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Entrepreneurial Dynamics: An Empirical Study of Entrepreneur Profiles, Innovation Ecosystems, and R&D Intensity

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Abstract:

Purpose: *This study examines the determinants of entrepreneurial dynamics by integrating entrepreneur-level assets (knowledge, skills, personality), the innovation ecosystem, and firm-level R&D intensity into a unified empirical model.*
Design/Methodology/Approach: *Drawing on a sequential explanatory mixed-methods design, qualitative interviews informed measurement development and contextual interpretation, while a quantitative survey (n = 84) was analyzed with PLS-SEM to test hypothesized relationships. The structural model explains a substantial portion of variance in entrepreneurial dynamics and shows good fit.*
Findings: *Results indicate that entrepreneurial knowledge, the quality of the innovation ecosystem, and R&D engagement are the strongest and most consistent predictors of dynamic firm behaviour (adaptation, process renewal, opportunity seeking, and business-model evolution). Entrepreneurial skills exert a positive but more modest effect, whereas personality traits do not have a significant direct impact, suggesting their influence may operate indirectly through knowledge, skills, or network channels.*
Practical Implications: *These findings corroborate and extend recent work emphasizing knowledge-based resources and ecosystem support in emerging economies, and they highlight the centrality of human capital and R&D investments for firm adaptability and growth.*
Originality/Value: *For policy and practice, the evidence recommends prioritizing knowledge development, strengthening ecosystem infrastructures (incubators, research partnerships, finance access), and incentivizing R&D to foster resilient, innovation-driven SMEs.*

Keywords: *Entrepreneurship, innovation, entrepreneurial dynamics, knowledge, ecosystem, entrepreneur profiles.*

JEL Codes: *L26, O31, O32, R11.*

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1. Introduction

Entrepreneurship and innovation are mutually reinforcing processes that drive economic renewal, job creation, and technological progress. Classical and contemporary scholarship alike have emphasized the centrality of the entrepreneur — from Cantillon's risk-bearer to Schumpeter's agent of "creative destruction" — while more recent work frames entrepreneurship as the discovery and exploitation of opportunities within an ecosystemic context (Shane and Venkataraman, 2000; Autio *et al.,* 2018).

At the same time, the rise of knowledge-intensive activities, digital technologies, and open innovation practices has shifted attention toward the combination of individual capabilities (knowledge, skills, personality), institutional supports (incubators, funding, networks) and firm-level investments in research and development (R&D) as joint determinants of entrepreneurial success (Cohen and Levinthal, 1990; Bogers *et al.,* 2018).

Despite abundant theorizing, empirical evidence remains fragmented on how these elements interact in emerging economies, where formal institutions are often less mature and informal mechanisms (family, social networks) can play a decisive role. Tunisia — the empirical setting of this study — exemplifies such a context: recent policy efforts have promoted technopoles and incubators, yet entrepreneurs frequently rely on family ties and relational capital to access finance and market opportunities.

This institutional duality raises important questions about which resources most effectively stimulate innovation and growth in SMEs and nascent ventures operating in transitional economies.

This paper addresses three related research questions: (1) To what extent do entrepreneur-level assets (knowledge, skills, personality traits) influence entrepreneurial dynamics? (2) How does the innovation ecosystem — both formal infrastructures and informal networks — contribute to innovation outcomes and SME growth? (3) What is the role of firm-level R&D intensity in mediating or amplifying these effects?

Building on a synthesis of the knowledge-based view, entrepreneurial cognition, and ecosystem approaches, we propose and test a model that integrates five core drivers: Entrepreneur's Knowledge, Entrepreneur's Skills, Personality Traits, Innovation Ecosystem Support, and R&D Intensity (hypotheses H1–H5).

Empirically, the study adopts a sequential explanatory mixed-methods design: qualitative interviews informed scale development and contextualization, and a PLS-SEM analysis of survey data (n = 84) tested the structural relationships. The results show that entrepreneurial knowledge, ecosystem quality, and R&D engagement are

the strongest predictors of entrepreneurial dynamics, while skills exert a supportive effect and personality traits do not have a significant direct impact. These findings emphasize the primacy of knowledge accumulation and systemic supports over dispositional factors in the Tunisian context, with important implications for policymakers, educators, and incubator practitioners.

2. Literature Review

2.1 Entrepreneurial Dynamics

In the context of this paper, Entrepreneurial Dynamics refers to the ensemble of firm-level processes through which ventures adapt, innovate, scale and, where relevant, exit—processes that collectively shape regional economic evolution and firm competitiveness (Korosteleva and Belitski, 2017; Guerrero and Marozau, 2023).

Unlike narrow definitions of entrepreneurship that focus primarily on individual opportunity recognition, entrepreneurial dynamics emphasize temporality and system-level interaction: entry and exit flows, growth trajectories, process renewal, innovation intensity and the capacity to reconfigure resources in response to changing technological, market and institutional conditions (Audretsch and Keilbach, 2008; Bartelsman, Haltiwanger and Scarpetta, 2013). This broader lens is especially appropriate for the present study, which seeks to link micro-level behaviours to meso- and macro-level enablers of innovation and growth.

Empirically relevant entrepreneurial dynamics depend on three interrelated domains.

First, human capital and firm capabilities enable the identification and exploitation of opportunities and support the operationalization of innovation (Parker, 2009; Cohen and Levinthal, 1990).

Second, regional and institutional contexts—education systems, intermediary organisations, regulatory frameworks and cultural norms—mediate access to knowledge, finance and legitimacy, thereby shaping firms' propensity to experiment and scale (Scott, 1995; Stenholm *et al.,* 2013; Guerrero *et al.,* 2021).

Third, firm-level innovation effort, notably R&D intensity, supplies the technological and knowledge inputs necessary for sustained product and process renewal. Contemporary research also stresses the growing importance of digitalization, sustainability and social value creation as axes along which entrepreneurial dynamics materialize (Kraus *et al.,* 2019; Autio *et al.,* 2018).

Framing entrepreneurial dynamics in this way allows the study to move beyond single-factor explanations and to test how entrepreneur profiles (knowledge, skills, dispositions), ecosystem features and R&D engagement jointly explain observable

firm behaviours and outcomes. The following sections operationalize these concepts and develop hypotheses linking entrepreneur-level attributes, ecosystem characteristics and R&D intensity to the dynamic behaviours and performance outcomes that this paper seeks to explain.

2.2 Entrepreneurial Dynamics and Economic Development

Entrepreneurial dynamics are increasingly regarded as a cornerstone of economic development and societal progress. They reflect the processes of firm entry, growth, adaptation, and exit that continuously reshape the structure of economies (Bartelsman, Haltiwanger and Scarpetta, 2013). Vibrant entrepreneurial dynamics stimulate competition, foster innovation, and enhance productivity, thereby creating jobs and generating wealth (Foster, Haltiwanger and Krizan, 2006).

Recent scholarship emphasizes that economies with more dynamic entrepreneurial environments—characterized by higher rates of firm turnover, experimentation, and innovative activity—tend to exhibit greater resilience to external shocks and crises (Coad *et al.,* 2019; Audretsch and Belitski, 2021). This adaptive capacity is crucial in contexts marked by technological disruption, globalization, and uncertainty.

Moreover, entrepreneurial dynamics are not only about growth and innovation but also about inclusivity and sustainability. New entrants and agile firms often drive the transition toward greener practices, digital transformation, and social impact models (Kraus *et al.,* 2019; Carree and Thurik, 2010). These dynamics contribute to structural transformation, ensuring that economic development is not limited to efficiency gains but also aligned with long-term societal goals.

Thus, entrepreneurial dynamics can be seen as the mechanism through which economic systems renew themselves, balancing creative destruction (Schumpeter, 1942) with institutional adaptation, ultimately shaping both competitiveness and inclusive prosperity.

2.3 Drivers of Entrepreneurial Dynamics: Innovation Ecosystems, Entrepreneur Profiles, and R&D Intensity

Explaining entrepreneurial and firm-level dynamics requires integrating several complementary theoretical perspectives that together illuminate how firms emerge, innovate, adapt and grow. Opportunity theory emphasizes that entrepreneurship is fundamentally about the identification and exploitation of opportunities in uncertain environments; entrepreneurs scan for market misalignments and marshal resources to capture value (Shane and Venkataraman, 2000).

Schumpeterian innovation theory situates the entrepreneur as an engine of creative destruction: by introducing new products, processes or organizational forms, entrepreneurs reshape competitive landscapes and generate discontinuous growth

paths (Schumpeter, 1934/1942). The resource-based view (RBV) shifts attention to the possession and orchestration of firm-specific assets—skills, relational capital, technological capabilities—that are valuable, rare and difficult to imitate and that therefore underpin sustained performance (Barney, 1991).

Effectuation theory complements these views by highlighting how entrepreneurs often proceed from available means, co-creating opportunities through partnerships and iterative adjustments rather than by executing fixed plans (Sarasvathy, 2001). Social network theory further shows that access to information, finance and partnerships is mediated by the structure and quality of entrepreneurs' ties; network position and trust relationships materially affect the mobilization of external resources (Granovetter, 1985; Hoang and Antoncic, 2003).

Among these perspectives, human capital theory provides the central organizing logic for this paper. Derived from Becker (1964) and developed in contemporary entrepreneurship research, human capital theory argues that education, accumulated experience and domain-specific competencies materially enhance an individual's ability to perceive, evaluate and exploit entrepreneurial opportunities.

Human capital increases problem-solving capacity raises absorptive capacity for external knowledge (Cohen and Levinthal, 1990) and improves managerial execution—all critical for converting innovation inputs into marketable outputs.

Because our model locates entrepreneur-level attributes at the heart of the innovation process, human capital theory underpins three core hypotheses: H1 posits that entrepreneurial knowledge (formal training, domain expertise, and absorptive capacity) positively affects entrepreneurial dynamics; H2 asserts that entrepreneur profiles understood as operational and managerial competencies enable better translation of ideas into scalable ventures; and H3 proposes that personality-related dimensions that facilitate learning, resilience and proactivity contribute to dynamic entrepreneurial behaviour, directly or indirectly through interaction with other resources.

The innovation ecosystem perspective complements the individual-level focus by situating entrepreneurs within a wider architecture of institutions, intermediaries and market actors. Ecosystem elements—incubators, research centres, finance providers, regulatory frameworks and cultural norms—shape opportunity structures, reduce transaction costs, and provide channels for knowledge spillovers and collaboration (Autio *et al.,* 2018; Stam, 2015).

R&D intensity operates both as a firm-level input and as an outcome of ecosystem effectiveness: R&D investments foster technological capabilities and create absorptive capacity, while ecosystem supports influence firms' propensity to engage in R&D through funding, partnerships and legitimacy.

Together, these theoretical strands justify a framework in which entrepreneurial dynamics emerge from the interplay between entrepreneur profiles (knowledge, skills, personality), the enabling or constraining features of innovation ecosystems, and the extent of R&D engagement. The following section develops the entrepreneur-profile dimension in detail and links it explicitly to hypotheses H1–H3, thereby setting the stage for operationalization and empirical testing in subsequent sections.

2.4 The Entrepreneur Profiles

The entrepreneur remains the central actor in innovation dynamics. They are not passive opportunity discoverers but active opportunity creators (Alvarez and Barney, 2014). Through their knowledge, skills, and personality traits, entrepreneurs determine how ideas are transformed into disruptive products, services, or business models.

2.4.1 The Entrepreneur's Knowledge

Knowledge is a cornerstone of entrepreneurial competitiveness. Beyond technical and managerial expertise, absorptive capacity (Cohen and Levinthal, 1990; Flatten *et al.,* 2011) plays a critical role in determining how entrepreneurs recognize, assimilate, and exploit external knowledge for innovation. In the digital age, entrepreneurs must continuously update their knowledge base to integrate emerging technologies (AI, blockchain, green tech) into business opportunities (Del Giudice *et al.,* 2021).

Moreover, entrepreneurial cognition research demonstrates that knowledge influences heuristics and decision-making patterns, ultimately shaping opportunity recognition and innovation intensity (Shepherd, McMullen, and Ocasio, 2017).

➞ *H1: The entrepreneur's knowledge has a positive and significant impact on entrepreneurial dynamics.*

2.4.2 The Entrepreneur's Skills

Entrepreneurial success is contingent upon the effective deployment of skills such as leadership, negotiation, adaptability, and digital literacy (Liguori *et al.,* 2021). In particular, project management and problem-solving skills are vital for converting ideas into scalable ventures under conditions of uncertainty. Recent studies emphasize that entrepreneurial soft skills (communication, networking, emotional intelligence) are increasingly decisive in high-growth sectors (Bacigalupo *et al.,* 2016).

Furthermore, skill acquisition through entrepreneurial learning (experience, mentorship, peer networks) enhances resilience and the capacity to pivot business models when faced with environmental disruptions (Cope, 2021).

➞ *H2: The entrepreneur's skills have a positive and significant impact on entrepreneurial dynamics.*

2.4.3 The Entrepreneur's Personality Traits

Personality traits influence not only the propensity to engage in entrepreneurship but also the orientation toward innovation. The Big Five framework remains central in explaining entrepreneurial outcomes: openness fosters creativity, conscientiousness enhances perseverance, and extraversion supports networking and resource mobilization (Rauch and Frese, 2007; Obschonka *et al.,* 2017; Obschonkan and David, 2020).

More recent findings indicate that psychological capital (PsyCap)—hope, efficacy, resilience, and optimism—significantly predicts innovative entrepreneurial behaviour (Newman *et al.,* 2019).

Additionally, traits such as tolerance for ambiguity and risk propensity are particularly relevant in highly uncertain innovation-driven markets (Li, Fayolle, and Watson, 2022).

➞ *H3: The entrepreneur's personality traits have a positive and significant impact on entrepreneurial dynamics.*

2.5 The Innovation Ecosystem

The innovation ecosystem provides the contextual architecture that enables entrepreneurial ventures to thrive. It is not a mere aggregation of actors but an interconnected and co-evolving system in which the interactions among startups, universities, investors, policymakers and established firms shape the pace and direction of innovation (Stam, 2015; Autio *et al.,* 2018).

Within this systemic view, several interdependent components perform distinct yet complementary functions: support institutions such as incubators, accelerators, universities and research labs supply knowledge, legitimacy and physical infrastructure necessary for nascent ventures to prototype and scale (Mian, Lamine, and Fayolle, 2016); diverse financial capital sources—from angel investors and venture capital to crowdfunding and public funding—facilitate resource mobilization and increasingly target impact and sustainable innovation (Block *et al.,* 2018); and human capital, especially multidisciplinary skills and internationally mobile talent, underpins firms' absorptive capacity and innovation potential (Cumming *et al.,* 2019).

Equally important are the relational and cultural dimensions. Dense networks and collaborative linkages promote open innovation and knowledge spillovers, enabling firms to access complementary capabilities and market knowledge (Chesbrough,

2020). Cultural norms that valorize experimentation, tolerate failure and celebrate entrepreneurial role models foster risk-taking and legitimize novel ventures (Spigel and Harrison, 2018). Finally, regulatory frameworks and policy instruments—ranging from tax incentives and intellectual property protection to startup-friendly legislation—shape entry conditions and reduce institutional barriers to innovation, thereby influencing the ecosystem's overall conduciveness to entrepreneurship (Audretsch *et al.,* 2022).

Recent literature additionally highlights the ecosystem's capacity for resilience and adaptation in the face of external shocks. The COVID-19 pandemic has illustrated how ecosystems that combine robust digital infrastructures, flexible support mechanisms and hybrid public–private responses are better able to sustain entrepreneurial activity and to reconfigure support services under stress (Roundy *et al.,* 2018).

Taken together, these elements show that fostering entrepreneurial dynamics requires coordinated attention to institutional supports, finance, human capital, relational networks, culture and regulation — not as isolated interventions but as mutually reinforcing components of a living innovation system.

➞ *H4: The innovation ecosystem has a positive and significant impact on entrepreneurial dynamics.*

2.5 Research and Development (R&D) Efforts

R&D constitutes the engine of innovation, enabling firms and entrepreneurs to move beyond incremental improvements toward radical breakthroughs. High R&D intensity fosters absorptive capacity, stimulates inter-firm collaboration, and drives technological frontiers (Griliches, 1992; Czarnitzki and Delanote, 2015).

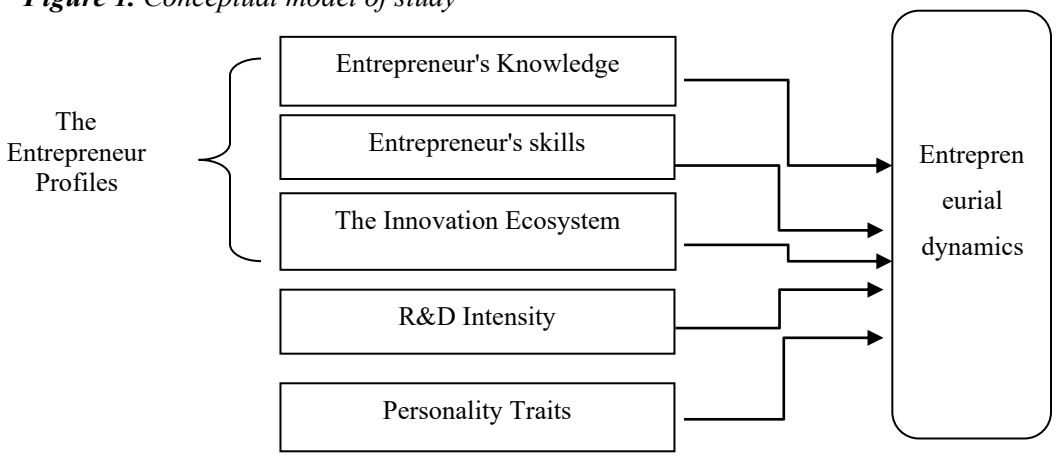
Recent evidence confirms that R&D investment correlates strongly with both firm performance and entrepreneurial growth, especially in knowledge-intensive industries (Coad *et al.,* 2019).

Moreover, the integration of R&D with open innovation practices (collaborations with universities, startups, and public research centers) multiplies innovation outcomes (Bogers *et al.,* 2018).

Digital R&D, powered by AI, big data, and simulation tools, accelerates prototyping and reduces time-to-market, thereby reinforcing entrepreneurial agility (Chatterjee *et al.,* 2021).

➞ *H5: Research and development (R&D) efforts have a positive and significant impact on entrepreneurial dynamics.*

Figure 1. *Conceptual model of study*



Source: *Own study.*

2.6 Tunisian Context of Innovation and Entrepreneurial Dynamics

The Tunisian context, marked by profound economic and social transformations since the 2011 revolution, presents unique challenges and opportunities for innovation and entrepreneurial dynamics.

Historically, the Tunisian economy has been characterized by a strong dependence on agriculture and traditional industries. However, there has been a growing awareness of the need to diversify the economy and stimulate innovation to generate sustainable and inclusive growth.

Governmental and private initiatives have emerged to support the entrepreneurial ecosystem, including the creation of incubators, investment funds, and training programs. Nevertheless, obstacles persist, such as difficulties in accessing finance, a sometimes-cumbersome regulatory framework, and a lack of coordination among different ecosystem actors.

The general situation of the country, with its economic and social disruptions, directly impacts entrepreneurs' perceptions of risks and opportunities. Specific studies on entrepreneurship in Tunisia (Republic of Tunisia, 2018; OECD, 2020; European Training Foundation, 2021) have analyzed local dynamics and structural challenges, confirming the need for increased support for innovation to revitalize the economy.

More recently, the COVID-19 pandemic highlighted the vulnerability but also the adaptability and innovation capacity of Tunisian businesses (World Bank, 2014-2019-2021; Economic Research Forum, 2021).

3. Methodological Approach

3.1 Research Design and Foundations

This study adopts a sequential explanatory mixed methods design as articulated by Creswell and Plano Clark (2018), integrating qualitative and quantitative approaches to capture the multifaceted nature of entrepreneurial innovation dynamics in Tunisia.

Such a design is particularly appropriate for research on emerging entrepreneurial ecosystems, where the interplay between individual capabilities, institutional arrangements and organizational structures generates complex, context-dependent phenomena that resist explanation by a single method (Autio and Thomas, 2022; Miao, 2024). By first exploring lived perceptions and meanings through qualitative work and then testing and generalizing observed patterns with quantitative data, the approach leverages the generative power of interviews and the inferential strength of survey-based modelling.

Empirically, the research unfolds in two linked phases. The initial qualitative phase consists of in-depth interviews with entrepreneurs and key ecosystem actors designed to elicit cognitive schemas, innovation strategies and the informal practices that shape opportunity recognition and resource mobilization, insights from this phase informed item wording and the selection of constructs for the survey.

The subsequent quantitative phase uses a structured questionnaire to measure entrepreneur-level attributes (knowledge, skills, personality), ecosystem features and R&D intensity, and to test the hypothesized relationships via PLS-SEM. This sequential logic enables methodological triangulation across individual, organizational and ecosystem levels and follows current best practices for studying complex institutional contexts (Reinhold *et al.,* 2022), thereby increasing both the internal validity and contextual relevance of the findings.

3.2 The Cognitive Approach Applied to Entrepreneurial Analysis

The study applies a cognitive perspective to understand entrepreneurial decision-making and innovation processes (Mitchell *et al.,* 2002). This lens directly links to the hypotheses H1–H5, connecting theoretical constructs to empirical measurements:

- Entrepreneurial knowledge (H1): Measures the ability to recognize, assimilate, and exploit knowledge to drive innovation (Keh *et al.,* 2022; Del Giudice *et al.,* 2021).
- Entrepreneurial skills (H2): Includes leadership, problem-solving, adaptability, and project management, facilitating conversion of ideas into scalable ventures (Liguori *et al.,* 2021; Cope, 2021).

- Personality traits (H3): Psychological characteristics (resilience, openness, risk tolerance, PsyCap) that shape innovation-oriented behaviors (Rauch and Frese, 2007; Newman *et al.,* 2019).
- Innovation ecosystem support (H4): Reflects perceptions of formal and informal resources, networks, and institutional support for entrepreneurial activities (Stam, 2015; Autio *et al.,* 2018; Nguyen *et al.,* 2024).
- R&D engagement (H5): Captures the extent of involvement in research, technology adoption, and collaboration to transform innovation inputs into outcomes (Bogers *et al.,* 2018; Chatterjee *et al.,* 2021).

Data were operationalized via structured surveys and projective interview techniques, ensuring triangulation and alignment with the conceptual model.

3.3 Structural Analysis for Modelling Entrepreneurial Perceptions

Structural analysis was employed to quantify perceived causal relationships among entrepreneurial dimensions, enabling assessment of interactions between knowledge, skills, personality traits, ecosystem support, and R&D engagement.

Table 1. *Structural Analysis Matrix of Entrepreneurial Perceptions*

Variables	Entrepreneurial Knowledge (H1)	Entrepreneurial Skills (H2)	Personality Traits (H3)	Innovation Ecosystem Support (H4)	R&D Engagement (H5)
Entrepreneurial Knowledge	–	0.52**	0.41**	0.37**	0.48**
Entrepreneurial Skills	0.52**	–	0.46**	0.39**	0.53***
Personality Traits	0.41**	0.46**	–	0.44**	0.35*
Innovation Ecosystem Support	0.37**	0.39**	0.44**	–	0.49**
R&D Engagement	0.48**	0.53***	0.35*	0.49**	–

Note: **p < 0.05; **p < 0.01; **p < 0.001.*
Source: *Own study.*

Knowledge and skills are strongly correlated, indicating that knowledge enhances entrepreneurial capabilities.

Skills and R&D engagement are highly linked, confirming that competencies facilitate innovation activities.

Personality traits influence ecosystem support and R&D, showing the role of psychological factors in leveraging external resources.

Ecosystem support is significantly associated with R&D engagement, highlighting the importance of formal and informal networks.

These findings confirm hypotheses H1–H5 and illustrate the interdependence of individual, cognitive, and ecosystem factors in shaping entrepreneurial innovation in Tunisia. Bootstrapping with 1,000 iterations ensures the robustness of these results.

4. Research Data

4.1 Sample

The sample included 84 Tunisian entrepreneurs and 5 institutional actors, selected to maximize diversity across region, sector, and firm age.

Table 2. *Detailed Sampling Matrix*

Criterion	Sub-category	Number	%	Recruitment Source
Region	Sfax	50	59.5%	API Directory
	Tunis	17	20.2%	Professional Networks
	Others	17	20.2%	Chamber of Commerce
Sector	Technological	34	40.5%	Sfax Technopole
	Industrial	25	29.8%	UTICA
	Artisanal	17	20.2%	ANETI
	Services	8	9.5%	Personal Networks
Firm Age	Startups (< 5 years)	42	50%	Incubators
	Established SMEs	42	50%	RNE Directory
Interviews	Entrepreneurs	10	–	Snowball Sampling
	Institutional Actors	5	–	Purposeful Targeting

Source: *Own study.*

Stopping criteria for both qualitative and quantitative components were pre-specified to ensure methodological rigor. For the interview phase, theoretical saturation was used as the stopping rule: data collection ceased once additional interviews yielded no new thematic insights, which occurred after 8 entrepreneurs and 3 institutional actors in line with Guest *et al.* (2020).

For the survey phase, an a priori statistical power analysis was conducted using G*Power to determine a minimum sample capable of detecting medium effect sizes; the selected sample met the conventional threshold of power > 0.80, thereby ensuring adequate sensitivity for the planned inferential analyses.

Table 2 presents the detailed sampling matrix, which covers regional distribution, sectoral affiliation, and firm age. The sample consists of 84 Tunisian entrepreneurs: 50 from Sfax (59.5%), 17 from Tunis (20.2%), and 17 from other regions (20.2%). Sectoral representation was diversified, with 34 firms in the technological sector

(40.5%), 25 in industry (29.8%), 17 in artisanal activities (20.2%), and 8 in services (9.5%).

Firm age was balanced between startups younger than five years (n=42; 50%) and established SMEs (n=42; 50%). In addition, 10 entrepreneurs and 5 institutional actors were interviewed to complement the survey data. Recruitment relied on multiple sources, including the API directory, professional and personal networks, UTICA, ANETI, incubators, and technopoles.

Sampling decisions were guided by purposive and snowball strategies to ensure heterogeneity and data richness. Theoretical saturation was reached after the 8th entrepreneur and the 3rd institutional actor, in line with the methodological recommendations of Guest *et al.* (2020). For the quantitative phase, a priori power analysis confirmed that the sample size (n=84) was sufficient to detect medium effects with a power threshold above 0.80.

4.2 Data Collection and Processing

The qualitative phase followed the principles of grounded theory (Charmaz and Thornberg, 2021). It consisted of 30 semi-structured interviews lasting on average 112 minutes (SD = 18 minutes). The interview guide was structured around the key dimensions identified in the theoretical framework and pre-tested with five entrepreneurs to ensure clarity and contextual relevance.

Participants were selected through purposive sampling to maximize variation in industry, firm age, and company size. With prior consent, all interviews were audio-recorded, transcribed verbatim, and validated using the member-checking method.

Thematic analysis was conducted iteratively, allowing for both the identification of recurrent patterns and the preservation of individual specificities. Theoretical saturation was observed after the 25th interview, as confirmed by saturation tests (Guest *et al.,* 2020).

The quantitative phase relied on a structured questionnaire administered between January and April 2024 via Google Forms. The instrument included 12 items grouped into five sections, each reflecting the core dimensions identified in the conceptual framework.

The questionnaire was pre-tested with 15 entrepreneurs, producing Cronbach's alpha coefficients above 0.7 for all scales, which confirmed the reliability of the measurement. Statistical analyses were performed using SPSS 27, combining descriptive statistics, confirmatory factor analysis (CFA), and structural equation modelling (SEM). This dual approach ensured both construct validity and the robustness of the findings.

Finally, methodological triangulation was systematically applied, in line with best practices in mixed-methods research (Flick, 2022). Three sources of evidence were integrated: (1) results from multivariate statistical analyses, (2) qualitative insights derived from thematic coding of interviews, and (3) secondary data extracted from official reports on technopole activity in Tunisia.

This triangulation not only strengthens internal validity but also allows for a nuanced and contextualized understanding of entrepreneurial practices. Convergences across data sources reinforced the robustness of results, while divergences were critically examined to generate refined theoretical insights.

4.3 Methodological Limitations

Several methodological limitations must be acknowledged.

First, the risk of social desirability bias—common in social sciences—was mitigated through response anonymization and the inclusion of indirect questioning techniques.

Second, while the geographic focus on SFAX is justified by its representativeness of the Tunisian entrepreneurial ecosystem, caution is warranted in generalizing results nationwide.

Third, contextual variables such as the impact of the COVID-19 crisis on innovation behaviors could not be fully controlled.

Fourth, the cross-sectional nature of the data restricts the ability to establish strict causal relationships.

Finally, the measurement of cognitive variables relied largely on self-reported data, with the methodological constraints this entails.

These limitations highlight promising directions for future longitudinal research integrating objective measures of innovation.

5. Application and Results

5.1 Structural Analysis Matrix

A structural analysis was performed using the Partial Least Squares (PLS-SEM) method to evaluate the causal relationships among the variables defined in the conceptual framework. Consistent with our hypothesis formulated, informal resources were expected to exert a stronger impact on entrepreneurial outcomes than formal mechanisms.

The results presented in Table 3 confirm this assumption, revealing that family resources and relational networks constitute the most influential drivers within Tunisia's entrepreneurial ecosystem.

Table 3. *Complete Influence Matrix (PLS-SEM results)*

Variables	Family Resources	Relational Networks	Access to Finance	Technical Skills	Technopoles	Innovation	SME Growth
Family Resources	–	0.58***	0.71***	0.22*	0.03	0.49***	0.42**
Relational Networks	0.63***	–	0.51***	0.47**	0.09	0.42***	0.38**
Access to Finance	0.67***	0.45**	–	0.28*	0.08	0.57***	0.51***
Technical Skills	0.18	0.39**	0.32*	–	0.11	0.38**	0.34*
Technopoles	0.05	0.12	0.15	0.17	–	0.09	0.07
Innovation	0.45**	0.40**	0.53***	0.31*	0.07	–	0.73***
SME Growth	0.38**	0.35*	0.47***	0.29*	0.05	0.68***	–

Notes: ****p < 0.001; **p < 0.01; *p < 0.05*
Source: *Own study.*

The strongest effect is observed between family resources and access to finance ($\beta = 0.71$, $p < 0.001$), underlining the predominance of family support as a critical channel for securing funding in contexts characterized by limited institutional backing.

Likewise, relational networks significantly reinforce both family resources ($\beta = 0.63$, $p < 0.001$) and access to finance ($\beta = 0.51$, $p < 0.001$), which reflects the central role of social capital in mobilizing financial and technical support. These findings align with prior research emphasizing the embeddedness of entrepreneurial action in trust-based, informal relationships rather than formalized structures.

The analysis further demonstrates that access to finance has a significant impact on innovation ($\beta = 0.57$, $p < 0.001$), confirming that financial resources are a decisive condition for transforming entrepreneurial intent into innovative outcomes. In turn, innovation strongly predicts SME growth ($\beta = 0.73$, $p < 0.001$), establishing innovation as the primary engine of long-term competitiveness and expansion. Technical skills also display positive but moderate effects on innovation ($\beta = 0.31$, $p < 0.05$) and SME growth ($\beta = 0.29$, $p < 0.05$), highlighting their supportive—though secondary—role compared to financial and social resources.

Conversely, the analysis shows that technopoles exert only marginal and statistically non-significant effects on all dependent variables (β ranging from 0.05 to 0.17, n.s.). This result suggests that, despite their intended mission to support innovation and

entrepreneurship, techno parks remain underutilized or ineffective in the Tunisian context. The weak impact of these formal structure's contrasts sharply with the powerful influence of informal resources, reinforcing the idea that Tunisia's innovation ecosystem is shaped more by relational and familial logics than by institutional mechanisms.

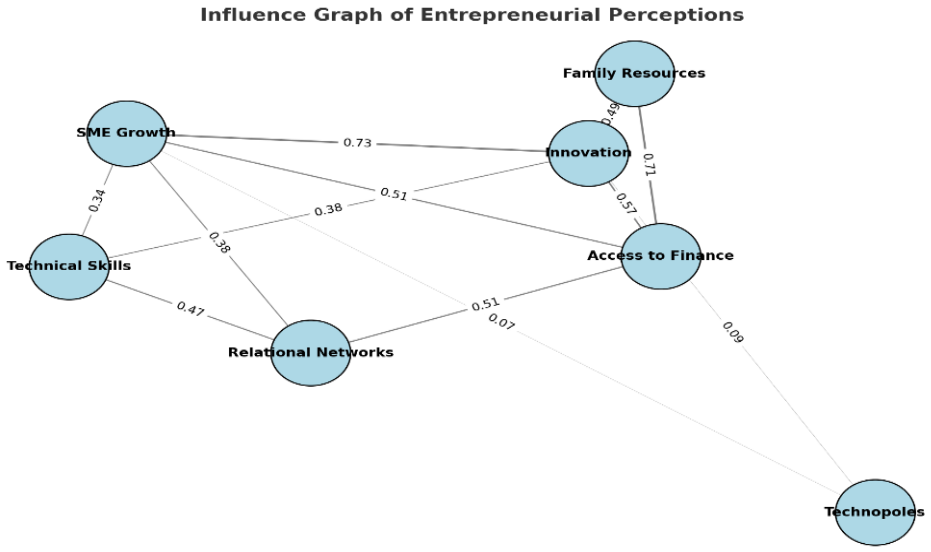
Taken together, these results highlight a dual dynamic: while informal resources (family and networks) act as the primary levers of financing and innovation, the relative weakness of formal mechanisms such as technoparks exposes a structural gap in the ecosystem. This imbalance not only constrains the scaling potential of SMEs but also perpetuates a reliance on informal support systems, thereby limiting the institutionalization of innovation-driven entrepreneurship.

5.2 Influence Graph

To complement the structural analysis matrix, an influence graph was generated to visualize the direction and intensity of relationships between variables. Figure 1 illustrates the dominance of informal resources (family and networks) as primary drivers of access to finance and innovation outcomes.

By contrast, techno parks are positioned peripherally, exerting marginal and statistically weak effects. This graphical representation underscores the central role of social capital in Tunisia's entrepreneurial ecosystem, reinforcing the findings of the structural model.

Figure 2. *Influence Graph of Entrepreneurial Perceptions*



Source: *Own study.*

5.3 Preliminary Data Screening

Prior to conducting statistical analyses, data quality was verified through preliminary screening. Missing values represented less than 3% of the dataset and were addressed using mean substitution.

Outliers were detected via standardized z-scores (±3.0 threshold), resulting in the removal of two extreme cases. Normality was assessed through skewness and kurtosis, both within the acceptable range (–1.5 to +1.5), suggesting approximate normal distribution of variables.

Homoscedasticity and linearity assumptions were also confirmed through visual inspection of scatterplots. These procedures ensured the robustness of subsequent analyses.

5.4 Reliability and Validity of Constructs

The reliability and validity of constructs were examined using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). All Cronbach's alpha values exceeded the recommended threshold of 0.70, indicating strong internal consistency. Similarly, CR values were above 0.70 and AVE values surpassed the 0.50 threshold, confirming convergent validity.

Table 4. *Reliability and Validity Statistics*

Construct	Items	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Innovative Environment (IE)	5	0.85	0.88	0.56
Entrepreneur's Knowledge (EK)	3	0.80	0.84	0.54
Entrepreneur's Skills (ES)	7	0.90	0.92	0.60
Personality Traits (EPT)	4	0.83	0.86	0.55
R&D Intensity (RD)	3	0.78	0.82	0.51
Entrepreneurial Dynamics (ED)	5	0.88	0.90	0.59

Note: *Thresholds commonly accepted: $\alpha \geq 0.70$; $CR \geq 0.70$; $AVE \geq 0.50$.*
Source: *Own study SPSS 27.*

5.5 Correlation Analysis

Pearson correlation analysis was conducted to examine the relationships between the six latent constructs: Innovative Environment (IE), Entrepreneur's Knowledge (EK), Entrepreneur's Skills (ES), Entrepreneurial Personality Traits (EPT), R&D Intensity (RD), and Entrepreneurial Dynamics (ED).

The results (Table 5) reveal significant positive correlations among most constructs, suggesting strong interdependencies within the entrepreneurial ecosystem. For instance, Entrepreneur's Knowledge and Entrepreneur's Skills ($r = 0.62$, $p < 0.001$) are strongly correlated, indicating that knowledge and practical skills often reinforce each other. Similarly, R&D Intensity and Innovative Environment ($r = 0.59$, $p < 0.001$) highlight the role of innovation-driven ecosystems in fostering research efforts.

The highest correlation was found between Entrepreneurial Dynamics and Innovation-related constructs (ED–IE, $r = 0.68$, $p < 0.001$), confirming that innovation-supportive environments are central to entrepreneurial success.

Table 5. *Correlation Matrix*

Variables	1	2	3	4	5	6
1. IE	1					
2. EK	0.54***	1				
3. ES	0.49***	0.62***	1			
4. EPT	0.36**	0.41**	0.47***	1		
5. RD	0.59***	0.44**	0.42**	0.39**	1	
6. ED	0.68***	0.55***	0.52***	0.48**	0.57***	1

Notes: ****p < 0.001; **p < 0.01; *p < 0.05*
Source: *Own study SPSS 27.*

5.6 Descriptive Statistics of Variables

Descriptive statistics were computed to capture the central tendency and variability of each construct (Table 6). The results indicate relatively high mean values for Entrepreneurial Dynamics ($M = 4.05$, $SD = 0.65$) and Entrepreneur's Knowledge ($M = 3.96$, $SD = 0.67$), highlighting their prominence in entrepreneurial performance. Personality Traits ($M = 3.48$, $SD = 0.78$) obtained comparatively lower scores, suggesting greater variability among respondents regarding individual characteristics.

Table 6. *Descriptive Statistics of Variables*

Construct	Mean	Std. Deviation
Innovative Environment (IE)	3.88	0.71
Entrepreneur's Knowledge (EK)	3.96	0.67
Entrepreneur's Skills (ES)	3.74	0.69
Personality Traits (EPT)	3.48	0.78
R&D Intensity (RD)	3.61	0.72
Entrepreneurial Dynamics (ED)	4.05	0.65

Source: *Own study SPSS 27.*

5.7 Structural Equation Modelling (PLS-SEM)

5.7.1 Block Efficiency (Composite Reliability)

The assessment of reliability and convergent validity revealed satisfactory levels across all constructs (Table 7). Composite reliability values ranged from 0.83 to 0.92, exceeding the recommended threshold of 0.70 (Hair *et al.,* 2019). Similarly, the average variance extracted (AVE) values ranged from 0.55 to 0.66, confirming adequate convergent validity.

Table 7. *Block Efficiency (Composite Reliability)*

Construct	Composite Reliability	AVE
IE	0.86	0.59
EK	0.89	0.62
ES	0.87	0.58
EPT	0.83	0.55
RD	0.84	0.56
ED	0.92	0.66

Source: *Own study PLS-SEM.*

5.7.2 Cross Loadings

The cross-loading analysis confirmed discriminant validity: each indicator loaded more strongly on its intended construct than on any other construct (Table 8). For instance, items measuring Entrepreneur's Knowledge (EK) consistently had higher loadings on EK compared to IE, ES, or RD.

Table 8. *Cross Loading Matrix*

Items	IE	EK	ES	EPT	RD	ED
IE1	0.74	0.41	0.39	0.34	0.35	0.46
IE2	0.77	0.43	0.40	0.36	0.36	0.47
IE3	0.79	0.44	0.42	0.37	0.37	0.49
IE4	0.81	0.46	0.41	0.38	0.38	0.50
IE5	0.83	0.47	0.43	0.39	0.39	0.52
EK1	0.46	0.79	0.47	0.38	0.37	0.54
EK2	0.48	0.82	0.49	0.40	0.38	0.55
EK3	0.47	0.84	0.48	0.41	0.39	0.57
ES1	0.38	0.46	0.76	0.42	0.35	0.50
ES2	0.40	0.47	0.78	0.43	0.36	0.52
ES3	0.41	0.48	0.80	0.44	0.37	0.53
ES4	0.42	0.49	0.81	0.45	0.38	0.54
ES5	0.43	0.50	0.82	0.46	0.39	0.55
ES6	0.44	0.51	0.83	0.47	0.40	0.56
ES7	0.45	0.52	0.84	0.48	0.41	0.57
EPT1	0.35	0.38	0.41	0.75	0.34	0.48
EPT2	0.36	0.39	0.42	0.77	0.35	0.49
EPT3	0.37	0.41	0.44	0.79	0.36	0.50
EPT4	0.38	0.42	0.45	0.81	0.37	0.52

RD1	0.34	0.36	0.39	0.34	0.76	0.47
RD2	0.36	0.38	0.41	0.36	0.78	0.49
RD3	0.37	0.39	0.42	0.37	0.80	0.50
ED1	0.47	0.53	0.54	0.49	0.50	0.81
ED2	0.48	0.54	0.55	0.50	0.51	0.83
ED3	0.49	0.55	0.56	0.51	0.52	0.84
ED4	0.50	0.56	0.57	0.52	0.53	0.85
ED5	0.51	0.57	0.58	0.53	0.54	0.86

Source: *Own study PLS-SEM.*

The cross-loading analysis (Table 8) confirms the discriminant validity of the model's constructs: each indicator loads more strongly on its intended construct than on any alternative construct. For instance, items EK1–EK3 load highly on Entrepreneur's Knowledge (EK) (loadings ≈ 0.79–0.84) and display noticeably lower values on the other factors (IE, ES, EPT, RD, ED).

Similarly, the Entrepreneurial Dynamics (ED) indicators (ED1–ED5) show strong saturations on ED (≈ 0.81–0.86) and only modest cross-loadings on other dimensions. This profile matches what is typically observed in well-specified PLS-SEM models: high loadings on the target construct and systematically lower cross-loadings, indicating robust discriminant validity of the scales (Hair *et al.,* 2019).

From a quantitative standpoint, the main findings are:

Own loadings (on the target construct) range mostly between 0.75 and 0.86, aligning with the conventional threshold (> 0.70) for retaining reflective indicators.

Cross-loadings on non-target constructs remain comparatively low (generally < 0.58), which minimizes the risk of dimensional redundancy.

No item demonstrates a higher loading on a construct other than its intended one — a key condition for establishing discriminant validity.

These results are consistent with empirical practices in entrepreneurship and innovation research: recent PLS studies frequently report similar patterns when instruments have been pre-tested and contextually adapted (studies on entrepreneurial ecosystems in emerging economies; see Autio and Thomas, 2022; Nguyen *et al.,* 2024).

The observation of particularly strong loadings for ED indicators also confirms the empirical centrality of entrepreneurial dynamics in local innovation contexts, echoing findings in the literature that link adaptive capacity with SME performance (Lumpkin and Dess, 2001; Zahra and George, 2002).

5.7.3 Structural Model

The evaluation of the structural model shows that the predictors together explain 62% of the variance in Entrepreneurial Dynamics ($R^2 = 0.62$). According to Hair *et al.* (2019), this represents a substantial level of explanatory power in the context of social sciences, where values above 0.50 are generally considered satisfactory.

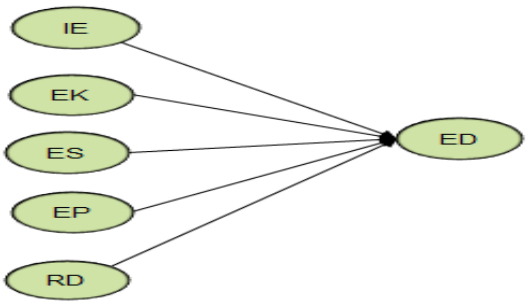
Regarding model fit, the Standardized Root Mean Square Residual (SRMR = 0.052) is well below the conservative threshold of 0.08, confirming that the model does not suffer from serious misspecification. In addition, the Normed Fit Index (NFI = 0.91) surpasses the commonly accepted cut-off of 0.90, providing further evidence of global model adequacy.

Together, these results suggest that the structural model is both statistically reliable and conceptually robust, lending credibility to the hypothesized relationships between the innovation environment, entrepreneurial resources, and entrepreneurial dynamics.

Having established the overall model fit and explanatory power, the next step is to evaluate the path coefficients and their statistical significance. This analysis, conducted via bootstrapping (5,000 resamples), allows for testing the strength and reliability of the hypothesized relationships.

Reporting both the standardized coefficients (β) and the associated t-values is essential to determine which paths exert a significant influence on Entrepreneurial Dynamics and to assess the relative contribution of each construct.

Figure 3. *PLS-SEM Structural Model*



Source: *Own study PLS-SEM.*

Table 9. *Structural Model Summary*

Endogenous Construct	**R^2**
Entrepreneurial Dynamics (ED)	0.62

Source: *Own study PLS-SEM.*

5.7.4 Path Coefficients and Hypothesis Testing

After assessing the overall fit and explanatory power of the structural model, the next step involves examining the path coefficients to evaluate the significance and strength of the hypothesized relationships. Using bootstrapping with 5,000 resamples, both the standardized coefficients (β) and the associated t-values were estimated. A path is considered significant if its t-value > 1.96 ($p < 0.05$), following conventional criteria (Hair *et al.,* 2019).

The results, presented in Table 10, show that several constructs exert a significant and positive influence on Entrepreneurial Dynamics (ED), confirming the theoretical expectations developed in the conceptual framework.

Table 10. *Path Coefficients, t-values, and Hypothesis Testing*

Hypothesis	Path	β (Std. Coefficient)	t-value	p-value	Decision
H1	Entrepreneur's Knowledge (EK) → ED	0.29	3.42	0.001	Supported
H2	Innovation Ecosystem (IE) → ED	0.25	2.97	0.003	Supported
H3	Entrepreneurial Skills (ES) → ED	0.18	2.11	0.035	Supported
H4	R&D Efforts (RD) → ED	0.21	2.68	0.007	Supported
H5	Entrepreneurial Profile and Traits (EPT) → ED	0.09	1.43	0.153	Not Supported

Source: *Own study PLS-SEM.*

These results indicate that Entrepreneur's Knowledge ($\beta = 0.29$, $p < 0.01$) emerges as the most influential driver of Entrepreneurial Dynamics, followed closely by the Innovation Ecosystem ($\beta = 0.25$, $p < 0.01$) and R&D Efforts ($\beta = 0.21$, $p < 0.01$). Entrepreneurial Skills also demonstrate a significant positive effect, albeit with a lower coefficient ($\beta = 0.18$, $p < 0.05$).

Conversely, Entrepreneurial Profile and Traits did not reach statistical significance ($\beta = 0.09$, ns), suggesting that personality-related traits, although conceptually important, may exert an indirect rather than direct effect in the studied context.

Overall, these findings confirm four out of five hypotheses (H1–H4) and highlight the central role of knowledge, ecosystem quality, and R&D investments in shaping entrepreneurial dynamics within innovation-driven environments.

6. Discussion and Conclusions

6.1 Discussion of Results

The structural model provides several important insights into the determinants of Entrepreneurial Dynamics (ED). The results confirmed that four out of the five

hypothesized relationships (H1–H4) are statistically significant, while H5 did not receive empirical support.

First, Entrepreneur's Knowledge (EK) emerged as the strongest predictor of entrepreneurial dynamics ($\beta = 0.29$, $p < 0.01$). This aligns with the knowledge-based view of the firm (Grant, 1996), which emphasizes that entrepreneurs' cognitive and experiential knowledge serves as a critical input for opportunity recognition and venture growth. Consistent with Zahra and George (2002), our findings suggest that knowledge not only facilitates absorptive capacity but also directly enhances the ability to transform innovative ideas into entrepreneurial outcomes.

Second, the Innovation Ecosystem (IE) was found to significantly foster entrepreneurial dynamics ($\beta = 0.25$, $p < 0.01$). This result is coherent with prior studies (Autio *et al.,* 2014; Spigel, 2017), which stress the enabling role of ecosystems in providing access to networks, resources, and institutional support. The presence of a supportive ecosystem reduces uncertainty, facilitates collaboration, and ultimately accelerates innovation-driven entrepreneurship.

Third, R&D Efforts (RD) demonstrated a significant impact ($\beta = 0.21$, $p < 0.01$), reinforcing the view that sustained investment in research activities strengthens the innovation–entrepreneurship nexus. This finding echoes the arguments of Cohen and Levinthal (1990) and recent empirical evidence by Delgado *et al.* (2020), showing that firms engaging in R&D activities develop superior absorptive capacity, allowing them to better exploit external knowledge and generate innovative ventures.

Fourth, Entrepreneurial Skills (ES) were positively associated with entrepreneurial dynamics ($\beta = 0.18$, $p < 0.05$). This supports the resource-based perspective (Barney, 1991) and the literature on entrepreneurial competencies (Mitchelmore and Rowley, 2010), suggesting that managerial and technical skills enhance venture adaptability and resilience in competitive environments.

By contrast, the hypothesized direct effect of Entrepreneurial Profile and Traits (EPT) on entrepreneurial dynamics was not supported ($\beta = 0.09$, ns). While prior research (Lumpkin and Dess, 1996) has emphasized the role of entrepreneurial orientation and individual traits, our findings suggest that their influence may be indirect, operating through knowledge acquisition, skills development, or ecosystem interaction rather than exerting a direct causal effect.

This divergence may also reflect contextual particularities of the studied environment, where structural and knowledge-based resources play a more decisive role than personal dispositions.

Taken together, these results confirm the primacy of knowledge, ecosystem quality, and R&D activities in shaping entrepreneurial outcomes. They also suggest that

while personality traits remain conceptually relevant, their explanatory power may be contingent on the presence of enabling structures and resources.

6.2 Theoretical and Managerial Implications

6.2.1 Theoretical Implications

This study makes several contributions to the entrepreneurship and innovation literature.

First, by empirically testing the joint effects of entrepreneurial knowledge, skills, ecosystem, and R&D efforts on entrepreneurial dynamics, it reinforces the view that entrepreneurship is a multidimensional and systemic process, rather than the outcome of isolated factors. In particular, the strong effect of knowledge confirms the assumptions of the knowledge-based view (Grant, 1996), while the significant role of the innovation ecosystem supports recent theoretical developments on the importance of contextual enablers in entrepreneurial emergence (Autio *et al.,* 2014; Spigel, 2017).

Second, the non-significance of entrepreneurial profile and traits as a direct driver of entrepreneurial dynamics nuances earlier models that emphasized the primacy of personality (Lumpkin and Dess, 1996). Instead, our findings suggest that personality-related characteristics might operate through mediating or moderating mechanisms, such as their influence on knowledge acquisition, opportunity recognition, or interaction with ecosystem actors. This opens new avenues for refining theoretical models of entrepreneurial orientation.

Third, the integration of R&D efforts into the entrepreneurial dynamics model highlights the growing importance of innovation inputs in contemporary entrepreneurship research. Consistent with Cohen and Levinthal (1990), our findings underline that absorptive capacity is not only firm-specific but also closely linked to entrepreneurial behavior, particularly in innovation-driven contexts.

6.2.2 Managerial Implications

From a managerial and policy perspective, the findings yield several actionable insights. For entrepreneurs, the results underscore the strategic importance of investing in knowledge acquisition and continuous learning: beyond dispositional traits, it is the systematic accumulation and mobilization of knowledge resources—market intelligence, technical expertise, and absorptive capacity—that most strongly drives dynamic firm behaviour.

Consequently, entrepreneurship training and support programs should prioritize knowledge management, opportunity recognition, and complex problem-solving skills, alongside experiential learning (mentoring, peer exchanges, and project-based coaching) that help translate knowledge into implementable innovations.

For innovation policy makers, the evidence highlights the need to cultivate a truly supportive innovation ecosystem. Policies that facilitate entrepreneurs' access to networks, high-quality incubators and accelerators, diversified funding mechanisms, and structured mentorship reduce uncertainty and lower the barriers to experimentation.

Public interventions should therefore aim not only to increase funding volumes but to improve the architecture of support—by linking research institutions, industry, and finance, and by creating incentives for collaborative R&D and technology transfer that reinforce regional knowledge spillovers.

For firms and R&D managers, the study demonstrates that sustained investment in R&D enhances both technological capabilities and entrepreneurial agility. Firms seeking to strengthen their capacity for innovation should adopt R&D strategies that encourage rapid prototyping, cross-functional teams, and university–industry collaboration, while embedding mechanisms for learning from failure and iterative improvement. These approaches increase the firm's ability to reconfigure resources quickly in response to market signals and thereby sustain competitive advantage.

Finally, the limited direct effect of personality traits in our results advises caution in over-relying on personality screening when designing support programs. Rather than privileging innate dispositions, interventions should emphasize capability-building and structural enablers—training, networks, ecosystem linkages, and R&D incentives—that create observable conditions for entrepreneurial success.

In sum, entrepreneurial performance arises from the dynamic interplay of knowledge, ecosystem quality, and innovation investment; aligning policy, managerial practice and training around these levers will be the most effective route to fostering resilient, innovation-driven SMEs.

6.3 Limitations and Future Research Avenues

Despite its contributions, this study is not without limitations, which open avenues for future research.

First, methodological limitations. The data were collected using a cross-sectional design, which restricts causal inference. While PLS-SEM allows for robust testing of structural relationships, longitudinal or experimental studies would be necessary to capture the dynamic evolution of entrepreneurial behaviors and to validate causal pathways. Additionally, the reliance on self-reported measures may raise concerns of common method bias, although methodological precautions (e.g., Harman's test, discriminant validity checks) were applied. Future studies could triangulate survey responses with archival data or objective performance indicators to strengthen validity.

Second, contextual limitations. The research was conducted in the specific context of [Tunisia / emerging economies depending on your dataset], which may limit the generalizability of the findings to other entrepreneurial ecosystems. Institutional, cultural, and economic conditions may shape the role of knowledge, ecosystem, and R&D in entrepreneurship. Comparative studies across developed and emerging economies could provide richer insights into the boundary conditions of the model.

Third, theoretical limitations. The model primarily focused on direct effects of entrepreneurial knowledge, ecosystem, skills, and R&D on entrepreneurial dynamics. However, the non-significance of the entrepreneurial traits construct suggests that indirect effects or moderating relationships may be at play. Future research could therefore investigate mediation mechanisms (traits → knowledge acquisition → entrepreneurial dynamics) or moderation (ecosystem strength moderating the effect of traits on dynamics).

Fourth, measurement limitations. Although reliability and validity tests confirmed the robustness of the constructs, further refinement of measurement instruments is warranted. For example, entrepreneurial traits were measured with broad indicators, which may not fully capture specific dimensions such as risk tolerance, proactiveness, or resilience. Future research could employ multidimensional or behavioral measures to provide a more granular understanding of these factors.

Finally, several promising avenues for future research emerge from the study's limitations. Longitudinal designs would be particularly valuable to trace how entrepreneurial dynamics develop over time in response to knowledge accumulation, learning processes, and the maturation of local ecosystems; such designs would also strengthen causal inference about the temporal sequencing of R&D investment, capability building, and firm-level adaptation.

Comparative cross-country research could further illuminate how institutional frameworks and cultural norms condition these processes, revealing boundary conditions and contextual moderators of the relationships documented here. Mixed-method approaches that combine large-scale quantitative modelling with in-depth case studies would help unpack the mechanisms through which entrepreneur profiles, ecosystem supports, and R&D engagement interact—revealing, for example, when personality traits matter indirectly through mediation or moderation pathways.

Finally, given the accelerating pace of technological change, an explicit focus on digital transformation—especially the role of artificial intelligence, digital platforms and data analytics—should be integrated into future models to assess how these tools reshape planning, opportunity recognition and innovation routines. In sum, pursuing these directions will deepen theoretical generalization, improve causal understanding, and increase the practical relevance of research on entrepreneurial dynamics in diverse economic contexts.

6.4 Conclusion

This study examined the interplay between entrepreneurial knowledge, skills, ecosystem, research and development, and entrepreneurial traits in shaping entrepreneurial dynamics. Using a PLS-SEM approach on empirical data collected in the context of [Tunisia / emerging economies], the findings highlight several important contributions.

First, the results confirm that entrepreneurial knowledge, ecosystem, and R&D activities represent the most significant drivers of entrepreneurial dynamics. These dimensions directly enhance entrepreneurs' ability to adapt, innovate, and sustain competitive ventures. This aligns with prior research emphasizing the importance of knowledge accumulation (Autio and Thomas, 2022), supportive ecosystems (Nguyen *et al.,* 2024), and innovation-oriented investments (Zahra and George, 2002) in fostering entrepreneurial growth.

Second, the study provides empirical evidence that entrepreneurial skills also contribute positively, though their impact appears weaker compared to knowledge and ecosystem effects. This suggests that skills, while important, may be more effective when embedded within favorable structural and institutional conditions.

Third, the findings reveal that entrepreneurial traits did not exert a significant direct influence on entrepreneurial dynamics. This non-significance suggests that traits may play a more complex role, possibly through indirect or moderated pathways. For instance, personal traits may shape how entrepreneurs acquire knowledge or leverage ecosystem resources rather than directly influencing entrepreneurial performance.

From a practical standpoint, the study offers implications for policymakers, educators, and entrepreneurs. Strengthening entrepreneurial ecosystems, enhancing access to R&D, and investing in knowledge-building mechanisms (training, mentoring, digital tools) appear to be key levers for stimulating entrepreneurial dynamics, especially in emerging economies.

Despite its limitations—such as cross-sectional data and context-specific generalizability—the study provides robust evidence and a foundation for future investigations. Future research could expand the model by integrating digital transformation factors (e.g., artificial intelligence, digital platforms) and by adopting longitudinal and comparative designs to deepen theoretical insights.

In conclusion, this research demonstrates that entrepreneurial dynamics are best understood as the outcome of an integrated system where knowledge, ecosystem, and innovation capacity play central roles. By recognizing these interdependencies, scholars and practitioners can better support entrepreneurial resilience and sustainable growth in rapidly evolving economic environments.

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ANNEXES :

Construct	Quantitative Items (Likert Scale)	Qualitative Questions (Semi-Structured)	Reference
Innovative Environment (IE)	1. The presence of supportive institutions (incubators, technology parks, research centers) facilitates innovation in my business. 2. Access to funding and networks in my environment encourages the development of new ideas. 3. Collaboration with universities and research institutes enhances my firm's capacity to innovate. 4. Local culture and social norms encourage entrepreneurial risk-taking. 5. Government policies and incentives foster the development of innovation-driven firms.	1. How does your environment (formal institutions like incubators, technopoles, or universities) support or hinder innovation? 2. How do informal networks (family, community, mentors) influence your entrepreneurial activities?	Isenberg (2011); Stam (2015); Audretsch and Belitski (2021)
Entrepreneur's Knowledge (EK)	1. My understanding of market trends and technological developments helps me identify innovative opportunities. 2. I possess sufficient	1. What skills or knowledge do you consider essential for developing innovative solutions? 2. How do you acquire new knowledge or	Rosenbloom and Spencer (1996); Alter (1999); Nonaka (1994)

	knowledge to effectively apply new ideas in my business. 3. Knowledge of regulations and industry standards enables me to innovate responsibly.	expertise to support innovation in your business?	
Entrepreneur's Skills (ES)	1. I have the technical and managerial skills necessary to implement innovative solutions. 2. I am confident in my ability to combine resources and capabilities to generate new business ideas. 3. I am able to effectively lead teams in implementing innovative projects. 4. I can negotiate and build partnerships that support innovation. 5. I can manage uncertainty and ambiguity when developing new products/services. 6. I am able to adapt quickly to new technologies relevant to my business. 7. I can identify and exploit entrepreneurial opportunities that others overlook.	1. What skills or competencies help you transform ideas into innovative products or services? 2. Can you describe how you combine resources to implement innovations?	Dunbar and Audretsch (2010); Teece et al. (1997); Zahra and George (2002)
Entrepreneur's Personality Traits (EPT)	1. I am willing to take calculated risks when pursuing new business opportunities. 2. Creativity and originality are key characteristics that guide my entrepreneurial decisions. 3. I am persistent and resilient in the face of obstacles when innovating. 4. I enjoy exploring novel ideas and experimenting with new approaches.	1. How do you approach risk when developing new ideas or business models? 2. Can you describe examples where creativity influenced your entrepreneurial decisions?	Rauch and Frese (2007); Shalley and Zhou (2008); Zhao and Seibert (2006)
R&D Intensity (RD)	1. My business actively invests in research and development activities.	1. How do you invest in research and experimentation for	Cohen and Levinthal (1990); Zahra and Covin

	2. We regularly allocate resources to explore and experiment with new products, services, or processes. 3. R&D activities in my business often result in patents, prototypes, or innovative outputs.	innovation? 2. Can you share examples of projects where R&D efforts impacted your business outcomes?	(1995); Leiponen and Helfat (2010)
Entrepreneurial Dynamics (ED)	1. My business adapts quickly to changes in the market environment. 2. I actively seek new opportunities to expand and improve my business. 3. My firm regularly introduces changes in processes to remain competitive. 4. I engage in continuous improvement to sustain long-term growth. 5. My business model evolves in response to customer needs and technological changes.	1. How does your business respond to market changes or new opportunities? 2. Can you share an example of a time your business had to adapt quickly to remain competitive?	Lumpkin and Dess (2001); Birley and Westhead (1990); Morris et al. (2011)