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The Effect of Competitor Alliances on New Venture Milestone Achievement Through Cox Proportional Hazards Modeling

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Abstract – New entrants, primarily because they are startup or early-stage organizations, are usually confined in the market and struggle to gain a footing and sometimes their survival depends on alliances formed by rivals. When competitors enter into strategic alliance, the nature of competition may change, especially when forming a new alliance poses threat to new entrant or increases the levels of competition between competing alliances. To examine this, we use the Cox Proportional Hazards Model, an appropriate statistical technique for studying time-to-event data with regard to how competitor alliances influence the timing of critical events for new ventures, including, for example, fund raising, product introduction, or attaining profitability. Our findings suggest that competitors' alliances influence the rate of completion of the milestones in new ventures and raise the likelihood of failure. Companies that undertook their competition in mature and highly related industries with considerable inter-organizational rivalry reported the highest levels of delay and risk in the initial phases. These findings imply that market forces especially through competitor alliances can dramatically shift growth and survival probabilities of new ventures, information useful to both new venture managers and public policy makers aiming at supporting innovation and entrepreneurship.

Keywords – New Ventures, Entrepreneurship, Competitor Alliances, Economic Development, Corporate Venture Capital, Technological Interdependence.

I. INTRODUCTION

A study by Bashir [1] theoretically defined the "entrepreneur as innovator" as a pivotal character in fostering economic progress. Entrepreneurial innovation stimulates a creative "destruction process" by perpetually disrupting an equilibrium economic system, hence generating chances for economic rent. As equilibrium is achieved, other inventions emerge, and a greater number of entrepreneurs join the economic system. Bashir's study posits that a rise in the number of entrepreneurs correlates with enhanced economic development. This hypothesis, however impactful, is mostly descriptive and challenging to formalize econometrically. As a result, entrepreneurship is absent from the majority of empirical models that explain economic development. Building upon this study, later empirical economic literature has embraced the concept of innovation as a catalyst for economic progress. A substantial amount of empirical data currently exists internationally. Conversely, although conceptual and descriptive literature about the role of entrepreneurs has proliferated, the empirical literature has long been silent on this topic. This is partly attributable to the challenges in quantifying and implementing entrepreneurial activity.

Ecosystem venturing has a wide array of options that may improve the success of new businesses. Recent research on innovation ecosystems and Corporate Venture Capital (CVC) suggests that ecosystem venturing is a novel method used by

ecosystem leaders to tackle these difficulties. Ecosystem venturing refers to a method used by certain organizations, especially in the high-tech industry, to foster the growth of their network of suppliers, consumers, and producers of supplementary goods by offering venture capital for their initiatives. Unlike conventional CVC investments, the primary objective of ecosystem venturing is to assist corporate investors in constructing their innovation ecosystems, as it is posited that equity investments enhance leaders' ability to coordinate and manage the evolution of their innovation ecosystems. From the standpoint of new businesses, they are inclined to engage in ecosystem venturing for many reasons.

Ecosystem leaders serve as strategic investors. When making equity investments in nascent enterprises, they often believe that the technology presented by start-ups would ultimately enhance the ecosystem, thereby positioning themselves as 'patient' investors who are prepared to commit capital over extended durations compared to independent venture capitalists. Secondly, by securing funding from ecosystem leaders, emerging companies may augment their prospects for cooperation and co-specialization. Due to ecosystem leaders' influence over essential technologies and the trajectory of innovation, extensive engagement with them is vital for the development of new companies. Ecosystem leaders often hold pivotal roles within an extensive network including suppliers, purchasers, and complementors, who might potentially become clients of emerging enterprises. Establishing CVC ties with ecosystem leaders may provide start-ups access to these corporations and create competitive advantages over other nascent enterprises that do not get equity investments from the ecosystem leader.

The impact investing sector remains nascent and encounters numerous challenges, such as inadequate capital and a scarcity of high-quality investment opportunities, alongside the necessity for enhanced enabling environments, efficient intermediaries, and appropriate legal frameworks to facilitate further expansion. Despite the well-recognized challenges confronting new businesses within ecosystems, few research has examined their adaptive strategies. A novel generation of locations was formed in the 1990s to address issues pertaining knowledge-oriented globalization and development. These have been designated as technological and regional innovation systems, learning regions, agglomeration economies and innovative clusters, and technology districts. These many explanatory frameworks were developed based on ideas of innovation via networking. According to McAdam et al. [2], the institutional model of these models is anticipated to include universities, basic and applied technology transfer agencies, regional private and public governance entities (e.g., trade associations and commerce chambers), financial institutions, vocational training institutions, research labs. venture capitalists, and interacting both small and large firms.

The purpose of this research is to explore the factors within and dynamics between alliances that influence the survival and attainment of key milestones by new ventures. In particular, it seeks to determine whether such alliances introduce other constraints or competition that hinders new ventures to achieve critical developmental phases including the ability to attract investments, to launch products or attain operational profitability. As the results of structural equation modeling show that competitor alliances have a significant impact on the venture performance, this research aims to give insights to the entrepreneurs, investors, and policymakers on how to manage competitive pressures. The rest of the research has been arranged as follows: Section II describes our theoretical framework and hypotheses such technological alliance as defense mechanism, moderator effects concerning the interdependence with the ecosystem. Section III presents the data and methods of variables, analytical framework, and estimations. Section IV and V discusses the empirical results and verification of findings. Lastly, Section VI concludes the findings obtained in this research.

II. THEORY AND HYPOTHESES

Technological Alliances as Defense Mechanism

Companies often use worldwide corporate venture capital investments and technological alliance strategies concurrently to acquire expertise. CVC investments and technological partnerships are strategies aimed at exploring information related to developing technologies, sharing traits like as flexibility in termination and comparatively modest commitment levels. Simultaneously, these two modalities exhibit considerable divergence in their methodologies and practices regarding inter-organizational connections and information exchanges. The alliance of technology entails collaborative knowledge exchange and development, generally occurring between developed companies that share costs and resources. In contrast, in corporate venture capital (CVC) activities, the target firm predominantly conducts the technology development processes, while the CVC investor primarily offers financial support and, occasionally, strategic advantages such as addressing immediate challenges, granting access to R&D facilities, or connecting the venture with its network.

Entrepreneurial initiatives and innovations have challenged the foundational assumptions of stable consumer preferences and established production operations that are central to neo-classical microeconomics. In modern day economy, competition is significantly more vibrant [3]; accessibility to public goods, institutions, external information, and specialized knowledge, along with the quick production of complementary products and the sharing of strategic future visions, defines ecosystem competition. An ecosystem investor may unilaterally alter technological policy without regard for the requirements of other stakeholders, thereby jeopardizing suppliers, customers, and complementors. When such modifications transpire, enterprises associated with the primary rivals of the ecosystem investor will experience less impact, since they possess access to alternate avenues for acquiring essential resources. Consequently, we provide Hypothesis 1 as follows:

Hypothesis 1: Technological relationships with primary rivals of the ecosystem investor will improve new venture performance.

Moderator Effects of Technological Interdependence with the Ecosystem Investor

Establishing technology partnerships with primary rivals of the ecosystem investor might be seen as a defensive strategy for new businesses to mitigate reliance on the ecosystem investor. These partnerships may be compared to an ecosystem, a metaphor first used by Wulf and Butel [4] to elucidate the notion of business ecosystems. Since that time, researchers have developed the notion of an ecosystem to elucidate the process of collaborative value production and appropriation. An ecosystem is, in a general sense, a network of participants that co-evolves their skills and duties, aligning with the directives established by one or more central enterprises.

Interactions within an innovative environment are typically structured based on technological frameworks with common interfaces, standards, and assets. These frameworks enable participants to integrate their distinct offers, therefore delivering a comprehensive value proposition to clients. Nonetheless, several researchers have examined innovation ecosystems that lack a central technological platform. Nylund and Brem [5] examined the mobile telecommunications ecosystem, where standardization promoted interoperability, allowing stakeholders to interact and create complementarities. According to Malecki [6], the focal offer serves as the beginning point for ecosystems, whereas networks research emphasizes the ecosystem investor and technical interconnectivity.

Technological Similarity

Patents include extensive information on a firm's research and development skills and technical assets, therefore functioning as a crucial data source for evaluating potential R&D partners. Recent research has shown the value of link prediction algorithms in locating possible cooperative links within patent R&D collaboration networks, which provide information about possible partners who have close ties to the target company. Moreover, researchers have included patent citations, IPC co-occurrence data, and other intricate aspects to enhance the study of company R&D cooperation networks. Notwithstanding these gains, the prevailing study on similarity-based methodologies for partner recommendation—utilizing technological attributes or network topology, exhibits limitations. Technologies that are highly analogous restrict the breadth of possible learning, reduce the incentive to pursue new possibilities, and adversely affect the quality and originality of research and development.

Research indicates that technical complementarity among R&D partners enhances information sharing, subsequently leading to the development of both impactful and novel patents. Rothaermel and Boeker [7] suggested a paradigm for proposing R&D cooperation partners that include both technology similarity and technological complementarity. Qian et al. [8] underscored the need of achieving a balanced strategy between technical similarity and technological complementarity in partner selection. Despite existing research emphasizing the substantial influence of technological similarity and technological complementarity on corporate partnerships, a viable approach for concurrently integrating these two essential technological attributes into collaborator recommendations remains undiscovered. Collaborating with other technology leaders, even rivals of the ecosystem investor, allows new ventures to distinguish their technical portfolios from those of the ecosystem investors, so mitigating the competitive threat presented by the latter. Consequently, we provide Hypothesis 2a as stated below.

Hypothesis 2a.: When a nascent enterprise exhibits significant technical similarities with its ecosystem investor, the positive correlation between technological alliances with the ecosystem investor's main rivals and the success of the new venture will be enhanced.

Technological Complementarity

Technology complementarity between enterprises refers to the extent to which their technical problem-solving efforts concentrate on distinct, narrowly determined knowledge domain with shared, widely determined domain of expertise. This concept facilitates the analysis of technical complementarity from both a portfolio and a dyadic viewpoint. As for the later level, complementarity signifies the capacity for relative integration across specified domains of knowledge. We establish sectoral boundaries due to the significance of novel knowledge inputs for firms' research and development efforts. This emphasis on the inter-sectoral aspect aligns with many taxonomies of sectoral innovation patterns that reflect inter-sectoral connections via knowledge production complementarities.

According to Solleiro and Castañón [9], one important component that may boost the competitiveness of the whole national innovation system is “vertical linkages,” which are the interactions and links that innovative companies have with businesses in other parts of the economy. The potential for inter-sectoral integration may differ across industries based on the extent to which their competitive advantages depend on information from companies in other sectors. The distinctions in sectoral innovation modes may be significant. Tu, Zhang, and Li [10] delineates four innovation modes in this context: science-based, specialized supplier, scale-intensive, and supplier-dominated. These emphasize the types of connections companies must enhance to provide advantages associated with intersectoral information dissemination.

The network approach or alliance portfolio contends that technological complementarity exists not alone at dyadic R&D collaboration levels, but is also a consequence of the whole collaboration portfolio of firms. A synthesis of these ideas indicates that establishing technical alliances with primary rivals of the ecosystem investor may adversely affect the performance of new ventures that possess significant technological complementarity with their ecosystem investor.

Hypothesis 2b. The positive correlation between new venture success and technical alliances with the ecosystem investor's main rivals will be less pronounced when the new venture has a high level of technological complementarity with its ecosystem investor.

III. DATA AND METHODS

This research seeks to establish the effect of strategic partner alliances with the core competitors of ecosystem investors on new venture performance including Initial Public Offering (IPO) or acquisition outcomes. The research uses a quantitative research method with the Cox proportional hazards model, which can be mathematically expressed as in Eq. (1).

$$\mathrm{Ht} = \mathrm{H_0t} \times \exp\beta_1 \mathrm{x}_1 + \beta_2 \mathrm{x}_2 + \cdots \beta_\mathrm{n} \mathrm{x}_\mathrm{n} \tag{1}$$

where $x_1 \cdots x_n$ denote the predictor variables and $H_0 t$ signifies the baseline hazard at time t, representing the hazard for an individual with the predictors set to zero. By calculating the exponential of the regression coefficients "$\beta_1 \cdots \beta_n$" (as explicitly supplied by the program), we may get the hazard ratio (HR) of a specific risk factor or predictor inside the model. Using the model, we examined how different technological and competitive factors influenced the probability of attaining major performance targets.

Data Collection and Variables

Our study is derived from a sample of 4903 new ventures created between the years 2010 and 2020. The dataset was obtained from various databases comprising of venture capital database, acquisition announcement database, and Initial Public Offering (IPO) database to have a holistic view of entrepreneurial activities. Every observation has variables reflecting the attributes of the venture, technological compatibility with ecosystem investors, and strategic partnerships. The dependent variable for this study is newly created as the event of new venture performance, where it takes the binary form as 1 if a venture has either gone public (IPO) or has been favorably acquired, otherwise as 0. This operationalization is mathematically represented as in the Eq. (2) below.

$$\mathrm{Performance} = \begin{cases} 1, & \text{if } \mathrm{IPO_i} \text{ or } \mathrm{Acquisition_i} \geq \mathrm{Capital_i} \\ 0, & \text{Otherwise} \end{cases} \tag{2}$$

The independent variables include Technological Complementarity (TC), which is the level of compatibility of technological skills of the venture and its ecosystems investors and Technological Similarity (TS) which is measured in terms of similarity index of technological specialties. Furthermore, core competencies of ecosystem investors are represented by the alliances with other core competitors within an ecosystem of the investors, which is a binary variable indicating that a new venture has established an alliance with a core competitor of its ecosystem investors. These control variables include industrial uncertainty, industrial growth, number of investors and patent count that are proposed to affect the probability of achieving performance milestones. The above stated control variables are termed Industrial Uncertainty (IU), Industrial Growth (IG), Number of Investors (NI), and Patent Count (PC).

Analytical Framework

Using Cox proportional hazards, the analytical framework measures timing of performance of milestones. The Cox model represents as a general form the Eq. (3). The hazard model in this case is $h(t|X)$, which depicts the hazard function at a certain time t when certain factors X are considered, $h_0(t)$ is the baseline hazard while β is coefficients which are estimated. The study carries forward using multiple models for overall analysis. The first model consists of the control variables only which is articulated in Eq. (4).

$$\mathrm{h(t|X)} = \mathrm{h_0(t)exp}(\beta^\mathrm{T}\mathrm{X}) \tag{3}$$

$$\mathrm{h(t|X)} = \mathrm{h_0(t)exp}(\beta_0 + \beta_1 \mathrm{IU} + \beta_2 \mathrm{IG} + \beta_3 \mathrm{NI} + \beta_4 \mathrm{PC} + \cdots + \beta_\mathrm{n} \mathrm{Z_n}) \tag{4}$$

where Z_n contains other appropriate control variables. The second model in Eq. (5) explains the research manipulation, alliances between ecosystem investors and core competitors. In the third model, technological similarity and alliances with core competitors as well as the cross-term product are added using Eq. (6).

$$\mathrm{h(t|X)} = \mathrm{h_0(t)exp}(\beta_0 + \beta_1 \mathrm{IU} + \beta_2 \mathrm{IG} + \beta_3 \mathrm{NI} + \beta_4 \mathrm{PC} + \cdots + \beta_{\mathrm{n}+1} \mathrm{Alliance_{investor}}) \tag{5}$$

$$\mathrm{h(t|X)} = \mathrm{h_0(t)exp}\left(\begin{matrix} \beta_0 + \beta_1 \mathrm{IU} + \beta_2 \mathrm{IG} + \beta_3 \mathrm{NI} + \beta_4 \mathrm{PC} + \\ \beta_{\mathrm{n}+1} \mathrm{Alliance_{investor}} + \beta_{\mathrm{n}+2} (\mathrm{TS} \times \mathrm{Alliance_{investor}}) \end{matrix}\right) \tag{6}$$

The fourth model in Eq. (7) includes the product–technology interaction term of technological complementarity and alliances with the core competitors. The final model in Eq. (8) integrates full specifications for both the independent and control variables.

$$h(t|X) = h_0(t)exp\begin{pmatrix}\beta_0 + \beta_1 IU + \beta_2 IG + \beta_3 NI + \beta_4 PC + \\ \beta_{n+1} Alliance_{investor} + \beta_{n+3}(TC \times Alliance_{investor})\end{pmatrix} \quad (7)$$

$$h(t|X) = h_0(t)exp\begin{pmatrix}\beta_0 + \beta_1 IU + \beta_2 IG + \beta_3 NI + \beta_4 PC + \beta_{n+1} Alliance_{investor} + \\ \beta_{n+2} Alliance_{investor} + \beta_{n+3}(TC \times Alliance_{investor})\end{pmatrix} \quad (8)$$

Estimation Procedure, Survival Model and Interactive Effects

The results presented in the study were obtained applying the Cox proportional hazards model which was fitted by the 'survival' package in R that provides tools for using a great variety of survival analysis methods. The models were checked for the PH assumptions using graphical and analytical methods like Schoenfeld residuals test to check for validity of the assumptions. To strengthen the analysis, other analyses have been carried out as follows; the study used an alternative measure of performance whereby the dependent variable was coded into IPOs and acquisitions in order to test findings against different performance measures. Since endogeneity was a concern, CEM was used to match the firms that formed alliances with competitors to firms that did not, by similar observable characteristics. The exponential, Weibull, and Gompertz distributions were employed to confirm the Cox model results presented in Eq. (9).

$$h(t) = \lambda \cdot exp(\beta^T X) \quad (9)$$

for each of the distributions, and λ differs for each distribution in question. The Heckman two-stage model was also used to address selection bias in the formation of alliances with competitors; the Inverse Mill's ratio was used in the second stage of the Heckman model. The first-stage selection model can also be expressed as in Eq. (10).

$$Y_i^* = \beta_0 + \beta_1 Alliance_{investor} + \beta_2 Z_i + u_i \quad (10)$$

The structural model is represented by the following equations: $Y_i^* > 0$, where Y_i^* is the unobserved variable, Z_i is observable characteristic, and u_i is an error term. To analyse the interaction effects satisfactorily, the marginal effects of the alliances with the core competitors of the ecosystem investors were calculated at different degrees of technological substitutability and complementary. We employed Eq. (11) and Eq. (12) assigned to technological similarity and technological complementarity, respectively.

$$\frac{\vartheta h(t|X)}{\vartheta Alliance_{investor}} = \beta_{n+1} + \beta_{n+2} \cdot TS \quad (11)$$

$$\frac{\vartheta h(t|X)}{\vartheta Alliance_{investor}} = \beta_{n+1} + \beta_{n+3} \cdot TC \quad (12)$$

The results of the marginal effect analysis were supported by graphical illustrations of the interactions and the respective confidence intervals, which provided a better understanding of how technological factors influence the moderating effects of alliances on new venture performance.

IV. RESULTS

Empirical Results

Table 1 encapsulates the main findings from the Cox models analyzing the influence of our independent variables on the likelihood of a new firm either going public or being acquired. Model 1, the baseline, used just the control variables shown in **Table 1**. The second model now included the independent variable "alliance investor competitor," denoting the investor's connections to the primary competitors within the ecosystem. Model 4 included alliances characterized by technical complementarity (TC) and technological similarity (TS) with principal rivals of the ecosystem investor, whereas Model 3 had analogous terminology about alliances with core competitors of the investor. Ultimately, Model 5 included all variables comprehensively.

Table 1. Cox Model for Assessing the Likelihood of Achieving Venture Performance Milestones

Variables	***New venture performance (IPO and acquisition)***				
	Model 1	Model 2	Model 3	Model 4	Model 5
Technological Complementarity (TC)	-0.501 [0.150]	-0.593 [0.058]	-0.581 [0.067]	-0.447 [0.148]	-0.418 [0.207]

Technological Similarity (TS)	0.293 [0.159]	0.278 [0.130]	0.256 [0.182]	0.245 [0.204]	0.302 [0.080]
Industrial uncertainty	-9.496 [0.001]	-9.930 [0.000]	-9.870 [0.000]	-9.753 [0.000]	-9.860 [0.000]
Industrial growth	1.937 [0.000]	1.955 [0.000]	1.951 [0.000]	1.948 [0.000]	1.953 [0.000]
Co-invested	-0.015 [0.899]	-0.048 [0.614]	-0.043 [0.668]	-0.025 [0.813]	-0.028 [0.784]
Secrecy defence	-0.012 [0.874]	-0.005 [0.949]	-0.005 [0.945]	-0.003 [0.966]	-0.001 [0.991]
Patent defence	0.021 [0.802]	0.027 [0.727]	0.027 [0.714]	0.024 [0.751]	0.022 [0.785]
Number of investors	0.024 [0.053]	0.024 [0.039]	0.024 [0.041]	0.024 [0.037]	0.024 [0.035]
Number of investment rounds	0.052 [0.000]	0.049 [0.000]	0.049 [0.000]	0.048 [0.000]	0.048 [0.000]
Alliance_investor non-competitor	0.003 [0.722]	-0.002 [0.741]	-0.003 [0.699]	-0.003 [0.651]	-0.002 [0.730]
Alliance_investor	0.159 [0.295]	0.019 [0.900]	0.021 [0.889]	0.025 [0.864]	0.020 [0.892]
Geographic location	0.056 [0.502]	0.059 [0.506]	0.059 [0.500]	0.064 [0.459]	0.067 [0.439]
Venture age	-0.000 [0.989]	-0.001 [0.928]	-0.001 [0.925]	-0.000 [0.948]	0.002 [0.877]
Technological diversity	-0.007 [0.409]	-0.005 [0.615]	-0.005 [0.640]	-0.004 [0.716]	-0.004 [0.700]
Patent count	-0.004 [0.920]	-0.015 [0.685]	-0.017 [0.660]	-0.023 [0.551]	-0.019 [0.625]
Number of observations	4903	4903	4903	4903	4903
TC × Alliance_investor competitor				-0.633 [0.000]	-0.893 [0.001]
TS × Alliance_investor competitor				-0.0829 [0.575]	-0.246 [0.170]
Alliance_investor competitor		0.373 [0.000]	0.352 [0.000]	0.576 [0.000]	0.722 [0.000]

*Notes: 1. **p < 0.001, **p < 0.01, *p < 0.05, +p<0.10; **tailed; **p values in parenthesis. There is no table support for the coefficients, and the regression includes ecosystem investor dummies.*

Hypothesis 1 posits that new enterprises are more inclined to attain performance benchmarks when they build technological alliances with the key competitors of the ecosystem investor. The positive and statistically significant coefficient for collaborations with primary competitors of ecosystem investors in Model 2 (b = 0.373, p = 0.000) aligns with the hypothesis. The findings indicate that, ceteris paribus, the likelihood of performance milestone events for new ventures increases by 19.85% when collaborations with primary competitors of ecosystem investors shift from the mean to one standard deviation above the mean.

According to Hypothesis 2a, the relationship between alliances with principal competitors of ecosystem investors and the success of a new endeavor may be positively influenced by technical similarities between the two parties. A positive although non-significant correlation (b = 0.083, p = 0.575) is shown for the interaction term TSÏ relationships with primary competitors of ecosystem investors in Model 3. Consequently, we are unable to accept Hypothesis 2a. According to Hypothesis 2b, alliances with principal competitors of ecosystem investors would negatively impact the performance of a new endeavor due to technological complementarity. This is applicable to ecosystem leaders and emerging enterprises. Hypothesis 2b is corroborated by the negative and statistically significant coefficient (b = −0.633, p = 0.000) for the interaction term TC× relationships with important rivals of the ecosystem investor in Model 4.

The coefficients for the main effect and interaction effect in Model 5 remain consistent: alliances with core competitors of the ecosystem investor: b = 0.722, p = 0.000; TS × alliances with core competitors of the ecosystem investor: b = −0.246, p = 0.170; TC × alliances with core competitors of the ecosystem investor: b = −0.893, p = 0.001. Initially, we assessed the marginal effect of ecosystem investors' collaborations with primary competitors on the development of new enterprises when technological similarity exceeds the mean by one standard deviation. The extent of alliances with primary competitors of ecosystem investors' beneficial effect on the probability of new ventures achieving performance milestone events diminishes by 7.30 percent as technological similarity rises from the mean to one standard deviation above the mean, with all other variables maintained at their means. We investigated the marginal consequences over the whole range of similarity values, from 0 to 0.80. The results indicate that the marginal effect of partnerships with primary competitors of ecosystem investors on the performance of new ventures remains positive and substantial, even when the similarity value fluctuates between 0 and 0.80.

Table 1 presents the findings of Model 5 about the marginal influence of partnerships with primary competitors of ecosystem investors on the development of new ventures. This is complemented by 95% confidence ranges for the moderating variable technical similarity, which span from 0 to 0.80 (refer to **Fig. 1**). The corresponding 95% confidence intervals indicate that, considering technical similarities, the marginal effect is statistically significant, ranging from 0 to 0.80. Collaborations with principal competitors of ecosystem investors adversely impact the development of new companies, as seen in **Fig. 1**. This impact intensifies with the degree of technical similarity. The positive link between relationships with important competitors of ecosystem investors and the performance of new enterprises decreases as technical proximity grows. The combined use of coefficient and marginal effect analysis refutes Hypothesis 2a.

To assess the influence of alliances with significant competitors of ecosystem investors on the success of new ventures when technological complementarity is one standard deviation above the mean, we first calculated the marginal effect of technological complementarity. The results indicate that, ceteris paribus, there is a 37-92% decrease in the probability of a new venture achieving performance milestone events when technological complementarity increases from the mean to one standard deviation above the mean. This phenomenon results from partnerships with primary rivals of ecosystem investors.

Additionally, **Table 1** presents 95% confidence intervals for the moderating variable of technical complementarity, which varied from 0 to 0.68 as per Model 5.

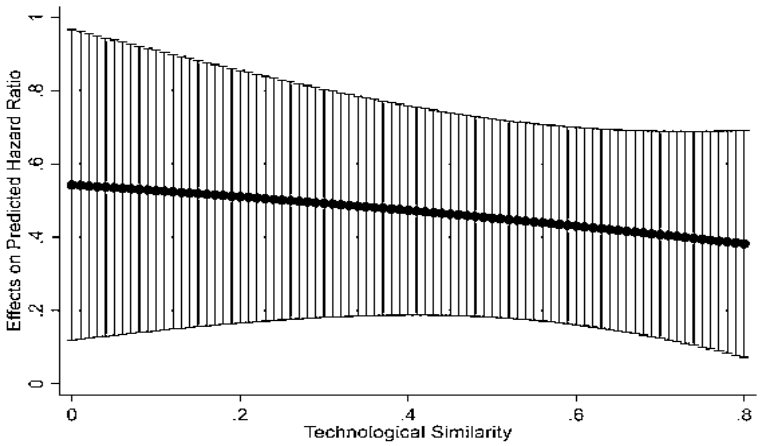

Fig 1. Interaction Effect Between Technical Similarity and Primary Competitors of Ecosystem Investors

Furthermore, we illustrated the marginal effect of alliances with principal competitors of ecosystem investors on the success of new ventures (refer to **Fig. 2**. **Fig. 2** illustrates that the marginal impact of agreements with primary rivals of ecosystem investors diminishes as technical complementarity increases. A rise in technical complementarity diminishes the beneficial correlation between agreements with key rivals of ecosystem investors and the success of new ventures. The 95% confidence intervals indicate that the positive impact is substantial when technological complementarity is below 0.65. Furthermore, this moderating effect is statistically significant at the 95% level for 98.59 percent of data (technological complementarity <0.65). The integration of coefficient and marginal impact analysis indicates support for Hypothesis 2b.

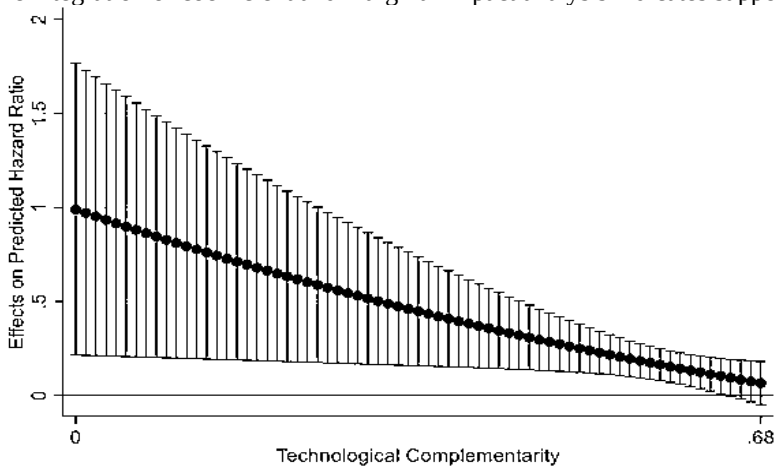

Fig 2. Interaction Impact Between Alliances with Main Ecosystem Investors and Technical Complementarity Verification of Results.

To validate the empirical findings, we conducted various further tests. Initially, we assessed the robustness of our results by using an alternate metric to evaluate new venture success. The performance of the new enterprise was awarded a value of '1' if it underwent an IPO or experienced a favorable acquisition; otherwise, it was assigned a value of '0'. A purchase is deemed favorable when the transaction value meets or exceeds the entire cash raised, as per Opler [11]. Regrettably, we were unable to get the transaction amounts for all acquisition agreements, resulting in a reduced sample size of 3,870 observations. For this subsample, we observed results that were consistent with the original findings.

Furthermore, we used the Heckman two-stage model to address the issue of endogenous selection in establishing alliances with rivals of ecosystem investors. To implement a Heckman two-stage model, we converted the number of alliances into a binary variable signifying that a new endeavor had at least one alliance with rivals of ecosystem investors. Initially, we analyzed the factors influencing a new venture's inclination to establish alliances with rivals of ecosystem investors, and later used the Inverse Mill's ratio as an extra covariate in the following stage. Bendig and Hoke [12] contended that it is essential to use exclusion limitations while executing the Heckman two-stage regression, which serves as the treatment effect model in this article. We used the proportion of other new ventures within the same industry as the focal

venture that establish alliances with rivals of ecosystem investors in the year t-1 (Industry % of other venture alliancet-1) as the excluded variable.

In the first phase, the coefficient for Industry % of other venture alliance at time t-1 is both positive and statistically significant (b = 1.653, p < 0.001). Furthermore, there is no definitive rationale to assert that the alliance activity of other ventures directly influences the performance of the focus venture via mechanisms outside its own alliance creation, hence satisfying the exclusion constraint of Industry % of other venture alliance t-1. The Heckman Cox models yielded consistent findings, as shown in **Table 2**.

Table 2. Heckman Two-Staged Model

Variables	***First-stage (Competitor_alliance_dummy)***	***Second-stage (New venture performance)***				
		Model 1	Model 2	Model 3	Model 4	Model 5
Technological Complementarity (TC)	0.889*** [0.000]	-0.471 [0.133]	-0.589 [0.069]	-0.576 [0.080]	-0.448 [0.162]	-0.424 [0.213]
Technological Similarity (TS)	1.308*** [0.000]	0.275 [0.187]	0.264 [0.151]	0.241 [0.217]	0.231 [0.223]	0.289 [0.104]
Industrial uncertainty	-0.488 [0.709]	-9.773*** [0.000]	-10.020*** [0.000]	-9.957*** [0.000]	-9.850*** [0.000]	-9.961*** [0.000]
Industrial growth	0.701 [0.058]	1.952*** [0.001]	1.943*** [0.000]	1.940*** [0.000]	1.935*** [0.000]	1.939*** [0.000]
Co-invested	0.087 [0.168]	-0.011 [0.928]	-0.045 [0.667]	-0.035 [0.720]	-0.034 [0.834]	-0.034 [0.797]
Secrecy defence	-0.122** [0.001]	-0.014 [0.843]	-0.006 [0.936]	-0.006 [0.931]	-0.001 [0.954]	-0.001 [0.984]
Patent defence	-0.042 [0.417]	0.025 [0.759]	0.026 [0.736]	0.027 [0.721]	0.020 [0.760]	0.020 [0.799]
Number of investors	-	0.023** [0.000]	0.025** [0.030]	0.024** [0.044]	0.024** [0.042]	0.024** [0.042]
Number of investment rounds	0.041*** [0.000]	0.057*** [0.000]	0.049*** [0.000]	0.049*** [0.000]	0.048*** [0.000]	0.048*** [0.000]
Alliance_investor non-competitor	-0.004 [0.621]	-0.003 [0.730]	-0.003 [0.687]	-0.003 [0.654]	-0.003 [0.761]	-0.002 [0.761]
Alliance_investor	-	0.071 [0.648]	0.021 [0.890]	0.027 [0.879]	0.022 [0.855]	0.022 [0.882]
Geographic location	-0.041 [0.446]	0.056 [0.541]	0.060 [0.492]	0.061 [0.485]	0.066 [0.442]	0.069 [0.421]
Venture age	-0.034*** [0.000]	-0.004 [0.757]	-0.001 [0.907]	0.001 [0.902]	0.002 [0.967]	0.002 [0.884]
Technological diversity	-0.046*** [0.000]	-0.008 [0.331]	-0.005 [0.547]	-0.004 [0.574]	-0.004 [0.665]	-0.004 [0.666]
Patent count	0.128*** [0.000]	0.005 [0.875]	-0.010 [0.781]	-0.012 [0.747]	-0.018 [0.619]	-0.016 [0.681]
Number of observations	4898	4898	4898	4898	4898	4898
IMR	0.289*** [0.000]	0.022 [0.856]	0.025 [0.832]	0.008 [0.939]	-0.014 [0.901]	-0.014 [0.901]
TC × Alliance_investor competitor	-	-0.630*** [0.000]	-	-0.907*** [0.000]	-	-0.907*** [0.000]
TS × Alliance_investor competitor	-	0.089 [0.577]	-	-0.257 [0.117]	-	-0.257 [0.117]
Alliance_investor competitor	0.355*** [0.000]	0.330** [0.005]	0.569*** [0.000]	0.741*** [0.000]	0.741*** [0.000]	0.741*** [0.000]
Cons	-1.856*** [0.000]	-	-	-	-	-
Industry % of other venture alliance	2.156*** [0.000]	-	-	-	-	-

Note: 1. Two-tailed; ***p < 0.001, **p < 0.01, *p < 0.05, +p < 0.10. 2. P-values included in parentheses. 3. Ecosystem investor dummy variables are included in the regressions, and the coefficients are not shown in the table.

Finally, acknowledging that an excessive number of alliances may lead to increased coordination costs and complications, we included the squared term of alliances with key rivals of ecosystem investors to examine possible

curvilinear impacts. The coefficient for partnerships with key rivals of the ecosystem investor is statistically significant and positive, however the squared term is not significant. This supplementary research validated the anticipated positive linear correlation between partnerships with main rivals of ecosystem investors and the success of new ventures.

V. DISCUSSION

New enterprises have significant obstacles inside innovation ecosystems due to role conflict and power imbalances. This research investigates the effects of defense mechanisms afforded by technology alliances between new ventures and their ecosystem investor rivals on the performance of new ventures. Our data demonstrate the beneficial effect of such agreements on the likelihood of new venture success. Furthermore, this influence is tempered by the technical interdependence between ecosystem investors and their investee firms. These findings indicate that in the context of ecosystem venturing, the success of new ventures is contingent upon their ability to mitigate the power disparity with their ecosystem investor and achieve an optimal equilibrium between two potentially conflicting roles: that of a follower within the ecosystem and a leader in their own company's development. Our research enhances comprehension of alliance strategy within innovation ecosystems and adds to several scholarly domains in entrepreneurship and strategic management.

Emerging enterprises inside the innovation ecosystem, referred to as 'platform-dependent entrepreneurs,' encounter power imbalances and role conflicts intrinsic to ecosystems, often resulting in the disadvantages of ecosystem membership. Platform-based entrepreneurship significantly diverges from conventional entrepreneurship. Cavoukian [13] assert that PDEs provide dual functions concurrently. PDEs manage enterprises aiming for objectives, with the platform serving as a middleman. To the platform owner, the PDEs serve as complementors, whose significance is contingent upon their ability to enhance the platform's value. Thus, entrepreneurial processes and results are influenced by the dynamics established by participation in a digital platform ecosystem. Jiang and Stylos [14] demonstrate that digital platforms in an app store provide ecosystem participants with insights on the financial viability of their goods, therefore affecting their inclination to commercialize their software applications. On the other hand, Srinivasan and Venkatraman [15] employing a network perspective explain how entrepreneurial performance in a digital context is related to the dynamic competition inherent in digital networks and their environments.

Our work focuses on the complex roles of technological interconnection, which is explained with the help of ideas from Dedehayir, Mäkinen and Ortt [16]. The rapid rate at which digitalization is occurring in the Information and Communication Technology (ICT) industry is forcing organizations to shift the locus of their technical innovation from discrete goods and services to complex value offerings. Such complex value offerings require restructuring that of the multilateral info, a difficult feat for any single organization to accomplish internally. Therefore, it is important in the area of technological advancement to gain diverse experience from counterparts from diverse industries. This is mainly due to the fact that technical innovations often arise from the amalgamation of pre-existing elements. Focusing on several disciplines might provide innovators with an extensive viewpoint, propelling them toward significant innovation. Breakthrough innovation refers to a category of breakthroughs that transform the industrial landscape, establishing new markets and clientele by altering the direction of current technological paradigms. Therefore, it is increasingly crucial to examine breakthrough technological innovation within the ICT industry in relation to the Innovation Ecosystem (IE).

Innovation Ecosystem (IE) is characterized as "the alignment structure of the multilateral set of partners that must interact for a focal value proposition to materialize". Companies generate value via complementarities arising from the integration of their products with other elements in the ecosystem. Complementarity is defined as the interdependence among current producers of complementary information, referred to as "complementors," and the integration of their expertise into innovative solutions. Non-generic complementarities among complementors are the essence of the IE. Unlike generic complementarities, which can manifest in markets without necessitating specific coordination among economic agents (for instance, consumers can independently purchase and combine boiling water, tea bags, and tea), non-generic complementarities demand the establishment of a precise relational structure and alignment among economic actors to create value within the ecosystem. These non-generic complementarities exhibit distinct and supermodular traits. Distinct complementarity indicates that the elements supplied by complementors precisely fulfill the needs of value co-creation. Simultaneously, supermodular complementarity underscores the interconnectedness of complementors to provide more value ideas.

We differentiate between two types of dependency in the technical sphere (i.e. similarity and complementarity) and examine their unique effects on the performance of new ventures. Our data indicate that technical complementarity adversely influences the association between alliances with key rivals of ecosystem investors and new venture success, but the moderating effect of technological similarity is insignificant. Our analysis elucidates the many moderating effects, highlighting the importance of unique technical links within the innovation ecosystem and their substantial impact on the value generation capacities of new businesses. An effective innovation and entrepreneurship ecosystem necessitates adaptation to obstacles and uncertainty due to its constantly evolving nature. Consequently, coherence is vital for understanding the evolution, extinction, and dynamics of the ecosystem's framework and is imperative for controlling innovation and technology advancements. Han et al. [17] propose that an innovation ecosystem is defined by the features of a complex adaptive system, including network connections, co-evolution, self-organization, and diverse levels of relational complexity. The type of interactor relationships is a crucial factor to examine within an innovation and entrepreneurship ecosystem.

Resource dependence theory posits that an organization, such as a commercial enterprise, must interact with other entities in its ecosystem to obtain resources. Whereas these transactions could be beneficial, they may also engender dependencies that are not. Resources required by the firms may be limited, not consistently accessible, or governed by unfriendly entities. The resultant inequitable transactions produce disparities in authority, power, and accessibility to more resources. Firms adopt strategies and internal organizational structures to strengthen their bargaining power in resource-related transactions, hence mitigating dependence. These approaches integrate participating in political activities, diversifying the firm's production capabilities, enhancing operations, and creating links with other groups. Increasing the line of production may reduce a firm's reliance on other companies and enhance its power and influence. Firms often modify their business strategy to accommodate shifts in power dynamics with other firms. According to the theory, uncertainty obscures an organization's control over resources, making the selection of dependence-reducing measures essential. As unpredictability and interdependencies increase, the need for connections to other organizations correspondingly intensifies. For instance, diminishing revenues may stimulate more company activity via diversification and strategic partnerships with other firms.

We extend the applicability of resource dependency theory by examining role conflict and power disparity in ecosystem venturing. Specifically, our research enhances the literature on how new enterprises navigate ecosystem-specific challenges by implementing a power-balancing operation. Researchers have utilized resource dependence theory in the study of interorganizational relationships, examining the 'swimming with sharks' dilemma and the defensive strategies employed by ventures (e.g., secrecy, timing, and third-party social defenses) in establishing connections, with a recent focus on the dynamics of these relationships in international settings. Consequently, we heed the appeal of Todeva and Knoke [18] to investigate the social defenses of initiatives facilitated by alternative interorganizational partnerships, such strategic alliances and industrial consortia.

Notwithstanding these substantial discoveries, academic research on the Von Busch and Palmås' [19] dilemma concentrates on certain defenses accessible just to some endeavors, excluding others. It is vague about the formation of connections in the absence of appropriate protections, such as when legal and temporal defenses are not accessible or when the most perilous sharks possess the most advantageous resources. A further unaddressed inquiry is to the impact of social context, since the social safeguards offered by a firm's current partners, which might deter theft in future relationships, may be more significant for nascent businesses with restricted access to alternative defenses. Our study enhances the existing literature by investigating the function of alliances with primary rivals as a mechanism of social defense in ecosystem venturing. When the emergence of new initiatives is restricted by influential ecosystem investors, strategic alliances may provide social defense, enabling these businesses to circumvent detrimental dependencies and alter the power dynamics with ecosystem investors.

VI. CONCLUSION

We emphasise the role of competitors' alliances in shaping success and new venture growth. Our findings indicate that cooperation between direct competitors can produce benefits as well as threats to entrants. On the one side, competitors' cooperation can be the source of novelty and new opportunities, as well as unlock new possibilities for industries, defining standards, and improving the cooperating environment. In the same breath, they can make it difficult for firms to break into the industry and increase rivalry where firms do not have necessary capital or partnership arrangements. As the research among new ventures demonstrates, companies are unable to come through important events like funding or market saturation, if they are faced with a network of allied incumbents. These alliances also have a possibility to alter the competitive forces by either limiting the access to critical resources, reducing the bargaining power of suppliers or modifying the customer attraction techniques. Our study also highlights the fact that when choices of markets and business models are different and have values propositions that are different and flexible, it may be challenging to make the competitive setting unwelcoming to new venturing if they opt for niches or innovation. Last but not the least, this study establishes that while competitor alliances present threats, they enhance market activation for dynamic new entrants. It means that strategic thinking and flexibility are contingent on new-venture formation in environments made up of alliances.

CRediT Author Statement
The author reviewed the results and approved the final version of the manuscript.

Data Availability
The datasets generated during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interests
The authors declare that they have no conflicts of interest regarding the publication of this paper.

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