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# Effective policy mixes in entrepreneurial ecosystems: a configurational analysis in China

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**Abstract** Policy-makers are seeking to build vibrant entrepreneurial ecosystems (EEs) to promote innovative entrepreneurship. However, the role of government policy in EEs, especially in the emerging economy context, is poorly understood, lacking a systematic concept of policy and theoretical framework, clear policy classification, and empirical research considering distinctive characteristics of policy mixes in EEs. This paper introduces the concept of *EE policy mixes* and classifies them into seven policy instruments. Using data from 21 national high-tech zones (NHZs) in China, fuzzy-set qualitative comparative analysis (fsQCA) is applied to identify effective configurations of *EE policy mixes* that support early-stage and late-stage technology start-ups to produce high entrepreneurial performance. The configurational analysis shows that *EE policy mixes* present causal complexity and stage differences. Based on interpreting multiple policy interactions, we reveal the differentiated support mechanisms of *EE policy mixes* in NHZs and draw out their implications for research, policy, and practice. This study contributes to the EE literature by adopting a policy-mix perspective to examine the role of policy, exploring the specific emerging economy context of China, suggesting further extensions of the research to other contexts, and applying a methodology that reveals causal mechanisms. It also supports better-informed EE policy and governance.

**Plain English Summary** How to maximize the potential of policy in entrepreneurial ecosystems (EEs)? Revealing the causal complexity, stage differences, and support mechanisms of policy mixes in China's EEs.
This study applies a policy-mix concept and a configurational analysis approach to explore the role of government policy in EEs. Taking China's national high-tech zones—a unique model of EEs in emerging economies—as the empirical context, we identify effective configurations of *EE policy mixes* supporting high early- and late-stage entrepreneurial performance. The findings show that *EE policy mixes* present causal complexity, reflected in the "joint effects" of policy instruments and multiple equally effective configurations, and stage differences, reflected in the differentiated support mechanisms for early- and late-stage start-ups in three dimensions. The principal implication is that policy-makers should design, implement, and evaluate EE policy from a holistic, interrelated policy-mix

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perspective, and consider fully local contextual applicability, entrepreneurial growth characteristics, and ecosystem maturity.

**Keywords** Entrepreneurial ecosystem · Government policy · Policy mixes · Emerging economies · China · Fuzzy-set qualitative comparative analysis (fsQCA)

**JEL Classification** L26 · M13 · R11 · R58 · 031 · 038

## 1 Introduction

The transition from a managed to an entrepreneurial economy is characterized by the increasingly important role of innovative entrepreneurship in economic development and social impact (Audretsch et al., 2020; Autio et al., 2014), and by calls for the development of an appropriate policy response (Thurik et al., 2013). Specifically, the entrepreneurial ecosystem (EE) approach has been heralded as an appropriate framework for both research and policy-making accommodating this transition (Cao & Shi, 2021; Stam, 2015). This develops dynamically the interaction between policy leading theory and theory informing policy and practice (Spigel, 2020), and emphasizes tailoring policies to multi-faceted regional contexts (Isenberg, 2010), creating a supportive ecosystem for innovative entrepreneurship (Spigel & Harrison, 2018), and promoting multi-level interactions among ecosystem actors to provide the government with policy levers to stimulate economic prosperity (Wurth et al., 2021).

Accordingly, governments in both advanced and emerging economies have increasingly adopted the EE approach to develop vibrant ecosystems (Cao & Shi, 2021; Jolley & Pittaway, 2019; Stam, 2018). Despite the rapid expansion of research and practice, this policy blockbuster does not guarantee its profundity (Brown & Mawson, 2019). Not only do policy design and implementation lack solid theoretical foundations (Candeias & Sarkar, 2022), but the actual effects of these policies have also been questioned (Chen et al., 2020; Colombo et al., 2019; Feld, 2012; Spigel & Harrison, 2018; Wurth et al., 2021).

In this paper, we seek to develop a systematic framework and two-stage methodological design for analyzing the precise role of government policy in EEs, based on four gaps in the literature. First, while the nature, process, key principles, guidelines, and ideal intervention types of policy in EEs have been widely discussed (Brown & Mawson, 2019; Candeias & Sarkar, 2022; Cavallo et al., 2019; Isenberg, 2010; Mason & Brown, 2014; Stam, 2018), there is still no clear, detailed EE policy classification. This reduces the possibility of comparison between studies, and restricts theoretical expansion based on the generalization of their findings. Specifically, developing a theoretical perspective on policy typology will facilitate the conceptual maturity of EE policy research, and provide a basis for exploring empirically the role of policy in EEs (Candeias & Sarkar, 2022; Stam, 2015). The existing EE literature does not recognize policy as a "mixed set" of multiple policy instruments (Rogge & Reichardt, 2016)—a holistic perspective which is conducive to clarifying the interrelated interventions that support the functioning of EEs, and serves as a framework for revealing theoretical mechanisms of EE policy in a specific context and also analyzing similarities and differences across contexts (Cao & Shi, 2021; Wurth et al., 2021).

Second, the complex challenges of developing EEs are calling for new, systematic conceptualizations of policy in both academic and policy communities which help address the overall goals, "joint effects" and dynamic evolution of policy in EEs (Autio et al., 2014; Feldman & Lowe, 2018; Isenberg, 2011). We respond to these challenges by developing the extended policy-mix concept, which considers comprehensively policy strategy, processes, instrument mixes, and their potential interactions (Flanagan et al., 2011; Kanger et al., 2020; Rogge & Reichardt, 2016). This concept can be adopted to develop a systematic analytical framework to capture the complex, dynamic nature of policy mixes in EEs, which is of particular relevance in the analysis of EEs with rich policy practice but uncertain institutional environments.

Third, existing studies on the role of policy in EEs lack sufficient empirical evidence, which is based on the application of fine-grained methods that can reflect the distinctive characteristics of policy mixes in EEs (Bramwell et al., 2019; Brown & Mawson, 2019; Stam, 2018). Also, obtaining precise details of policy support mechanisms in EEs has so far "proven elusive" (Feldman & Lowe, 2018, p.338). This reflects causal complexity in EEs: in line with

the policy-mix concept, configurations of interactive factors rather than single factors bring about the outcome; and multiple configurations arising from different contexts can lead to the same outcome (Furnari et al., 2021). Furthermore, nascent and growing start-ups tend to have different policy needs (Autio et al., 2014; Brown & Mason, 2017). However, few studies have compared the actual effects of policy on different entrepreneurial stages (Audretsch et al., 2020; Guerrero et al., 2021), nor have they explored the "joint effects" of interactive policy mixes in EEs and the possibility of equally effective configurations. We address this by employing the policy mix as a multi-configurational, entrepreneurial process-oriented perspective which requires the development and application of a matching method for empirical research. This helps reveal the complex policy support mechanisms to deepen insights into the precise role of policy in EEs.

Fourth, existing studies on EE policy have mostly been conducted in advanced economies, while insufficient attention is paid to the context of emerging economies (Cao & Shi, 2021; Wei, 2022). Given the insufficient resources, market vulnerabilities, and underdeveloped institutions (Du & Kim, 2021), governments in emerging economies often play a stronger role in EEs with some unique policies, but they also risk greater policy uncertainty and failure due to the lack of theoretical guidance and practical experience (Manimala & Wasdani, 2015; Yang & Zhang, 2021). These phenomena are important but under-researched, which hinders the understanding of EEs in emerging economies and further magnifies the gap in the EE literature on the role of policy. In particular, China, as the largest emerging economy, has built a distinctive economic system, a key part of which is the exploration of the EE approach, albeit with Chinese characteristics that reflect the distinctive "China Business Model" (Chen et al., 2020; Paulet & Rowley, 2017a). By establishing unique institutional arrangements and conducting multi-level policy actions, the Chinese government has successfully promoted the rapid growth of EEs nationwide (Shi & Shi, 2021; Xie et al., 2018). Given this, China's practice of developing EEs provides rich empirical evidence and an enlightening research context for a closer examination on the role of policy. Furthermore, revealing the support mechanisms of policy mixes in the Chinese EE context may provide other countries, especially emerging economies, with valuable implications for EE research, policy, and practice.

In response, this study explores the precise role of government policy in EEs, especially in China as an example of a country in transition which allows us to address the under-researched emerging economy context, through the theoretical and empirical application of the concept of *EE policy mixes*. We address two questions. First, which policy instruments constitute the classification of *EE policy mixes*? We identify the overall goals of *EE policy mixes*, then delineate specific policy intervention points, and finally define seven types of policy instruments based on a comparative analysis of the common and special interventions in EEs in emerging economies (henceforth referred to as E4s) compared with EEs in advanced economies. Second, can *EE policy mixes* manifest in multiple configurations to effectively support innovative start-ups in the specific E4s context of China? If so, how and why can the interactions among different policy instruments produce effective support mechanisms, and to what extent do these differ for start-ups at different stages of maturity? Using the unique hand-collected data from 21 of China's national high-tech zones (NHZs), we apply fuzzy-set qualitative comparative analysis (fsQCA) to explore the effective configurations of *EE policy mixes* supporting early- and late-stage technology start-ups to produce high entrepreneurial performance. By interpreting these configurations, we reveal the internal interactions and support mechanisms of *EE policy mixes* in China's NHZs and the universal and specific implications brought about by the differentiated mechanisms, and develop the arguments on how policy may play an effective role in EEs.

This study makes four contributions. First, we adopt a policy-mix perspective to explore the classification, distinctive characteristics, and support mechanisms of *EE policy mixes*, adding a fine-grained insight into the current debate on the role of policy in EEs. Second, in so doing, we make several methodological contributions to the EE literature in examining causal mechanisms of specific factors, collecting EE policy information, and developing relevant measurement regimes. This provides guidance for similar future research. Third, we contribute to the E4s literature (Cao & Shi, 2021) by exploring empirically the support mechanisms of *EE policy mixes* in the context of China's NHZs and developing evidence-based

theoretical arguments. This advances understanding of China's unique entrepreneurial phenomena and policy practice (Bruton et al., 2018) and provides a theoretical basis for future extensions of this research to other contexts. Fourth, this study provides policy-makers with guidance on EE policy design, implementation, and evaluation, and in particular offers policy-makers in emerging economies specific lessons from China's experience in developing EEs.

## 2 Literature review

### 2.1 EEs and the role of government policy

The concept of EEs, as "regional communities of interconnected actors related to entrepreneurship" (Kuckertz, 2019, p.2), has gained currency within policy, academic, and practitioner communities, as both a policy approach to catalyze resilient, entrepreneurship-led economic development, and a systematic framework to understand regional entrepreneurial dynamics (Spigel & Harrison, 2018). However, research on EEs is still underdeveloped and undertheorized (Spigel, 2017), mainly in three aspects.

First, it has focused mostly on advanced economies, which have many superior conditions to nurture strong EEs, including resource endowments, institutional provision, and governance structures (Spigel & Harrison, 2018). However, how such literature relates to emerging economies is not well understood (Cao & Shi, 2021). As emerging economies assume an increasingly dominant position in the world economy, and as most of them are positioning innovative entrepreneurship as engines for economic restructuring (He et al., 2019), this gap requires further attention. Second, existing studies often take macro- and descriptive perspectives without sufficient clarity about causations regarding specific factors, such as government policy (Feld, 2012; Jolley & Pittaway, 2019; Stam, 2015). The usefulness of the EE concept depends on an advanced understanding of such causal mechanisms (Wurth et al., 2021). This requires both methodological innovations to interpret the "messiness" of ecosystems, and the linking of EEs with other emerging theories (Brown & Mawson, 2019; Wurth et al., 2021). Third, the current focus is typically on case studies of a single EE (typically defined as a city or a region) without a broader comparative perspective. This fails to address the unclear relationship between the specificity of the local context and the generalizability of EE dynamics and policy support (Cao & Shi, 2021). Clarifying the similarities and uniqueness of EEs in different contexts is a necessary first step to establishing a theoretical framework which builds on the experience derived from unique phenomena (e.g., China's unique approach to developing EEs).

The role of government policy in EEs is ambiguous. Under a "top-down" governance model, EEs can be governed by a Chandlerian visible hand (Colombo et al., 2019), in which policy incubates and facilitates successful EEs (Brown & Mawson, 2019; Nordling, 2019), linking entrepreneurs with sufficient tangible and intangible resources (Chen et al., 2020). Conversely, under a "bottom-up" governance model, EEs can develop naturally (Spigel & Harrison, 2018) in response to endogenous stimuli, such as interactions of entrepreneurs, rather than exogenous stimuli, such as government actions (Thompson et al., 2018). In this view, policy interventions might produce adverse effects on entrepreneurial dynamics (Colombo et al., 2019).

In practice, while policy alone is insufficient to generate a self-organizing ecosystem (Spigel & Harrison, 2018), the complex evolution processes of any EE inevitably involve public sector participation (Feldman & Lowe, 2018; Kuckertz, 2019). This suggests the rationality of an integrated view pointing to a dynamic "bottom-up-top-down" governance model (Bramwell et al., 2019; Colombo et al., 2019), in which the role of each actor changes as the EE evolves (Colombelli et al., 2019). The dynamic role of government includes setting policy priorities to address ecosystem bottlenecks (Stam, 2018), providing the necessary resources (Feld, 2012), promoting multi-level interactions among stakeholders (Feldman & Lowe, 2018), and remedying institutional voids and structural gaps (Cao & Shi, 2021). Contextual differences are also an important aspect in determining policy's role in EEs, affecting the specific types, scope, and intensity of policy interventions (Candeias & Sarkar, 2022). Compared with advanced economies, government policy usually plays a greater role in emerging economies and underdeveloped institutional contexts (Wei, 2022).

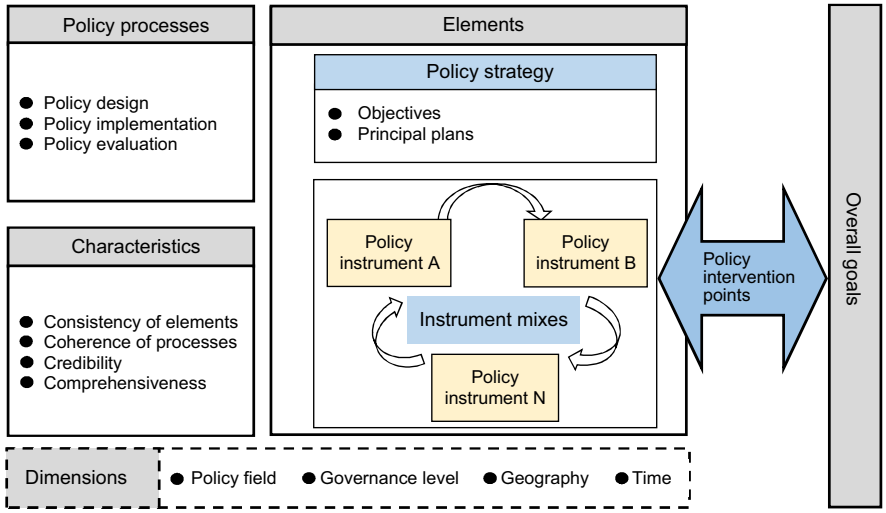


**Fig. 1** The conceptual framework of the policy mix. Source: own summary based on Rogge and Reichardt (2016) and Kanger et al. (2020)

Overall, these studies provide a basis for further scrutiny of policy in specific contexts, such as the under-explored emerging economy context represented by China (Yang & Zhang, 2021). Furthermore, an emerging, more fine-grained research perspective is to move beyond the previous view of policy as an undifferentiated factor to draw on the policy-mix concept for EE policy analysis (Bramwell et al., 2019; Stam, 2018; Szerb et al., 2020).

## 2.2 Policy mixes

The policy mix has been conceptualized as a combination of different policy instruments (Flanagan et al., 2011) but increasingly gives more consideration to the complexity of real-world policy mixes, such as the guiding role of policy strategy (Rogge & Reichardt, 2016), and the processes of policy emergence, interaction, monitoring, and adaptive learning (Caloffi et al., 2022; Feldman & Lowe, 2018; Flanagan et al., 2011).

Rogge and Reichardt's (2016) extended concept of the policy mix consists of three building blocks, namely, elements, policy processes, and characteristics (left side of Fig. 1). Elements comprise the policy strategy which provides long-term, ambitious objectives, and the interactive instrument mixes. In response to the overarching policy strategy, each instrument type has short-term goals and incorporates specific measures. Policy processes determine how the elements are implemented, evaluated, and redesigned over time. Furthermore, the policy mixes can be specified and delineated in four dimensions, which visualize the spaces for policy interactions by pointing to the constituent origin of policy mixes (Flanagan et al., 2011).

This policy-mix perspective provides a comprehensive framework for capturing the dynamics between policy mixes and the overall goals. However, previous studies focus mainly on the "what" and "why" of policy mixes for pursuing the overall goals, while relatively neglecting the "how" issue (Kanger et al., 2020). To address this, Kanger et al. (2020) introduce the concept of "policy intervention points" as a "mid-step" between overall goals and particular policy instruments for achieving the goals. This helps design more effective policy strategies and targeted instrument mixes by identifying the critical issues of the goals and delineating what to target in the first place. In our updated framework, interactions of policy instruments largely influence the combined effects of instrument mixes, and provide feedback on policy strategy and processes. Therefore, interactions of policy instruments are the analytical focus of any policy-mix concept (Flanagan et al., 2011; Rogge & Reichardt, 2016).

## 2.3 Policy mixes in EEs

Given the complexity and dynamics of EEs, "siloed" policy approaches might be ineffective (Stam, 2015; Wurth et al., 2021), and the focus needs to shift from single policies to a more holistic, interrelated approach (Audretsch et al., 2020; Autio et al., 2014). This is

reflected in the analyses of the EE policy processes (Stam, 2018), evolution of the "right mix" of policies (Bramwell et al., 2019, p.278), and use of policy portfolio simulations (Szerb et al., 2020) to help foster local EEs. However, while previous studies confirm the necessity of the leading policy strategy and appropriate combinations of policy instruments, they lack a unified terminology and rarely draw insights from the policy-mix literature for theory building and empirical research.

Therefore, this paper adopts the central elements of the policy-mix concept—a combination of interactive instruments embraced by an overarching policy strategy—as the theoretical basis (Rogge & Reichardt, 2016). We define the set of all policy instruments applied in a particular EE under the current policy strategy as *EE policy mixes*. Currently, our understanding of what types of policy work and how they work is quite limited (Stam, 2018), and quantitative evidence assessing the effects of various policy instruments is lacking, mixed, and inconclusive (Brown & Mawson, 2019; Caloffi et al., 2022; Guerrero et al, 2021). Therefore, it is necessary to clarify the classification of *EE policy mixes* and apply fine-grained methods reflecting the distinctive characteristics of this for empirical research. This will enable us to address the two research questions proposed, especially to reveal the support mechanisms of *EE policy mixes* in the Chinese context.

The first unique characteristic of *EE policy mixes* can be summarized as causal complexity, reflected in two respects. First, since EEs are multi-actor and multi-scale phenomena, policy design should address simultaneously interacting variables in non-formulaic ways, and consider comprehensively the complementarity and substitution in policy interactions. This indicates the need to understand the "joint effects" of *EE policy mixes* (Audretsch et al., 2020; Feldman & Lowe, 2018; Isenberg, 2011). Second, policy interventions should fit region-specific contexts to maximize intervention effects (Autio et al., 2014), rather than following a standard formula. This indicates that there are multiple complementarities and substitutions within *EE policy mixes*—their different combinations help form diversified configurations, which might be suitable for different contexts but consistently present positive intervention effects.

We currently know little about such causal complexity, mainly because of the unavoidable limitations of mainstream methods (Douglas et al., 2020): multivariate regression treats each variable as discrete, focusing on marginal effects of specific variables while saying little about system-level "joint effects"; case study research, typically focused on small-N samples, restricts the ability to generalize and capture diverse findings. Therefore, applying a system-level, multi-configurational method will help interpret the causal complexity of *EE policy mixes*. This is the first key to gaining a fine-grained understanding of the role of policy.

A second unique characteristic of *EE policy mixes* is related to stage differences. Existing studies on EEs are largely typological and atheoretical without fully exploring how they influence the entrepreneurial process (Spigel & Harrison, 2018). In terms of policy intervention, while researchers have pointed out the overall direction and main concerns of policy in each EE evolutionary stage (Brown & Mason, 2017; Brown & Mawson, 2019; Mack & Mayer, 2016), they largely overlook the different policy needs of innovative start-ups at different entrepreneurial stages (Audretsch et al., 2020; Guerrero et al., 2021), which would cause stage differences in the effects of *EE policy mixes*.

The entrepreneurial activity of start-ups ranges from exploring a potential entrepreneurial initiative to consolidating a venture (Guerrero et al., 2021), which can be simply divided into early-stage (within 3.5 years) and late-stage (3.5–8 years) (Li & Atuahene-Gima, 2001; Reynolds et al., 2005). This study follows this division to define early-stage start-ups and late-stage start-ups. Arguably, interpreting stage differences is another key to better understanding the role of policy—it is necessary to explore separately the effective configurations for early- and late-stage innovative start-ups, which, from the set theory, are two subsets with a possible intersection within the overall *EE policy mixes*. This allows us to take a further step: based on the interpretation of causal complexity, we further reveal the policy's role in producing differentiated support mechanisms for start-ups at different entrepreneurial stages in EEs.

## 3 Research design and methodology

### 3.1 Research design

We adopted a two-stage research design (Fig. 2): develop the classification of *EE policy mixes*; and

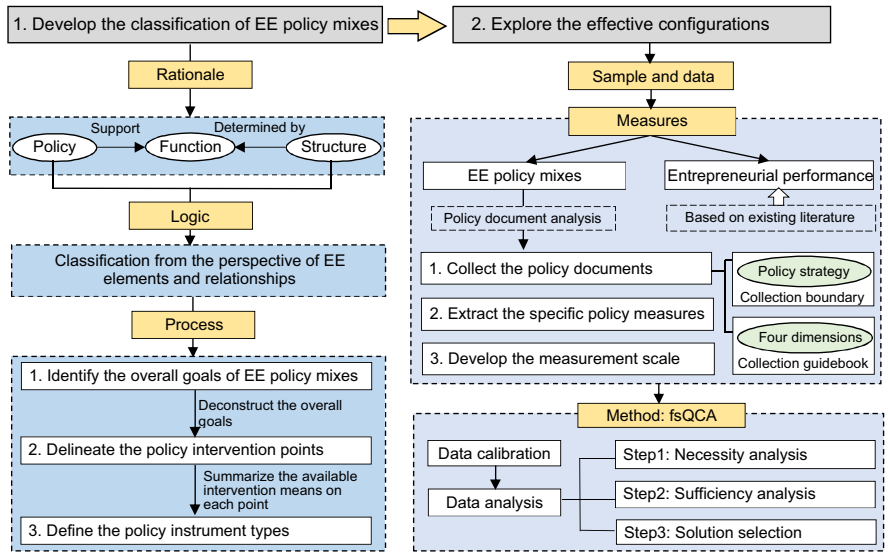


**Fig. 2** Research framework

explore the effective configurations. The left side of Fig. 2 illustrates the rationale, logic, and process of classification. Since government policy aims to support the effective functioning of ecosystems, and ecosystem structure largely determines its functions (Isenberg, 2011; Spigel & Harrison, 2018), we classified *EE policy mixes* from the perspective of EE elements and relationships to capture the multi-faceted impact of policy on ecosystem functions. EE elements and relationships provide a grammar on how to create an entrepreneurial-friendly environment (Kuckertz, 2019; Stam, 2018), thus helping identify the overall goals of *EE policy mixes.* Then, we delineated the policy intervention points as a "mid-step" between overall goals and particular policy instruments (Kanger et al., 2020), and facilitated this process by illustrating available intervention means for each point.

The right side of Fig. 2 describes the process for exploring the effective configurations. We sampled 21 NHZs in China and collected data from their technology start-ups. We developed the measures of *EE policy mixes* through policy document analysis (Brown & Mawson, 2019). This requires addressing some challenges: the broad definition of entrepreneurship results in entrepreneurship-related measures being included in policy documents across diverse fields (Isenberg, 2010); governments at all levels have the authority to promulgate policy documents; while national-level documents often have universal applicability, local-level documents are more specific and bespoke to local conditions (Autio et al., 2014); and policy documents may be revised or withdrawn over time. In response, we used Fig. 1, and specifically the four dimensions of policy interactions under the guidance of overarching policy strategy, to guide our collection of documents related to *EE policy mixes* that are blurred-boundary, multi-level, region-specific, and dynamic. Finally, we applied fsQCA to perform the analysis.

### 3.2 Policy classification

To better understand the EE elements and relationships, we drew on the structure model (Stam, 2015, p.1765–1766) which divides EE elements into systemic conditions (knowledge, talent, finance, networks of entrepreneurs, leadership, and support services) and framework conditions (culture, physical infrastructure, formal institutions, and market demand). These elements collectively reflect the support for EE functions of resource endowments and institutional arrangements (Stam and van de Ven, 2021). Furthermore, a dynamic EE is not simply a collection of isolated elements, but represents the outcome of interdependence among elements (Spigel, 2017). This is mainly achieved through internal and external network interactions of EE actors (Spigel, 2020; Wurth et al., 2021). Therefore, we identified the overall goals of *EE policy mixes*—create a supportive environment for innovative entrepreneurship and eliminate network failures hindering ecosystem functioning (Table 1).

Then, we deconstructed the overall goals to delineate six distinct policy intervention points. For each point, we summarized the available intervention means based on the existing literature. Here, considering a significant difference that EEs in advanced economies are usually built on sound resource and structural and institutional environments that are generally deficient in E4s (Cao & Shi, 2021; Harrison et al., 2018), we paid particular attention to the available intervention means adopted in E4s. We believe that identifying both common and special concerns at each point lays a foundation for developing a policy classification with wide applicability. Specifically, this is achieved by promoting a process from indigenous theorizing to theoretical generalization. Following Bruton et al., (2021, p.5), the common intervention points delineated from the universal EE structure model can be seen as "stream Broad," while the special intervention means of E4s represent "stream Narrow"—"stream Broad" presents the universally useful and necessary aspects; "stream Narrow" helps further explain the unique E4s phenomena to facilitate indigenous theorizing, and further produces cross-context commonality in policy rationale and intervention points (e.g., with advanced economies). By doing so, we could provide sufficient details and empirical evidence for developing a classification that facilitates theoretical generalization, within the constraints of the specificity of the particular research context.

Specifically, existing studies have pointed out three unique aspects of E4s compared with EEs in advanced economies: resource scarcities, formal institutional voids, and structural gaps (Cao & Shi, 2021; Harima et al., 2021; Kantis et al., 2020), which may in part be addressed by the pursuit of digital opportunities in E4s (Autio et al., 2018; Foo et al., 2020). By directly linking these four aspects with the policy intervention points, we identified eleven special concerns of E4s (indicated by "*" in Table 1).

First, E4s present salient resource scarcities in knowledge, talent, finance, and infrastructure (corresponding to intervention points 1, 2, and 4). For knowledge and talent, E4s generally lack the up-to-date entrepreneurship-related methods, courses, and mentoring (Kantis & Federico, 2012). Bespoke interventions include incorporating entrepreneurship themes into all educational levels (Kantis et al., 2020), and inviting returnee entrepreneurs into enterprises or giving lectures (Cao & Shi, 2021). The scarcities of finance are highlighted as fewer early-stage investments and underdeveloped financial markets (Armanios et al., 2017; de Oliveira et al., 2022). Bespoke interventions include cultivating diversified venture capital (VC) funds and local VC industries (Kantis & Federico, 2012), and expanding international capital markets (Lai & Vonortas, 2019). The scarcities of infrastructure include insufficient or underdeveloped public infrastructure (e.g., roads, telecommunications) and innovation infrastructure (e.g., incubators, accelerators), so there is an urgent need to accelerate the construction and functional upgrading of broad types of infrastructure (Wei, 2022).

Second, E4s present formal institutional voids in firm entry and exit, technology transfer-commercialization, talent incentives, and market regulations (corresponding to intervention point 5).[1] To fill the key institutional voids or address tensions in complex institutional fabric, bespoke interventions include simplifying the procedures for applying for business licenses, developing incentives for the development, global investment in and acquisition of new technologies and the introduction of overseas talent (Bruton et al., 2018; Harima et al., 2021), and formulating market regulatory rules with wide coverage. Furthermore, as alternatives and supplements to formal institutions, culture-based trust and reciprocity norms, political networks, Chinese-style *guanxi*, and other social capital provide informal institutions for securing resources and legitimacy (He et al., 2019; Puffer et al., 2010), and institutional intermediaries and broader innovation infrastructure provide new businesses with certification and capability-building paths to access critical resources and network partners (Armanios et al., 2017) (corresponding to intervention points 3 and 4).

Third, E4s have structural gaps in gathering useful structural elements and establishing dense, self-organizing networks, especially inter-ecosystem

[1] Indeed, no societal sphere is institutionally void, so it cannot be prejudiced that the absence of all Western institutions in E4s is equal to voids; instead, we acknowledge the necessity of some key institutions and the diversification of local institutions (Harrison et al., 2018). Thus, formal institutional voids here refer to the weakness of the key supporting institutions for entrepreneurial innovation, and the uncoordinated interface and conflict of the existing institutional fabric.

**Table 1** Classification of EE policy mixes

| Overall goal | Policy intervention point | Available intervention means for each point | Policy instrument type |
|---|---|---|---|
| To promote the creation, diffusion, allocation, or improvement of various EE elements | **1.** Creation and diffusion of knowledge and talent (Spigel, 2017; Stam & van de Ven, 2021) | Support knowledge exploration and learning, skills training, and business guidance in the community<br>* Facilitate the popularization of entrepreneurship education and professionalization of corporate training, and invite transnational entrepreneurs and returnee entrepreneurs to share advanced knowledge and skills<br>* Support online or remote video education, training, and lectures | Education and training[1] |
| | **2.** Financial support and financing accessibility (Audretsch et al., 2020) | Provide grants, subsidies, low-interest loans, fund projects, etc | Direct funding support[3] |
| | | Establish universal and targeted tax incentives in forms of tax reductions, exemptions, and credits | Tax incentives[3] |
| | | Provide financing guarantees, guidance, and related support<br>* Cultivate diversified VC funds and financing guarantee agencies, and expand international capital markets<br>* Support the development of crowdfunding platforms and Fin-techs | Widening financial engagement[1,3] |
| | **3.** Culture cultivation and improvement (Cao & Shi, 2021; Spigel & Harrison, 2018) | Strengthen cultural guidance and publicity, and support various entrepreneurship and innovation activities<br>* Foster a social capital network of trust, mutual aid, and co-prosperity | Culture and infrastructure improvement[1,3] |
| | **4.** Physical and digital infrastructure improvement (Autio et al., 2018; Stam, 2015) | Build or upgrade infrastructure that provides public products, services, and innovation conditions<br>* Improve infrastructure functions, and establish more institutional intermediaries to endow entrepreneurs with critical resources, legitimacy, and networking channels<br>* Build shared, interconnected digital infrastructure and platforms | |
| | **5.** Evolution of formal institutions (Cao & Shi, 2021) | Refine the laws, regulations, and incentive-restraint mechanisms on: business registration, licensing, and bankruptcy; knowledge transfer-commercialization process; and market competition<br>* Establish simplified business application procedures, incentivize global technology investment and acquisition, and improve the attraction and mobility mechanisms of overseas talent<br>* Standardize the development of digital economy, sharing economy, and platform economy | Formal institutional refinement[2] |
| To strengthen the connectivity and coordination among different EE elements | **6.** Multi-level network establishment and frequent network interactions (Wurth et al., 2021) | Provide guidance, channels, events and related support for network interactions between entrepreneurs and extensive stakeholders<br>* Formulate strategies for multi-level cooperation between local entrepreneurs and MNCs and transnational entrepreneurs, and support the Triple Helix interactions and the development of diversified intermediaries<br>* Promote the establishment of cross-organizational cooperation, international connections, and service supply–demand matching based on digital infrastructure and platforms | Networking[1,2,3] |

Intervention means with "*" in front represent the special concerns of E4s in addition to the common concerns of both EEs in advanced economies and E4s

Source of intervention means: own summary and elaboration—common concerns are based on Audretsch et al. (2020), Brown and Mawson (2019), Feld (2012), Guerrero et al. (2021), Isenberg (2011), Jolley and Pittaway (2019), and Nordling (2019). Special concerns of E4s are based on Armanios et al. (2017), Cao and Shi (2021), Chen et al. (2020), de Oliveira et al. (2022), Du and Kim (2021), Foo et al. (2020), Harima et al. (2021), He et al. (2019), Kantis and Federico (2012), Kantis et al. (2020), Lai and Vonortas (2019), and Wei (2022)

Superscripts: following the instrument typology proposed by Rogge and Reichardt (2016), each instrument can be aligned with one or more of three overlapping primary types—1, information; 2, regulation; 3, economic instruments

networks (corresponding to intervention point 6). This is mainly reflected in the poorly connected triple helix agents, insufficient support service organizations, and sparse networks of domestic and multinational entrepreneurs (Cao & Shi, 2021; Chen et al., 2020). Bespoke interventions include establishing alliances and collaborative projects for triple helix interactions, incentivizing the development of diversified service organizations, and formulating open cooperation strategies that attract multinational companies (MNCs), transnational entrepreneurs, and returnee entrepreneurs (de Oliveira et al., 2022; Kantis et al., 2020).

Lastly, the ever-expanding opportunities brought about by digital affordances are improving entrepreneurial practice and ecosystem dynamics (Autio et al., 2018), especially in E4s where the exploration and utilization of digital opportunities are more critical for entrepreneurship and innovation (e.g., ecosystems around Baidu, Alibaba, and Tencent in China). This affects each intervention point (de Oliveira et al., 2022; Foo et al., 2020). Together, these contrasts and descriptions provide the basis for refining terms and creating appropriate combinations, leading us to the final step of defining seven policy instrument types.

### 3.3 Research context

These ideas are explored in the context of EE policy in China. Since the Reform and Opening-up in 1978, China has moved from a closed, centrally planned economy to a more market-oriented one, based on the reform of state-owned enterprises (SOEs), the growth of the private sector and small- and medium-sized enterprises (SMEs), and a focus on the innovative performance of start-ups (Li, 2011; Paulet & Rowley, 2017b; Rowley & Cooke, 2010; Warner & Rowley, 2011). In particular, the Chinese government has made great efforts to legitimate and incentivize entrepreneurship, including the Provisional Regulations on Private Enterprises in 1988, which recognized private enterprises as profit-making businesses in the form of individual enterprises, partnerships, or limited liability companies, and the SME Promotion Law in 2002, which recognized the role of SMEs in scientific and technological development (Atherton, 2008). As a result, China has jumped from a relatively small economy to the world's second-largest, with entrepreneurship being a major driver (Bruton et al., 2018).

The idea of creating EEs specifically started in the 1980s when the government was inspired by Silicon Valley and began to explore the Chinese model of EEs (Chen et al., 2020) as part of the wider development of the "China Business Model" (Paulet & Rowley, 2017a). For example, under the "National High-tech Industrialization Development Plan," the pilot construction of Beijing-Zhongguancun NHZ was approved in 1988, aiming to create an ecosystem with all-round support for innovative entrepreneurship and high-tech enterprises (Chen et al., 2020). With the cooperation of multi-level governments, more NHZs have been established successively nationwide. Since 2015, the Mass Entrepreneurship and Innovation (MEI) strategy has emerged as a new economic development strategy, with the high-quality development of NHZs and their innovative start-ups as a key element, aiming to promote the prosperity of EEs through a new round of policy innovation. By 2018, the number of NHZs had reached 169, with no additions since then.[2]

NHZs can be regarded as an appropriate scale for studying EE dynamics in China's specific geographic, economic, and institutional contexts, for two main reasons. First, most NHZs are geographically zoned as parts of metropolitan cities where favorable conditions, such as entrepreneurial culture, infrastructure, capital markets, and human resources, are superior to those in other parts of these cities or ordinary cities, enabling each NHZ to form a resource-rich and interactive entrepreneurial community (Xie et al., 2018). Second, in terms of governance, each NHZ has established an independent governmental management agency—Management Committee—which is under the multi-level leadership of the national, provincial, and municipal governments and performs administrative functions on behalf of the local government (Du et al., 2018; Yan et al., 2020). This enables each NHZ to implement governance based on local resource endowments, industrial structure, and economic development goals. Particularly since 2015, NHZs

[2] Introduction and total number of NHZs: http://www.ctp.gov.cn/gxq/gaikuang/202109/0b679ebeaf7444d5810d8111a915c163.shtml

have been heralded as China's pioneering areas for institutional reform and policy innovation (Xie et al., 2018). NHZs are thus important demonstration sites for local governments to customize *EE policy mixes* in response to the MEI strategy.

### 3.4 Sample and data collection

To maximize heterogeneity over a minimum number of cases (Rihoux & Ragin, 2008), sample selection followed two principles: the NHZs should be located in widely different provinces to represent diversified configurations of policy mixes and entrepreneurial activities (Lai & Vonortas, 2019); and the NHZs should present significant differences in entrepreneurial innovation levels to better capture the causal relationships between policy mixes and performance. Following the division of China's four major economic areas and considering the availability of data, we selected six provinces in each of the central, eastern, and western areas, and all three provinces in the northeastern area (21 provinces in total). Then, referring to the comprehensive ranking of NHZs based on the capacity, performance, environment, and sustainability of entrepreneurship and innovation released by the Ministry of Science and Technology, we selected one NHZ from each target province, ensuring that the 21 selected NHZs covered the top, middle, and bottom positions in the overall ranking (Appendix Table 8).

We collected data via a questionnaire survey. After forming the initial questionnaire, we clarified the wording and question flow through panel discussion, and further modified it according to the feedback from two experts in entrepreneurship and innovation. Finally, we conducted the pilot test in Harbin NHZ in March 2020. One hundred thirteen valid responses were collected and SPSS26.0 was used to run an exploratory factor analysis to test the validity and reliability of the scale. This led us to adjust several items to arrive at the final version.

The formal survey was conducted from April 25 to June 25, 2020. All respondents were senior and middle managers of technology start-ups established for less than 8 years in 21 sample NHZs. The questionnaire was issued online by entrusting a leading professional survey firm, to which we detailed the survey's purpose, expected sample size and structure, and the judgment principles of effective responses.[3] This enabled us to obtain a satisfactory effective response rate—a total of 1898 questionnaires were issued to qualified managers who agreed to participate and complete the questionnaire, and 1351 valid responses were left after the platform review and authors' manual review, with an effective response rate of 71.18% (see Appendix Table 9 for the descriptive statistics).[4]

For each NHZ, at least 62 valid responses were collected, and early- and late-stage responses both exceed 30 (Appendix Table 8), indicating the data were sufficient and well-structured. Harman's single-factor test showed that eight factors had eigenvalues greater than 1, and the variance interpretation rate of the first principal component without rotation extraction was 18.39%, less than 50%, indicating that no single factor accounted for the majority of the covariance. We further adopted the "single-common-method-factor approach" (Podsakoff et al., 2003). The eight-factor model showed good fit ($\chi^2$/df = 2.56; GFI = 0.95; CFI = 0.97; RMSEA = 0.034; RMR = 0.022), and the fit indices improved slightly after adding a latent method factor ($\chi^2$/df = 2.32; GFI = 0.97; CFI = 0.98; RMSEA = 0.027; RMR = 0.019). Taken together, common method bias may not be a serious problem. Non-response bias was examined by employing two-tailed *t*-statistics. We compared the last 10% of responses with the first 10% in each NHZ and found none of the *t*-statistics was statistically significant ($p > 0.05$) in the characteristics of respondents and start-ups, suggesting that non-response bias may also not be a concern. Finally, we used the within-group interrater reliability ($r_{WG}$) and intraclass correlation coefficients (ICC(1), ICC(2)) to perform data aggregation tests (LeBreton & Senter, 2008). For each variable, the $r_{WG}$ value in each NHZ was greater than 0.70, indicating high interrater

[3] Wenjuanxing (https://www.wjx.cn) is one of the earliest and well-known consulting service firms in China. Its questionnaire survey platform provides a professional "Sample Service.".

[4] The high level of compliance benefits from the platform's incentive mechanism (e.g., providing cash or points rewards for effective respondents); in a similar study on Chinese entrepreneurship, Du and Kim (2021) also entrusted a professional survey firm, obtaining an effective response rate of 95.22%—comparably, since our sample has a larger scale and more stringent qualification requirements, this rate of 71.18% seems reasonable.

agreement and consistency; the ICC(1) value was greater than 0.10, and the ICC(2) value was greater than 0.70, indicating that the respondent-level data had sufficient within-group homogeneity and inter-group heterogeneity, and that calculating the average value of all respondent data within each NHZ to represent the Zone-level data has high reliability and stability (LeBreton & Senter, 2008).

### 3.5 Measures

To measure *EE policy mixes*, we specified the MEI strategy as the current policy strategy guiding EE development nationwide. This helps define the overall boundary for our collection of policy documents. Next, we applied the four-dimensional framework to search for documents.

First, to cover relevant policy fields comprehensively, we targeted governments and sub-departments including science and technology, education, finance, culture, and human resources as policy developers. Then, to consider multi-level governance and the targeted geographies, we searched on the "MEI" Policy Library portal which lists all relevant policy documents published by the State Council and National Ministries[5]; we also searched on the portals of the provincial, municipal, and zone-level governments to which the 21 NHZs belong. Finally, we reviewed the starting and expiration date of each document to ensure continuity and timeliness. After searching and filtering in February 2020, we achieved a final set consisting of 186 policy documents.

As the next step, we encoded and extracted the specific policy measures in each document. Referring to the available intervention means in Table 1, we picked the EE-related measures, summarized and named them (23 in total), and further classified each of them into one of the seven primary types of policy instrument (see Appendix Table 10 for details). Finally, for multiple specific measures belonging to the same instrument, we developed corresponding items one-to-one based on their descriptions in policy documents, which together constituted a combined scale for measuring the instrument (Table 2).

[5] "MEI" Policy Library: http://www.gov.cn/zhengce/shuangchuangzck/index.htm

We measured three dimensions of entrepreneurial performance—profitability, growth, and innovativeness (Stam, 2015; Stam & Elfring, 2008; Venkatraman & Ramanujam, 1986). For each dimension, we adopted three indicators from existing literature and developed corresponding items to ask about respondents' perceptions of their company performance in the last year compared to that of major competitors (Table 3). All items were measured on a 5-point Likert scale.

The reliability and validity of the scale were tested before analysis (Table 4). The Cronbach's $\alpha$ value for each variable was higher than 0.70, indicating high reliability of the scale (Fornell & Larcker, 1981). We tested validity using confirmatory factor analysis. The model fit indices suggest that the model was acceptable. For each variable, the factor loadings of all items exceeded 0.60, the composite reliability (CR) value was greater than 0.70, and the average variance extracted (AVE) value was greater than 0.50, indicating good convergent validity (Hair et al., 1998); the square root of AVE value was greater than the Pearson correlation coefficient (PCC) values between variables, indicating good discriminant validity (Fornell & Larcker, 1981). Overall, the scale had good reliability and validity.

### 3.6 Configurational analysis—fsQCA

FsQCA is becoming increasingly popular in entrepreneurship research (Douglas et al., 2020). In particular, there have been studies applying fsQCA to analyze aspects of EEs (Sperber & Linder, 2019; Vedula & Fitza, 2019; Yang & Zhang, 2021). Building upon set-theoretic techniques, QCA is a multiple case-oriented method regarding each case as a configuration of multiple conditions leading to an outcome (Ragin, 2008). The introduction of fuzzy-set analysis enables fsQCA to achieve accurate measures for conditions varying by degree.

We believe three advantages of fsQCA make it an appropriate method here. First, fsQCA defaults the interdependence and potential interactions among conditions (Douglas et al., 2020), conducive to measuring the "joint effects" of *EE policy mixes* and capturing internal complementarity and substitution (Furnari et al., 2021). Second, by revealing the "equifinality" of configurations for each outcome (Rihoux & Ragin, 2008, p.8), fsQCA helps identify multiple

**Table 2** Items for measuring *EE policy mixes*

| Policy instrument | Specific measures | Items (evaluate based on the reality of your company's NHZ) |
|---|---|---|
| Education and training | Entrepreneurship and innovation education | There are many online/offline courses, public education activities, and knowledge lectures related to entrepreneurship and innovation |
| | Skills training programs | Entrepreneurs and employees can receive regular training in entrepreneurial, financial, and managerial skills and expertise |
| | Business advise and start-up guidance | Potential entrepreneurs and young entrepreneurs can get entrepreneurship-related advice, experience, and start-up guidance easily |
| Direct funding support | Start-up funding support | The government provides lots of subsidies and loan discounts for entrepreneurs and start-ups |
| | R&D funding support | The government provides lots of subsidies, grants, fund projects, and loan discounts for R&D activities |
| | Technology transfer funding support | The government provides lots of grants, rewards, and fund projects for technology transfer-commercialization across diverse actors |
| Tax incentives | Universal tax incentives for entrepreneurship and innovation | The government provides various universal tax incentives for entrepreneurship and innovation, including tax relief for small and micro firms, R&D tax credits, and accelerated depreciation of fixed assets |
| | Targeted tax incentives for entrepreneurship and innovation | The government provides various targeted tax incentives for high-tech firms and talent, and special entrepreneurial groups including transnational entrepreneurs, returnee entrepreneurs, scientific researchers, and college graduates |
| | Support service tax incentives | The government provides various tax incentives for incubators, accelerators, service intermediaries, financial institutions, etc |
| Widening financial engagement | Governmental guarantees | Entrepreneurs and start-ups can obtain strong financing support such as credit guarantees and risk compensation |
| | Venture capital funds | The government establishes various VC funds to direct local and international capital into entrepreneurship and innovation |
| | Diversifying financing channels | There are lots of angel investors, VC institutions, crowdfunding platforms, and developed equity markets |
| | Promoting new financing models | There are lots of new financing models, including intellectual property pledge financing, equity debt financing, insurance financing, and "investment-loan-insurance" joint financing |

**Table 2** (continued)

| Policy instrument | Specific measures | Items (evaluate based on the reality of your company's NHZ) |
|---|---|---|
| Culture and infrastructure improvement | Fostering an entrepreneurship and innovation culture | There are many entrepreneurship and innovation activities, competitions, exhibitions, mutual-aid projects, news stories, and a thick culture encouraging entrepreneurship and innovation |
| | Improving public infrastructure | There is well-functioning public infrastructure including transportation, telecommunication, broadband, data centers, computing facilities, logistics, and energy supply |
| | Improving innovation infrastructure | There is well-functioning innovation infrastructure including laboratories, incubators, accelerators, and science parks |
| Formal institutional refinement | Business institutional refinement | There are low thresholds for start-up registration and simplified business registration, licensing, and bankruptcy procedures |
| | Technology institutional refinement | There is a robust institutional framework that stimulates and protects the intellectual property operation and technology transfer-commercialization processes worldwide |
| | Talent institutional refinement | There is a robust institutional framework that attracts overseas talent, encourages entrepreneurial research personnel, and promotes the free flow of talent across sectors, industries, and regions |
| | Market regulatory refinement | There is a healthy market regulatory environment with fair competition between formal and informal economies, strong contract enforcement and property rights protection, and fewer price and trade controls |
| Networking | Promoting interactions among entrepreneurs | Large, medium, and small firms, start-ups, and MNCs have formed multi-scale entrepreneur networks with close business partnerships, collaborative R&D partnerships, and peer-based support |
| | Promoting interactions among the Triple Helix agents | The academic, business, and government sectors within and across regions have formed alliance networks of resource sharing, complementary advantages, and collaborative innovation |
| | Promoting the establishment of a support service network | There is a tight and interactive service network consisting of professional business service, knowledge-intensive service, and financial service intermediaries, and various well-functioning comprehensive service platforms and specialized service platforms |

equally effective configurations for early- and late-stage start-ups, respectively. Third, fsQCA uses counterfactual analysis to distinguish core and peripheral conditions (Ragin, 2008). This distinction is very useful in policy-mix analysis (Rogge & Reichardt, 2016), as it helps further compare the key/auxiliary policy instruments that support start-ups at different growth stages. Overall, fsQCA can facilitate a fine-grained understanding of causal complexity and stage differences of *EE policy mixes*.

#### *3.6.1 Data calibration*

Before formal analysis, fsQCA requires the raw scores of variables to be calibrated into fuzzy membership scores (Ragin, 2008). This requires specifying the value of interval-scale variables corresponding to three qualitative thresholds that structure a fuzzy set. For the thresholds of full membership (0.95), full non-membership (0.05), and cross-over point (0.50), we used the upper quartile and median and lower quartile data of each variable, respectively (Fiss, 2011; Sperber & Linder, 2019), shown in Table 5.

#### *3.6.2 Necessity analysis*

We started fsQCA with the necessity analysis. A condition is necessary when the outcome is its subset. It is identified by two measures: consistency, assessing how closely a perfect subset relation is approximated, and coverage, indicating the empirical relevance of a consistent subset (Ragin, 2008; Rihoux & Ragin, 2008). Conventionally, for a condition to be deemed necessary, it must exhibit consistency exceeding the 0.90 threshold and have non-trivial coverage (Douglas et al., 2020). Here, the consistency of each condition is less than 0.90, implying that none of the conditions alone is necessary for the outcome (Table 6). Further configurational analysis is thereby needed.

#### *3.6.3 Sufficiency analysis*

We then constructed the truth table to identify the configurations of conditions that are sufficient for each outcome. A configuration is sufficient when it is a subset of the outcome. First, the fuzzy membership scores are used to construct an initial truth table with $2^k$ rows, where $k$ represents the number of conditions and $2^k$ represents the number of logically possible configurations (Ragin, 2008). Our analysis generated 128 ($2^7$) rows for each outcome. Then, the truth table was reduced by specifying the case frequency threshold and consistency threshold to retain only the rows of configurations sufficient for each outcome. Since our sample size ($n=21$) is relatively small, we set the case frequency threshold to 1 (Ragin, 2008), the consistency threshold to 0.80 (Fiss, 2011), and the proportional reduction in inconsistency (PRI) threshold to 0.70 (Greckhamer et al., 2018).

#### *3.6.4 Solution selection*

Next, we used the Quine-McCluskey algorithm in the fsQCA 3.0 software package to transfer logically the truth table into simplified configurations, which form the solution for the desired outcome (Ragin, 2008). Based on the counterfactual analysis of conditions, this algorithm allows the formation of complex, intermediate, and parsimonious solutions, and distinguishes core and peripheral conditions: the former exist in both intermediate and parsimonious solutions whereas the latter only appear in the intermediate solution (Greckhamer et al., 2018). We chose to report the intermediate solution which is often the most interpretable (Rihoux & Ragin, 2008), and referred to the parsimonious solution to distinguish the core and peripheral conditions.[6]

## 4 Results

### 4.1 Identification of effective configurations

Our analysis identified three effective configurations of *EE policy mixes* that support high performance in early- and late-stage technology start-ups in NHZs (referred to as early-stage configurations and late-stage configurations) (Table 7). We report the consistency and coverage of individual configurations and the overall solution. Table 7 shows that for each stage, the consistency of each configuration and the overall solution exceeds 0.90, higher than the recommended

[6] The intermediate solution restricts the number of causal conditions and conditional configurations to the most plausible, and helps clarify and interpret the potential core-periphery relationship between conditions (Fiss, 2011), thus advancing our insights into the internal interactions of *EE policy mixes*.

**Table 3** Items for measuring entrepreneurial performance

| Dimension | Items (compared to your major competitors in the last year) | Reference |
|---|---|---|
| Profitability | Our company had a higher return on sales | Li and Atuahene-Gima (2001); Murphy et al. (1996); Venkatraman and Ramanujam (1986) |
| | Our company had a higher return on investment | |
| | Our company had a higher level of net profit | |
| Growth | Our company had a higher growth in sales | Li and Atuahene-Gima (2001); Murphy et al. (1996); Stam and Elfring (2008) |
| | Our company had a higher growth in market share | |
| | Our company had a higher growth in employees | |
| Innovativeness | Our company had more patent applications and licensing activities | Lawton Smith and Ho (2006); Rasmussen et al. (2016); Stam and Elfring (2008) |
| | Our company launched more new products and services | |
| | Our company developed new products and services faster | |

**Table 4** Reliability and validity test

| Variable | Items | Cronbach's $\alpha$ | Factor loadings | CR | AVE | Square root of AVE | PCC between variables | Model fit indices |
|---|---|---|---|---|---|---|---|---|
| *EDUCA* | 3 | 0.89 | 0.83 to 0.92 | 0.90 | 0.75 | 0.87 | 0.03 to 0.06 | $\chi^2$/df = 2.56, GFI = 0.95, CFI = 0.97, NFI = 0.94, NNFI = 0.96, RMSEA = 0.034, RMR = 0.022 |
| *FUNDI* | 3 | 0.90 | 0.85 to 0.90 | 0.90 | 0.76 | 0.87 | 0.02 to 0.07 | |
| *TAXIN* | 3 | 0.79 | 0.69 to 0.79 | 0.80 | 0.56 | 0.75 | 0.02 to 0.33 | |
| *WIDEN* | 4 | 0.80 | 0.65 to 0.76 | 0.81 | 0.51 | 0.72 | 0.05 to 0.28 | |
| *CUL&INF* | 3 | 0.76 | 0.70 to 0.77 | 0.77 | 0.53 | 0.73 | 0.03 to 0.33 | |
| *INSTI* | 4 | 0.81 | 0.66 to 0.76 | 0.81 | 0.52 | 0.72 | 0.04 to 0.33 | |
| *NETWO* | 3 | 0.83 | 0.71 to 0.84 | 0.83 | 0.62 | 0.79 | 0.04 to 0.27 | |
| *PERFO* | 9 | 0.90 | 0.66 to 0.75 | 0.90 | 0.51 | 0.71 | 0.05 to 0.18 | |

*EDUCA*, education and training; *FUNDI*, direct funding support; *TAXIN*, tax incentives; *WIDEN*, widening financial engagement; *CUL&INF*, culture and infrastructure improvement; *INSTI*, formal institutional refinement; *NETWO*, networking; *PERFO*, performance

0.80 (Ragin, 2008), indicating that all identified configurations are sufficient for supporting high performance, and these configurations as a whole model are informative and of high validity (Greckhamer et al., 2018). In terms of coverage, fsQCA generates three variants to evaluate the ability of configurations to capture real-world instances (Rihoux & Ragin, 2008). The overall solution coverage is 63% and 71% in early- and late-stage configurations, demonstrating that the identified configurations collectively explain most of the high-performing instances. For each configuration, raw coverage indicates the proportion of cases in the outcome that it explains, showing its empirical relevance, while unique coverage indicates the proportion explained exclusively by it while excluding overlapping elements, showing its relative importance (Greckhamer et al., 2018; Ragin, 2008). The raw coverage (unique coverage) of each configuration exceeds 13% (10%), confirming that there are multiple "equifinality" configurations suitable for different contexts.

Specifically, three early-stage configurations share two core conditions of *CUL&INF* and *INSTI*, while showing differences in the other five instruments. To enhance the identifiability and distinguishability of configurations, we name each configuration according to its orientation (Furnari et al., 2021). Meanwhile, considering the overlap of core conditions, we describe and distinguish each configuration's orientation according to the presence or absence of non-shared conditions

**Table 5** Descriptive statistics and calibration criteria

| Variable | Descriptive statistics | | Calibration criteria | | |
|---|---|---|---|---|---|
| | Mean | SD | Full membership (upper quartile) | Cross-over point (median) | Full non-membership (lower quartile) |
| *EDUCA* | 3.89 | 0.20 | 4.05 | 3.82 | 3.77 |
| *FUNDI* | 3.89 | 0.16 | 4.02 | 3.83 | 3.77 |
| *TAXIN* | 4.03 | 0.15 | 4.18 | 4.00 | 3.91 |
| *WIDEN* | 3.83 | 0.14 | 3.89 | 3.82 | 3.72 |
| *CUL&INF* | 4.01 | 0.15 | 4.12 | 4.03 | 3.87 |
| *INSTI* | 3.93 | 0.17 | 4.05 | 3.95 | 3.81 |
| *NETWO* | 3.88 | 0.13 | 4.00 | 3.88 | 3.76 |
| *E-PER* | 3.69 | 0.18 | 3.85 | 3.61 | 3.56 |
| *L-PER* | 3.59 | 0.19 | 3.77 | 3.50 | 3.45 |

*E-PER*, entrepreneurial performance of early-stage start-ups; *L-PER*, entrepreneurial performance of late-stage start-ups

**Table 6** Necessary analysis

| Condition | High *E-PER* | | High *L-PER* | |
|---|---|---|---|---|
| | Consistency | Coverage | Consistency | Coverage |
| *EDUCA* | 0.61 | 0.66 | 0.59 | 0.61 |
| *FUNDI* | 0.65 | 0.69 | 0.48 | 0.50 |
| *TAXIN* | 0.63 | 0.66 | 0.75 | 0.76 |
| *WIDEN* | 0.68 | 0.66 | 0.85 | 0.80 |
| *CUL&INF* | 0.81 | 0.85 | 0.61 | 0.61 |
| *INSTI* | 0.80 | 0.84 | 0.62 | 0.63 |
| *NETWO* | 0.59 | 0.62 | 0.89 | 0.91 |

(either core or peripheral), which is the main principle of naming. For configuration 1, since almost all instruments are present, its orientation is to provide all-round and high-intensity policy support, so we name it *Comprehensive Configuration*. In configuration 2, the presence of core *FUNDI* and peripheral *EDUCA* and the absence of peripheral *TAXIN* play important roles. This reflects an orientation that inputs directly funding and knowledge into start-ups to alleviate resource scarcities, rather than providing commitments on tax incentives, so we name it *Input Configuration*. Configuration 3 highlights the presence of core *TAXIN* and peripheral *WIDEN* and the absence of *FUNDI*. By providing diversified tax incentives and favorable financing support, configuration 3 is orientated to encourage the on-going innovation initiative of start-ups and guide wider financial engagement, instead of providing short-term, direct funding support, so it is named *Guided Configuration*.

Three late-stage configurations only share one core condition, *NETWO*. According to Fiss (2011), while the presence of multiple configurations with different core characteristics indicates first-order equifinality (e.g., early-stage configurations), first-order equifinal configurations with exactly the same core characteristics further point to second-order equifinality, referred to as neutral permutations (e.g., late-stage configurations around the single-core *NETWO* here). Specifically, configuration 4 incorporates the peripheral presence of almost all other instruments. It again reflects an all-round support orientation, so we name it *Comprehensive Configuration*. Configuration 5 incorporates the presence of *TAXIN* and *WIDEN* and the absence of *FUNDI* as peripheral conditions. This is in line with configuration 3 as the input-oriented instruments (*FUNDI* and *EDUCA*) are absent or irrelevant, while the guidance-oriented instruments (*TAXIN* and *WIDEN*) are both present, reflecting the same orientation to guide innovation direction and financial engagement. Therefore, configuration 5 is also named *Guided Configuration*. Configuration 6 incorporates the presence of *EDUCA*, *WIDEN*, *CUL&INF*, and *INSTI* and the absence of *FUNDI* as peripheral conditions. Obviously, configuration 6 is orientated to improve the hard and soft environments of NHZs by strengthening both tangible (infrastructure, capital market) and intangible (knowledge, formal institutions, culture) support (Chen et al., 2020), so it is named *Supported Configuration*.

### 4.2 Comparison between early- and late-stage configurations

When comparing the early- and late-stage configurations, we identify three-dimensional stage differences of *EE policy mixes*. First, different policy instruments, especially those as shared core conditions, have different effects on early- and late-stage start-ups. Second, the applicability of differently oriented configurations to early- and late-stage start-ups is quite different—given that all identified configurations are equally effective, the applicability of each configuration can be further judged by comparing its raw coverage, which shows its empirical relevance (Ragin,

**Table 7** Configurations of *EE policy mixes* for high *E-PER* and high *L-PER*

| | Early-stage configurations | | | Late-stage configurations | | |
|---|---|---|---|---|---|---|
| Condition | 1 | 2 | 3 | 4 | 5 | 6 |
| *EDUCA* | ● | ● | | ● | | ● |
| *FUNDI* | ⬤ | ⬤ | ⊗ | | ⊗ | ⊗ |
| *TAXIN* | | ⊗ | ⬤ | ● | ● | |
| *WIDEN* | ● | | ● | ● | ● | ● |
| *CUL&INF* | ⬤ | ⬤ | ⬤ | ● | | ● |
| *INSTI* | ⬤ | ⬤ | ⬤ | ● | | ● |
| *NETWO* | ● | | | ⬤ | ⬤ | ⬤ |
| Consistency | 0.94 | 0.99 | 0.98 | 0.97 | 0.90 | 0.96 |
| Raw coverage | 0.35 | 0.21 | 0.17 | 0.34 | 0.29 | 0.13 |
| Unique coverage | 0.27 | 0.13 | 0.15 | 0.31 | 0.27 | 0.10 |
| Overall solution consistency | | 0.97 | | | 0.95 | |
| Overall solution coverage | | 0.63 | | | 0.71 | |
| Configuration name | *Comprehensive Configuration* | *Input Configuration* | *Guided Configuration* | *Comprehensive Configuration* | *Guided Configuration* | *Supported Configuration* |
| Sample NHZs (ranked by performance) | Beijing; Shanghai; Xi'an; Hangzhou | Chengdu; Guangzhou | Jinan; Zhengzhou | Shanghai; Hangzhou; Beijing; Xi'an | Harbin; Changchun; Shenyang; Wuhan | Changsha |

"⬤" indicates the presence of a condition while "⊗" indicates its absence; large circles represent core conditions while small circles represent peripheral conditions; blank spaces indicate that the condition can either be present or absent; for robustness tests see Appendix Table 11

2008). Third, within *EE policy mixes*, the causal complexity of late-stage configurations is lower than early-stage configurations. This is reflected in the consistent role of the three neutral permutations (Fiss, 2011), and specifically in fewer core conditions and higher overall solution coverage of late-stage configurations, indicating that simpler, clearer, and similar configurations overlap with the real-world instances to a greater extent (Vedula & Fitza, 2019). We expand upon these findings in the "Discussion."

### 4.3 Robustness checks

Following the mainstream measures to assess the robustness of fsQCA, we first chose varying calibration thresholds (Greckhamer et al., 2018), and set the alternative cross-over calibration points at the 45th (−0.05) and the 55th (+0.05) percentile, respectively (Fiss, 2011). Besides the slight changes in consistency and coverage, the higher cross-over points generated the same configuration results as Table 7, while the lower cross-over points generated a new early-stage configuration (configuration 10 in Appendix Table 11), which can also be described as *Input Configuration*. Then, we chose alternative specifications for editing the truth table (Douglas et al., 2020), and raised the consistency threshold from 0.80 to 0.85 and 0.90. The results remained unchanged. We thus concluded that our findings were robust.

## 5 Discussion

The configurational findings clearly demonstrate the causal complexity and stage differences of *EE policy mixes*. For causal complexity, there are complex interactions among seven policy instruments, and their "joint effects" determine actual policy effects. Also, "one size does not fit all." *EE policy mixes* can take multiple equally effective configurations. For stage differences, our three-dimensional findings are important because a process perspective on the ecosystem and its innovative start-ups contribute to more effective policy interventions (Spigel & Harrison,

2018). To better address the research questions proposed, we take causal complexity and stage differences as the lens for discussion to reveal the internal interactions and differentiated support mechanisms of *EE policy mixes* for start-ups at different growth stages in NHZs.

## 5.1 Causal complexity of EE policy mixes

### *5.1.1 Policy interactions within the early-stage configurations*

*CUL&INF* and *INSTI* are the shared core conditions in early-stage configurations, playing a primary role in new business survival and initial growth in China's NHZs. Previous studies show that networks are important for new businesses, helping them overcome liabilities of smallness and newness and develop essential operating routines (Birley, 1985; Shi & Shi, 2021). In emerging economies, developing networks with urgency, resource adequacy, and social impact is argued to be more important for new businesses to reduce uncertainty and risk posed by the underdeveloped institutional environments (Puffer et al., 2010). Focusing on the Chinese context characterized by strong government intervention (Wei, 2022), our configurational findings here reveal an effective approach adopted by NHZs, manifested as the complementary mechanism produced by the interaction between *CUL&INF* and *INSTI* which supports early-stage start-ups to develop well-functioning networks.

Specifically, *CUL&INF* shapes a culture of trust, mutual aid, and encouragement of risk-taking. This type of culture is the local basis for network construction (Puffer et al., 2010) and, especially in the Chinese context, is reflected in the role of *guanxi* as an informal institution facilitating interpersonal and utilitarian relationships for reciprocal exchange (Chi & Seock-Jin, 2017; Langenberg, 2007; Puffer et al., 2010). *Guanxi* is usually characterized by proximity, enabling early-stage start-ups in NHZs to develop informal networks to access key resources while also alleviating bureaucratic costs, facilitating smooth business transactions, and creating trust and trustworthiness (Langenberg, 2007; Paulet & Rowley, 2017b). *CUL&INF* also represents the great efforts of NHZs in building infrastructure (Du et al., 2018), with the number of publicly funded incubators, accelerators, and science parks experiencing rapid growth (Chen et al., 2020). Such infrastructure is seen as institutional intermediaries which provide public resources and basic entrepreneurial services (Armanios et al., 2017; Wei, 2022), helping address the lack of private support organizations in China's overall entrepreneurial environment. The infrastructure in NHZs also functions as basic platforms for connecting early-stage start-ups with informal resource holders and more formally structured organizations such as banks, financial institutions, and universities (Du et al., 2018; Kuebart, 2021). In cooperation with *CUL&INF*, NHZs have implemented a series of *INSTI* to support the operation and expansion of these formal and informal networks, including providing start-ups with official procedures for settling business disputes, establishing incentives for technology commercialization and cooperation of incubated start-ups, and improving the regulatory framework for fair competition and property rights protection. Overall, the complementary mechanism of *CUL&INF* and *INSTI* can be specified as an ecosystem intra-networking mechanism, which supports early-stage start-ups in NHZs to develop networks flexibly to achieve rapid growth.

Besides the two shared cores, *Comprehensive Configuration* represents the most straightforward and all-round policy approach. Despite great efforts and high costs, this has proved to be effective in promoting early-stage entrepreneurial performance in NHZs. *Input Configuration* has a simpler pattern than *Comprehensive Configuration*, but the commonality is that *FUNDI* also plays a core condition besides the shared two cores, and is also supplemented by the peripheral *EDUCA*. This indicates that the interaction between the two could produce another complementary mechanism. *FUNDI*-related measures, such as start-up subsidies, grants, and innovation funds, help alleviate the financial constraints of start-ups, and stimulate more R&D activities by compensating for the inherent risks and externalities of innovation (Takalo, 2012). In conjunction, with the support of *EDUCA*, financial management courses and financial literacy lectures delivered in NHZs help improve the capital utilization efficiency of start-ups. Also, training programs in professional skills and business enable them to no longer spend as much on hiring highly skilled employees and reduce outsourcing of technical and business modules (de Oliveira et al., 2022). Overall, the complementary mechanism of *FUNDI* and

*EDUCA* can soften capital constraints while deepening human capital, jointly addressing the knowledge, skills, and financial gaps typical in the initial stage of entrepreneurial growth in NHZs.

*Guided Configuration* incorporates the absence of *FUNDI* and a new core condition of *TAXIN*. *FUNDI* and *TAXIN* do not come together in all configurations, implying their functional equivalence (Furnari et al., 2021). They thus produce a substitution mechanism applicable to different NHZs, depending on whether direct funding or indirect guidance is adopted to alleviate the financial constraints and incentivize innovation. The interaction between *TAXIN* and *WIDEN* mainly characterizes *Guided Configuration*. Consistent with the strategic focus of NHZs to support innovative entrepreneurship, *TAXIN* provides target-oriented incentives (e.g., tax exemptions, reductions, or credits) for starting a business and on-going R&D activities in emerging industries and technologies. This prompts start-ups to form a positive expectation to formulate innovation strategies from the formation. Furthermore, considering China's insufficient sources of early-stage investment in start-ups and underdeveloped capital markets, it is sensible to enhance *WIDEN* based on *TAXIN*. Typical measures include establishing "Technology-based SME VC Guidance Funds," and guiding financial institutions to provide customized financial products for new businesses in NHZs. Overall, *TAXIN* encourages innovation planning ex ante and offers preferential benefits ex post to trigger greater innovation-enhancing effects (Takalo, 2012), while *WIDEN* helps complete the financing chain coupled with the innovation chain. They thus produce a complementary mechanism to support early-stage innovative start-ups in NHZs.

#### 5.1.2 *Policy interactions within the late-stage configurations*

*NETWO* and *WIDEN*, as the only shared core and peripheral conditions in late-stage configurations, produce an indispensable complementary mechanism in supporting late-stage start-ups in NHZs. The development of social relationships and platform-based financial networks makes it easier for start-ups to find new investors, establish novel financing models and channels, and match high-quality deals. This is critical for the scale-up stage of start-ups (Kuebart, 2021). Moreover, investors often act as business and legal advisers to help start-ups access valuable managerial know-how and business acumen (Vedula & Fitza, 2019). This enables late-stage start-ups in NHZs to establish effective cooperation and address conflicts rationally in complex networks.

Another overall finding is that *FUNDI* is not present in all late-stage configurations. While subsidies and grants are the customary approaches adopted by NHZs to support entrepreneurial survival (Du et al., 2018; Xie et al., 2018), the ultimate goal of any start-up is to evolve from being subsidized to becoming market funded and financially self-sustaining. Access to finance from the expanding financial networks along with the tacit knowledge spillovers from investors determines a start-up's sustainable growth (Spigel, 2017). Given this, we believe that for late-stage start-ups in NHZs, the complementary mechanism of *NETWO* and *WIDEN* produces a unilateral substitution mechanism for *FUNDI*.

*Comprehensive Configuration* extends our early-stage findings, indicating that a comprehensive policy design can effectively support both early and late-stage start-ups in NHZs. *Guided Configuration* again highlights the interaction between *TAXIN* and *WIDEN*. Interestingly, it exhibits more empirical evidence of high-performing NHZs than the early-stage *Guided Configuration* (4 cases vs. 2 cases), which merits further consideration in the discussion of stage differences. Another important feature of *Guided Configuration* is the absence of *FUNDI*, rather than it just playing an irrelevant role, indicating that *FUNDI* is sometimes counterproductive for late-stage start-ups in NHZs. Besides the possible crowd-out effect on private investment, government-funded projects often lack sufficient consideration of the uncertainty and growth potential of start-ups, resulting in distortions in the long-term market selection (Takalo, 2012). Moreover, the institutional voids breed the gradual dependence and even bribery of start-ups on government subsidies (Cao & Shi, 2021). As such, misuse or overuse of *FUNDI* may exacerbate the misallocation of resources caused by less-efficient start-ups surviving in NHZs.

*Supported Configuration* shares a high similarity with *Comprehensive Configuration*, as *EDUCA*,

*CUL&INF*, and *INSTI* are the three additional peripheral conditions distinguishing them from *Guided Configuration*, although all configurations present *NETWO*-centered neutral permutations. This points to a complementary mechanism between the three instruments and the core *NETWO*, which supports late-stage start-ups in NHZs to perform effectively in the increasingly open networks. Specifically, *EDUCA* helps them learn international business knowledge and improve their social networking skills and collaborative innovation capacities. *CUL&INF* helps enhance the consistency of beliefs, values, and norms in NHZs, and facilitates transport links and eases business communication. This enables start-ups to attract high-quality talent and enhance information and knowledge exchanges with partners (Audretsch & Belitski, 2017; Xie et al., 2018). Finally, since unfair competition, property rights disputes, and unreasonable income distribution usually persist in emerging markets (Manimala & Wasdani, 2015), especially in transnational cooperation and transactions, constant *INSTI* in NHZs is useful in addressing the institutional barriers to further expansion and internationalization of start-ups.

## 5.2 Stage differences of EE policy mixes

### 5.2.1 *Different policy instruments as shared core conditions*

The first dimension of stage differences is the varying effects of different policy instruments, especially reflected in the shared core conditions. A clear contrast is that *CUL&INF* and *INSTI*, as the shared cores in the early-stage configurations, are not as effective as *NETWO* in supporting late-stage start-ups; conversely, while *NETWO* is central to the late-stage configurations, it is less effective in supporting early-stage start-ups. This interesting finding reveals the entrepreneurial process-oriented policy priorities of China's NHZs, which produce the intra-networking and inter-networking mechanisms of ecosystems to support start-ups at different growth stages to develop dynamic networks.

For early-stage start-ups, as we have argued, *CUL&INF* shapes the cultural and material attributes supporting the emergence of interactive networks within an ecosystem, and provides the initial resources available in or acquired through the networks (Spigel, 2017), while the cooperative *INSTI* provides legal and regulatory guarantees for the operation of these localized networks. In contrast to this intra-networking mechanism, we find that *NETWO* implemented in NHZs has its own characteristics according to the policy document analysis and developed measures (Table 2), aimed at promoting interactions within and outside NHZs, with a focus on the latter. Typical measures include establishing diverse channels, activities, and collaborative projects for transnational interactions between local start-ups and MNCs, foreign investors, and overseas R&D centers. Overall, considering the proven effectiveness of the intra-networking mechanism in NHZs and the characteristics of entrepreneurial growth (Guerrero et al., 2021; Kuebart, 2021), early-stage start-ups can access the resources necessary for initial growth from the localized networks, so they rarely expand their strategic horizons to broader geographic areas. They also often lack experience in managing multi-scale connections and the capacity to absorb external knowledge (Li & Atuahene-Gima, 2001; Vedula & Fitza, 2019). This may explain the lack of effectiveness of *NETWO* for early-stage start-ups.

For late-stage start-ups, while localized networks are the basis and catalyst for their growth (Kuebart, 2021), *guanxi*-based connections with limited scope, functions, and low interaction frequency gradually no longer meet their needs for business expansion and on-going innovation (Bramwell et al., 2019; Cao & Shi, 2021; Kantis & Federico, 2012). Linkages between ecosystems are emphasized as a key process for start-ups during the scale-up stage (Autio et al., 2018; Wurth et al., 2021), so it is sensible to move the policy focus to the more outward-oriented *NETWO*. *NETWO* supports late-stage start-ups to establish cross-geographic, multi-scale connections to expand their business, innovation, and service networks. Such inter-networking mechanism helps them acquire more external knowledge and complementary resources to avoid lock-in and achieve internationalization. Given this, we view *NETWO* as a successful practice in experimenting with policies to support scale-up ventures and ecosystem development and enhance connectivity across multiple ecosystems in the context of China's NHZs.

#### 5.2.2 *Differently oriented configurations*

The second dimension is the varying applicability of differently oriented configurations. One obvious contrast is that *Input Configuration* with high applicability in the early-stage configurations is not included in the late-stage configurations. This indicates that the support mechanism of input-oriented instruments (*FUNDI* and *EDUCA*) can provide early-stage start-ups in NHZs with critical resources (e.g., finance, knowledge, and skills) underpinning their localized networking activities; in the long-term, however, ready access to critical resources breeds their dependence and laziness, deterring them from developing resource seeking skills and market adaptability. Therefore, this finding highlights the importance of distinguishing start-ups at different growth stages when selecting the target groups of *FUNDI* and *EDUCA*; otherwise, government efforts to broadly input resources into start-ups are unlikely to yield sustainable benefits (Shi & Shi, 2021). However, according to the policy document analysis, we find that funding projects and skills training programs for start-ups in China's NHZs usually specify the location and industry type of supported start-ups, but rarely establish clear standards for their age/maturity. This provides evidence from the NHZs context to help explain the high quantity but low quality of entrepreneurship in China under the MEI strategy (Chen et al., 2020; He et al., 2019), and prompts policy-makers to reflect and refine these policies.

By contrast, *Guided Configuration* has longer-lasting effectiveness and, especially, higher applicability for supporting late-stage start-ups. Compared with *FUNDI* which has narrower funding objectives and tightly defined targets (Harrison et al., 2018), *WIDEN* and *TAXIN* incorporate broader beneficiaries and allow greater autonomy. This helps improve the performance of start-ups at different stages of network development. For example, *TAXIN* helps reduce the operating costs of early-stage start-ups in the initial incubator-based networks, and provides tax incentives for late-stage start-ups to develop and transfer cutting-edge technologies through diverse innovation collaborations; *WIDEN* helps start-ups absorb more social capital and investors' knowledge from their expanding financial networks. This is of great assistance to their scale-up and internationalization activities. Given this, we believe that the extensive interactions among *WIDEN*, *TAXIN*, and the shared core instruments in *Guided Configuration* could produce highly complementary support mechanisms that enhance performance progressively as start-ups develop their networks.

#### 5.2.3 *A lower causal complexity of late-stage configurations*

The third dimension is a lower causal complexity of late-stage configurations, indicating simpler and clearer policy support mechanisms for late-stage start-ups in NHZs. This finding can be extended to the general E4s context. From a broader lens of ecosystem governance and evolution, governments in E4s need to constantly redefine their roles and actions as the ecosystem evolves (Harima et al., 2021; Mack & Mayer, 2016).

Specifically, in a nascent E4 with vibrant early-stage entrepreneurial activity but underdeveloped institutional environments and insufficient resources and supporting organizations, a "top-down" governance model with the government playing the role of creator and the central governor would be quite effective (Candeias & Sarkar, 2022). As the E4 evolves, the necessary resources, organizations, and institutional arrangements for early-stage entrepreneurial growth will gradually be in place as a result of previous policy efforts, and more start-ups will mature. Given the proven effectiveness of *NETWO* and guidance-oriented instruments for late-stage start-ups, the governance model needs to evolve towards a more horizontal and relational design, in which government is no longer the central governor, but instead plays a role as mobilizer, connector, and collaborator (Colombelli et al., 2019). This can promote the self-organization and sustainable evolution of the E4 in resource allocation, mobilization, and circulation led by start-ups and their broad stakeholders (Shi & Shi, 2021).

### 5.3 Support mechanisms of EE policy mixes in China's NHZs

Figure 3 summarizes and visualizes our findings as the basis for discussing the wider theoretical significance of our findings. Figure 3 is an extended application of the core parts of Fig. 1—policy strategy, instrument mixes, and overall goals—in EE research, and demonstrates the causal complexity and stage differences of *EE policy mixes* and their details.

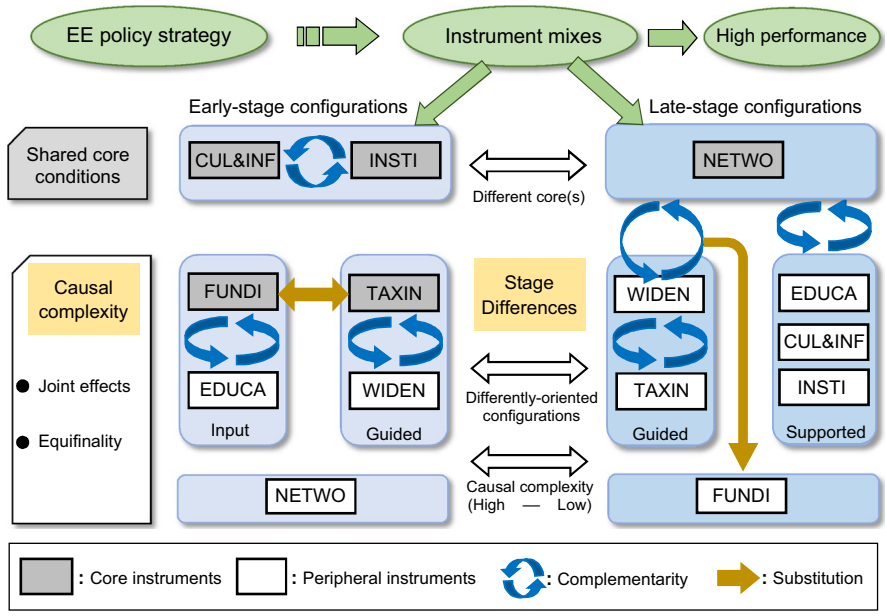


**Fig. 3** Support mechanisms of *EE policy mixes* in China's NHZs

Overall, based on Table 7 which has depicted "what" are the effective configurations of *EE policy mixes* in NHZs and "how" different policy instruments interact, the two distinctive characteristics of *EE policy mixes* shape the way we develop the arguments. In doing so, we have addressed more important issues, regarding "why" the policy interactions identified can produce effective support mechanisms in the specific E4s context of China's NHZs, and "why" the mechanisms show differences for start-ups at different growth stages. This enables us to interpret comprehensively the theoretical and practical implications behind these differentiated mechanisms, and provides a basis for future research.

## 6 Conclusions

This study aims to explore the precise role of government policy in EEs. Based on dividing *EE policy mixes* into seven policy instruments, we pay particular attention to the context of an emerging economy, China, and apply a configurational approach to identify the effective configurations of *EE policy mixes* in China's NHZs. The findings show that *EE policy mixes* present significant causal complexity and stage differences. By interpreting potential policy interactions within early and late-stage configurations and the three-dimensional stage differences, we further reveal the differentiated support mechanisms of *EE policy mixes* for start-ups at different growth stages in NHZs. Overall, our findings emphasize that government policy could play an effective role in EEs as *EE policy mixes*, which require different policy instruments to be combined appropriately according to the region-specific contexts, meet the differentiated needs of early and late-stage entrepreneurial growth, and adjust dynamically as the EE evolves. This study has multiple implications for EE research, policy, and practice in global economies, especially emerging economies with their increasingly important economic position.

However, in drawing this conclusion, it is important to recognize that China is in many ways distinctive as a research context. From a comparative political economy standpoint, for example, it is clear that there is no single unified model of capitalism or of the development pathways to capitalism (De Leon, 2015) and that China, variously described as "(post-) socialist" (Witt & Redding, 2013), "market socialism" (Hundt & Uttam, 2017), or "authoritarian capitalism" (Andriesse, 2014), falls outside the range of typical capitalist political economies (Windsor, 2017; Witt & Redding, 2013). This essential uniqueness of the Chinese context is reinforced by the absence of a strong rule of law (i.e., a legal system that exercises institutional power to review and police government actions) as an institutional prerequisite for economic development and its substitution by a "disinterested government" that fulfills most of the

functions performed by the rule of law in other societies (Mazur & Ursu, 2017). Although this unique institutional arrangement has contributed to China's historic economic growth during its economic transformation, it is still imperfect and fragile (Mazur & Ursu, 2017), and to some extent has fostered the extensive influence of social capital, culture, and informality on economic activities (Witt & Redding, 2013). We believe that indigenous Chinese research can provide both new insights and a basis for future extensions of the research to other contexts to facilitate theoretical generalization (Bruton et al., 2021). That said, there are some important issues of wider concern in the development of a deeper understanding of EE dynamics that emerge from our discussion.

### 6.1 Theoretical contributions

The theoretical contributions are mainly twofold. On the one hand, we have demonstrated the value of adopting a policy-mix perspective (Kanger et al., 2020; Rogge & Reichardt, 2016) in EE research to advance the understanding of the role of policy in EEs. On the other hand, we contribute to the E4s literature (Cao & Shi, 2021) by exploring empirically *EE policy mixes* in the context of China as an emerging economy.

#### *6.1.1 Policy mixes and EEs*

We make three specific contributions to the discussion of the role of policy in EEs.

First, the typology of EE policy, which has not been extensively addressed in the literature, is valuable for developing theory and guiding practice (Candeias & Sarkar, 2022). By bridging an EE structural framework (Stam, 2015) and the core elements of the policy-mix framework, we developed a specific EE policy classification, which depicts clearly policy interventions that support ecosystem functioning in different aspects of EE structure, and considers the similarities and differences between EEs in advanced economies and E4s. Therefore, in doing so, we have demonstrated the applicability of the policy-mix perspective and how it can be applied as a promising framework for future EE policy research and theoretical expansion based on different contexts.

Second, by introducing a new concept of *EE policy mixes* and developing this both theoretically and empirically, this study brings fine-grained insights to the current debate on the role of policy in EEs (Colombo et al., 2019; Jolley & Pittaway, 2019; Spigel & Harrison, 2018; Wurth et al., 2021). No longer viewing policy as an undifferentiated factor, we have demonstrated EE policy as a collection of interactive instruments embraced by an overarching policy strategy. We have further proposed two distinctive characteristics of *EE policy mixes*, causal complexity, and stage differences, and investigated potential policy interactions and support mechanisms in response to calls to obtain specific details of EE policy (Feldman & Lowe, 2018). We argue that policy could play an important supportive role in EEs, provided that different instruments are combined adapting to local contexts, and that the growth characteristics of start-ups and the EE evolution stages are fully considered. Overall, these conditions address the inconsistent and even contradictory perspectives in the literature on the role of policy by integrating natural and artificial perspectives into a single framework (Candeias & Sarkar, 2022), in which the actual role of policy depends on the coordination and synergy of these conditions.

Third, the typological and conceptual contributions to *EE policy mixes* enable us to make several methodological contributions to the EE literature. The four-dimensional framework in Fig. 1 can serve as the specific guidebook for collecting EE-related policy documents encompassing broad policy fields, multi-governance engagement, specific geographical scope, and time periods. The processes we have introduced to develop the measures of *EE policy mixes* can also provide guidance for future research. Finally, by applying a configurational approach to explore *EE policy mixes* in multiple cases, we respond to calls for a comparative perspective, examination of the causal mechanisms of specific EE factors, and methodological innovations (Brown & Mawson, 2019; Wurth et al., 2021). In particular, we have demonstrated the intrinsic fit between fsQCA and policy-mix research to inspire future configurational analysis on EE policy issues.

#### *6.1.2 EEs in emerging economies*

Evidence from China's NHZs is used to develop a theoretical framework (Fig. 3) to inspire future research into the identification of core and peripheral policy instruments, the complementarities and substitutions among instruments, and how these vary over space (within and across national contexts and types of political

economies) and time (as the ecosystem evolves). More importantly, evidence from NHZs enables us to provide new insights into E4s and Chinese entrepreneurship, responding to calls for both more in-depth research on E4s (Foo et al., 2020; Kantis et al., 2020) and for more scrutiny of entrepreneurial dynamics in China (Chen et al., 2020; He et al., 2019). The new insights and wider issues raised can be summarized in four areas.

First, the core policy instruments of NHZs can produce intra-networking and inter-networking mechanisms of ecosystems. This helps reveal the differences in the nature of well-functioning networks between EEs in advanced economies and E4s (primarily organic development vs. development under government intervention) (Manimala & Wasdani, 2015), and the main types of networks that effectively support early and late-stage start-ups (localized networks vs. cross-regional networks). In particular, linkages between ecosystems are a key mechanism in the scale-up stage of start-ups that is under-explored (Autio et al., 2018; Kuebart, 2021). We reveal that *NETWO* adopted by NHZs can produce an effective inter-networking mechanism. This has wide implications as the exploration of such systemic policies is viewed as an increasingly important EE policy issue and research agenda (Candeias & Sarkar, 2022; Wurth et al., 2021).

Second, NHZs are a microcosm of the high quantity and low quality of entrepreneurship in China: due to insufficient attention to the growth stage and characteristics of supported start-ups, there are significant inefficiencies in policy efforts to improve resource investment which require further refinement. The policy-mix perspective serves a useful purpose in stimulating a greater focus on the complementarity between the core policy instruments and the broader policy environment which could produce high-level "joint effects" to improve the performance of start-ups at different growth stages.

Third, with the improvement of resources and structural and institutional elements in E4s under strong policy intervention, the ideal role of government is to shift gradually from central governor to mobilizer, connector, and collaborator to promote the self-organization and sustainable evolution of E4s. This provides evidence-based theoretical support for the dynamic governance in the E4s context (Cao & Shi, 2021).

Finally, in a general sense, our key findings on the core policy instruments suggest that the role of formal and informal institutions and of networks varies by the growth stage of start-ups. This has not hitherto been reported in the EE literature (either in the emerging economy context or in the broader context), raising important issues of wider concern for our understanding of the process dynamics of entrepreneurial growth in EEs (Spigel & Harrison, 2018). Unlike previous studies focusing mainly on the alternative role of cultural-related informal institutions to underdeveloped formal institutions (Chi & Seock-Jin, 2017; Gu et al., 2008; He et al., 2019; Langenberg, 2007; Puffer et al., 2010), we have used the strength of the configurational approach to capture a rarely observed complementarity between formal and informal institutions. This is manifested as the intra-networking mechanism produced by the interacting *CUL&INF* and *INSTI*, which supports the synergetic development of informal *guanxi* and organizational-based relationships of early-stage start-ups on the basis of synchronous attempts of the government to refine formal institutions. Overall, this finding integrates the argument that economic transition has increased institutional complexity (Paulet & Rowley, 2017b) with analyses of China's political economy that highlight the unique "rule of law" (Mazur & Ursu, 2017) as well as the distinctiveness of culture, informality, and multiplexity (Andriesse, 2014; Witt & Redding, 2013). This distinctiveness includes, for example, the role of *guanxi* as a cultural repertoire (Yang, 2002). It also deepens the argument that formal institutional voids in EEs are barriers to entrepreneurship but also provide an opportunity for institutional development (Cao & Shi, 2021) through indigenous configurations of formal and informal institutions.

Furthermore, our findings also suggest that the importance of localized *guanxi*-based networks diminishes with entrepreneurial growth and progressively gives way to international market-oriented networks, which are mediated by more complex, cross-contextual configurations of formal and informal institutions (e.g., formal agreements in transnational cooperation and the evolution of *guanxi*-like informal reciprocal relationships). Although requiring further research, we argue that *guanxi*, as a key element of EE networking mechanisms, co-evolves with the growth stage of start-ups and the increasingly complex institutional configurations in their networks. Given that *guanxi* shares some characteristics with other East Asian societies also strongly influenced by Confucianism (e.g., *kankei* in Japan and *kwankye* in Korea) and that similar institutional configurations also exist in other collectivist cultures (e.g., *blat* in

Russia, and the emphasis on kinship in Italy, Israel, and South Korea as a key social capital for networking) (Chi & Seock-Jin, 2017; Gu et al., 2008), there is scope to replicate our research to expand our conclusions on the varying roles of formal and informal institutions and networks in entrepreneurial dynamics in EEs, thereby contributing to the development of generalizable theories.

### 6.2 Practical implications

This study provides several implications for policy and practice. In terms of universal implications for policy-makers worldwide that are interested in developing robust EEs, our findings provide guidance on the whole processes of policy mixes including policy design, implementation, and evaluation.

For policy design, we recommend that policy-makers target each policy intervention point identified in Table 1, and apply the classification of *EE policy mixes* to design policy instruments with both complementarity and contextual characteristics, so as to reflect fully the holistic, interrelated, and region-specific policy features of the EE approach.

For policy implementation, policy-makers should provide customized support for start-ups at different growth stages, and combine policy instruments appropriately to enhance their "joint effects." This does not necessarily mean that an all-round policy approach is the best practice. According to Fig. 3, policy-makers should move beyond thinking that "joint effects" are equal to the sum of the parts, and gain an in-depth understanding of the complementarities and substitutions among instruments and the stage differences in these relationships. In addition, there is no "one-size-fits-all" approach. Policy-makers should formulate a unique policy recipe according to local heterogeneity, rather than uncritically copy the recipes in successful regions. Finally, effective policy implementation is adaptive rather than immutable. According to the development level of EE framework conditions and systemic conditions (Stam, 2015) and the overall age structure of start-ups, policy-makers should adjust the intervention types and scope, and find out the optimal balance between policy intervention and ecosystem self-governance.

For policy evaluation, we recommend that policy-makers adopt a holistic evaluation paradigm to capture the actual effects of policy mixes rather than individual instruments, and evaluate periodically as the ecosystem evolves to provide feedback for policy redesign and a new policy cycle.

In terms of specific implications for policy-makers in emerging economies, this study opens a window for them to draw lessons from China's experience in developing EEs, which are summarized into four aspects.

First, formulate a national-level EE strategy and strengthen cooperation between multi-level and cross-field government departments. The Chinese government has placed the flourishing of EEs at the strategic center of economic development since the 2015 MEI strategy. The national-level strategy has overall, detailed planning and the strongest implementation remit, which has promoted the vertical cooperation of governments at different governance levels and the horizontal cooperation of government departments at each governance level, resulting in the widespread distribution of EEs nationwide, represented primarily by NHZs. Currently, many emerging economies have not yet introduced the EE concept into national strategy design and understand poorly how to use the EE approach as an economic development tool (Brown & Mawson, 2019), making entrepreneurship more of a muddling-through process than a planned and systematic one (Manimala & Wasdani, 2015). Therefore, they can learn from the overall planning of China's MEI strategy and the practice of how different government departments coordinate and perform their respective roles, in order to formulate their own EE strategy and build effective strategic operations networks.

Second, identify the appropriate EE locations and scale. As to where and on what scale to develop EEs, an important principle is that the target region preferably has complete framework conditions and systemic conditions. China presents significant inter-regional imbalances and intra-regional agglomerations of favorable conditions, which are the common features of most emerging economies (Wei, 2022). This explains why NHZs are mostly located in metropolitan cities, and why they are zoned as parts of these cities. Therefore, compared with the provincial and city-level E4s identified in the literature, which are sometimes more like a simple, large-scale set of isolated elements (Brown & Mawson, 2019; Chen et al., 2020), China's NHZs as an appropriate EE scale is instructive. This facilitates resource allocation and the formation of dense networks and agglomeration effects within specific regions (Xie et al., 2018), and enables local governments to provide targeted support.

Third, we establish flexible management institutions and conduct pilot governance (Zheng & Li, 2020). NHZs

and their special governance are a unique institutional arrangement in China's overall underdeveloped institutional environments. By obtaining authorization from higher-level governments and establishing a streamlined organizational structure, the Management Committee flexibly integrates and delivers multiple administrative functions, which helps reduce approval procedures and the duplication of work and conflicts (Yan et al., 2020). This can be extended to other emerging economies where government acts as a powerful architect in economic development. Furthermore, NHZs are positioned as pioneer areas to conduct pilot governance under the MEI strategy (Xie et al., 2018). Lessons learned from failed and successful policies of each NHZ can be disseminated to other regions. Therefore, considering the difficulties and inevitable failures of institutional reform and policy innovation in economic transition, the pilot governance of NHZs offers a low-risk and promising approach for emerging economies, by which they can avoid the system-wide failure caused by a failed policy, and also highlight their own EE development path by promoting successful experience.

Fourth, set policy priorities to address ecosystem bottlenecks. Specific to policy design and implementation, policy-makers in E4s should diagnose accurately their ecosystem bottlenecks in addition to following the universal suggestions proposed above. This enables them to set policy priorities to respond quickly to critical problems in E4s with multiple, complex problems but limited resources and abilities (Stam, 2018), thus creating essential conditions for the functioning of the ecosystem. Most high-performing NHZs have set three policy priorities of *CUL&INF*, *INSTI*, and *NETWO*, which produce coherent networking mechanisms that support entrepreneurial growth. Given the common bottleneck of E4s, that well-resourced and interactive networks are difficult to develop naturally (Chen et al., 2020), NHZs' policy priorities are not exclusive, but rather an important part of the alternative set of policy priorities in emerging economies.

In terms of managerial implications, this study can advance EE actors' understanding of different policy instruments, and guide them as to how best to leverage policy support skillfully for their own growth and synergetic development with partners. For the core EE actors, innovative start-ups, if they want to gain sustainable competitive advantages, they should gradually reduce reliance on direct, transactional support, and instead promote resource allocation and open innovation with heterogeneous actors with the policy support of multi-scale networking and diversified financing and taxation. We also suggest that universities, large firms, service intermediaries, and other EE actors actively establish innovation and business collaborations with start-ups according to their growth characteristics and stage needs. Diverse actors play limited but complementary roles with interrelated interests: only by enhancing interaction and coordination can they access reciprocal benefits and facilitate sustainable ecosystem evolution.

### 6.3 Limitations and prospects

Admittedly, our study is not free of limitations. We only chose a single empirical context of China. Although useful for our research purposes, it may have contextual particularity in the institutional environments for entrepreneurship (e.g., NHZs) and specific policy measures, which may mean that the policy support mechanisms might not be as applicable to other emerging economies. In addition, as an emerging configurational approach, fsQCA helps capture the under-explored policy interactions; however, fsQCA is unable to address the question "why" these interactions produce effective support mechanisms (Douglas et al., 2020). Based on our multi-faceted work, there are still great opportunities to apply appropriate theories and interpret entrepreneurial practice in specific EEs to advance insights into theoretical mechanisms underlying empirical findings (Bruton et al., 2018).

Despite these limitations, this study provides valuable insights into an important and timely issue regarding policy's role in EEs, for which we see three promising avenues for future research. First, we recommend adopting a policy-mix perspective to conduct EE research in more emerging economies, and taking advanced or underdeveloped economies as the empirical context, as the policy's role in EEs remains a globally controversial topic (Wurth et al., 2021). Second, there is an opportunity for subsequent research to extract specific cases from this study, and apply emerging theories or develop indigenous theories to conduct context-driven analysis (Bruton et al., 2021), so as to reveal the policy support mechanisms in more depth and sharpen the theory. Finally, we recommend that further research incorporates more firm-level factors (e.g., size, sector, ownership) and contextual factors (e.g., economic, social, industrial environments) besides policy to identify the configurations of multi-level "factor mixes" that lead EEs to flourish, thereby better informing the development of theory and practice.

## Appendix

**Table 8** Name list and survey responses of 21 sample EEs

| Area | Province | National high-tech zone | Responses (early-stage; late-stage) |
|---|---|---|---|
| Eastern | Beijing | Zhongguancun | 66 (32; 34) |
| | Shanghai | Zhangjiang | 65 (34; 31) |
| | Shandong | Jinan | 63 (31; 32) |
| | Jiangsu | Xuzhou | 66 (31; 35) |
| | Zhejiang | Hangzhou | 66 (35; 31) |
| | Guangdong | Guangzhou | 62 (30; 32) |
| Central | Henan | Zhengzhou | 64 (33; 31) |
| | Hubei | Wuhan | 63 (32; 31) |
| | Hunan | Changsha | 62 (32; 30) |
| | Jiangxi | Nanchang | 64 (33; 31) |
| | Anhui | Huainan | 63 (32; 31) |
| | Shanxi | Changzhi | 62 (31; 31) |
| Western | Shaanxi | Xi'an | 66 (35; 31) |
| | Sichuan | Chengdu | 65 (34; 31) |
| | Gansu | Lanzhou | 63 (32; 31) |
| | Guizhou | Anshun | 63 (31; 32) |
| | Yunnan | Chuxiong | 64 (31; 33) |
| | Qinghai | Qinghai | 66 (34; 32) |
| Northeastern | Heilongjiang | Harbin | 68 (36; 32) |
| | Jilin | Changchun | 65 (31; 34) |
| | Liaoning | Shenyang | 65 (32; 33) |
| Total | 21 provinces | 21 NHZs | 1351(682; 669) |

**Table 9** Descriptive statistics of sample ($N = 1351$)

| Item | Characteristics | Quantity | Percentage (%) | Item | Characteristics | Quantity | Percentage (%) |
|---|---|---|---|---|---|---|---|
| Gender | Male | 764 | 56.55 | Size | 1–10 | 43 | 3.18 |
| | Female | 587 | 43.45 | | 11–50 | 249 | 18.43 |
| Age | 18–29 | 213 | 15.77 | | 51–100 | 545 | 40.34 |
| | 30–39 | 999 | 73.95 | | 101–300 | 356 | 26.35 |
| | 40–49 | 129 | 9.55 | | 301 + | 158 | 11.70 |
| | 50 + | 10 | 0.74 | Industry category | Next-generation IT | 378 | 27.98 |
| Education level | PhD | 22 | 1.63 | | High-end manufacturing | 141 | 10.44 |
| | Master | 467 | 34.57 | | New materials | 196 | 14.51 |
| | Undergraduate | 823 | 60.92 | | Biotechnology | 64 | 4.74 |
| | High school and below | 39 | 2.89 | | Energy saving and environmental protection | 210 | 15.54 |
| Position | Senior manager | 448 | 33.16 | | New energy vehicles | 35 | 2.59 |
| | Middle manager | 903 | 66.84 | | New energy | 130 | 9.62 |
| | | | | | Digital creativity | 76 | 5.63 |
| Established years | 0–3.5 years | 682 | 50.48 | | Related services | 95 | 7.03 |
| | 3.5–8 years | 669 | 49.52 | | Others | 26 | 1.92 |

**Table 10** Demonstration of the coding, naming, and matching process of policy measures (partial)

| Document | Examples of EE-related policy measures | Coding | Naming | Type matching |
|---|---|---|---|---|
| State Council issued (2015) No.32 | Accelerate the reform of "Three Certificates in One" and "One Address with Multiple Licenses" | N-1–4 | Business institutional refinement | Formal institutional refinement |
| | Support the development of intellectual property pledge financing and insurance financing | N-1–9 | Promoting new financing models | Widening financial engagement |
| Ministry of Industry and Information Technology issued (2018) No.248 | Promote data-driven, platform-based interaction models to provide digital solutions for business cooperation among large, medium, and small firms | NM-7–5 | Promoting interactions among entrepreneurs | Networking |
| | Relying on China-Germany, China–Europe, and other SMEs cooperation platforms to support international technology exchanges in key fields such as green manufacturing and biomedicine | NM-7–6 | | |
| Jiangsu Government issued (2018) No.112 | Encourage online sharing of entrepreneurship courses and lectures by well-known entrepreneurs | P-4–3 | Entrepreneurship and innovation education | Education and training |
| | Introduce high-skilled talent in key industries in our province, and simplify talent recruitment procedures | P-4–8 | Talent institutional refinement | Formal institutional refinement |
| Shanghai Government issued (2019) No.29 | Accelerate the transformation of government-led VC funds to marketization, diversification, and internationalization | M-13–2 | Venture capital funds | Widening financial engagement |
| | Encourage the exploration of "investment-loan-insurance" joint financing models | M-13–7 | Promoting new financing models | |
| Hefei NHZ Management Committee issued (2019) No.112 | Develop comprehensive service platforms integrating online and offline, domestic and international services | Z-10–12 | Promoting the establishment of a support service network | Networking |
| | Guide the agglomeration and internationalization of knowledge-intensive services, and welcome the transfer of global high-tech services | Z-10–15 | | |

Abbreviations: *N*, national; *NM*, national ministries; *P*, provincial; *M*, municipal; *Z*, zone level

Coding principles: governance level—document serial number—measure serial number, e.g., N-24–6 represents the 6th measure in the 24th document selected from national policies

**Table 11** Robustness check results with cross-over points at the 45th percentile

| | Early-stage configurations | | | | Late-stage configurations | | |
|---|---|---|---|---|---|---|---|
| | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| *EDUCA* | ● | ● | | ● | ● | | ● |
| *FUNDI* | ● | ● | ⊗ | ● | | ⊗ | ⊗ |
| *TAXIN* | | ⊗ | ● | ⊗ | ● | ● | |
| *WIDEN* | ● | | ● | | ● | ● | ● |
| *CUL&INF* | ● | ● | ● | ● | ● | | ● |
| *INSTI* | ● | ● | ● | ● | ● | | ● |
| *NETWO* | ● | | | ● | ● | ● | ● |
| Consistency | 0.88 | 0.86 | 0.94 | 0.82 | 0.95 | 0.89 | 0.92 |
| Raw coverage | 0.35 | 0.18 | 0.17 | 0.11 | 0.34 | 0.29 | 0.13 |
| Unique coverage | 0.24 | 0.11 | 0.13 | 0.08 | 0.31 | 0.27 | 0.10 |
| Overall solution consistency | | | 0.91 | | | 0.93 | |
| Overall solution coverage | | | 0.74 | | | 0.71 | |

For key to symbols, see Table 7; consistent with Table 7: configurations 7–9 (configurations 1–3); configurations 11–13 (configurations 4–6); while *NETWO* can either be present or absent in configuration 2, it is present in configuration 10, making configuration 2 a logical superset of configuration 10. Configuration 10, like configuration 2, can also be described as *Input Configuration*, as they share the presence of core *FUNDI* and peripheral *EDUCA* and the absence of peripheral *TAXIN*, which characterize them

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**Data Availability** The datasets generated during and/or analyzed during the current study are not publically available as they are still being used for on-going research but are available from the corresponding author on reasonable request.

**Code availability** The fsQCA 3.0 software used in this study can be found and downloaded free of charge at the following links: https://compasss.org/software/ and http://www.socsci.uci.edu/~cragin/fsQCA/software.shtml

**Declarations**

**Ethics approval** This study was performed in line with the principles of the Declaration of Helsinki. Approval of the questionnaire and methodology was granted by the Ethics Committee of the University of Edinburgh (CAHSS Research Governance office) on June 18, 2020.

**Consent to participate** Informed consent was obtained from all individual participants included in the study.

**Consent for publication** Participants have consented to the use of anonymous questionnaire data for academic research and submit it to journals.

**Competing interests** The authors declare no competing interests.

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