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performance*

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Multi-level entrepreneurial ecosystem framework: Founder, incubator, and country characteristics for start-up performance

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ABSTRACT

The entrepreneurial ecosystem literature assumes the multi-faceted and multi-level nature of the ecosystem interactions and includes macro-, meso-, and micro-level characteristics. The joint multi-level analysis of start-up founders' team characteristics, type of entrepreneurship ecosystem support, and its effect on start-up performance is limited. Our article bridges this gap and contributes to the entrepreneurial ecosystem literature by examining a multi-level model of the entrepreneurial ecosystem, including the role of the founder's team, business incubation process characteristics, and macroeconomic characteristics where a start-up is located, in predicting start-up growth and fundraising success. Using a global data set of start-ups from 408 incubation programs across 178 countries and employing multi-level random intercept modeling, the analysis revealed that start-up performance relies on a specific combination of founders' team and incubator-type characteristics.

KEYWORDS

Start-up performance; equity; founder characteristics; business incubation; entrepreneurial ecosystems

Introduction

Supporting start-ups has long been a priority for scholars and policymakers worldwide, as start-ups are recognized as engines of growth and regional economic development (Audretsch & Link, 2012; Boyer & Blazy, 2014; Fritsch & Mueller, 2004). The concept of “entrepreneurial ecosystem” is a relatively new term that captures the complex, multi-faceted, and interdependent relationships among actors, institutions, and contextual factors that shape entrepreneurial activity in specific geographic settings (Audretsch & Belitski, 2017; Isenberg, 2010; Stam & Van de Ven, 2021; Theodoraki & Messeghem, 2017).

Over the last 15 years, the literature on entrepreneurial ecosystems has expanded significantly. However, much of it remains conceptual in nature,

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and theoretical development in this area is still emerging, with limited cross-sectional and case studies mainly focused on Western economies (Kansheba & Wald, 2020; Wadichar et al., 2024). While prior research has largely concentrated on Western economies, this study adopts a broader, global perspective. Drawing on a global data set, our findings and recommendations are not bound to a single region but capture patterns across both developed and emerging economies. Nevertheless, we acknowledge that ecosystem maturity and national development contexts may influence the intensity of outcomes, and this is reflected in the discussion. Existing research has primarily addressed structural, interaction, temporal, and spatial perspectives (Theodoraki et al., 2023), often examining macro-level ecosystem attributes and their broad impact on entrepreneurial activity (Audretsch & Belitski, 2017, 2021; Audretsch et al., 2024; Harima et al., 2024; Spigel, 2017; Stam & Van de Ven, 2021), with the paucity of knowledge on understanding the role of institutional context (North, 1993; Audretsch et al., 2019) in shaping start-up entrepreneurial outcomes, as well as being an additional enabler or impediment for the founder's team experience and human capital that enables such experience to be transferred into growth and fundraising. The variation in start-up performance is different across countries, while these interdependencies, in particular the effect of economic development in facilitating founders' team experience and capabilities for entrepreneurial outcomes, have not been sufficiently explored in a multi-level analysis (Audretsch et al., 2015, 2022). Theodoraki and Messeghem (2017) presented a multi-level approach to the entrepreneurial ecosystem by taking the regional/national ecosystem at the macro-level, the entrepreneurial support ecosystem at the meso-level, and the business incubator ecosystem at the micro-level. Subsequent research has begun exploring how these levels interact to influence start-up outcomes (Pindado et al., 2023). However, much of the literature on entrepreneurial ecosystems still leans toward macro-level impact, with limited attention given to the dynamic interplay between founder characteristics and incubator environments, particularly in underrepresented contexts.

The extant literature on the antecedents of start-up performance at the micro level has a very strong focus on founder characteristics (Marvel et al., 2020), often overlooking how these individual factors interact with ecosystem-level structures and supports (Tavassoli et al., 2023; Zheng et al., 2020). This fragmentation creates a gap in understanding how multi-level ecosystem elements jointly shape critical entrepreneurial outcomes such as growth and fundraising.

The objective of this study was to address this gap in the literature by conducting a multi-level analysis of the entrepreneurial ecosystem and examining how founder characteristics, business incubator features, and macroeconomic conditions are interconnected to increase start-up fundraising and growth. We drew on the frameworks proposed by

Theodoraki and Messeghem (2017) and Audretsch and Belitski (2017), integrating founder-level attributes (education, start-up experience, and incubation experience) (Battaglia et al., 2024; Jiao et al., 2023), incubator characteristics (type of program and support) (Sohail et al., 2023), and macro-level conditions to examine their combined effect on start-up growth and fundraising.

We theoretically developed and empirically tested a multi-level model that situates start-up performance within a broader ecosystem context. Our study contributes to the literature on entrepreneurial ecosystems and incubators in two important ways. First, it incorporates founder characteristics into a multi-level framework and explores how these characteristics interact with institutional support, specifically from incubators. Second, it examines the boundary conditions under which the relationship between founders' characteristics and start-up performance holds. In doing so, it provides practical insights for business incubators, showing how incubator type moderates founder attributes to affect outcomes. It also introduces country-level economic characteristics as a moderator, illustrating how broader contextual conditions shape the effectiveness of founders' team characteristics for start-up performance.

This study integrates the entrepreneurial ecosystem literature, which primarily emphasizes policy-level interventions to generate macro-level impact, and the small business literature, which focuses on micro-level factors influencing start-up performance. By integrating these two perspectives, we demonstrate a more nuanced and actionable understanding of how start-up success is co-produced across micro-, meso-, and macro-levels of the ecosystem.

The following section discusses the theoretical background and develops a multi-level entrepreneurial ecosystem framework with research hypotheses. The following section describes data and methodology, followed by a description of the results. The final section concludes with a discussion on theoretical contributions, practical implications, and directions for future research.

Theoretical grounding and hypotheses development

This section focuses on integrating the distinct literature streams to develop and extend the multi-level model of start-up performance. The proposed model is an extension of the available literature on the multi-level model of the entrepreneurial ecosystem by taking macro-level country characteristics and meso-level incubator characteristics, and extending them further to include start-up founders' characteristics at the micro-level. The model aims to understand the impact of factors at all three levels on start-up performance.

The following section discusses the influence of factors at all three levels on start-up performance and proposes hypotheses for the study.

Founder characteristics and start-up performance

Research linked to start-up performance has long been focused on the characteristics of the founders, particularly in early-stage ventures where the founder represents the firm and the firm is characterized by the qualities of the founder (Colombo & Grilli, 2005; Delmar & Shane, 2006; Landström, 2005). Many start-ups are founded by teams, and scholars argue that founding teams, rather than individuals, typically drive venture creation, as each member brings complementary human capital to support start-up growth (Ratzinger et al., 2018). This study adopts a founding team perspective, treating solo founders as one-person teams for comparison. A founding team is defined as “two or more individuals who jointly establish a business in which they have an equity (financial) interest” (Kamm et al., 1990).

The human capital of founder(s) is a core resource for start-ups, with knowledge as one of its most critical dimensions. Prior research has recognized knowledge as a key competitive advantage (Barney, 1991; Dimov & Shepherd, 2005; Marvel et al., 2020; Millan et al., 2014; Ratzinger et al., 2018). The relationship between the founder’s education level and start-up performance has been widely debated in the literature, with some studies suggesting that education is a critical determinant of start-up success (Chowdhury & Audretsch, 2024; Franco et al., 2021; Millan et al., 2014; Ratzinger et al., 2018), while others claim that education as a single-faceted variable is not enough to represent the knowledge capital, and other factors in human capital are also important influencers of start-up performance (Pinelli et al., 2020).

Prior entrepreneurial experience is another important facet of human capital and experience related to it for start-up performance (Marvel et al., 2020). It enhances opportunity recognition and brings valuable strategic resources like market intelligence and stakeholder networks (Boso et al., 2019; Cope, 2005). Founding teams with prior start-up experience have a higher probability of survival during early stages (Delmar & Shane, 2006) and growth (De Cock, 2020). Some studies report no significant effect (Delmar & Shane, 2006), while others find negative associations with performance indicators such as sales (Vissa & Chacar, 2009), innovation output (Uzuegbunam et al., 2019), and employee growth (Scholten et al., 2015). These inconsistencies suggest that prior start-up experience (De Cock et al., 2020) may be contingent upon other factors and the performance outcome in question. Notably, its impact on fundraising and equity growth remains underexplored.

The advent and propagation of incubation programs have added another dimension to human capital. Participation in an incubation program enhances founder capabilities, providing lasting knowledge and networks that extend beyond the current venture (Acs et al., 2014; Belitski & Desai, 2016). Intensive

incubation helps mitigate the liability of newness by addressing knowledge gaps and enabling resource access. Importantly, prior incubator experience (across ventures) reflects accumulated learning and network development (Battaglia et al., 2024), whereas current participation affects more immediate outcomes. While incubation has been theorized as a form of human capital, empirical work linking prior incubator experience to start-up performance remains scarce (Busch & Barkema, 2022; Woolley & MacGregor, 2022). We hypothesize:

H1: *The founder's higher education level positively impacts start-up performance.*

H2: *The founder's prior start-up experience positively impacts start-up performance*

H3: *The founder's prior incubator experience positively impacts start-up performance.*

Incubator characteristics and start-up performance

Research has demonstrated that incubators hold an important position in the entrepreneurial support ecosystem (Klofsten & Jones-Evans, 2000; Pauwels et al., 2016; Theodoraki, 2020), as they bridge the gap between the incubatee start-ups and the external environment (Bergek & Norrman, 2008). Incubation programs refer to the support services provided to start-ups to improve start-up performance (Aernoudt, 2004; Bergek & Norrman, 2008; Chan & Lau, 2005; Hackett & Dilts, 2004; Theodoraki, 2020). Empirical evidence supports their effectiveness. Hallen et al. (2014) found that the accelerator-backed start-ups secured funding and customer traction more rapidly than non-accelerated ones. Similar effects on fundraising were reported by Polo García-Ochoa et al. (2020). According to Chan et al. (2020), 11 percent of the variance in start-up performance can be explained by participation in acceleration programs.

Breznitz and Zhang (2019) studied the student start-ups at the University of Toronto and identified that participation in the university accelerator program improved product growth for student start-ups, particularly for founders with prior entrepreneurial experience and when programs were more intensive.

However, Del Sarto et al. (2020), using a fuzzy set qualitative comparative analysis, found that accelerator participation alone did not determine start-up survival. Other factors, such as sector and geographic reach, were critical in differentiating performance outcomes among incubated and non-incubated start-ups.

While these studies emphasized the importance of participation in incubation programs, there remains a gap in understanding what kind of founder teams, when selected for incubation, lead to increased performance. The literature on the moderating role of these incubation programs on the relationship between founder characteristics and start-up performance is scarce (De Cork et al., 2020; Jiao et al., 2023). Addressing this gap can improve incubation selection processes and program design. We hypothesize:

H4: *Participation in the incubation program positively moderates the relationship between the founder's higher education level and start-up performance.*

H5: *Participation in the incubation program positively moderates the relationship between the founder's prior start-up experience and start-up performance.*

H6: *Participation in the incubation program positively moderates the relationship between the founder's prior incubator experience and start-up performance.*

The extant literature emphasized the direct and indirect impacts of incubation on start-up performance but often overlooked the specific characteristics and value-added services that drive these outcomes. Since incubators vary widely in design and services (Stayton & Mangematin, 2019), understanding how different incubation features influence founder experience and start-up outcomes, such as growth and equity raising, is essential.

Various incubation models provide a variety of services to start-ups, focused on financing, training, and specialized incubator programs (Sohail et al., 2023). Some incubation programs, specifically accelerators, offer seed funding or equity investment (Pauwels et al., 2016; Bliemel, Flores et al. 2018), such as Y-Combinator or Techstars, while others, such as social and university incubators, may not provide direct financial support. By providing capital with support services, incubators reduce risk and offer founders a low-cost environment to experiment. Incubators function as a springboard for receiving venture capitalist financing, as their investment can also signal credibility to future investors.

Entrepreneurial education and training, often termed “entrepreneurial schooling,” facilitate start-ups (Bingham et al., 2007; Ghina & Sinaryanti, 2021; Sohail et al., 2023). The exact form of this training varies across program types, but it generally includes formal workshops and seminars, mentorship, networking, and peer learning (Cohen, 2013), and has been shown to enhance opportunity recognition, business knowledge, and stakeholder credibility (Elert et al., 2015; Gedeon, 2017; Gianiodis & Meek, 2020; Markman et al.,

2005; Ulvenblad et al., 2013; Yeh et al., 2021). This draws the theoretical pinning of the increasing contribution and impact of entrepreneurial education and training in incubator programs on start-up performance. However, empirical studies specifically evaluating the impact of entrepreneurial education within incubators remain limited (Gonzalez-Uribe & Leatherbee, 2018), thus highlighting the need for more studies to understand the impact of this design element on start-up performance.

Finally, a third key design feature of incubation is the specialized incubator programs that target specific sectors or industries. Specialized incubators offer benefits like specialized equipment and premises, sector-focused knowledge and networks, synergies through networking, image and credibility enhancement, and regulatory jurisdictions, thus improving sector-based entrepreneurial capabilities (De Massis et al., 2018). However, they also have downsides, such as underutilized capacity when sectoral demand is low (Aerts et al., 2007), reduced knowledge diversity, and limited peer collaboration due to competition or lack of trust among similar firms (McAdam & Marlow, 2007; Tötterman & Sten, 2005).

The extant literature has shown mixed evidence of specialized incubators. Some studies have identified competitive advantages due to a focused strategy and synergy (Schwartz & Hornych, 2008; Von Zedtwitz & Grimaldi, 2006), while others have found no significant effect on start-up outcomes (Aerts et al., 2007). Moreover, Yang and Cheong (2019) argued for the value of cross-sectoral alliances in addressing structural gaps in NGO incubators.

With these sparse and contradictory results on the impact of sector-focused strategy on start-up performance, it is important to use a wider data set to assess the moderating role of specialized incubators on start-up performance. We hypothesize:

H7: *Financial support in incubation programs positively impacts start-up performance.*

H8: *Structured education and training in incubation programs positively impact start-up performance.*

H9: *Specialized incubation programs positively impact start-up performance.*

Country characteristics and start-up performance

Entrepreneurs as start-up founders operate within a national ecosystem where a variety of interdependent actors and contexts influence the development and growth of start-ups (Amezcuca et al., 2020; Spigel, 2017; Wright, 2014). Thus,

along with understanding the impact of founder characteristics at the micro level and incubator characteristics at the meso level, it is also important to take into account the macro-level factors crucial for start-up growth and entrepreneurial development (Cantner et al., 2021). The variation in start-up performance in different countries is related to the interdependencies between institutions, as explained by institutional theory (North, 1993) and economic development that, in turn, affects other characteristics, such as access to resources (Patel et al., 2021), perceptions of entrepreneurs (Acs et al., 2008), and the impact of public administration on start-up activity (Patel & Wolfe, 2023). Country-level contextual factors impact the relationship between founder characteristics and start-up performance exogenously. The strength of formal institutions and the availability of funding for entrepreneurship (Fuentelsaz et al., 2015) further enhance the role of education and the prior start-up and incubator experience of founders (Acs et al., 2008). Thus, we hypothesize:

H10: *The level of economic development in the country positively moderates the relationship between the founder's higher education level and start-up performance.*

H11: *The level of economic development in the country positively moderates the relationship between the founder's prior start-up experience and start-up performance.*

H12: *The level of economic development in the country positively moderates the relationship between the founder's prior incubator experience and start-up performance.*

We conceptualize our hypothesis into a model in [Figure 1](#).

Data and method

To test our research hypotheses, we used multiple sources of data from the Entrepreneurship Database Program at Emory University, supported by the Global Accelerator Learning Initiative (GALI). This program collects data from business incubation programs around the world and tracks start-up progress over time. The program collects data from entrepreneurs applying to incubation programs, tracks their selection (or non-selection) and participation (or nonparticipation), and recollects the data after a year to track their progress.

The data consisted of 23,364 observations for the ventures that applied to various incubation and acceleration programs between the years 2013 and 2019 across 408 programs and 176 countries. Of these 23,364 ventures, 9,576

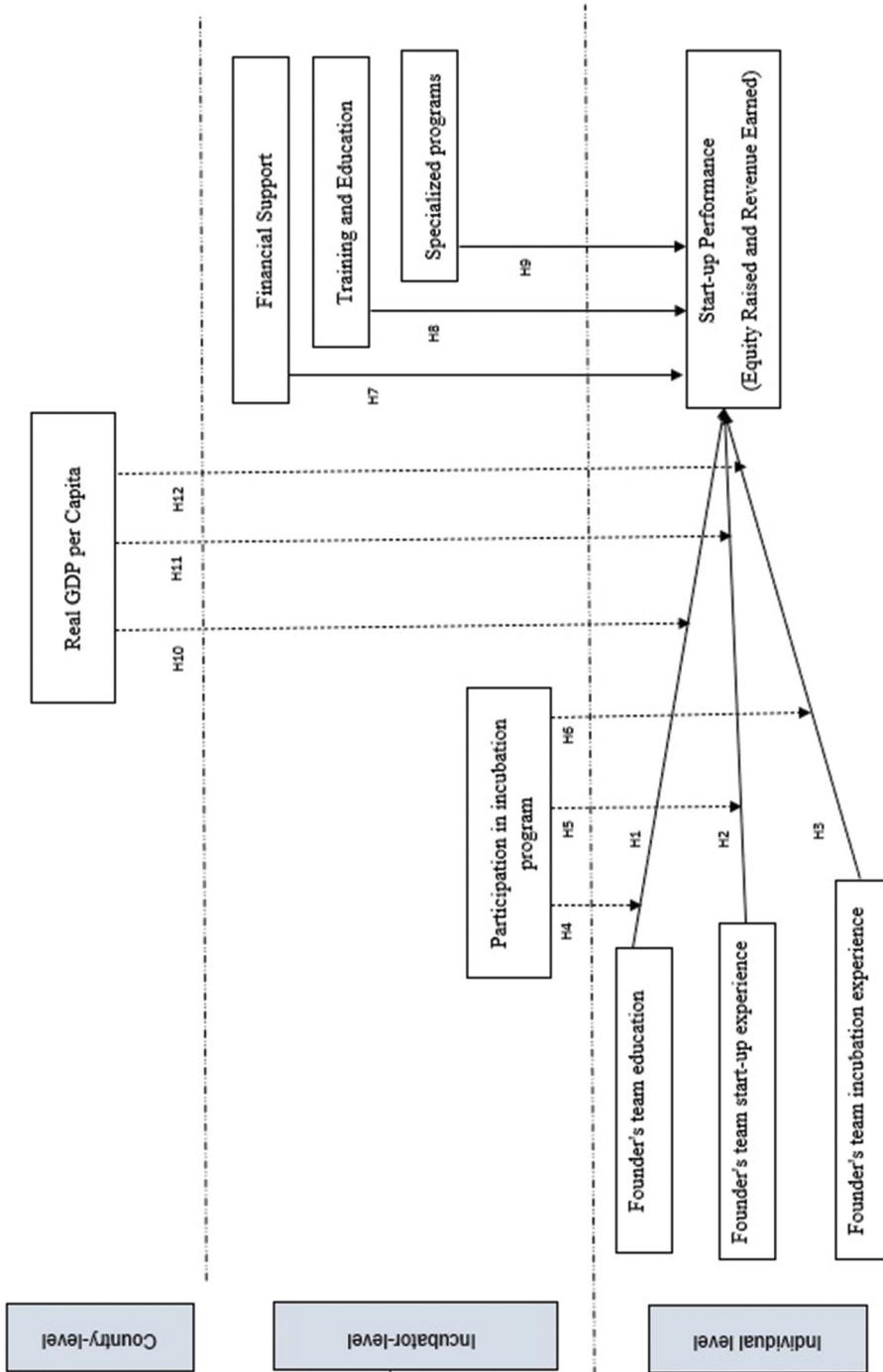


Figure 1. Conceptual model.

participated in a follow-up survey after one year. These 9,576 start-ups included 2,451 start-ups that went through the incubation program, while the remaining 7,116 did not. The availability of pre- and post-incubation data helped track the performance of incubated and non-incubated start-ups. Since the research model requires data at three levels and start-up performance can be assessed with the availability of pre- and post-incubation data, this data set served the purpose by providing information across different incubators and countries pre- and post-incubation. The data set has been used in other studies, as it offers a global collection of data on various start-up variables (Chowdhury & Audretsch, 2024). Data for country characteristics were collected from the Quality of Government (QoG) data set by the University of Gothenburg. To construct our sample, we matched the GALI data with the QoG database using the country and year as the base variables.

Dependent variables

Start-up success in this study was operationalized through two performance outcomes: fundraising and growth. Fundraising, measured as equity raised, is widely used in entrepreneurship research as an early-stage success proxy, reflecting external validation of the venture's potential and the ability to secure resources critical for scaling (Franco et al., 2021; Ratzinger et al., 2018). Growth, while a broad construct, is defined here specifically as sales revenue earned one year after incubation, capturing commercialization capacity and market acceptance of the start-up's offering. Together, these measures provide a balanced view of both financial sustainability and market traction (Delmar & Shane, 2006; Vissa & Chacar, 2009). The first dependent variable is the amount of equity raised by the start-ups from various sources between pre-incubation and one year post-incubation. This included equity raised from any sources, including family and friends, angel investors, venture capitalists, private placements, equity investments, and grants. The second dependent variable is the sales revenue earned between pre-incubation and one year post-incubation. We applied a logarithmic transformation to both variables to enhance the normality of these variables.

Independent variables

Independent variables for the study were taken at three levels: individual or micro level (that is, founder level), incubator or meso level, and country or macro level.

Three founder-level characteristics were taken as independent variables. All three characteristics depict the human capital of the start-up and cover its knowledge facet (Franco et al., 2021). The first variable is based on the founder

team's education level (Ratzinger et al., 2018; Suchart, 2017), and it takes a value of 1 if one founder only or one of three founders (in cases with teams of three) has a university graduate degree or above; a value of 2 if two founders out of a team of two or three have a university graduate degree or above; and a value of 3 if all three founders from the team have a university graduate degree or above.

The second individual-level variable is based on the founder team's start-up experience (Dimov & Shepherd, 2005). The variable takes the value of 1 if one founder only or one out of three founders (in case the team of three) has start-up experience; a value of 2 if two founders out of the team of two or three have start-up experience; and 3 if all three founders from the team have prior start-up experience. Similarly, the third individual-level variable is based on the founder team's incubation experience. It is a dummy variable with the value of 1 for the founder teams that have at least one founder with prior incubation experience. The available literature shows the theoretical grounding for the incubation experience as the founders' human capital (Acs et al., 2014; Belitski & Desai, 2016), but lacks the empirical testing of this experience as part of the founder's characteristics and its impact on start-up performance.

The incubator-level variables were taken as the characteristics of different incubation programs to analyze the impact of these characteristics on start-up performance. The first incubator-level variable taken is the dummy variable with a value of 1 for incubator programs that offer any form of financial support for the participating start-ups. The second incubator-level variable is based on the education and training provided in the incubation programs. Many incubation programs provide structured entrepreneurial training as part of the incubation program. This is a dummy variable with the value of 1 for the incubator programs that offer any structured education and training to the participating start-ups. The third incubator-level variable was taken to differentiate between the specialized and non-specialized incubator programs. These sector-focused specialized programs bring in exclusive sector-specific support services to the participating start-ups. This is a dummy variable with the value of 1 for incubator programs specialized in a specific industry or sector.

Along with analyzing the impact of incubator characteristics on start-up performance, the study also analyzed the moderating role of participation in incubation programs on the relationship between founder characteristics and start-up performance. Thus, participation in incubation was used as a moderating variable. This is a dummy variable with a value of 1 for those start-ups that participated in the incubation program.

The variation in start-up performance in different countries is related to differences in the level of economic development. In developed countries, conditions are more conducive for incorporating a business, as there is greater access to formal financing and ease in terms of labor contracts and taxes (Acs

et al., 2008). Therefore, the real GDP per capita was taken as a country-level variable to study its impact on start-up performance. It is a continuous variable, and we applied a logarithmic transformation on the variable to enhance its normality. It was used as a moderating variable to analyze its moderating role on the relationship between founder characteristics and start-up performance. All the country-level variables were taken at $t-1$ to address simultaneity and reverse causality problems (Bradley et al., 2011).

Control variables

The study used firm-level and country-level controls. The firm-level control variables include the age of the venture, the number of full-time employees, the application year, and industry fixed effects. Country-level control variables include unemployment percentage and the natural log of total population.

Table 1 presents a summary of all the variables used in the study.

Table 1 demonstrates that the sample consists of start-ups ranging from 0 to 9 years, with an average age of 2.34 years. The mean value for the founder's team education is 0.65, whereas it is 1.22 for the founder team's start-up experience. Only 5 percent of the founding teams have at least one member with prior incubator experience. Similarly, the incubator characteristics in the sample show that 67 percent of the incubators provide some form of financial support, 74 percent provide education and training as part of the program, and 38 percent focus on specialized sector-focused strategies. Table 2 shows the correlation between the variables. All correlation values are below 0.6, and VIF scores of all models are below 5; thus, the data are screened for multicollinearity.

Model

Since the study is a multi-level study, we used multi-level modeling to consider the hierarchical structure of the data and the conceptual model. In the study, the individual or founder level represents the start-up firms at level one, incubating in various incubation programs that represent level two. These incubation programs are located in various countries across the globe and represent level three. Observations from founders within the same incubation program and the same country usually face contexts more similar to each other compared to founders or start-ups in different incubation programs and countries. The multi-level modeling thus adjusts for these variances and unobserved heterogeneity of the database (Rabe-Hesketh et al., 2005). We used a multi-level random intercept model that includes random intercepts at fixed slopes at the specified level (Gelman & Hill, 2006).

We used a step testing strategy to test the hypotheses of the study. Initially, in the first specification, we tested the significance of the incubator and country groups' variances using the null random model, that is, the model excluding all the

Table 1. Descriptive statistics.

Variable name	Variable description	Source	Mean	SD	Min	Max	Skewness	Kurtosis
Revenue earned	Revenue of a firm in logarithms	GALI	6.80	4.87	0	14.32	-0.44	1.62
Equity raised	Equity raised by the start-ups from various sources between pre-incubation to one-year post-incubation. This includes equity raised from any sources, including family and friends, angel investors, venture capitalists, private placements, equity investments, and grants. The variable used is the logarithmic transformation of the original value.	GALI	1.42	3.66	0	13.30	2.29	6.50
Age	Age of venture in years since establishment, in logarithms	GALI	2.34	2.44	0	9	1.41	4.25
Full-time employees	Number of full-time employees hired by start-ups, in logarithms	GALI	0.84	0.96	0	3.85	0.95	3.21
Founders team education	It takes a value of 1 if one founder only or one out of three founders (in case the team of three) has a university graduate degree or above; 2 if two founders out of team of two or three have a university graduate degree or above; and 3 if all three founders from the team have a university graduate degree or above.	GALI	0.65	0.88	0	3	1.16	3.35
Founder's team start-up experience	The variable takes the value of 1 if one founder only or one out of three founders (in case the team of three) has start-up experience; 2 if two founders out of the team of two or three have start-up experience; and 3 if all three founders from the team have prior start-up experience.	GALI	1.22	1.14	0	3	0.360	1.70
Founder's team incubation experience	Dummy variable for founder teams having at least one founder with prior accelerator experience (yes = 1, no = 0)	GALI	0.05	0.21	0	1	4.29	19.44
Participated	Dummy variable for those start-ups that participated in the incubation program. (yes = 1, no = 0)	GALI	0.17	0.38	0	1	1.73	4.02
Financial support	Dummy variable for the incubator programs that offer any form of financial support for the participating start-ups. (yes = 1, no = 0)	GALI	0.67	0.47	0	1	-0.72	1.52
Education and training	Dummy variable for the incubator programs that offer structured education and training for the participating start-ups. (yes = 1, no = 0)	GALI	0.74	0.44	0	1	-1.07	2.16
Specialized program	Dummy variable for the incubator programs that offer industry or sector-focused incubation programs for the participating start-ups. (yes = 1, no = 0)	GALI	0.38	0.48	0	1	0.50	1.25
Real GDP per capita	Natural log of real GDP per capita in 2011 U.S. dollars (taken at $t-1$)	QoG	9.40	1.09	6.30	11.96	-0.17	2.06
Population	Natural log of population in millions of the country (taken at $t-1$)	QoG	4.42	1.67	-3.04	7.27	-0.62	3.78
Unemployment	Natural log of the share of the labor force that is without work but available for and seeking employment (taken at $t-1$)	QoG	6.19	4.29	0.11	34.93	2.57	11.66

Source: GALI and QoG data.

Table 2. Correlation metrics.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Revenue earned	1.000													
Equity raised	0.091	1.000												
Age	0.297	-0.053	1.000											
Full-time employees	0.376	0.064	0.414	1.000										
Founder's team education	0.044	0.120	0.005	0.067	1.000									
Founder's team start-up experience	0.082	0.063	-0.002	0.130	0.154	1.000								
Founder's team incubation experience	-0.026	0.042	-0.015	-0.010	0.009	-0.002	1.000							
Participated	-0.082	0.079	-0.108	-0.074	0.071	-0.016	0.081	1.000						
Financial support	0.115	0.082	0.046	0.075	0.048	-0.027	0.006	-0.121	1.000					
Education and training	0.025	0.005	0.045	0.043	-0.077	0.010	-0.009	-0.035	0.037	1.000				
Specialized program	-0.020	0.140	-0.022	0.038	0.111	0.113	0.019	0.139	-0.021	0.042	1.000			
Real GDP per capita	-0.079	0.135	-0.082	-0.249	0.098	-0.089	0.003	0.030	0.078	-0.014	0.125	1.000		
Population	-0.100	0.114	-0.114	-0.057	0.168	-0.042	0.017	0.234	-0.089	-0.134	0.267	0.355	1.000	
Unemployment	-0.037	-0.008	-0.022	-0.050	-0.038	-0.061	-0.011	0.001	-0.008	-0.056	-0.031	0.166	-0.048	1.000

Source: GALI and QoG data.

individual, incubator, and country-level independent, moderating, and control variables. The significant results of these variances justified the use of multi-level modeling (Bliese, 2000). In the second specification, we added individual, incubator, and country-level independent and control variables to test their impact on start-up performance indicators. In the third specification, we added the incubator-level interactions with individual-level independent variables to study the moderating role of incubator participation on the relationship between founder-level independent variables and start-up performance dependent variables. Finally, in the fourth specification, we added the country-level interactions with individual-level independent variables to study the moderating role of the economic development of the country on the relationship between founder-level independent variables and start-up performance dependent variables. At every step, a likelihood ratio test was conducted to assess the goodness of fit and justify the use of multi-level predictors.

Selection bias correction

Accelerators look for certain elements in the application of the candidate start-up teams, which may result in selection bias. For example, selection could take into account start-up-specific characteristics such as intellectual property, intangibles, sales, and others. When estimating our multi-level model, it was necessary to control for a sample selection bias, which could have originated from the fact that incubators base their selection on certain characteristics of the founders and start-ups. We applied the Heckman (1979) selection procedure, where in the first step we predicted the likelihood for a start-up to be selected in the incubation program. The dependent variable is selection in the incubation program; it equals 1 if selected, zero otherwise (if not selected). The Heckman (1979) procedure was used to test and correct for the selection bias using all available n observations. Given missing and unreported values of innovation outputs, we used 18,707 observations available in the original sample (see Table A1 in Appendix A). The independent variables include the founder's team education and the founder's team start-up experience, along with exclusion criteria required for Heckman selection, such as innovation-based models, social motives, patents, copyrights, and trademarks (Heckman, 1979). The inverse Mill's ratio was then computed and included on the second stage in our multi-level estimation.

Results

We started by estimating the null random model (Tables 3 and 4, specification 1) for both the dependent variables, fundraising and revenue, to assess the significance of between-group variance (Bliese, 2000). A likelihood ratio test (LRT) was calculated to compare the null multi-level model to a null linear model. The result was significant, with an LRT of 660.02 ($p < .001$) and 396.05 ($p < .001$) for revenue

Table 3. Multi-level random intercept regression. Dependent variable: equity raised, in logarithm.

Specification	(1)	(2)	(3)	(4)	OLS
Age		-0.087*** (0.02)	-0.085*** (0.02)	-0.087*** (0.02)	-0.090*** (0.02)
Full-time employees		0.566*** (0.08)	0.532*** (0.08)	0.528*** (0.08)	0.554*** (0.08)
Application year		-0.032 (0.04)	-0.033 (0.04)	-0.035 (0.04)	-0.048 (0.03)
Founder's team education (H1)		0.325*** (0.06)	0.232*** (0.06)	-0.500 (0.41)	-0.397 (0.43)
Founder's team start-up experience (H2)		0.106** (0.05)	0.089* (0.05)	-0.578* (0.34)	-0.747** (0.34)
Founder's team incubation experience (H3)		0.408* (0.22)	0.036 (0.25)	0.556 (1.50)	1.704 (1.51)
Participated			0.341** (0.16)	0.369** (0.16)	0.241 (0.15)
Financial support (H7)		0.363*** (0.14)	0.429*** (0.14)	0.425*** (0.14)	0.395*** (0.09)
Education and training (H8)		0.036 (0.14)	0.022 (0.15)	0.014 (0.15)	0.026 (0.10)
Specialized program (H9)		0.699*** (0.13)	0.723*** (0.14)	0.709*** (0.14)	0.575*** (0.09)
Real GDP per capita		0.430*** (0.05)	0.395*** (0.06)	0.253*** (0.07)	0.285*** (0.06)
Population		0.062 (0.04)	0.074* (0.04)	0.077* (0.04)	0.069** (0.03)
Unemployment		-0.012 (0.01)	-0.011 (0.01)	-0.009 (0.01)	-0.0125 (0.01)
Inverse Mills Ratio		0.917* (0.51)	0.948* (0.51)	0.904* (0.51)	1.084** (0.50)
Participated × Founder's team education (H4)			0.236** (0.10)	0.226** (0.10)	0.240* (0.12)
Participated × Founder's team start-up experience (H5)			0.116 (0.09)	0.097 (0.09)	0.123 (0.10)
Participated × Founder's incubator experience (H6)			1.309*** (0.44)	1.321*** (0.44)	1.361** (0.57)
Real GDP per capita × Founder's team education (H10)				0.077* (0.04)	0.070 (0.05)
Real GDP per capita × Founder's team start-up experience (H11)				0.073** (0.04)	0.0873** (0.04)
Real GDP per capita × Founder's incubator experience (H12)				-0.056 (0.16)	-0.179 (0.17)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	1.47*** (0.07)	60.33 (88.93)	62.69 (90.18)	66.85 (89.54)	92.50 (62.94)
Number of obs.	9576	9576	9576	9576	9576
Variance of random intercept—incubator	1.19	0.48	0.52	0.51	
Variance of random intercept—country	0.12	0.01	0.01	0.01	
Number of groups—incubator	294	294	294	294	
Number of groups—country	1098	1098	1098	1098	
ICC—incubator	0.08	0.03	0.04	0.04	
ICC—incubator country	0.09	0.03	0.04	0.04	
chi-squared	396.05***	392.91***	458.33***	470.01***	
loglikelihood	-25478.08	-20025.08	-19990.97	-19986.58	

Note: Standard errors are in parentheses. Reference category for industry = Other manufacturing. Significance level **p* value < .1; ***p* value < .05; ****p* value < .001.

Source: GALI and QoG data.

earned and equity raised, respectively, thus supporting the use of multi-level models. The results of the multi-level random intercept model are presented in Tables 3 and 4 for equity raised and revenue earned, respectively. The goodness-of-fit measures indicate that the models have an acceptable fit. The use of multi-level

Table 4. Multi-level random intercept regression. Dependent variable: revenue in logarithm.

Specification	(1)	(2)	(3)	(4)	OLS
Age		0.199*** (0.03)	0.201*** (0.03)	0.200*** (0.03)	0.228*** (0.03)
Full-time employees		1.053*** (0.09)	1.008*** (0.09)	1.008*** (0.09)	1.027*** (0.09)
Application year		0.210*** (0.05)	0.205*** (0.05)	0.205*** (0.05)	0.201*** (0.04)
Founder's team education (H1)		-0.079 (0.07)	-0.174** (0.08)	-0.231 (0.49)	-0.334 (0.50)
Founder's team start-up experience (H2)		0.312*** (0.06)	0.346*** (0.06)	0.326 (0.41)	0.265 (0.40)
Founder's team incubator experience (H3)		0.165 (0.26)	0.201 (0.30)	1.662 (1.81)	2.254 (1.67)
Participated			0.882*** (0.20)	0.882*** (0.20)	0.720*** (0.19)
Financial support (H7)		-0.152 (0.16)	-0.0561 (0.16)	-0.055 (0.16)	-0.059 (0.11)
Education and training (H8)		-0.142 (0.17)	-0.152 (0.17)	-0.151 (0.17)	-0.090 (0.12)
Specialized program (H9)		-0.091 (0.16)	-0.0561 (0.16)	-0.055 (0.16)	-0.201* (0.11)
Real GDP per capita		0.184*** (0.07)	0.137** (0.07)	0.138 (0.09)	0.139* (0.08)
Population		-0.173*** (0.05)	-0.149*** (0.05)	-0.148*** (0.05)	-0.195*** (0.04)
Unemployment		-0.034** (0.01)	-0.030** (0.01)	-0.029** (0.01)	-0.027** (0.01)
Inverse Mills Ratio		-3.988*** (0.62)	-3.920*** (0.62)	-3.919*** (0.62)	-4.000*** (0.61)
Participated × Founder's team education (H4)			0.227* (0.13)	0.225* (0.13)	0.260** (0.13)
Participated × Founder's team start-up experience (H5)			-0.086 (0.11)	-0.086 (0.11)	-0.067 (0.11)
Participated × Founder's team incubator experience (H6)			-0.260 (0.53)	-0.226 (0.53)	-0.348 (0.55)
Real GDP per capita × Founder's team education (H10)				0.006 (0.05)	0.021 (0.05)
Real GDP per capita × Founder's team start-up experience (H11)				0.002 (0.04)	0.009 (0.04)
Real GDP per capita × Founder's team incubator experience (H12)				-0.157 (0.19)	-0.212 (0.18)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	6.830*** (-0.11)	-410.7*** (-104.1)	-401.4*** (-106.71)	-400.6*** (-106.51)	-391.9*** (75.71)
Number of obs.	9576	9576	9576	9576	9576
Variance of random intercept—incubator	2.83	0.38	0.47	0.47	
Variance of random intercept—country	0.59	0.34	0.31	0.31	
Number of groups—incubator	392	294	294	294	
Number of groups—country	1098	1098	1098	1098	
ICC—incubator	0.12	0.02	0.02	0.02	
ICC—incubator country	0.14	0.03	0.04	0.04	
chi-squared	660.02	1372.42	1427.50	1429.59	
Log-likelihood	-28002.27	-21440.45	-21409.01	-21408.67	

Note: Standard errors are in parentheses. Reference category for industry = Other manufacturing. Significance level * - p value < .1; **p value < .05; ***p value < .001.

Source: GALI and QoG data.

analysis may result in biased estimates and/or inefficient estimates if certain assumptions are not met, primarily the normality of the residuals at the random effect level. We calculated the distribution of the residuals with the skewness = -0.39 and kurtosis = 2.21 for the estimation of the revenue equation and residuals

skewness = -0.86 and kurtosis = 4.47 for the estimation of the equity fundraising revenue equation, which is within the normality assumption. The regression coefficient of the Inverse Mills ratio calculated on the first stage of the Heckman (1979) estimation was statistically significant and positive. This means that firms that were selected in the incubation process had average higher revenues and equity funding compared to those not selected in the program. If not included, this could generate positive selection bias.

For the equity raised as dependent variable, specification 2 (Table 3) shows that all three individual-level variables that is, founder's team education ($b = 0.325$; $p < .001$), start-up experience ($b = 0.016$; $p < .05$) and incubation experience ($b = 0.408$; $p < .1$) have a positive and significant effect on start-up performance in terms of raising equity. Therefore, hypotheses H1, H2, and H3 are supported for raising equity. Analyzing the incubator characteristics in specification 3 (Table 3) shows that financial support ($b = 0.363$; $p < .001$) and specialized incubation program ($b = 0.699$; $p < .001$) have a positive and significant impact on equity raised, whereas education and training programs do not contribute significantly toward raising equity. Thus, hypotheses H7 and H9 are supported for raising equity, while H8 is not supported.

In specification 3 (Table 3), we introduced incubator participation as a moderating variable between founder characteristics and equity raised. Results show that the coefficient of interaction of participation in incubation programs is positive and significant with founders' team education ($b = 0.236$; $p < .05$) and incubation experience ($b = 1.309$; $p < .001$). This implies that participation in incubation programs enhances the impact of founder characteristics in terms of higher education and prior incubation experience on raising equity by the start-up. Thus, hypotheses H4 and H6 are supported for raising equity.

In specification 4 (Table 3), we further introduced real GDP per capita as a moderating variable between founder characteristics and equity raised. Results show that the coefficient of interaction of real GDP per capita is positive and significant with founder's team education ($b = 0.077$; $p < .1$) and start-up experience ($b = 0.073$; $p < .05$). This implies that the economic development stage of the country enhances the impact of founder characteristics in terms of higher education and start-up experience on raising equity by the start-up. Thus, hypotheses H10 and H11 are supported for raising equity.

Interestingly, the results are different for revenue earned as the dependent variable. Specification 2 (Table 4) shows that out of the three founder characteristic variables, only the founder's team start-up experience has a positive and significant impact on revenue ($b = 0.312$; $p < .001$). The remaining two individual-level variables, that is, founders' team education and incubation experience, are insignificant. Therefore, hypothesis H2 is supported, while H1 and H3 are not supported for revenue earned. Interestingly, analyzing the incubator characteristics in specification 2 (Table 4) shows that none of the incubator characteristics have

a significant impact on start-up performance in terms of percentage change in revenue. Thus, hypotheses H7, H8, and H9 are not supported for revenue earned.

In specification 3 (Table 4), we introduced incubator participation as a moderating variable between founder characteristics and equity raised. Results show that the coefficient of interaction of participation in the incubator program is positive and significant with the founder’s team education ($b = 0.227$; $p < .1$), but is insignificant with start-up experience and incubation experience. This implies that participation in incubation programs enhances the impact of founders with graduate or above degrees on earning revenues by the start-up. Thus, hypothesis H4 is supported, while H5 and H6 are not supported for an increase in revenues.

In specification 4 (Table 4), we further introduced real GDP per capita as a moderating variable between founder characteristics and revenue earned. Results show that the coefficient of interaction of real GDP per capita is insignificant with all three founder characteristics. This implies that the economic development stage of the country does not moderate the impact of founder characteristics on earning revenue by the start-up. Thus, hypotheses H10, H11, and H12 are not supported for revenue earned. Table 5 presents the summary of findings for all the hypotheses.

Table 5. Summary of hypotheses testing.

Hypotheses	Equity Raised	Hypothesis	Revenue	Hypothesis
H1: The Founder’s team education level positively impacts start-up performance.	0.325*** (0.06)	Supported	-0.079 (0.07)	Not supported
H2: The founder’s team start-up experience positively impacts start-up performance.	0.106** (0.05)	Supported	0.312*** (0.06)	Supported
H3: The founder’s team incubation experience positively impacts start-up performance.	0.408* (0.22)	Supported	0.165 (0.26)	Not supported
H4: Participation in the incubation program positively moderates the relationship between the founder’s higher education level and start-up performance.	0.236** (0.10)	Supported	0.227* (0.13)	Supported
H5: Participation in the incubation program positively moderates the relationship between the founder’s prior start-up experience and start-up performance.	0.116 (0.09)	Not Supported	-0.086 (0.11)	Not supported
H6: Participation in the incubation program positively moderates the relationship between the founder’s prior accelerator experience and start-up performance.	1.309*** (0.44)	Supported	-0.260 (0.53)	Not supported
H7: Financial support in incubation programs positively impacts start-up performance.	0.363*** (0.14)	Supported	-0.152 (0.16)	Not supported
H8: Structured education and training in incubation programs positively impact start-up performance.	0.036 (0.14)	Not supported	-0.142 (0.17)	Not supported
H9: Specialized incubation programs positively impact start-up performance.	0.699*** (0.13)	Supported	-0.091 (0.16)	Not supported
H10: The level of economic development in the country positively moderates the relationship between the founder’s higher education level and start-up performance.	0.077* (0.04)	Supported	0.006 (0.05)	Not supported
H11: The level of economic development in the country positively moderates the relationship between the founder’s prior start-up experience and start-up performance.	0.073** (0.04)	Supported	0.002 (0.04)	Not supported
H12: The level of economic development in the country positively moderates the relationship between the founder’s prior incubator experience and start-up performance.	-0.056 (0.16)	Not supported	-0.157 (0.19)	Not supported

Robustness check

As a robustness check, we performed the ordinary least squares (OLS) estimation of our model without controlling for levels of analysis but using the identical variables and moderation effects (see [Tables 3](#) and [4](#), specification 5). We found similar results in both the signs of the coefficients and confidence intervals, supporting our hypothesis for both equity raised and revenues. The results for OLS regression are given in [Tables 3](#) and [4](#) in the last column for equity raised and percentage revenue raised, respectively. Results remain robust and consistent with estimates using the multi-level model (spec, 4, [Tables 3](#) and [4](#)).

Our main findings are summarized in [Table 4](#), along with a comparison across hypothesis results.

Discussion and conclusion

Theoretical contribution

Our study extends the literature on the multi-level nature of entrepreneurial ecosystems where the performance of start-ups is shaped by founders' team characteristics (Alterskye et al., 2025; Audretsch & Belitski, 2021; Roundy et al., 2018) and contributes to prior research on the effect of incubation on start-ups, building on work by Pauwels et al. (2016), Theodoraki (2020), and Sohail et al. (2023). By adapting the micro-, meso-, and macro-level perspective to the entrepreneurial ecosystem, we demonstrate that incubator type, founder's education, start-up and incubator experience, and the country where the start-up is located all shape start-ups' ability to raise funding and grow, thus extending prior research in entrepreneurship theory (Bergman & McMullen, 2022; Woolley & MacGregor, 2022). Kansheba and Wald's (2020) review emphasizes that entrepreneurial ecosystems are under-theorized and require integrating micro-, meso-, and macro-level perspectives, as our study explicitly adopted this multi-level perspective by showing how founders' characteristics (micro), incubator type and design (meso), and country conditions (macro) jointly shape start-up fundraising and growth. Thus, our work empirically operationalizes the multi-level framework Kansheba and Wald (2020) called for. Furthermore, Kansheba and Wald (2020) identified business support services, including incubators, as a critical but underexplored component of entrepreneurial ecosystems, while our study empirically tested how incubator type and support mechanisms (for example, financial support, specialization) influence fundraising and growth, thereby addressing one of the review's highlighted gaps. More specifically, this study contributes to the entrepreneurship literature by demonstrating that founder characteristics have different effects on fundraising vis-à-vis revenue growth. Higher education and prior incubator experience significantly increase equity

raised but do not improve revenue, while prior start-up experience is important for both fundraising and growth, extending prior research on understanding founders' characteristics, particularly education and start-up experience in shaping firm performance (Franco et al., 2021). This finding challenges the assumption in the literature that formal education universally translates into better venture performance, while we see it's a congruence of both educational and human capital, experience, and skills.

Interestingly, managers of incubators and entrepreneurs need to be aware that program design matters for both fundraising and growth. Specialized programs and those offering financial support significantly enhance equity raised, highlighting that targeted, sector-focused support attracts investors. Structured education and training had no effect on start-up performance, raising concerns about the efficiency of generic training programs.

We extend Sohail et al. (2023) and Theodoraki (2020) on the role of incubator participation to enhance the benefits related to higher education and prior incubator experience of entrepreneurs to bolster equity fundraising, suggesting that incubators help founders leverage existing human capital more effectively. Country contextual factors, such as real GDP per capita as a proxy for economic development, indicate that ecosystem maturity enhances incubators' value-creation potential, showing how country-level conditions shape incubation program impact, extending prior research on specialized programs and cluster creation for entrepreneurs (Acs et al., 2008; Belitski & Desai, 2016).

The implications of this research extend beyond start-up founders to other stakeholders, including regional policymakers (Boyer & Blazy, 2014; Fritsch & Mueller, 2004), to create public policy for the support of start-ups through incubator programs (Patel et al., 2021). By doing so, our study extends prior research on resources available to start-up founders in the form of human capital (Azeem & Khanna, 2023; Millan et al., 2014) and how business incubation programs may enhance participating start-ups to achieve higher fundraising and growth goals, compared to start-ups not participating in business incubation programs, and what boundary conditions there are to meet such growth expectations (Del Sarto et al., 2022; Hallen et al., 2014).

In evidencing micro-meso-level interactions for start-up performance, our study extends the work by Breznitz and Zhang (2019), who suggested that the influence of serial entrepreneurs and venture capitalists within specialized programs, such as incubators, indirectly supports start-up experience positively while raising equity. The results also extend the research by Woolley and MacGregor (2022), who identified a higher probability of raising funds among founders attending multiple venture support programs. Unlike their study, we found that these founder-level characteristics are not significant influencers in generating revenue for start-ups, but are mainly supportive for fundraising. Our results show that only the prior start-up experience of founders positively impacts start-up fundraising and revenue growth, as suggested by Delmar and

Shane (2006) and Dencker and Gruber (2015) in their analysis of the effects of opportunities and founder experience on new firm performance, whereas founders' education level and prior incubator experience positively impact only start-up fundraising and not growth. This contributes to the prior discussion on incubator-specific factors when developing business incubation programs for raising equity and growth in incubated start-ups, as suggested by Han (2021) and Hallen et al. (2014). Participation in these programs provides additional support to founders with higher education levels, prior start-up experience, and prior incubator experience (De Cork et al., 2020; Jiao et al., 2023), mainly for investor signaling strategy (Breznitz & Zhang, 2019; Hallen et al., 2014), but how these characteristics affect growth trajectory altogether has not been studied, and in doing this, we compare and contrast founders' characteristics contributing to a better understanding of what founders look for while joining an incubation program and what programs should offer to match their expectations.

Managerial implications

For incubator program managers, we suggest that our study may help to revise and redesign sector-focused programs, in particular for specialized incubators that drive better fundraising outcomes than generic education and training-focused incubators, which is a novel finding. To provide financial support mechanisms, incubated start-up founders do not necessarily need to learn pitching and be part of a structured education and training program. On the contrary, going into a specialized incubator where the focus is on industry networks and developing a prototype could ensure direct fundraising a lot faster than general incubators and significantly boost start-ups' ability to secure both equity and growth. Incubation managers should also pay attention to the founders' team and individual backgrounds, supporting highly educated founders or those with prior incubation experience, as they are more likely to benefit most from incubator participation and raise more equity. However, different incubation services, such as financial support, structured education, and specialized sector focus, do not influence the revenue generation of start-ups. Selection into specialized incubation programs and working within a specialized network increase the credibility of start-ups (Schwartz & Hornysh, 2008; Yin & Luo, 2018). This suggests a need for tailored mentoring to increase founders' strengths and match them to the program.

We argue that selecting founding teams with graduate or above degrees, prior start-up experience, and prior incubator experience for incubation and providing them with financial support and specialized sector focus should increase fundraising, especially if they are from a more developed country. However, suppose raising external equity is not a start-up's objective, and it is more focused on

generating revenue. In that case, incubator resources can be better directed to other start-ups whose performance can be improved by these scarce resources.

For start-up founders with prior start-up experience, we advise that they can expect revenue growth, but those with education or prior incubator experience benefit more in terms of fundraising, helping them secure critical early-stage capital. Choosing an incubator that better fits the capabilities and skills of teams and the objectives of the start-up, and opting for incubator programs that are more specialized, may significantly increase access to external funding and growth. Founders should assemble teams with strong human capital in terms of higher education, prior start-up experience, and prior incubator experience, to enhance start-up performance. The study aids founders in selecting the most suitable incubation program that effectively moderates their characteristics to achieve the desired start-up performance outcomes. If the goal of a start-up is to raise equity, then financial grants, formal entrepreneurial training, and specialized focus are critical. However, if the objective is commercialization of innovation and sales, then prior start-up experience of founders is critical, while founders' team education is not. However, the founder's team's education, combined with participation in the incubation program, will increase sales.

Policymakers aiming to support the acceleration and incubation process should include funding capacity and ecosystem alignment over generic training to better support venture scaling in high-growth contexts. Incorporating country-level characteristics and knowing what region an incubator is located in could be important for localized knowledge exchange and knowledge spillovers from industry and communities (Audretsch, Belitski, & Fiedler, 2025). Policymakers can promote policies that encourage incubation programs offering financial support and specialized focus to stimulate sales growth and attract investments, both national and foreign. As a country's economic wealth grows, policymakers should be aware that it will lead to increased consumer demand for variety and create new niches for new incubator programs to support small businesses to cater to those needs and develop specific programs with industry (Jackson, 1984).

Although the framework developed in this study is globally generalizable, its application may vary across regions. Ecosystem maturity, investor culture, and the level of national economic development can shape how incubators influence start-up performance. For instance, while fundraising may be more viable in capital-rich markets, revenue growth may serve as a stronger performance signal in resource-constrained economies. This nuance highlights the adaptability of the framework across different regional contexts.

Limitations and future research

While this study makes strong theoretical and practical contributions, there are certain limitations that open avenues for further research. The study

extends multi-level research on entrepreneurial ecosystems, but in doing so, captures only a limited number of entrepreneurial ecosystem actors and their characteristics. Future research should focus on rethinking education/training components in the incubator program. Since structured training alone did not significantly impact performance, managers should focus on practical, market-oriented interventions (for example, investor pitching, sector-specific networking).

The data limitation here is an issue. Future research should include micro-, meso-, and macro-level data collection, with larger sample sizes from both developed and developing countries to further test our empirical model.

Our second limitation is related to longitudinal data and more fine-grained variable selection at the founder and incubator level, as well as in terms of breadth and depth of incubator participation-intensity, number of networks on engagement, and length of incubator/accelerator program, including the repetition of a program.

Future research should also incorporate more start-up resource input data, as well as control for other fine-grained characteristics of founders, particularly related to soft and digital skills for starting a business with or without an incubator program. Finally, this study operationalized start-up performance as equity raised and revenue earned. The empirical findings suggest differences in the antecedents of these two start-up performance variables, which demonstrates the need for further research to understand the mechanisms behind them, as well as other non-economic measures of start-up performance, such as social emotional wealth, well-being, sustainability, job creation, and value congruence, among others.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A

Table A1. First stage Heckman procedure for selection bias using logit regression. Dependent variable: selected for incubation = 1, zero otherwise.

Specification	(1)
Age	0.020** (0.01)
Full-time employees	0.131*** (0.02)
Invention-based model (exclusion criteria 1)	-0.160*** (0.04)
Social motives-based model (exclusion criteria 2)	-0.108 (0.07)
Patents (exclusion criteria 3)	0.021 (0.06)
Copyrights (exclusion criteria 3)	-0.114* (0.06)
Trademarks (exclusion criteria 3)	0.092** (0.04)
Application year	-0.001 (0.02)
Founder's team education	0.060*** (0.02)
Founder's team start-up experience	-0.041** (0.02)
Industry fixed effects	
Artisanal	0.174 (0.13)
Culture	-0.051 (0.15)
Education	-0.319*** (0.08)
Energy	0.157 (0.11)
Environment	0.149 (0.09)
Financial services	-0.081 (0.09)
Health	0.184** (0.08)
Housing development	0.063 (0.18)
Information and communication technologies	-0.036 (0.08)
Infrastructure/facilities development	0.259 (0.17)
Supply chain services	0.237* (0.13)
Technical assistance services	-0.159 (0.20)
Tourism	0.301** (0.13)
Water	0.0745 (0.17)
Constant	-1.539 (37.16)
Number of observations	18,707
Log-likelihood	-8750.73
Chi2	188.93

Note: Standard errors are in parentheses. Reference category for industry = Other manufacturing. Significance level * - p value < .1; ** p value < .05; *** p value < .001.

Source: GALI and QoG data.