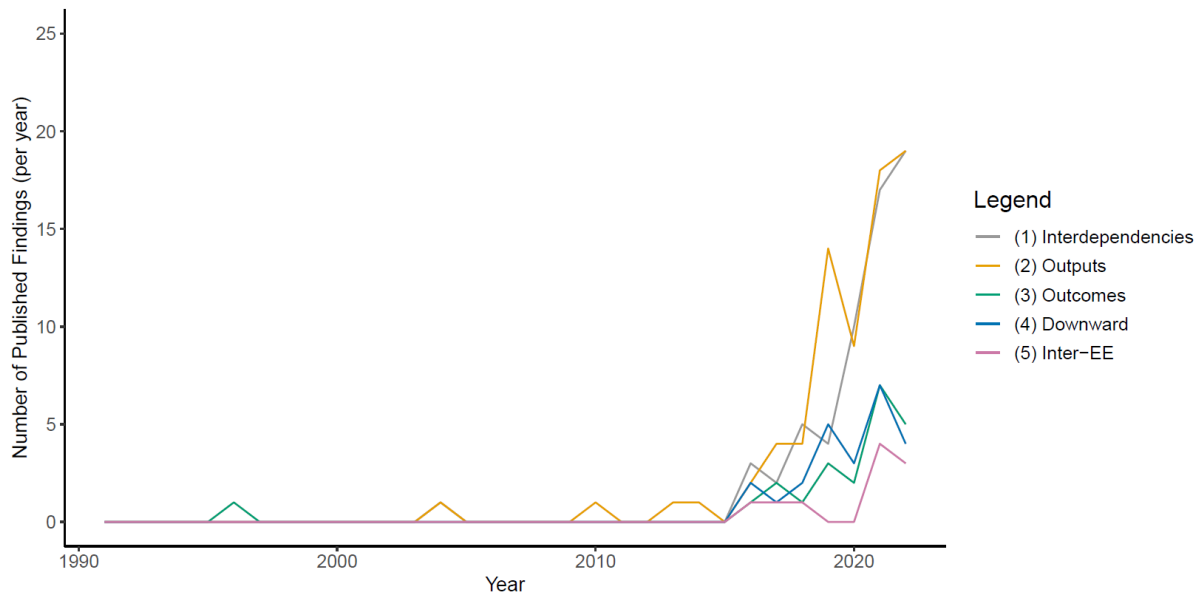


Figure 4: Overview of published findings referring to the five causal mechanisms (some papers included multiple findings relating to different mechanisms, which are included separately here)

Table 1: Interdependence of entrepreneurial ecosystem elements

Main Arguments	Focus*	Main Findings	Methodology	Selected Empirical Studies	
Individual actors can increase connectivity and provide required resources (sometimes acting beyond their expected realm, particularly in less developed ecosystems)	Support organizations	Four types of accelerator expertise—connection, development, coordination, and selection—combined lead to higher commitment among stakeholders to the ecosystem, validation through faster experimentation and ecosystem additionality.	Qualitative: 54 interviews, secondary data	Goswami, Mitchell & Bhagavatula (2018)	
		Intermediary organizations in entrepreneurial ecosystems play a significant role in orchestrating collaborations beyond their regular realm.	Qualitative: case study (38 semi-structured interviews)	Hernández-Chea et al. (2021)	
		Incubators do not fundamentally address unfavorable institutions and only provide ‘symptomatic’ solutions, therefore new ‘systemic’ incubators are needed.	Qualitative: multiple case study (281 semi-structured interviews)	van Weele et al. (2018)	
		Through an open innovation approach, accelerators can support the connectedness within and beyond the ecosystem and increase the resources available within the ecosystem.	Qualitative: 19 semi-structured interviews, secondary data	Pustovrh, Rangus & Drnovšek (2020)	
	Multiple elements		Elements are related in a unique way for every ecosystem.	Qualitative: 20 interviews, survey to develop genealogical model (184 responses)	Neck et al. (2004)
			Actors need to interact and reinforce each other to support the EE.	Quantitative: general LMM (based on 911 innovative startups)	Noelia & Rosalia (2020)
			Actors need to reach legitimacy across three complementary dimensions – institutional, cultural and relational – to make an impact within EEs.	Qualitative: longitudinal, in-depth case study	Lechner, Delanoë-Gueguen & Gueguen (2022)
			Role models and intermediary organizations are crucial for creating local buzz, promoting shared visions, and bridging cultural holes, which improves the flow of resources and information.	Quantitative: topic modelling	Hannigan et al. (2021)
			Learning and change in entrepreneurial ecosystems are endogenous processes that involve all actors, not just central ones.	Qualitative: embedded case design (38 interviews)	Korber, Swail & Krishanasamy (2022)
			In the absence of ‘traditional’ factors, some actors (local ‘champions’) can create momentum and vitalise the EE.	Qualitative: case study (archival data)	Roundy (2019)
			Dealmakers are essential for fostering connectivity and knowledge spillovers in EEs.	Quantitative: social network analysis	Pittz, White & Zoller (2019)
	Government		Government sponsorship is an effective driver of ecosystem development beyond increasing individual recipient firms’ performance.	Qualitative: 51 semi-structured interviews	Motoyama & Knowlton (2016)

Universities	Universities as hub institutions can support the development of ecosystems through the sequential development of boundary spanning, network building, and orchestrator functions, but rely on the development of complementary support structures.	Qualitative: case study (21 semi-structured interviews over 12 years, supplementary documents and information)	Schaeffer & Matt (2016)
	Learning and universities pro-actively supporting this beyond their traditional remit contribute to entrepreneurial ecosystem development.	Qualitative: case study (questionnaires, interviews, participatory and non-participatory observations, documentary evidence)	Pugh et al. (2019)
	Universities adapt to the state of the ecosystem and contribute in multiple ways (often beyond their traditional remit of teaching and research).	Qualitative: multiple embedded case studies (participant observation, workshops, interviews, secondary data)	Wagner et al. (2019)
Anchor firms and institutions	Complex interdependencies mean that changes to anchor firms or institutions can alter the structure and resilience of the EE.	Qualitative: case study (two panel discussions and 13 in-depth semi-structured interviews)	Sohns & Wójcik (2020)
	Large/anchor firms can support (sub-)EEs through active engagement and governance without taking absolute control.	Qualitative: case study (43 semi-structured interviews, observations, document analysis)	Lo & Theodoraki (2021)
	MNEs, through spin-outs and spillovers, can shape the technological trajectory and evolution of an EE.	Mixed: longitudinal mixed-method case study	Ryan et al. (2021)
	Start-up competitions can act as anchor events by fostering local connections, but do not draw in high-profile or external investors.	Qualitative: comparative case study (45 interviews)	Stolz (2022)
	Key (institutional) actors within entrepreneurial ecosystems disproportionately contribute to the formation of networks, which are crucial to the iterative development of EEs.	Mixed: social network analysis (2232 Meetup events with 21,612 unique members), 23 semi-structured interviews	Rocha, Brown & Mawson (2021)
Entrepreneurs	Family entrepreneurs' embeddedness as a social fabric drives regional entrepreneurial ecosystem development.	Qualitative: exploratory case study (20 semi-structured interviews)	Bichler et al. (2022)
	Successful start-ups ("lighthouses") play an important role in shaping the cultural, social and material attributes of an EE.	Qualitative: multiple case study (40 interviews)	Tiba, van Rijnsoever & Hekkert (2020)
	Lifestyle entrepreneurs often act as mediators between the different actors of EEs, namely local entrepreneurs, public sector agencies, financial bodies, local community leaders.	Qualitative: multiple case study (8 interviews, secondary material)	Cunha, Kastenholz & Carneiro (2020)

		Entrepreneurs working in the sharing economy shape the sustainability of an entrepreneurial ecosystem through building a supportive environment, disrupting normative standards, and reframing the sustainability paradigm.	Qualitative: 31 in-depth interviews	Pankov, Schneckenberg & Velamuri (2021)
Feedback and (non-linear) co-evolutionary dynamics between ecosystem elements (and the wider socio-economic context)	Multiple elements	Entrepreneurial culture as well as tailored stakeholder support and collaboration lead reinforce the perception of the ecosystem.	Quantitative: OLS regression (106 survey respondents)	Bischoff (2019)
		Individual ecosystems are unique due to their co-evolving elements and historical, cultural, and institutional heritage.	Qualitative: Semi-structured interviews (23 and 122 at two points in time), archival data	Mack & Mayer (2016)
		Ecosystem configurations can vary significantly, and new policies/investments should develop support among underlying social and cultural attributes.	Qualitative: case study (71 semi-structured interviews)	Spigel (2017)
		Different forms of proximity allow for development of entrepreneurial ecosystem even in smaller, peripheral places and the emergence of industries.	Qualitative: case study (10 expert interviews, reports)	Yamamura & Lassalle (2020)
		EE elements are highly interdependent and form a complex system.	Quantitative: correlation, regression (QOG, GEM World Bank, ESS, RIS, RCI, EIB, CORDIS, Crunchbase, Eurostat, CB Insights, Dealroom)	Leendertse, Schrijvers & Stam (2021)
		Connection of place (including institutions and structures) and people give rise to entrepreneurial ecosystem dynamics.	Qualitative: case study (33 semi-structured, in-depth interviews)	Daniel et al. (2022)
		EEs trajectories are chaotic and the result of co-evolving sub-ecosystems through several sequences.	Qualitative: 23 semi-structured interviews, participatory observations, secondary data	Cloutier & Messegem (2022)
		National culture, market characteristics, available resources, and networks in an ecosystem spark ecosystem-specific narratives, which in turn shape tendencies towards effectuation and causation.	Qualitative: 43 interviews	Hubner et al. (2022)
		EE elements are highly interdependent, and policies/support should focus on the bottlenecks.	Mixed: 25 expert interviews, fuzzy analytic hierarchy process, cross-matrix analysis MICMAC	Aliabadi, Ataei & Gholamrezai (2022)
		A dominant industry influences the development of an entrepreneurial ecosystem through impacting various elements.	Mixed: 14 semi-structured interviews; descriptive statistics (336 survey responses)	Eichelberger et al. (2020)

		Improving the weakest part of an entrepreneurial ecosystem at a local level requires unique approaches and different levels of resources but can have a large impact on entrepreneurial ecosystem performance.	Quantitative: index development (REDI, RIERC, HSO)	Szerb et al. (2022)
		Dynamic interplay across intellectual capital enablers is critical for an entrepreneurial ecosystem to flourish and evolve adaptively.	Qualitative: participant observations, in-depth interviews, archival documents	Grande et al. (2022)
		Governance of entrepreneurial ecosystems is an iterative process that relies on effective management of relationships, communication ties with local and national agendas and a shared collaborative culture.	Qualitative: policy document analysis, 31 semi-structured interviews, observational notes	Knox & Arshed (2022)
		EEs contain a complex system of unique dimensions and interrelationships.	Mixed: eight expert interviews informed survey (100 responses), exploratory factor analyses	Stephens et al. (2022)
		EEs are affected by and, in turn, affect the underlying competitive and regulatory dynamics that play out globally.	Mixed: historical event analysis	Bessagnet, Crespo & Vicente (2021)
		Ecosystem elements are complementary and stronger elements can compensate for weaker elements.	Qualitative: eleven interviews	Godley, Morawetz & Soga (2021)
Anchor firms and institutions	Governance changes from hierarchical to relational as the ecosystem evolves; similarly, the role of different actors evolves with the ecosystem (including anchors who initiate and support the initial growth).	Mixed: case study (archives, 53 questionnaire responses, structured interviews, SNA)	Colombelli, Paolucci & Ughetto (2019)	
Government and finance	Non-linear evolution of the EE, with often contradictory developments within the various pillars.	Qualitative: case study (22 semi-structured interviews supported by secondary data)	Radinger-Peer, Sedlacek & Goldstein (2018)	
Bottom-up evolution of ecosystems through individual interactions	(Informal) Institutions	Institutions are perceived differently by ecosystem actors and are constantly co-created through the interaction of these actors.	Qualitative: in-depth interviews, focus groups, secondary data	Lowe & Feldman (2017)
		Informal institutions lead to 'integration' whereas formal institutions and public policy can have disintegrative tendencies.	Qualitative: case study (27 semi-structured interviews)	Pocek (2022)
	Multiple elements	Instead of isolated investments/actions, ecosystems are adaptive and evolve through interactions of individuals with different motivations (including non-market forces).	Qualitative: in-depth interviews, focus groups, secondary data	Feldman & Lowe (2018)
		Ecosystems form through endogenous, bottom-up, and time-patterned processes (rather than exogenous sources such as government action or instrumental policy goals).	Qualitative: 25 structured interviews, secondary data	Thompson, Purdy & Ventresca (2018)

		EEs are complex adaptive systems that are based on heterogenous actors' nonlinear interactions, adaptive evolutionary dynamics, and multiscale governance boundaries, while being sensitive to initial conditions.	Qualitative: case study (23 group interviews, six types of secondary data)	Han et al. (2021)
		Technology-focused entrepreneurial ecosystems are interrelated systems composed of environmental conditions, support entities and functions, and tech entrepreneurs.	Qualitative: 37 in-depth, semi-structure interviews, secondary data	Maysami & Mohammadi Elyasi (2020)
		Interaction of individual entrepreneurial talent/aptitudes and the ecosystem (place-based interactions).	Quantitative: Scale construction (semi-structured interviews, focus group), linear regression (1402 survey responses)	Pushkarskaya et al. (2020)
		When an industry in a region matures and a cluster emerges, local generic entrepreneurial ecosystem service providers may be bypassed by their local entrepreneurs.	Quantitative: descriptive statistics (581 Internet IPOs)	Li et al. (2022)
		Constant interchange between intellectual capital components (human, structural, and relational capital) occurs at the micro and the meso level.	Qualitative: case study	Marinelli et al. (2022)
		Ecosystem evolution depends on both munificence (in the built environment) and the dynamism and behavioral responses of agents in the ecosystem.	Qualitative: two case studies (34 interviews, document analysis)	Johnson, Bock & George (2019)
	Networks	Gender issues can constrain the bottom-up evolution of ecosystems and women-only networks are not sufficient improve connectedness and engagement in entrepreneurial activities of women.	Qualitative: 28 in-depth interviews	McAdam, Harrison & Leitch (2019)
		Different ecosystem configurations are required for high informal, formal, or external networking behaviour in the ICT sector.	Mixed: 29 interviews, fsQCA	Komlósi et al. (2022)
		Coliving, coworking and coexperience support networking and communication among residents, entrepreneurs and tourists.	Qualitative: case study (17 guided interviews)	Thees, Zacher & Eckert (2020)
		Communities and interaction among entrepreneurial ecosystem actors provide support and resilience during crisis.	Quantitative: SEM (239 survey responses)	Kansheba, Marobhe & Wald (2022)
Ecosystems enable the sharing and circulation of resources	Multiple	EEs facilitate resource circulation, mobilisation and allocation.	Qualitative: 51 semi-structured interviews, site visits, focus group, and secondary data	Shi & Shi (2021)
	Social trust	Social trust facilitates the flow of information and knowledge exchange across entrepreneurial ecosystem actors and fosters knowledge spillovers.	Quantitative: multilevel models (Eurostat, ESS, REDI, QOG)	Corradini (2022)

Ecosystems best describe regional/local dynamics	Multiple	Heterogeneity in the composition of entrepreneurial ecosystems across NUTS-3 regions and some spatial patterns would not be visible using larger spatial units.	Quantitative: spatial analysis, Theil index, regression (ISTAT, Movimprese, Bank of Italy)	Perugini (2022)
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* All studies in this list include a variety of ecosystem elements, but some emphasize the role of particular element(s) as indicated in this column.

Table 2: Entrepreneurial ecosystems linked to outputs

Main Arguments	Focus*	Main Findings	Methodology	Selected Empirical Studies
Different ecosystem configurations lead to different outputs	Multiple elements	Different ecosystem configurations can support knowledge-intensive entrepreneurship, leading to different yet productive outputs.	Mixed: fsQCA (CAGED, SEADE, IBGE, PIPE-FAPESP)	Cherubini Alves et al. (2021)
		Different entrepreneurial ecosystem configurations lead to different entrepreneurial ecosystem performances and behaviors.	Quantitative: seemingly unrelated regression (GEM, OECD, World Bank, Google trends)	Yan & Guan (2019)
		Efficiency at the entrepreneurial ecosystem level can be obtained through different configurations, but efficiency also does not correlate with the Index of Dynamic Entrepreneurship (IDE).	Quantitative: DEA (IDE report)	Dionisio, Inácio Júnior & Fischer (2021)
		EEs are place-sensitive and complex, where different configurations can lead to desirable (high-growth) and non-desirable (low-growth) outputs simultaneously.	Mixed: fsQCA (GEM, Amorós et al., 2019)	Muñoz et al. (2020)
		Family businesses and start-ups, two ends of the entrepreneurship continuum, are embedded in different kinds of entrepreneurial ecosystems.	Quantitative: descriptive statistics (Destatis, Bureau van Dijk)	Wolff et al. (2022)
		Multiple and equally effective entrepreneurial ecosystem configurations can lead to both high-quantity and high-quality entrepreneurship.	Mixed: fsQCA (China City Statistical Yearbook, Hurun Global Unicorn List, Wind Financial Terminal)	Xie et al. (2021)
		Small town entrepreneurial activities are the result of forces that differ from those identified in ecosystems in large urban areas.	Qualitative: comparative case study (370 archival documents)	Roundy (2019)
		EE outputs can arise from different configurations and strong NSEs (high GEI rankings) are not necessarily efficient.	Quantitative: indicator/index creation	Inacio Junior et al. (2021)
		Marginal changes in the initial configurations of entrepreneurial ecosystems can lead to unexpected, disproportionate changes in the outputs.	Quantitative: Pointwise D2, Brock-Dechert-Scheinkman test and Local Largest Lyapunov Exponents	Haarhaus, Strunk & Liening (2020)
	Universities	EE configuration is linked to university spin-outs' growth (employment and sales) in Spain but not in Italy; there are specific mechanisms to support successful entrepreneurial activity beyond locational factors.	Quantitative: Multilevel modelling (516 Spanish and 904 Italian USOs)	Prencipe et al. (2020)
(Informal) institutions and policy	Policy makers can use formal institutions to foster high-growth and social entrepreneurship, even in nations whose cultural conditions do not seem to be supportive of entrepreneurship.	Quantitative: OLS regression (Gelfand et al., 2011; GEM, OECD, World Bank)	Harms & Groen (2017)	

		Four distinct institutional settings enable different types of entrepreneurship (e.g., high/medium/low-tech ventures).	Quantitative: PCA and OLS regression (Eurostat, OECD, World Bank)	Dilli, Elert & Herrmann (2018)
Nested sub-systems or clusters with ecosystems can produce different outputs	Multiple elements	Ecosystems are host to a variety of sub-clusters based on organizational- and individual-level factors.	Mixed: social network analysis; interviews (45 each for two regions)	Neumeyer & Santos (2018)
		Subsystems within the same entrepreneurial ecosystem can produce different outputs.	Qualitative: 43 semi-structured interviews and participant observation	Scheidgen (2021)
		Sub-ecosystems within a region support different output (here: worker cooperatives).	Qualitative: comparative case study (22 semi-structured interviews, document analysis of 19 organisations)	Spicer & Zhong (2022)
		Subsystems of the wider entrepreneurial ecosystem support internationalization efforts of companies.	Qualitative: 20 semi-structured interviews	Theodoraki & Catanzaro (2022)
	Social and human capital	Even very advanced ecosystems remain nested, with few cross-over points between different communities, yet general managerial/entrepreneurial know-how is still important across all subsystems for high-growth firms.	Quantitative: descriptive statistics (1,570 individuals in 380 British FinTechs)	Spigel (2022)
	Digitalization	DEE (as a subsystem of the wider EE) is linked to higher share of small ICT firms.	Quantitative: PCA, composite indicator, GWR (INSEE, TechOnMap)	Cornet, Bonnet & Bourdin (2022)
	Networks	There are social clusters within entrepreneurial ecosystem that focus on particular types of entrepreneurship.	Mixed: Social network analysis; 300 interviews	Neumeyer, Santos & Morris (2019)
Outputs of ecosystems evolve over time	Multiple elements	Entrepreneurial and intrapreneurial activities as entrepreneurial ecosystem outputs fluctuate over time	Quantitative: OLS panel regression (Mannheim Enterprise Panel, OECD, German Statistics Office)	Buratti et al. (2022)
Ecosystems foster productive entrepreneurship (e.g., scale-ups)	Multiple elements	Ecosystem elements are interrelated at the national level with a penalty for bottlenecks among elements.	Quantitative: Weighted index-development (based on e.g., GEM, WEF, World Bank)	Acs, Autio & Szerb (2014)
		Ecosystems provide the basis for high-tech entrepreneurship.	Qualitative: 20 interviews, survey to develop genealogical model (184 responses)	Neck et al. (2004)
		The most relevant entrepreneurial ecosystem factors enabling the birth and activity of high-growth startups can be identified in cultural and social norms, government programs, and internal market dynamics.	Quantitative: stochastic multicriteria acceptability analysis (GEM, Eurostat EIP)	Corrente et al. (2019)

	EEs lead to high-growth firms (persistent in the short- and medium-term).	Quantitative: 'within-between' random effects model (UK ONS, APS, HEBICI, NOMIS)	Fotopoulos (2022)
	EEs have a positive effect on levels of regional innovation capital and high-growth firms.	Quantitative: OLS, bootstrap and robust estimation	Mikic, Horvatinovic & Kovac (2021)
	EEs support the growth of VC-backed start-ups, but the regional resource dependencies dynamically shift as start-ups mature.	Mixed: fsQCA	Vedula & Fitza (2019)
	Favorable aspects of the local entrepreneurial ecosystem enable entrepreneurs to more effectively translate their personal resources into firm performance.	Quantitative: descriptive statistics, bivariate correlations and reliability coefficients (based on 223 survey responses)	Lux, Macau & Brown (2020)
	Overall quality of an ecosystem is positively related to entrepreneurial output.	Quantitative: PCA, linear regression model (Quality of Government, CBS, EU RCI, Nat Assoc of Private Equity, Birch)	Stam & van de Ven (2021)
	EE performance is linked to productive entrepreneurship.	Quantitative: correlation, regression (QOG, GEM World Bank, ESS, RIS, RCI, EIB, CORDIS, Crunchbase, Eurostat, CB Insights, Dealroom)	Leendertse, Schrijvers & Stam (2021)
	Larger and more innovative start-ups appear to rely more on their local EE.	Quantitative: regression (163 start-ups)	Gueguen, Delanoë-Gueguen & Lechner (2021)
	A well-developed entrepreneurial ecosystem is a prerequisite to (smart specialization) industry prioritization because the latter will fail without the entrepreneurial ecosystem being able to nurture high growth ventures.	Quantitative: index creation, penalty of bottleneck (REDI)	Szerb et al. (2020)
	Seven propositions, which open new avenues for understanding EEs, global value chains, and their interplay in emerging high-tech industries.	Qualitative: case study (eight semi-structured interviews, document analysis)	Reis et al. (2022)
	EEs that allow immigrant entrepreneurs to rapidly build a network, get reputational benefits from being located in this EE, and provide access to a market for experimentation are attractive to immigrant entrepreneurs and conducive to their performance.	Mixed: QCA (54 semi-structured, in-depth interviews plus follow-up interviews five years later)	March-Chordà, Adame-Sánchez & Yagüe-Perales (2021)

		EEs mitigate obstacles for innovative start-ups.	Quantitative: general LMM (based on 911 innovative startups)	Noelia & Rosalia (2020)
(Informal) Institutions		Institutional trust within regional entrepreneurial ecosystems affects productive entrepreneurship in challenging institutional environments.	Mixed: OLS estimation (657 survey respondents) and 51 semi-structured interviews	Khlystova, Kalyuzhnova & Belitski (2022)
		Institutions (economic freedom) at the regional level enable Schumpeterian entrepreneurship.	Quantitative: Panel data econometric methods (US Census Bureau Business Dynamism Statistics)	Bennett (2021a)
Digitalization		DEEs might be more useful to explain high-quality entrepreneurship (e.g., unicorns) than new business creation, although not all elements are equally important.	Quantitative: necessary condition analysis and fsQCA (World Bank, CB Insights, EIDES)	Torres & Godinho (2022)
Institutions and human capital		In developing economies, human capital and institutions are crucial to support knowledge spillovers for high tech start-ups.	Quantitative: hierarchical linear modelling (SII, INE, CBC, INAPI, Global Data Lab, CASEN Survey)	Mahn & Poblete (2022)
Government and policy		EEs amplify the effectiveness of public and social services by regional governments for supporting opportunity entrepreneurship.	Quantitative: fixed effect model (CEIC China Premium Database, Yearbook of Industry and Commerce Administration of China, Finance Yearbooks of China, NERI, China Statistical Yearbook, China Education Statistical Yearbook, Science and Technology Statistics Compilation of Higher Education Institutions, China Civil Affair Statistical Yearbook)	Wei (2022)
		The gap between productive and unproductive entrepreneurship in emerging economies is mainly caused by the market uncertainty and the perception of political entrepreneurship and corruption.	Mixed: 18 in-depth interviews; index generation, OLS regression (218 survey responses and secondary data)	Belitski, Grigore & Bratu (2021)
Universities		Different entrepreneurial ecosystem configurations lead to higher spin-out retention (lower urbanization and localization economies) and attraction rates (higher localization economies and innovation resources).	Quantitative: regression (universities' websites, HEFCE, SFC, HEFCW,	Rossi, Baines & Smith (2021)

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	Social capital and support organizations	Dense ecosystems do not automatically lead to more interactions, but those entrepreneurs who do, have a higher rate of survival (especially high-tech start-ups).	Quantitative: Cox non-parametric proportional hazards model (Kauffman Firm Survey)	Bandera & Thomas (2019)
	Universities and finance	Local presence of research-oriented universities, access to capital, and business concentration are correlated to the emergence of knowledge-intensive entrepreneurship.	Quantitative: descriptive statistics with year-to-year variations with Heckit correction (1196 proposals to FAPESP)	Fischer, Queiroz & Vonortas (2018)
		High information asymmetries impede high-tech entrepreneurial ideas based on university knowledge to attract external finance. In provinces where residents tend to behave opportunistically, the relative presence of cooperative banks magnifies the positive effect of university knowledge on high-tech entrepreneurship. Conversely, this effect is negligible in provinces with less opportunistic residents.	Quantitative: zero-inflated negative binomial regression (Movimprese, Bank of Italy)	Ghio, Guerini & Rossi-Lamastra (2019)
Ecosystems foster entrepreneurial activity in general (start-ups)	Multiple elements	Ecosystems (including internet access and connectivity) are linked to start-up rates in cities.	Quantitative: exploratory factor analysis, SEM (Eurostat, REDI)	Audretsch & Belitski (2017)
		EE supports start-up creation.	Quantitative: panel regression (Annual Survey of Industrial Firms of China, National Enterprise Credit Information Publicity System of China, China Statistical Yearbook, National Intellectual Property Administration of China, NASA, Chinese Academy of Sciences)	Long, Zheng & Qian (2022)
		Even a high local knowledge base does not guarantee knowledge spillovers and start-ups if there is not an entrepreneurial ecosystem that fosters collaboration.	Quantitative: bibliometrics (WoS, USPTO, Traxn)	Cetindamar, Lammers & Zhang (2020)
		EEs facilitate collisions of diverse actors which can lead to higher levels of diverse start-ups.	Quantitative: panel regression (CrunchBase, UN)	Nylund & Cohen (2017)

	Ventures in high-performance ecosystems perform better, higher survival chances (less important for serial entrepreneurs).	Quantitative: index development, semi-parametric Cox hazard regression (variety of public and private secondary sources, Kauffman Firm Survey)	Vedula & Kim (2019)
Networks	Inter-organizational ties among actors make entrepreneurial ecosystems in low-income countries more conducive to entrepreneurial dynamics.	Mixed: quantitative graph theory, web scraping, fsQCA	Guéneau, Chabaud & Sauvannet (2022)
Universities	Despite their prominence, university spin-offs are mostly not high-growth businesses and do not drive an ecosystem but depend on it in their development.	Mixed: Case study and descriptive statistics (HEFCE)	Harrison & Leitch (2010)
	Descriptive evidence of how academic spinoffs depend on entrepreneurial ecosystem conditions in Norway.	Quantitative: descriptive statistics (FORNY, BRREG, Retriever)	Abootorabi et al. (2021)
	Human connectedness to the physical environment, including urban design, buildings, and infrastructure, can affect entrepreneurial activity.	Qualitative: two case studies (34 interviews, document analysis)	Johnson, Bock & George (2019)
Government	Ecosystems require stakeholder alignment and a holistic approach to create a fertile environment for entrepreneurial activity.	Qualitative: Q-Methodology (44 statements based on semi-structured interviews)	Jung, Eun & Lee (2017)
Digitalization	Level of digital technology, especially when complemented by a strong EE, is positively associated with start-up rates at the national level.	Quantitative: fixed effect panel data model (GEM APS data)	Zhang, van Gorp & Kievit (2022)
(Informal) Institutions	Ecosystem development is important for growing 'entrepreneurial spirit' and support programs can lower the fear of failure.	Quantitative: regression with moderator analysis (GEM, Turkish Chamber of Commerce)	Oner & Kunday (2016)
	Institutional transparency positively moderates the relationship between entrepreneurial ecosystems and start-up rates.	Quantitative: regression (PORDATA, Transparência e Integridade)	Riaz, Leitão & Cantner (2022)
	Subculture rather than mainstream culture plays a key role in entrepreneurial ecosystems for fostering new venture creation in the ICT sector.	Quantitative: EFA (Census data 2011 combined with e.g., Gründerszene.de, Urban audit, Eurostat)	Audretsch, Lehmann & Seitz (2019)
	Different regional institutions (the multiple dimensions of economic freedom) affect regional entrepreneurship rates in different ways.	Quantitative: Panel data econometric methods (US Census Bureau Business Dynamism Statistics)	Bennett (2021b)

	Human capital	Entrepreneurial absorptive capacity drives knowledge-based entrepreneurial activity; high technology and cultural diversity contribute to the vibrancy of ecosystems.	Quantitative: SEM (Business Information Tracking System, Integrated Postsecondary Data Set, Milken Institute, US Census, USPTO)	Qian, Acs & Stough (2013)
	Quality of life	Quality of life as an additional aspect of EEs, which together support entrepreneurial activities in tourism.	Qualitative: case study (20 semi-structured interviews)	Bichler, Kallmuenzer & Peters (2020)
	Smart cities	Smart city policies promote entrepreneurship through fostering the ecosystem.	Quantitative: multiple linear regression (INE, DIRCE, Eurostat)	Barba-Sánchez, Arias-Antúnez & Orozco-Barbosa (2019)
Ecosystems foster social and sustainability-oriented entrepreneurship	Multiple elements	Different regional entrepreneurial ecosystem configurations are required to support the emerging needs of nonprofit-oriented innovators and social entrepreneurs.	Qualitative: exploratory case study (28 semi-structured interviews and secondary data)	Audretsch, Eichler & Schwarz (2022)
		EEs with high GDP and either (1) high shares of female founders of startups or (2) high shares of non-religious people in the population lead to relatively high levels of sustainability enterprises.	Mixed: generative probabilistic topic model and fsQCA	Tiba, van Rijnsoever & Hekkert (2021)
	Networks	EEs support social enterprises, particularly networks and entrepreneurial resources (across industries).	Quantitative: regression (Statistics Korea, KSEPA)	Woo & Jung (2022)
Ecosystems support female entrepreneurship	Multiple elements	Regional rather than national entrepreneurial ecosystem configurations have a greater impact on women tech entrepreneurs.	Mixed: fsQCA (StartupGenome, UNDP)	Berger & Kuckertz (2016)
	Social capital and demand	Family moral support, social network support, and exposure to local markets at start-up affect the success of women-owned businesses in Indian EEs.	Quantitative: Ordinal logistic regression (based on 258 survey responses)	Welsh et al. (2023)
Ecosystems foster frugal and informal entrepreneurship	Multiple elements	EEs are linked to frugal innovation and informal entrepreneurship.	Qualitative: 10 interviews, 2 focus groups (5 and 7 participants)	Igwe et al. (2020)
Ecosystems foster entrepreneurship in the creative industries	Social capital	Entrepreneurs from underrepresented groups help promote each other within the wider entrepreneurial ecosystem and support the formation of creative businesses.	Qualitative: case study (55 in-depth interviews, field observations, and archival documentation)	Wang & Richardson (2021)
Ecosystems foster the creation of knowledge intensive business services	Multiple elements	Quality of the ecosystem positively influences KIBS formation rates and positively moderates the relationship between manufacturing specialization and the rate of new KIBS; a healthy entrepreneurial ecosystem seems essential for an effective territorial servitization.	Quantitative: Spatial Durbin cross-section models (Eurostat, GEM, REDI)	Horváth & Rabetino (2019)

Ecosystems or at least many of their elements do not impact entrepreneurial activity	Multiple elements	Several national level ecosystem aspects have no significant impact on rates of male or female entrepreneurial engagement.	Quantitative: regression, GMM estimator (World Bank, GEM APS & NES)	Hechavarría & Ingram (2019)
		Inadequate entrepreneurial ecosystems hinder the development of 'transformative entrepreneurship' (sustainable businesses with societal impact).	Quantitative: multiple linear regression (based on 576 survey responses)	Egere, Maas & Jones (2022)
		Perceptions of a weaker entrepreneurial ecosystem in remote/peripheral regions mitigate (potential) entrepreneurs' ambitions and actions and opportunities to scale.	Quantitative: Mann-Whitney U-test (595 completed surveys)	Freitas & Kitson (2018)
	Government	Context makes innovative entrepreneurship difficult despite substantial government support.	Qualitative: 40 in-depth, semi-structured interviews, document analysis and observation	Biru, Gilbert & Arenius (2020).
	Universities and human capital	Regional scientific knowledge and talent has a limited effect on the internationalization of academic spin-offs, regional demand growth has a negative effect.	Quantitative: regression, DiD, PSM (1568 innovative Italian start-ups)	Civera, Meoli & Vismara (2019)

* All studies in this list include a variety of ecosystem elements, but some emphasize the role of particular element(s) as indicated in this column.

Table 3: Entrepreneurial ecosystems linked to outcomes

Main Arguments	Focus*	Main Findings	Methodology	Selected Empirical Studies
Ecosystems foster economic growth and more efficient resource allocation due to knowledge spillovers	Multiple elements	Ecosystems at the country level are linked to economic growth.	Quantitative: fixed effects model (GEM, Penn World Table, World Bank, WEF)	Acs et al. (2018)
		EEs contribute to national productivity by promoting Kirznerian and Schumpeterian entrepreneurship.	Quantitative: DEA (IMF, GEM, GCI, Doing Business Index)	Lafuente et al. (2019)
		National entrepreneurial ecosystem configurations with high levels human capital, research and infrastructures lead to high levels of sport-related GDP in European Union countries.	Mixed: fsQCA (Eurostat, GII)	González-Serrano et al. (2021)
		EEs must not only produce high-potential start-ups but support their growth, as the quality of entrepreneurship is more relevant than the quantity for economic development.	Quantitative: index development, correlations (Business registration records, USPTO, SDC)	Andrews et al. (2022)
		EEs, beyond the technological environment, have a positive effect on the performance of ICT cultural industries.	Quantitative: SEM (478 survey responses)	Xie, Xie & Martínez-Climent (2019)
		Firms in more consolidated entrepreneurial ecosystems are better able to translate key resources and capabilities into competitiveness.	Quantitative: benefit-of-the-doubt analysis (based on 348 firms)	Lafuente et al. (2021)
		EEs impact strategic positioning, hereby enabling learning and knowledge spillovers across industry boundaries.	Quantitative: text-based analysis, network visualizations, and topic modeling	Basole, Park & Chao (2019)
		Mature ecosystems enable knowledge spillovers, which increase efficient resource allocation.	Quantitative: DEA (DBI, GCI, GEM, World Bank)	Lafuente, Szerb & Acs (2016)
Regional development through ecosystems that are more mature or have a higher quality	Multiple elements	Positive impact of interaction between company–university–government on entrepreneurial development (greater for more developed regions/ecosystems).	Quantitative: factor analysis (data from 368 Latvian companies)	Erina, Shatrevich & Gaile-Sarkane (2017)
		EEs lead to resilience at local levels beyond start-up rates.	Quantitative: OLS estimation (ISTAT and other sources)	Iacobucci & Perugini (2021)
		Entrepreneurial success stories and strong local leadership and governance create synergies, innovation and co-creation.	Qualitative: case study (15 semi-structured interviews)	Grama-Vigouroux et al. (2022)

		EEs with a high concentration of creative industries support productive entrepreneurship and GVA in the region.	Quantitative: fixed effect regression and random effect estimation (Eurostat)	Audretsch & Belitski (2021)
		The quality of an entrepreneurial ecosystem is vital to the economic performance of a region.	Qualitative: panel interviews, secondary data, document analysis	Spilling (1996)
Ecosystems support sustainable innovation and addressing grand societal challenges	Multiple elements	Entrepreneurs' attitudes and beliefs are pivotal lever to the development of a thriving entrepreneurial ecosystem that is able to face grand challenges.	Mixed: case study (32 survey responses and 16 interview)	Moggi, Pierce & Bernardi (2022)
		EEs (and particularly policy, finance and infrastructural and administrative support), have a positive impact on national levels of sustainable innovation.	Quantitative: PCA and HCA (World Bank, WTO, UNESCO, UNIDO, UNCTAD, IMF, ILOSTAT, IEA, CWN)	Khatami et al. (2022)
Functioning ecosystems have a positive impact on society	Support organizations	Incubators within entrepreneurial ecosystems can stimulate entrepreneurship with lowering crime, recidivism, and economic inequality, as well as increased social capital, community trust, and optimism as spillovers.	Qualitative: descriptive case study (secondary data)	McDaniel et al. (2021)
	Multiple elements	Entrepreneurship support in entrepreneurial ecosystems is negatively related to homicide (moderated by education but not start-up creation density)	Quantitative: fixed-effects model (Golden, nationalsurvey.org, FFIEC, FBI, U.S. Census Bureau)	McDaniel, Ge & Yuan (2022)
Measuring the outcome of ecosystems should be tailored to its configuration and the context	Multiple elements	EEs should not be reduced to standardized measures but evaluated based on their configuration according to the Varieties of entrepreneurial ecosystem and within their context and state of development.	Qualitative: multiple case study (field visits, 80 semi-structured interviews)	Kapturkiewicz (2021)
Ecosystems as a moderator for the relationship between entrepreneurship and economic development	Multiple elements	Positive moderating effect of the ecosystem on the relation between entrepreneurship (both Kirznerian and Schumpeterian) on regional economic growth.	Quantitative: OLS regression (Eurostat, GEM, REDI)	Szerb et al. (2019)
		Ecosystems moderate the impact of regional entrepreneurial outputs on economic development (outcomes).	Quantitative: latent class analysis (GEM)	Content et al. (2020)
Ecosystems or at least many of their elements do not impact entrepreneurial/ economic outcomes	Multiple elements	No moderating effect of entrepreneurial ecosystems on the relation between entrepreneurship and economic growth.	Quantitative: multilevel growth regression, latent class analysis (Eurostat, GEM)	Bruns et al. (2017)
	Finance	Improving the entrepreneurial ecosystem leads to higher venture capital investments, but links to wider economic benefits (e.g., GDP growth) are inconclusive (most likely due to their complexity).	Quantitative: composite indicators using 'benefit of the doubt' (GEI)	Lafuente, Ács & Szerb (2021)

* All studies in this list include a variety of ecosystem elements, but some emphasize the role of particular element(s) as indicated in this column.

Table 4: Downward causation and path-dependency

Main Arguments	Focus*	Main Findings	Methodology	Selected Empirical Studies
Path dependence and Matthew effects in regions	Multiple elements	Path dependence in the evolution of entrepreneurial ecosystems as entrepreneurial output feeds back into the regional EE	Quantitative: PCA, linear regression model (Quality of Government, CBS, EU RCI, Nat Assoc of Private Equity)	Stam & Van de Ven (2021)
		Entrepreneurial agents, especially individual (regional) entrepreneurs, drive the evolution and resource dynamics of regional EEs.	Qualitative: 51 semi-structured interviews, site visits, focus group, and secondary data	Shi & Shi (2021)
		EE shaped by economic development of the country and high-growth firms have greater impact on entrepreneurial ecosystem than new ventures in general.	Quantitative: SEM (GEM, NES data)	Martínez-Fierro, Biedma-Ferrer & Ruiz-Navarro (2019)
	Institutions	Regional entrepreneurial activity positively affects objective institutional performance and also negatively affects subjective performance.	Quantitative: mixed-effects regression (USCMP, StatsAmerica, CMS, AHA)	Meek & Tietz (2022)
	Anchor firms and institutions	Large anchor firms can stimulate the development and an EE, but this can also lead to dependencies and the entrepreneurial ecosystem not maturing without the anchor firm (particularly problematic in case of the anchor firm going out of business).	Qualitative: comparative case study (process tracing from 102 interviews)	Ornston & Camargo (2022)
		Local start-ups develop capabilities slower than MNE entrants, but with higher spillovers of skills and knowledge and higher engagement/support for the local EE.	Qualitative: comparative case study (19 interviews, secondary data)	Lorenzen (2019)
Ecosystems enable entrepreneurial 'recycling'	Institutions	Local institutional structures support recycling and mobility within entrepreneurial ecosystems after shocks.	Quantitative: descriptive statistics (data from career-based social media platform for 782 individuals)	Spigel & Vinodrai (2021)
	Informal institutions and social capital	EEs with strong informal institutions (particularly de-stigmatizing failure) and networks are more supportive of entrepreneurs who want to start a new venture after a previous business failure.	Quantitative: fixed-effect dynamic GMM estimation of panel data (GEM, World Bank, WEF, IMF)	Espinoza-Benavides et al. (2021)
	Multiple elements	The framework conditions of entrepreneurial ecosystems have different influences on the reentry decisions of males and females who experience business failure.	Quantitative: hierarchical linear modeling (GEM, WDI, Flash EB Nos. 192, 283, and 354)	Simmons et al. (2019)

		EEs facilitate the quality and speed of the re-entry of failed entrepreneurs.	Qualitative: 20 semi-structured interviews, secondary data	Guerrero & Espinoza-Benavides (2021)
Women and men benefit in different ways from ecosystems and their elements	Multiple elements	Globally, women benefit more from many of the ecosystem factors than men, but in some cases depending on the phase of economic development men might benefit more.	Quantitative: regression, GMM estimator (World Bank, GEM APS & NES)	Hechavarría & Ingram (2019)
		Regional entrepreneurial ecosystems are not generic and so not affect all entrepreneurs equally; peer support, learning opportunities, and visible female role models can support women entrepreneurs.	Qualitative: participatory action research	Birdthistle, Eversole & Walo (2022)
		Start-up strategies chosen are a reflection of the perceived support from the ecosystem, the entrepreneurs' current life situation, and the intended goals. Women tend to mobilize more resources than men in order to overcome support constraints, men are more confident of their capabilities.	Mixed: fsQCA (PSED II)	Sperber & Linder (2019)
State of the ecosystem affects individual entrepreneurs' behaviors and the influence of top-down policy interventions	Multiple elements	State of the ecosystem impacts whether entrepreneurs come/stay to start a new tech venture.	Mixed: logistic regression and 45 semi-structured, in-depth interviews	Stephens et al. (2019)
		Local/regional ecosystem characteristics are crucial for effectiveness of systemic innovation policy.	Qualitative: Longitudinal case study (secondary sources; 44 interviews at three points in time over 10 years)	Brown, Gregson & Mason (2016)
		Descriptive evidence that in countries characterized by an underdeveloped VC market and with a limited number of large firms, innovative start-ups often locate in entrepreneurial ecosystems with SMEs clustered in industrial districts.	Quantitative: descriptive statistics (ISTAT)	Cavallo, Ghezzi & Rossi-Lamastra (2021)
	Finance	Angel investments have a positive impact on firm growth, performance, survival, and follow-on fundraising, which is independent of the level of venture activity and entrepreneur-friendliness in the country; but in less mature ecosystems only more mature start-ups apply for angel investment.	Quantitative: regression discontinuity (self-reported data from angel groups)	Lerner et al. (2018)
	Government and finance	Nature and prevalence of finance changed due to changes in formal institutions and the resulting regulatory changes; path development of the ecosystem is strongly shaped by endogenous initiatives of foremost public authorities.	Qualitative: case study (22 semi-structured interviews supported by secondary data)	Radinger-Peer, Sedlacek & Goldstein (2018)
	Government	Ecosystems represent higher-level system in which, e.g., clusters are embedded; policy making needs to account for current state of the ecosystem and interventions have different effects on involved clusters/industries.	Quantitative: case study with descriptive statistics (e.g., ACS, Inc 5000, NSF, USPTO, WoS)	Auerswald & Dani (2017)

		Effective entrepreneurial ecosystem policy should use a policy mix by combining different instruments and adapted to local contexts (including the growth characteristics of start-ups and the current state of the EE).	Mixed: fsQCA (1351 survey responses)	Wang et al. (2022)
		Particularly in emerging economies, dedicated entrepreneurship policies need to be complemented by and harmonised with other policies, including taxation, social and educational policies.	Quantitative: cluster analysis (World Bank, WEF, IMF, GEM, GCI, GII, UNIDO, World Value Survey, UNDP, ILO, UNESCO, G. Hofstede Database)	Kantis, Federico & García (2020)
		National economies can be categorized by their entrepreneurial ecosystem framework conditions; improving their performance and competitiveness requires tailored interventions based on the current state of the EE.	Quantitative: factorial and cluster analysis (GEM)	Farinha et al. (2020)
	Informal institutions and human capital	Entrepreneurial readiness is a more valid representation of individual-level characteristics than other individual traits and is also influenced by several dimensions of the national environment, forming a reinforcing loop.	Quantitative: EFA, PLS-based CFA, multilevel logistic regression (GEM, World Bank, GCI)	Schillo, Persaud & Jin (2016)
	Universities	Students' perception of entrepreneurial ecosystem is positively related to their entrepreneurial intention.	Quantitative: PLS-SEM (259 survey respondents)	Elnadi & Gheith (2021)
		Entrepreneurial universities in post-conflict entrepreneurial ecosystems are orientated toward rebuilding human capital in the region, before being able to focus on knowledge exchange.	Qualitative: case study (secondary data, field notes)	Nkusi et al. (2020)

* All studies in this list include a variety of ecosystem elements, but some emphasize the role of particular element(s) as indicated in this column.

Table 5: Links between entrepreneurial ecosystems

Main Arguments	Focus*	Main Findings	Methodology	Selected Empirical Studies
Actors/ideas/practices/norms travel and migrate between ecosystems (and across spatial or cultural boundaries or language barriers)	Human capital	Ecosystems are part of a wider transnational social field that shapes and is shaped by the circulation of actors, ideologies, texts, and objects in and across near and distant spaces.	Qualitative: ethno-graphic study (14 interviews, visits, other documents)	Fraiberg (2017)
		Remigration, ‘sunshine return migration’, and outmigration influence the emergence and evolution of ecosystems.	Qualitative: 27 interviews and secondary data	Schäfer & Henn (2018)
	Social capital	Local embeddedness and non-local connections are vital to returnee entrepreneurs’ business development.	Qualitative: four narrative interviews	Wang et al. (2022)
	Digitalization	Digitally enabled entrepreneurial ecosystems overcome spatial barriers and increase access to resources beyond its boundaries.	Qualitative: 19 interviews	Alaassar, Mention & Aas (2022)
	Multiple elements	Spillover effects from large metropolitan centers to adjacent peripheral regions.	Quantitative: panel regression (Annual Survey of Industrial Firms of China, National Enterprise Credit Information Publicity System of China, China Statistical Yearbook, National Intellectual Property Administration of China, NASA, Chinese Academy of Sciences)	Long, Zheng & Qian (2022)
Transnational entrepreneurs play a key role in creating momentum and initiating institutional change in less-developed EEs.		Qualitative: 35 interviews	Harima, Harima & Freiling (2021)	
Ecosystems are attractive to external entrepreneurs and become hubs	Multiple elements	EEs that allow immigrant entrepreneurs to rapidly build a network, get reputational benefits from being located in this EE, and provide access to a market for experimentation are attractive to immigrant entrepreneurs and conducive to their performance.	Mixed: QCA (54 semi-structured, in-depth interviews plus follow-up interviews five years later)	March-Chordà, Adame-Sánchez & Yagüe-Perales (2021)
Bi-directional learning for migrant entrepreneurs and ecosystems	Multiple elements	Home-country entrepreneurial ecosystems have positive effects on immigrants’ business opportunity exploitation and actualization.	Qualitative: content analysis of secondary data	Duan, Kotey & Sandhu (2021)
		Migration leads to a potential brain drain which limits opportunities in the "home" EE, yet this can potentially be advantageous when migrants remain in close contact with their home entrepreneurial ecosystem through remittances.	Mixed: Multilevel logistic regression (GEM data) and qualitative case study (data for six months, based 70+ interviews)	Schmutzler, Andonova & Perez-Lopez (2001)

		Entrepreneurs coming to China must be prepared, flexible, associate themselves with reputable partners and take advice from those familiar with business in China to overcome cultural-cognitive barriers; regulative barriers can only be removed by the government.	Qualitative: 43 interviews and observations from five meetings and five seminars	Steinz, Van Rijnsoever & Nauta (2016)
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* All studies in this list include a variety of ecosystem elements, but some emphasize the role of particular element(s) as indicated in this column.