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The Relationship between Venture Capital Dimensions and Innovation Performance among Start-Ups in the Eastern Cape

Zizile Mbombo*, Miston Mapuranga

Department of Business Management and Economics, iYunivesithi Walter Sisulu, South Africa. *Email: zizilembombo@gmail.com

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ABSTRACT

This study investigates the associations between venture capital dimensions and start-up innovation performance in the Eastern Cape, South Africa, with a specific focus on financial resources, investor expertise, VC-enabled research and development (R&D) investment, networking and partnerships, and market access support. Drawing on the Resource-Based View (RBV), Knowledge-Based View (KBV), and Triple Helix Model of Innovation, the study conceptualises venture capital as a multidimensional construct comprising financial, knowledge-based, and relational support mechanisms associated with firms' innovation capabilities. A quantitative cross-sectional research design was employed, and data were collected from 385 start-up founders, owners, and managers in the Eastern Cape using a structured questionnaire. The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) using SmartPLS 4. The findings revealed that Market Access Support ($\beta = 0.503$, $P < 0.001$) and Networking and Partnerships ($\beta = 0.163$, $P < 0.05$) were significantly associated with Start-up Innovation Performance, whereas Financial Resources, Investor Expertise, and VC-enabled R&D Investment demonstrated no statistically significant relationships. The findings suggest that non-financial venture capital dimensions, particularly relational and market-oriented support mechanisms, are more strongly associated with innovation performance than financial and knowledge-based inputs within this sample of Eastern Cape start-ups. Due to the cross-sectional and convenience sampling design, the findings should be interpreted as associative rather than causal and should therefore not be statistically generalised beyond the study sample. The study contributes to the literature by providing a multidimensional perspective on venture capital and offering practical insights for entrepreneurs, investors, and policymakers in emerging economy contexts seeking to strengthen innovation ecosystems in resource-constrained regions.

Keywords: Venture Capital, Innovation Performance, Start-ups, Market Access Support, Networking and Partnerships, PLS-SEM, Eastern Cape
JEL Classifications: G24, L26, M13, O31, O32

1. INTRODUCTION

Innovation is widely recognised as a key driver of economic growth, productivity, and competitive advantage, particularly among start-ups operating in dynamic and uncertain environments (Carayannis and Campbell, 2021; Rosenbusch et al., 2011). It enables firms to develop new products, improve processes, and respond effectively to changing market conditions, thereby enhancing long-term sustainability and growth. However, innovation is inherently resource-intensive and risky, requiring access to financial capital, technological capabilities, managerial expertise, and strategic networks. In emerging economies such as South Africa, and particularly in provinces such as the Eastern Cape, these challenges are intensified by limited access to finance, weak institutional support, and underdeveloped innovation ecosystems (Anwar et al., 2021a, 2021b; Hellmann and Puri, 2002).

Venture capital has emerged as a critical mechanism for addressing these resource constraints by providing not only financial support but also strategic guidance, industry expertise, and access to networks (Gompers and Lerner, 2001; Sapienza et al., 1996; Hellmann and Puri, 2002). Unlike traditional financing, venture capital represents a multidimensional resource that combines financial, knowledge-based, and relational elements (Anwar

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et al., 2021a, 2021b; Hellmann and Puri, 2002). However, the empirical operationalisation of this multidimensionality remains underdeveloped (Sapienza et al., 1996; Hellmann and Puri, 2002). Existing literature generally supports a positive relationship between venture capital and innovation performance (Kortum and Lerner, 2000; Engel and Keilbach, 2007; Hirsch and Walz, 2014); more broadly, innovation is a key driver of productivity gains in emerging economies (Cirera et al., 2020); however, much of this research treats venture capital as a single aggregated construct, thereby limiting a nuanced understanding of how specific dimensions contribute differently to innovation outcomes. Furthermore, most empirical studies are concentrated in developed economies, particularly the United States and Western Europe, with comparatively limited evidence from developing regions such as South Africa. Although emerging literature from African contexts, including Kenya and Nigeria, has begun examining relationships between entrepreneurial financing and innovation, empirical evidence remains fragmented and limited in provincial and regional contexts within South Africa. Consequently, there remains limited evidence from regions such as the Eastern Cape, where contextual constraints may significantly influence these relationships (Anwar 2021a, 2021b; Hellmann and Puri, 2002).

According to the (Small Enterprise Development Agency, 2023), formal venture capital investment in the Eastern Cape accounts for <5% of South Africa's total venture capital deal flow, with many start-ups relying on grants, bootstrapping, or informal financing mechanisms. This limited venture capital activity highlights the importance of understanding how venture capital-related support mechanisms are associated with innovation performance within the regional entrepreneurial ecosystem. Accordingly, the present study focuses on a broader sample of start-up founders, owners, and managers operating within the Eastern Cape rather than exclusively on formally venture capital-funded firms.

To address this gap, this study examines the relationships between multiple venture capital dimensions and start-up innovation performance in the Eastern Cape. Drawing on the Resource-Based View (Barney, 1991), the Knowledge-Based View (Grant, 1996), and the Triple Helix Model of Innovation (Etzkowitz and Leydesdorff, 2000), the study conceptualises venture capital as a strategic combination of financial, knowledge-based, and relational resources. Specifically, the study investigates how financial resources, investor expertise, VC-enabled research and development (R&D) investment, networking and partnerships, and market access support relate to innovation performance among start-ups in this regional context. These dimensions were selected based on prior dimensionalisations of venture capital value-add activities (Sapienza et al., 1996; Hellmann and Puri, 2002).

2. LITERATURE REVIEW

This study is grounded in three complementary theoretical perspectives that provide a robust foundation for analysing the relationships between venture capital dimensions and start-up innovation performance: The Resource-Based View (RBV), the Knowledge-Based View (KBV), and the Triple Helix Model of Innovation.

2.1. Resource-Based View (RBV)

The Resource-Based View (RBV), developed by Barney (1991), posits that firms achieve sustained competitive advantage through access to valuable, rare, inimitable, and non-substitutable resources. These resources may be tangible, such as financial capital, or intangible, including managerial capabilities, knowledge, and relational networks. In the context of start-ups, venture capital provides critical financial and non-financial resources that enable firms to invest in innovation activities, adopt new technologies, and strengthen their competitive positioning (Block et al., 2021; Anwar et al., 2021a). However, RBV has been criticised for its limited consideration of resource utilisation and for overlooking external environmental factors, particularly in dynamic and resource-constrained environments (Bianchini et al., 2023). This criticism is particularly relevant in the Eastern Cape context, where institutional voids and market failures continue to shape access to resources and entrepreneurial development (Chitongo, 2026).

2.2. Knowledge-Based View (KBV)

The Knowledge-Based View (KBV), developed by Grant (1996) and Kogut and Zander (1992), extends the RBV by emphasising knowledge as the most strategically significant resource for the firm. According to KBV, innovation is fundamentally a knowledge-driven process, and firms with strong capabilities in creating, integrating, and applying knowledge are more likely to achieve superior performance. Venture capital contributes to this process by providing investor expertise, strategic guidance, and access to external knowledge, thereby strengthening start-ups' absorptive capacity and innovation capability (Cohen and Levinthal, 1990; Zahra and George, 2002; Hochberg et al., 2021). Despite its strengths, KBV has been criticised for underestimating the financial and institutional constraints that may limit firms' ability to effectively utilise knowledge, particularly within developing and resource-constrained environments (Grant, 1996).

2.3. Triple Helix Model of Innovation

The Triple Helix Model of Innovation, introduced by Etzkowitz and Leydesdorff (2000), conceptualises innovation as the result of dynamic interactions between universities, industry, and government. This model highlights the importance of collaboration, networks, and institutional linkages in fostering innovation. Within the venture capital context, networking and partnerships, as well as market access support, play a critical role in integrating start-ups into broader innovation ecosystems and facilitating knowledge exchange and collaboration (Carayannis and Campbell, 2021; Presutti et al., 2021; Arnold et al., 2024). However, the model has been criticised for assuming ideal levels of institutional collaboration, which may not always exist in developing regions (OECD, 2022). In the Eastern Cape, weak university–industry linkages and fragmented government support programmes have been identified as persistent barriers to entrepreneurial innovation and ecosystem development (Small Enterprise Development Agency, 2023).

2.4. Synthesis of Theories in the Current Study

These three theoretical perspectives provide a comprehensive framework for this study. The RBV emphasises the importance of access to strategic resources, the KBV highlights the role of

knowledge and learning in driving innovation, and the Triple Helix Model underscores the significance of networks and institutional collaboration. Together, these theories explain how venture capital operates as a multidimensional mechanism comprising financial, knowledge-based, and relational resources. This integrated perspective is particularly relevant in the Eastern Cape context, where start-ups face acute resource constraints and weak institutional support (Anwar et al., 2021a, 2021b; Hellmann and Puri, 2002). Accordingly, the study examines how financial resources, investor expertise, VC-enabled research and development (R&D) investment, networking and partnerships, and market access collectively relate to start-up innovation performance.

2.5. Venture Capital Dimensions: Conceptualisation and Measurement

Following Hellmann and Puri (2002) and Sapienza et al. (1996), venture capital is conceptualised not as a monolithic financial instrument but as a bundle of value-adding activities. These activities span financial provisioning (capital injection), knowledge transfer (investor expertise and strategic guidance), VC-enabled research and development (R&D) investment, and relational intermediation through networking and market access support. This multidimensional conceptualisation aligns with the study's theoretical foundations, where the RBV emphasises access to strategic resources, the KBV highlights knowledge transfer and absorptive capacity, and the Triple Helix Model emphasises collaboration and relational positioning within innovation ecosystems. The five dimensions included in this study were selected based on prior venture capital value-add literature, which recognises that venture capital support extends beyond financial investment to include strategic, relational, and market-oriented contributions to firm development (Hellmann and Puri, 2002; Kaplan and Strömberg, 2004; Sapienza et al., 1996). Importantly, VC-enabled R&D investment is conceptualised as a firm-level innovation activity, facilitated by venture capital support, rather than as a venture capital dimension in itself.

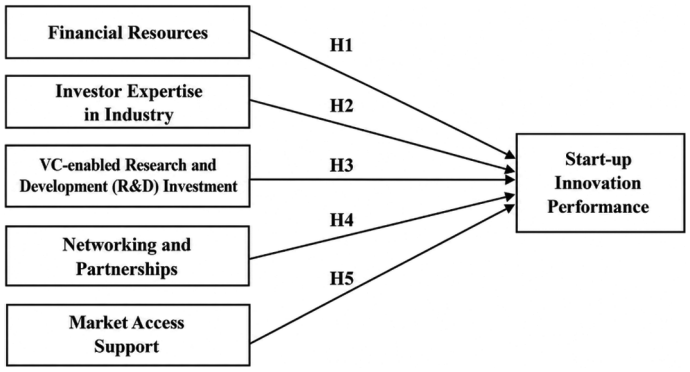
3. CONCEPTUAL MODEL AND HYPOTHESIS FORMULATION

Based on the theoretical foundations and empirical literature reviewed, a conceptual model was developed to examine the relationships between venture capital dimensions and Start-up Innovation Performance. The model proposes that five venture capital dimensions, namely Financial Resources, Investor Expertise, VC-enabled Research and Development (R&D) Investment, Networking and Partnerships, and Market Access Support, serve as independent variables associated with Start-up Innovation Performance. The model reflects the view that venture capital operates as a multidimensional bundle of financial, knowledge-based, and relational resources. The proposed relationships are illustrated in Figure 1 below.

3.1. Hypotheses Formulation

This section outlines the hypothesised relationships between venture capital dimensions, namely financial resources, investor expertise, VC-enabled research and development (R&D) investment, networking and partnerships, and market access support, and start-up innovation performance, drawing on the theoretical and empirical literature reviewed.

Figure 1: Conceptual model



3.2. Financial Resources and Start-up Innovation Performance

Financial resources are essential for supporting innovation activities in start-ups, particularly in resource-constrained environments. They enable investment in R&D, technological infrastructure, and skilled human capital (Brem et al., 2021). From a Resource-Based View perspective, financial capital strengthens organisational capabilities and firm performance, while venture capital reduces financial constraints and uncertainty (Cheng and Huizingh, 2021; Chemmanur et al., 2020). However, the effectiveness of financial resources may be contingent on absorptive capacity and the firm's ability to strategically utilise available resources (Cohen and Levinthal, 1990). Furthermore, empirical evidence suggests that financial resources alone may not guarantee innovation outcomes without complementary organisational capabilities (Block et al., 2018). Therefore, it is hypothesised that:

- H_1: Financial resources provided through venture capital have a significant positive relationship with start-up innovation performance in the Eastern Cape Province.

3.3. Investor Expertise and Start-up Innovation Performance

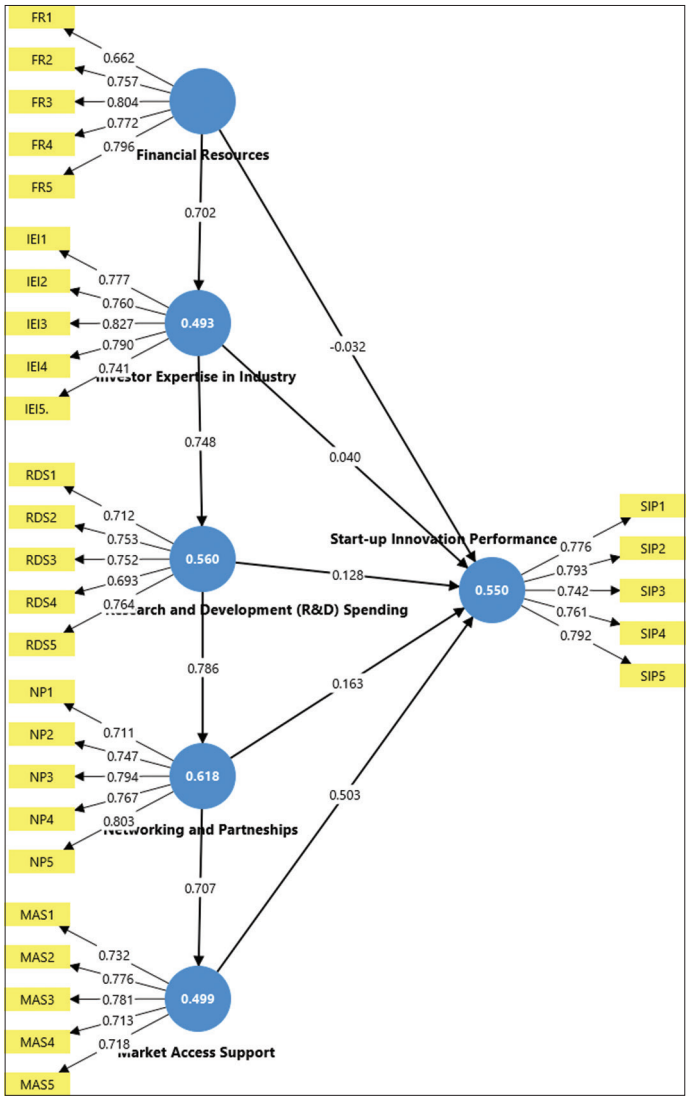
Investor expertise represents a critical non-financial resource that strengthens innovation capabilities through industry knowledge, strategic guidance, and governance support (Hochberg et al., 2021; Fisher et al., 2021). From a Knowledge-Based View perspective, access to external knowledge strengthens decision-making and innovation outcomes (Grant, 1996; Zahra and George, 2002). Although excessive investor control may limit entrepreneurial autonomy, experienced investors generally strengthen managerial capabilities and reduce uncertainty (Colombo and Grilli, 2010). Therefore, it is hypothesised that:

- H_2: Industry-specific investor expertise has a significant positive relationship with start-up innovation performance in the Eastern Cape Province.

3.4. VC-Enabled R&D Investment and Start-up Innovation Performance

Research and development (R&D) investment is widely recognised as a key driver of innovation performance, supporting knowledge creation, technological development, and product improvement

Figure 2: Structural equation model (PLS-SEM) results showing path coefficients and factor loadings



(Hall and Lerner 2010). Within the venture capital context, venture capital support may enable start-ups to invest in R&D activities by providing financial resources, strategic guidance, and access to specialised expertise. From a Knowledge-Based View perspective, sustained investment in R&D strengthens a firm's ability to acquire and apply new knowledge (Cohen and Levinthal, 1990). However, the effectiveness of R&D investment may be constrained by absorptive capacity and contextual limitations within developing regions (Hall and Lerner, 2010). Therefore, it is hypothesised that:

- H_3: VC-enabled Research and Development (R&D) Investment is positively and significantly associated with Start-up Innovation Performance in the Eastern Cape Province.

3.5. Networking and Partnerships and Start-up Innovation Performance

Networking and partnerships provide access to external knowledge, resources, and opportunities, thereby strengthening innovation performance (Nambisan et al., 2019; Das and Teng, 2000). The Triple Helix Model highlights the importance of collaboration and institutional linkages in fostering innovation (Etzkowitz and Leydesdorff, 2000). While strong networks strengthen knowledge sharing and organisational credibility, excessive reliance on existing networks may limit exploration and innovation (Uzzi, 1997). Therefore, it is hypothesised that:

- H_4: Networking and partnerships facilitated by venture capital have a significant positive relationship with start-up innovation performance in the Eastern Cape Province.

3.6. Market Access Support and Start-up Innovation Performance

Market access support facilitates the commercialisation of innovation by enabling start-ups to enter new markets, connect with customers, and scale operations (OECD, 2021; Gans et al., 2023). From a Resource-Based View perspective, market access strengthens competitive positioning and organisational growth (Weaven et al., 2021; Su et al., 2023). Although rapid expansion into new markets may create operational challenges, market access remains an important mechanism associated with innovation success among start-ups (Bocken and Snihur, 2020). Therefore, it is hypothesised that:

- H_5: Market access support from venture capital has a significant positive relationship with start-up innovation performance in the Eastern Cape Province.

While not formally hypothesised due to the exploratory nature of this study within the Eastern Cape context, indirect pathways between venture capital dimensions are examined post hoc in the discussion of results section.

4. METHODOLOGY

This study employed a quantitative, cross-sectional research design to examine the relationships between venture capital dimensions and Start-up Innovation Performance within the Eastern Cape Province. A cross-sectional design was selected because it was appropriate for capturing respondents' perceptions of venture capital support and innovation performance within the resource and time constraints of the study. The target population consisted of registered and operational start-ups in the Eastern Cape Province, with respondents comprising founders, owners, and senior managers. Although the Companies and Intellectual Property Commission (CIPC, 2024) reports a substantial number of small and medium enterprises operating within the province, a comprehensive and accessible sampling frame of active start-ups could not be obtained due to limitations in publicly available databases and inconsistencies in business registration records. Consequently, a convenience sampling strategy was employed.

A sample size of 385 respondents was determined using G*Power software for a medium effect size ($f^2 = 0.15$), significance level ($\alpha = 0.05$), and statistical power of 0.80 (Faul et al., 2009). Data were collected using a structured, self-administered questionnaire distributed electronically through email, LinkedIn, WhatsApp business groups, and entrepreneurial support networks within the province. The questionnaire utilised a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) to measure all study constructs.

Venture capital was operationally defined in the questionnaire as external equity investment from professional investors who

Table 1: Sample demographic characteristics

Gender	Frequency	Percentage	Age Category	Frequency	Percentage	Marital Status	Frequency	Percentage
Male	143	37.1	18–25	46	11.9	Single	158	41.0
Female	242	62.9	26–35	144	37.4	Married	111	28.8
			36–45	149	38.7	Divorced	88	22.9
			46 and above	46	11.9	Other	28	7.3
Total	385	100	Total	385	100	Total	385	100

Qualification	Frequency	Percentage	Role in Start-up	Frequency	Percentage
High School	35	9.1	Founder	116	30.1
Diploma	94	24.4	Owner	168	43.6
Degree	189	49.1	Manager	101	26.2
Postgraduate	67	17.4			
Total	385	100	Total	385	100

Years in Operation	Frequency	Percentage
<1 year	31	8.1
1–3 years	158	41.0
4–6 years	138	35.8
7+years	58	15.1
Total	385	100

Table 2: Cross loadings

Constructs	Financial Resources	Investor Expertise in Industry	Market Access Support	Networking and Partnerships	Research and Development (R&D) Spending	Start-up Innovation Performance
FR1	0.662	0.446	0.374	0.347	0.387	0.263
FR2	0.757	0.495	0.386	0.436	0.459	0.326
FR3	0.804	0.529	0.372	0.444	0.445	0.320
FR4	0.772	0.567	0.382	0.437	0.438	0.316
FR5	0.796	0.612	0.378	0.428	0.472	0.330
IEI1	0.551	0.777	0.419	0.531	0.566	0.411
IEI2	0.538	0.760	0.458	0.499	0.579	0.371
IEI3	0.571	0.827	0.508	0.543	0.619	0.459
IEI4	0.563	0.790	0.440	0.480	0.562	0.377
IEI5.	0.512	0.741	0.477	0.564	0.588	0.406
MAS1	0.397	0.431	0.732	0.536	0.543	0.543
MAS2	0.327	0.437	0.776	0.541	0.551	0.548
MAS3	0.419	0.470	0.781	0.536	0.520	0.545
MAS4	0.354	0.409	0.713	0.515	0.517	0.484
MAS5	0.351	0.454	0.718	0.502	0.490	0.541
NP1	0.421	0.602	0.516	0.711	0.591	0.435
NP2	0.447	0.489	0.529	0.747	0.579	0.476
NP3	0.414	0.532	0.535	0.794	0.626	0.487
NP4	0.424	0.461	0.543	0.767	0.581	0.491
NP5	0.409	0.493	0.579	0.803	0.629	0.511
RDS1	0.462	0.589	0.481	0.533	0.712	0.467
RDS2	0.452	0.555	0.561	0.638	0.753	0.471
RDS3	0.435	0.558	0.542	0.572	0.752	0.446
RDS4	0.362	0.515	0.466	0.551	0.693	0.423
RDS5	0.418	0.533	0.535	0.593	0.764	0.476
SIP1	0.362	0.422	0.560	0.511	0.501	0.776
SIP2	0.336	0.383	0.541	0.506	0.468	0.793
SIP3	0.296	0.359	0.562	0.450	0.492	0.742
SIP4	0.306	0.428	0.535	0.473	0.468	0.761
SIP5	0.286	0.420	0.567	0.486	0.472	0.792

All measurement items loaded highest on their respective constructs, supporting discriminant validity

provide both financial capital and strategic support to early-stage, high-growth potential businesses. Respondents completed questionnaire items relating to venture capital dimensions based on their experiences and perceptions of the identified support mechanisms. The study examined five venture capital dimensions, namely Financial Resources, Investor Expertise, VC-enabled Research and Development (R&D) Investment, Networking and Partnerships, and Market Access Support, in relation to Start-up Innovation Performance. Measurement items were adapted from prior entrepreneurship, innovation, and venture capital literature to ensure content validity and contextual relevance. A table presenting the measurement items, construct sources, and Likert-scale anchors is provided in Appendix A.

Ethical clearance for the study was obtained from the Walter Sisulu University Research Ethics Committee (Approval No: 29/2025/MBM/BME/8910). Participation in the study was voluntary, and informed consent was obtained from all respondents prior to data

collection. Confidentiality and anonymity of participants were maintained throughout the study.

To reduce omitted variable bias, control variables including firm age, firm size, industry sector, and geographic location within the Eastern Cape Province were conceptually considered in the study design. The data were analysed using IBM SPSS Statistics for preliminary data screening and descriptive analysis, while SmartPLS 4 (Ringle et al., 2024) was used to perform Partial Least Squares Structural Equation Modelling (PLS-SEM) to test the proposed hypotheses. Missing data were minimal (<5%/variable) and were handled using mean imputation after confirming that the missingness pattern was random. Reliability, convergent validity, discriminant validity, and structural model relationships were subsequently assessed in accordance with recommended PLS-SEM procedures (Hair et al., 2022; Henseler et al., 2016; Kline, 2016).

5. RESULTS

5.1. Respondent Profile

The demographic profile of the respondents (Table 1) indicates a predominantly female sample (62.9%), with males accounting for 37.1%. The age distribution shows that the majority of respondents fall within the 26-35 (37.4%) and 36-45 (38.7%) age groups, suggesting that the findings largely represent individuals in their economically active years. In terms of marital status, most respondents were single (41.0%), followed by married individuals (28.8%) and those who were divorced or separated (22.9%). Regarding educational attainment, the majority of respondents held a degree (49.1%), followed by diploma qualifications (24.4%), indicating a relatively well-educated sample. Regarding roles in start-ups, most respondents were owners (43.6%), followed by founders (30.1%) and managers (26.2%), suggesting that the data were collected from individuals directly involved in strategic and operational decision-making. In terms of business experience, the majority of start-ups had been in operation for 1-3 years (41.0%) and 4-6 years (35.8%), indicating that the sample consists largely of early-stage, growing ventures. The predominance of female respondents may reflect potential sampling bias and should therefore be considered when interpreting the findings. This demographic profile may not necessarily reflect the broader national profile of entrepreneurship and should therefore be acknowledged as a limitation when interpreting and generalising the findings.

5.2. Measurement Model Assessment

The measurement model was assessed using factor loadings, reliability measures, and cross-loadings. All factor loadings exceeded the recommended minimum threshold of 0.60. confirming acceptable indicator reliability and convergent validity (Hair et al., 2022). Furthermore, cross-loadings (Table 2) indicated that each measurement item loaded highest on its intended construct, thereby supporting construct validity and reducing concerns about construct overlap.

5.3. Discriminant Validity

Discriminant validity (Henseler et al., 2016) was assessed using the Heterotrait–Monotrait (HTMT) ratio and the Fornell–Larcker criterion. Table 3 presents the HTMT matrix. Although most HTMT values were below the recommended threshold of 0.90, one value exceeded the threshold. Specifically, the HTMT value of 0.977 between Networking and Partnerships and VC-enabled Research and Development (R&D) Investment suggests potential conceptual overlap between these constructs and should therefore be interpreted with caution. However, the constructs were retained due to their theoretical distinctiveness and acceptable cross-loading patterns. Furthermore, the Fornell–Larcker criterion confirmed that the square root of the AVE for each construct exceeded its inter-construct correlations, providing additional evidence of discriminant validity.

5.4. Structural Model Assessment

The structural model was assessed using model fit indices, path coefficients, t-statistics, and p-values to determine the relationships between venture capital dimensions and start-up innovation performance. The Standardised Root Mean Square Residual (SRMR) values for the saturated model (0.054) and estimated model (0.075) were below the recommended threshold of 0.10, indicating acceptable model fit. Although the Normed Fit Index (NFI) values of 0.813 and 0.806 were slightly below the recommended threshold of 0.90, they remained within marginally acceptable levels for exploratory PLS-SEM research.

5.4.1. Common method bias

Given that the study relied on self-reported questionnaire data collected from a single source, common method bias (Podsakoff et al., 2003) was considered as a potential limitation. Procedural remedies, including anonymity, confidentiality, and clear questionnaire wording, were implemented during data collection to minimise potential response bias. However, Harman's single-factor test was not formally conducted, which should be acknowledged as a limitation of the study.

5.4.2. Variance inflation factors (VIFs)

Multicollinearity was assessed by examining construct relationships and discriminant validity measures. Although formal variance inflation factor (VIF) statistics were not reported, the structural model results and discriminant validity assessment did not indicate severe multicollinearity concerns among the study constructs. Future studies are encouraged to include full collinearity diagnostics to strengthen model assessment procedures.

5.5. Coefficient of Determination (R^2)

The explanatory power of the structural model was assessed using the coefficient of determination (R^2). As shown in Table 5, the venture capital dimensions collectively explain 55.0% of the variance in Start-up Innovation Performance. This R^2 value indicates substantial explanatory power and suggests that the model possesses satisfactory predictive capability in explaining innovation performance among start-ups in the Eastern Cape Province. The adjusted R^2 value, which closely aligns with the R^2, further confirms the robustness of the model and suggests that the explanatory power is not the result of model overfitting. However, the absence of control variables implies that some variation in innovation performance may also be attributable to omitted organisational or contextual factors. Overall, the findings

Table 3: Hetero-Trait Mono-Trait (HTMT) Ratio

Constructs	Financial Resources	Investor Expertise in Industry	Market Access Support	Networking and Partnerships	Research and Development (R&D) Spending	Start-up Innovation Performance
Financial Resources						
Investor Expertise in Industry	0.844					
Market Access Support	0.618	0.723				
Networking and Partnerships	0.675	0.812	0.872			
Research and Development (R&D) Spending	0.723	0.921	0.888	0.977		
Start-up Innovation Performance	0.497	0.623	0.878	0.759	0.768	

Table 4: Model fit index results

Fit index	Saturated model	Estimated model
SRMR	0.054	0.075
d_ULS	1,347	2,623
d_G	0.508	0.539
Chi-square	1084,238	1122,726
NFI	0.813	0.806

Table 5: R-squared

Research construct	R-square	R-square adjusted
Start-up innovation performance	0.550	0.544

Table 6: Effect size (f^2)

Research construct	f-square
Financial Resources -> Investor Expertise in Industry	0.971
Financial Resources -> Start-up Innovation Performance	0.001
Investor Expertise in Industry -> Research and Development (R&D) Spending	1.272
Investor Expertise in Industry -> Start-up Innovation Performance	0.001
Market Access Support -> Start-up Innovation Performance	0.246
Networking and Partnerships -> Market Access Support	0.998
Networking and Partnerships -> Start-up Innovation Performance	0.019
Research and Development (R&D) Spending -> Networking and Partnerships	1.617
Research and Development (R&D) Spending -> Start-up Innovation Performance	0.010

According to Cohen (1988), f^2 values above 0.35 are considered large effect sizes. The exceptionally large effect sizes observed in certain relationships, particularly VC-enabled Research and Development (R&D) Investment→Networking and Partnerships ($f^2 = 1.617$) and Investor Expertise in Industry→VC-enabled Research and Development (R&D) Investment ($f^2 = 1.272$), may indicate potential conceptual overlap between constructs rather than purely substantive effects and should therefore be interpreted with caution

indicate that the model explains a meaningful proportion of variation in start-up innovation performance within the Eastern Cape context.

5.6. Effect Size (f^2)

The effect size (f^2) was assessed to determine the relative contribution of each venture capital dimension to the endogenous constructs within the structural model (Table 6). The results reveal varying levels of influence among the examined relationships. Market Access Support demonstrated the strongest direct effect on Start-up Innovation Performance ($f^2 = 0.246$), confirming its practical importance in enhancing innovation outcomes among start-ups in the Eastern Cape Province. Networking and Partnerships exhibited a relatively small effect on innovation performance ($f^2 = 0.019$), while Financial Resources ($f^2 = 0.001$), Investor Expertise in Industry ($f^2 = 0.001$), and VC-enabled Research and Development (R&D) Investment ($f^2 = 0.010$) demonstrated negligible direct effects.

However, several indirect relationships produced exceptionally large effect sizes. VC-enabled Research and Development (R&D) Investment demonstrated a very large effect on Networking and Partnerships ($f^2 = 1.617$), while Investor Expertise in Industry exerted a substantial effect on VC-enabled Research and Development (R&D) Investment ($f^2 = 1.272$). These findings suggest that certain venture capital dimensions may contribute to innovation performance indirectly through relational and ecosystem-based pathways rather than through direct effects alone. This observation aligns with the assumptions of the Triple Helix Model, which emphasises collaborative and interconnected innovation processes. Although these large effect sizes may indicate strong theoretical relationships among the constructs, they may also suggest potential conceptual overlap between certain dimensions. Future studies should therefore further explore these indirect pathways and assess potential construct interdependencies within venture capital ecosystems.

5.7. Hypothesis Testing

The hypothesis testing results are presented in Table 7. Path coefficients, t-statistics, p-values, and 95% confidence intervals obtained through bootstrapping were used to evaluate the proposed relationships. Networking and Partnerships ($\beta = 0.163$, $P = 0.025$, 95% CI [0.019, 0.305]) and Market Access Support ($\beta = 0.503$, $P < 0.001$, 95% CI [0.348, 0.638]) were positively and significantly associated with Start-up Innovation Performance. These findings suggest that relational and market-oriented venture capital dimensions are associated with innovation performance among start-ups operating within the Eastern Cape Province.

However, Financial Resources ($\beta = -0.032$, $P = 0.566$, 95% CI [−0.139, 0.076]), Investor Expertise in Industry ($\beta = 0.040$. $P = 0.575$, 95% CI [−0.103, 0.176]), and VC-enabled Research and Development (R&D) Investment ($\beta = 0.128$, $P = 0.120$. 95% CI [−0.032, 0.291]) did not demonstrate statistically significant relationships with Start-up Innovation Performance. Accordingly, there was insufficient evidence to conclude that these dimensions were significantly associated with innovation performance within the sampled start-ups. Therefore, the null hypotheses relating to these relationships could not be rejected.

Table 7: Path analysis results

Hypothesised relationship	Hypothesis	Path coefficient (β)	T-Statistics	P-value	95% Confidence interval	Decision Outcome
Financial Resources→Start-up Innovation Performance	H_1	−0.032	0.574	0.566	(−0.139, 0.076)	Not significant (fail to reject null)
Investor Expertise→Start-up Innovation Performance	H_2	0.040	0.561	0.575	(−0.103, 0.176)	Not significant (fail to reject null)
VC-enabled Research and Development (R&D) Investment→Start-up Innovation Performance	H_3	0.128	1.555	0.120	(−0.032, 0.291)	Not significant (fail to reject null)
Networking and Partnerships →Start-up Innovation Performance	H_4	0.163	2.239	0.025	(0.019, 0.305)	Significant and supported
Market Access Support→Start-up Innovation Performance	H_5	0.503	6.889	0.000	(0.348, 0.638)	Highly significant and supported

5.8. Path Model

The PLS estimation path coefficient values and item loadings for the research constructs are presented in Figure 2. The path coefficients from the structural model reveal the specific strengths of the relationships between venture capital dimensions and start-up innovation performance. The results confirm that market access support (β = 0.503) is the strongest predictor of innovation performance, followed by networking and partnerships (β = 0.163). In contrast, financial resources (β = −0.032), investor expertise in industry (β = 0.040), and research and development (R&D) spending (β = 0.128) demonstrate relatively weak relationships with innovation performance. Furthermore, the model exhibits satisfactory psychometric properties, as evidenced by the high factor loadings of the measurement items on their respective constructs, thereby confirming the reliability of the measurement scales used in the study. Overall, the structural model establishes that market-oriented and relational venture capital dimensions are more strongly associated with innovation performance among start-ups operating within the Eastern Cape Province.

6. DISCUSSION OF RESULTS

6.1. Discussion of Significant Findings

The findings of this study provide important insights into the relationships between venture capital dimensions and Start-up Innovation Performance within this sample of Eastern Cape start-ups. The results partially support the proposed conceptual model, with only two of the five hypothesised relationships found to be statistically significant. The strongest relationship was observed between Market Access Support and Start-up Innovation Performance (H_5: β = 0.503, P < 0.001), followed by Networking and Partnerships and Start-up Innovation Performance (H_4: β = 0.163, P = 0.025). These findings suggest that non-financial venture capital dimensions, particularly market-oriented and relational support mechanisms, are more strongly associated with innovation performance than purely financial and knowledge-based inputs within this sample of Eastern Cape start-ups. This aligns with the findings of Acs et al. (2017) and Audretsch and Belitski (2021), who emphasised the importance of external market opportunities and entrepreneurial ecosystems in promoting innovation outcomes among start-ups.

The significant relationship between Networking and Partnerships and Start-up Innovation Performance confirms the importance of collaboration and strategic alliances within entrepreneurial ecosystems. These findings support previous studies by Granovetter (1985), Nahapiet and Ghoshal (1998), who argued that networks facilitate access to critical resources, information, and opportunities associated with organisational performance. From a theoretical perspective, this finding supports the Triple Helix Model, which emphasises the importance of collaboration between firms, institutions, and stakeholders in shaping innovation processes (Etzkowitz and Leydesdorff, 2000). The findings therefore suggest that strong networks and partnerships are associated with improved access to knowledge, institutional support, and strategic opportunities within entrepreneurial ecosystems.

Similarly, the findings indicate that Market Access Support demonstrates the strongest positive relationship with Start-up Innovation Performance. This suggests that access to markets, customers, and distribution channels is positively associated with innovation outcomes among start-ups operating within the Eastern Cape Province. These findings are consistent with prior studies emphasising that market access enables firms to commercialise innovations and strengthen competitive positioning (Acs et al., 2017; Audretsch and Belitski, 2021). From a Resource-Based View (RBV) perspective, market access support may be regarded as a valuable external resource associated with a firm's ability to exploit entrepreneurial opportunities (Barney, 1991). The findings therefore highlight the importance of integrating market-oriented support mechanisms within venture capital initiatives aimed at strengthening innovation performance.

6.2. Interpretation of Insignificant Findings

In contrast, the non-significant direct relationship between Financial Resources and Start-up Innovation Performance does not demonstrate that financial resources are unimportant. Rather, the findings suggest that within this sample, financial resources alone, without complementary organisational capabilities such as absorptive capacity, strategic direction, and managerial competence, may not directly predict innovation performance. This interpretation aligns with the Resource-Based View's emphasis on resource complementarity (Barney, 1991) and with prior studies conducted in developing economies (Duran et al., 2021). It may

also reflect that the financial resources available to start-ups were insufficient in magnitude or were not specifically aligned with innovation-related activities, a dimension not directly captured by the perceptual measures used in the present study. However, because absorptive capacity was not measured in the present study, this interpretation remains speculative. Future research should therefore examine whether absorptive capacity mediates the relationship between financial resources and innovation performance.

Similarly, the non-significant relationship between Investor Expertise in Industry and Start-up Innovation Performance suggests that external expertise may have limited direct influence unless it is effectively integrated into organisational learning and strategic processes. This finding supports the argument by Cohen and Levinthal (1990) that firms require absorptive capacity to recognise, assimilate, and apply external knowledge effectively.

The findings further revealed that VC-enabled Research and Development (R&D) Investment demonstrated a positive but statistically insignificant direct relationship with Start-up Innovation Performance. One possible explanation is that innovation outcomes associated with R&D investments may take longer to materialise, particularly among early-stage firms operating within resource-constrained environments (Duran et al., 2021). However, because time-lag effects were not formally tested in the present study, this interpretation should also be treated cautiously.

6.3. The Role of Indirect Pathways

While not formally hypothesised, the effect size (f^2) results revealed substantial indirect pathways among the venture capital dimensions. Investor Expertise in Industry strongly predicted VC-enabled Research and Development (R&D) Investment ($f^2 = 1.272$), which in turn strongly predicted Networking and Partnerships ($f^2 = 1.617$), which subsequently predicted Start-up Innovation Performance ($\beta = 0.163$). This cascading pathway suggests that venture capital dimensions may operate synergistically within entrepreneurial ecosystems. Specifically, investor expertise may facilitate R&D investment, which in turn contributes to the development of strategic networks and partnerships associated with innovation performance.

This finding aligns with the Knowledge-Based View's emphasis on knowledge integration and capability development (Grant, 1996), as well as the Triple Helix Model's emphasis on collaborative innovation and interconnected entrepreneurial ecosystems (Etzkowitz and Leydesdorff, 2000). The findings therefore suggest that relational and ecosystem-oriented mechanisms may provide stronger explanatory relevance within the Eastern Cape context than purely financial or knowledge-based resources examined independently.

6.4. Comparison with Prior Literature

The findings of the present study differ from studies conducted in developed economies, where financial resources frequently emerge as significant direct predictors of innovation performance (Kortum and Lerner, 2000). However, the results align more closely with evidence from developing and emerging contexts, where the effectiveness of financial support is often dependent upon broader institutional and ecosystem conditions. For example, Ali et al. (2024) similarly found that market access support and ecosystem-oriented mechanisms were more strongly associated with entrepreneurial performance than purely financial inputs. Comparable findings have also been reported in emerging economy settings, where relational support structures and institutional mechanisms often demonstrate stronger associations with entrepreneurial outcomes than direct financial resources alone.

These comparisons suggest that contextual factors, including institutional quality, market maturity, and ecosystem development, may moderate the relationships between venture capital dimensions and innovation outcomes. Consequently, the findings imply that the relationships between venture capital dimensions and innovation performance may differ across contexts and may not necessarily mirror patterns observed in highly developed venture capital markets.

7. CONCLUSION AND IMPLICATIONS OF THE STUDY

This study offers important theoretical and practical insights into the relationships between venture capital dimensions and Start-up Innovation Performance within the Eastern Cape Province. The findings revealed that Market Access Support and Networking and Partnerships were positively and significantly associated with innovation performance, whereas Financial Resources, Investor Expertise in Industry, and VC-enabled Research and Development (R&D) Investment did not demonstrate statistically significant direct relationships with innovation performance. These findings suggest that innovation outcomes within emerging regional economies may be associated not only with financial investment but also with start-ups' ability to access markets, establish strategic relationships, and integrate into broader entrepreneurial ecosystems.

7.1. Theoretical Implications

This study makes three important contributions to the literature on venture capital and innovation performance within emerging economies. First, the study provides empirical evidence from an under-researched regional context, namely the Eastern Cape Province of South Africa, demonstrating that not all venture capital dimensions are equally associated with innovation performance. Second, the findings indicate that relational and market-oriented dimensions, specifically Networking and Partnerships and Market Access Support, were significantly associated with innovation performance within this sample of Eastern Cape start-ups. Within this sample of start-ups. Third, the study identified substantial indirect pathways among the venture capital dimensions, suggesting a cascading process in which Investor Expertise in Industry strongly predicts VC-enabled Research and Development (R&D) Investment, which subsequently predicts Networking and Partnerships, which in turn is associated with Start-up Innovation Performance.

Rather than extending existing theories, the findings illustrate the complementary application of the Resource-Based View (RBV), Knowledge-Based View (KBV), and Triple Helix Model of Innovation within a developing regional context. Specifically, the findings suggest that relational and ecosystem-oriented mechanisms may provide stronger explanatory relevance within resource-constrained entrepreneurial environments than purely financial inputs examined independently. Furthermore, the study contributes to venture capital literature by disaggregating venture capital into multiple dimensions, thereby providing a more nuanced understanding of how different venture capital mechanisms relate to innovation performance within emerging regional economies. This study also highlights the potential limitations of applying venture capital theories developed in high-income, highly liquid capital markets directly to resource-constrained and emerging regional contexts, where entrepreneurial ecosystems and institutional conditions may differ substantially.

7.2. Practical and Managerial Implications

For entrepreneurs, investors, business support organisations, and policymakers operating within the Eastern Cape Province, the findings provide several practical implications for strengthening innovation performance and entrepreneurial ecosystems.

- Start-up founders should prioritise building strategic partnerships, collaborative networks, and market linkages to strengthen innovation capabilities and improve access to commercial opportunities.
- Venture capitalists and investors should move beyond traditional financial investment approaches by incorporating mentorship, networking facilitation, strategic guidance, and market access initiatives into their investment strategies.
- Business support organisations and incubation hubs should integrate networking activities, collaboration programmes, and institutional partnerships into their core support offerings to strengthen entrepreneurial learning and ecosystem development.
- In the Eastern Cape context specifically, organisations such as the Small Enterprise Development Agency (SEDA) and the Eastern Cape Development Corporation (ECDC) should prioritise market linkage programmes, networking platforms, and ecosystem development initiatives alongside direct financial support mechanisms.
- Policymakers should prioritise the development of entrepreneurial ecosystems that facilitate collaboration between start-ups, universities, industry stakeholders, and innovation institutions in line with the Triple Helix Model of Innovation.
- The findings further support the implementation of targeted interventions such as export support initiatives, innovation hubs, collaborative innovation platforms, and entrepreneurial networking programmes aimed at improving start-up competitiveness and innovation performance within developing regional economies.
- Venture capital firms operating within the Eastern Cape should consider allocating dedicated personnel and resources toward market access facilitation and network brokering activities, as these mechanisms appear more strongly associated with innovation outcomes than financial capital alone.

7.3. Limitations and Future Research Directions

While this study provides valuable insights into venture capital and Start-up Innovation Performance, several limitations present opportunities for future scholarly inquiry.

The primary limitation is that the study was geographically confined to the Eastern Cape Province, which may limit the generalisability of the findings to other regions and entrepreneurial contexts. Furthermore, the use of a cross-sectional research design captured respondents' perceptions at a single point in time, thereby limiting the ability to assess how venture capital dimensions relate to innovation performance over time. Additionally, the study focused on selected venture capital dimensions and did not incorporate potential moderating or mediating variables such as entrepreneurial orientation, organisational culture, absorptive capacity, or institutional support.

The study also relied on a convenience sampling strategy in the absence of a comprehensive sampling frame, which limits the representativeness and generalisability of the findings. Furthermore, although venture capital was operationally defined for respondents, the study did not distinguish between respondents who had received formal venture capital investment and those responding based on broader perceptions of venture capital-related support mechanisms. Because the study relied on self-reported data from a single source, common-method bias may have influenced some of the observed relationships. In addition, the study did not directly measure absorptive capacity, despite its relevance in explaining the integration of external knowledge and resources. Finally, reverse causality cannot be ruled out, as higher levels of innovation performance may also attract stronger venture capital support and ecosystem opportunities.

Building on these findings and limitations, future research should:

- Replicate the study across different provinces, industries, and emerging economies to improve external validity and identify contextual differences in venture capital and innovation relationships.
- Employ longitudinal research designs to examine how venture capital dimensions relate to innovation performance over time and to establish stronger causal inferences.
- Investigate the moderating and mediating effects of variables such as absorptive capacity, entrepreneurial orientation, organisational culture, and institutional support on innovation performance.
- Formally test indirect and mediation pathways involving investor expertise, R&D investment, networking development and innovation performance using advanced statistical techniques.
- Expand the conceptual model by incorporating additional entrepreneurial ecosystem variables such as digital transformation, innovation capability, strategic orientation, and institutional quality.
- Complement quantitative findings with qualitative approaches such as interviews and case studies to gain deeper insights into how entrepreneurs experience venture capital support

and how relational and market-oriented mechanisms shape innovation activities within start-up environments.

Furthermore, the study relied on self-reported perceptual measures of Start-up Innovation Performance, which may not necessarily correspond with objective indicators such as patent outputs, new product launches, or revenue generated from innovative products and services. Additionally, the study did not differentiate between different categories of start-ups, such as technology and non-technology ventures or product- and service-based firms, which may moderate the observed relationships between venture capital dimensions and innovation performance.

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APPENDIX A: MEASUREMENT ITEMS

Items below are reproduced from the study questionnaire (Sections B–G). All items were measured on a five-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = moderately agree, 4 = agree, 5 = strongly agree.

Code	Item	Construct
FR1	VC funding has provided sufficient financial resources for my start-up's innovation activities.	Financial Resources
FR2	Access to VC financial resources has enabled investment in new product or service development.	Financial Resources
FR3	VC funding has improved my start-up's ability to commercialise innovative ideas.	Financial Resources
FR4	Without VC financial resources, my start-up would struggle to sustain innovation projects.	Financial Resources
FR5	VC financial support has directly enhanced the overall innovation performance of my start-up.	Financial Resources
IEI1	VC partners provide valuable industry knowledge that supports innovation in my start-up.	Investor Expertise in Industry
IEI2	My start-up has improved product–market fit through the strategic guidance of VC investors.	Investor Expertise in Industry
IEI3	VC expertise has accelerated the speed of innovation in my business.	Investor Expertise in Industry
IEI4	Investor knowledge and experience have helped my start-up overcome industry-related challenges.	Investor Expertise in Industry
IEI5	VC industry expertise has positively influenced the innovation performance of my start-up.	Investor Expertise in Industry
RDS1	VC funding has allowed my start-up to increase R&D investment.	VC-enabled Research and Development (R&D) Spending
RDS2	R&D spending made possible by VC has improved the quality of our products/services.	VC-enabled Research and Development (R&D) Spending
RDS3	VC-backed R&D activities have enabled us to adopt new technologies.	VC-enabled Research and Development (R&D) Spending
RDS4	Increased R&D expenditure has led to faster development of innovative products.	VC-enabled Research and Development (R&D) Spending
RDS5	VC-supported R&D spending has significantly enhanced the innovation performance of my start-up.	VC-enabled Research and Development (R&D) Spending
NP1	VC partners have connected my start-up with valuable business networks.	Networking and Partnerships
NP2	Networking facilitated by VC has created opportunities for collaboration and innovation.	Networking and Partnerships
NP3	VC partnerships have enhanced my start-up's credibility in the market.	Networking and Partnerships
NP4	VC-supported networks have provided access to resources otherwise unavailable to my start-up.	Networking and Partnerships
NP5	Networking and partnerships enabled by VC have positively influenced the innovation performance of my start-up.	Networking and Partnerships
MAS1	Venture capital support enabled us to secure distribution and sales partnerships that improved our market presence.	Market Access Support
MAS2	My start-up benefits from VC connections that open doors to national or international markets.	Market Access Support
MAS3	Venture capital partners actively facilitate introductions to potential clients, suppliers, or distributors.	Market Access Support
MAS4	Market access support from VC investors has improved the visibility and credibility of my start-up.	Market Access Support
MAS5	VC-backed market access opportunities have positively contributed to the innovation performance of my start-up.	Market Access Support
SIP1	Our start-up has introduced new products or services to the market in the past three years.	Start-up Innovation Performance
SIP2	We have made significant improvements in processes or operations through innovation.	Start-up Innovation Performance
SIP3	A substantial portion of our sales or revenue comes from products or services developed in the last three years.	Start-up Innovation Performance
SIP4	Our start-up has filed for or registered intellectual property (e.g., patents, trademarks, copyrights) as part of our innovation activities.	Start-up Innovation Performance
SIP5	Our innovations have improved our competitive position in the market compared to rivals.	Start-up Innovation Performance