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Coupling in Platform-Led Entrepreneurial Ecosystems and Startup Performance: Evidence from a Survey of Chinese Startups

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Abstract

Although the entrepreneurial incubation performance of the platform-led entrepreneurial ecosystem is remarkable, existing research lacks insights into how to empower startups and how to effectively improve their performance as important ecosystem participants. To address this gap, this study analyzed the questionnaire data from 368 employees of startups associated with platform enterprises established for less than 8 years. Research findings indicate that within these ecosystems, the coupling relationship between startups and platform ecosystem participants facilitates the formation of interest communities within the platform ecosystem's inner circles. Crucially, this study reveals that formal platform governance significantly moderates these relationships, acting as an institutional safeguard that curbs opportunistic behavior and amplifies the performance-enhancing effects of coupling. This synergistic interplay between coupling and formal governance mechanisms drives collective value creation across the entire platform, and thus improves startup performance. Finally, based on the coupling intensity and governance maturity, this study has built a practical decision-making matrix, which provides clear strategic rules for startups, large enterprises and policymakers, so as to enhance sustainable collaboration and resource allocation among all ecosystem participants.

Keywords: startups; ecosystem; coupling; formal platform governance; startup performance; empowerment mechanism

1. Introduction

The entrepreneurship boom has given rise to many emerging enterprises and entrepreneurship support platforms. However, the high failure rate is still a major challenge for entrepreneurial activities [1]. Relevant studies show that many entrepreneurial support models are difficult to adapt to the changing needs of entrepreneurial enterprises [2], resulting in problems such as insufficient value-added service capacity and single business model of incubators [3]. Against this background, the entrepreneurial ecosystem built by platform companies has gradually become a phenomenon worthy of attention. Based on market mechanisms and resource complementarity, these ecosystems promote cooperation and symbiosis among participants and provide a new growth environment for startups.

In studies using entrepreneurial ecosystems constructed by enterprises such as Xiaomi [4] as typical cases, many academics have analyzed their operating mechanisms. They propose that platform-led entrepreneurial ecosystems can address existing challenges

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in entrepreneurship and facilitate reverse incubation for startups [5]. These studies are primarily normative or exploratory based on single-case analyses, offering insufficient explanations for the high performance observed among startups within platform-led entrepreneurial ecosystems. In addition, enabling value co-creation is a crucial function of platform ecosystems. Existing studies have further elaborated the mechanism underlying value co-creation through perspectives such as intersubjective symbiotic relationships [6], platform governance [7], and business models within platform ecosystems [8]. However, most of these studies focus on single constructs or multiple independent constructs, failing to effectively integrate multiple constructs into a research framework or explore the operation mechanisms of platform-led entrepreneurial ecosystems.

Therefore, this study explicitly focuses on the context of platform-led entrepreneurial ecosystems and aims to address the following core research questions: Why can startups more effectively enhance their performance by joining platform-led entrepreneurial ecosystems? How do such ecosystems empower startups? Addressing these questions will not only provide pathways for startups to access platform empowerment and offer a basis for platform enterprises to optimize their ecosystem layouts, but also, by constructing an integrated theoretical framework, reveal the core operational logic of platform ecosystems. In doing so, this study moves beyond single-dimensional or case-based descriptions to empirically validate an existing tripartite coupling framework and demonstrate the synergistic interplay between coupling and formal governance. This integrated approach addresses calls for deeper elucidation of platform ecosystem operating mechanisms, thereby advancing the development and refinement of entrepreneurial incubation theory.

The paper is organized as follows. Section 2 reports the analysis of the literature and the derivation of the research hypotheses. Section 3 presents the research methodology. Section 4 provides the empirical analysis and discussion, and Section 5 describes the conclusions.

2. Literature Review and Hypothesis Development

2.1. Literature Review

2.1.1. Platform-Led Entrepreneurial Ecosystems and Empowerment

Platform-led entrepreneurial ecosystem combines characteristics of both entrepreneurial ecosystem and platform ecosystem. It is a kind of entrepreneurial ecosystem in which the platform enterprise provides core components and boundary resources around its own strategic objectives and value proposition, and multi participating subjects collaborate symbiotically to achieve value co-creation. It is fundamentally a platform-based value network system [9,10].

For platform enterprises, relying on a single product or service limits innovation and long-term growth. Thus, they need to build their own product ecosystems and pursue cross-industry entrepreneurship. By creating platforms and leveraging modular interfaces, they can attract startups to co-create ecosystems, rapidly integrate resources, and drive innovative value creation, which is a key pathway to sustaining their development. Resources constitute fundamental inputs for corporate innovation and development. However, most enterprises, especially startups, are faced with serious resource constraints. The lack of "systemic effectiveness", which prevents them from fully mobilizing ecosystem resources, is a root cause of low entrepreneurial success rates [11]. Therefore, for startups, joining a platform-led entrepreneurial ecosystem enables them to leverage the platform enterprise's social network to bridge external resources, thereby filling gaps in other resources and capabilities during the product innovation process. This approach can significantly boost their performance.

Platform empowerment draws on the concept of 'empowerment' in psychology, which emphasizes the co-creation of value and energy interaction between organizations and individuals, so that the empowered can acquire the corresponding skills and abilities [12]. Accompanied by the development of the Internet and the transformation of organizational management models, business organizations have shifted from mechanical organizational design to more diverse approaches, and organizational-level empowerment has begun to receive attention [13]. Research on empowerment based on the organizational level argues that platform enterprises can empower platform participants to produce, innovate and compete by means of technology transfer and transformation, expanding interactive scenarios and opening up platform interfaces, promoting resource integration and configuration optimization between the platform and both supply and demand sides [12,14]. The essence of the platform empowerment theory is to transform virtual social capital into real social capital, and to promote the continuous optimization of the configuration structure of physical, intellectual and social capital of enterprises in the industrial Internet platform [15].

Regarding the empowerment mechanism of platform ecosystems, many scholars have conducted research from the perspective of value co-creation, arguing that an important empowerment mechanism of platform ecosystems lies in the platform's ability to achieve value co-creation through open collaboration and the integration of multilateral supply and demand participants. Overall, most of the empowerment objects in existing studies are based on enterprise employees or customers [4,12], and there are relatively few studies that examine the mechanism of platform empowerment realization from the perspective of startups. Furthermore, the internal structure and operation mechanism of platform ecosystems have yet to be fully elucidated [16], and the factors that drive the realization of platform empowerment have not been identified.

2.1.2. Inter-Subjective Coupling

Coupling refers to the phenomenon where two or more systems or forms of motion affect each other and even unite through various relative roles [17]. Weick [18] introduced loose coupling to describe systems where elements are responsive to one another but retain their own identity and separateness. Lian and Liu [19], in their study of the coupling of industrial innovation networks, proposed that coupling refers to the process in which two or more enterprises in a network establish cooperative relationships with other member enterprises, engage in mutual learning, and achieve synergistic development through certain cooperative methods according to changes in the external environment. According to Liu Chang [20], there are interactions among various symbiotic units in the innovation ecosystem, which links different enterprises and organizations, and in the process of sharing information and exchanging resources, each member achieves complementary advantages and value co-creation. This kind of interaction constitutes coupling.

Therefore, coupling can be defined as the relationship and process of mutual cooperation and coordinated development between platform enterprises and startups, or between startups themselves, within a platform-led entrepreneurial ecosystem.

The impact of digital technology and the rise of organizational forms, such as platform ecologies, have led to increasing modularity in corporate organizational structures and value creation processes [21]. An organization can be regarded as a loosely coupled system, and modularity is the process of deconstructing and reconfiguring the organization through certain rule designs, standard interfaces and interface settings [22]. Existing modularization research has experienced an evolution from technology and product modularity, industrial modularity to organizational modularity, and expanded to ecosystems, platforms, and other fields [23], and it can be classified into two categories: internal modularization

and external modularization of organizations [24]. Internal modularization repositions, decomposes and combines the value chain within the enterprise around product or function modularization, while external modularization achieves synergy between organizations by building a modular system to broaden the value network and strengthen the upstream and downstream cooperation and sharing of the industrial chain [25].

In other words, under the form of modular organizational structure, each enterprise and department forms modularity according to its own functional division of labor. Based on its own specialization, each node modular organization operates independently and cooperates with each other, and jointly promotes the maximization of the overall network efficiency. The entrepreneurial ecosystem oriented by platform enterprises is based on organizational modularity, and each subject relies on loose coupling to achieve organizational modularity. It is evident that coupling is an important indicator for evaluating the overall effectiveness of an ecosystem, and the degree of coupling among the nodes directly determines the overall effectiveness of the system.

While the concept of coupling offers a powerful lens for understanding inter-organizational relationships in ecosystems, existing research remains fragmented. Studies often treat coupling as a broad, undifferentiated concept or focus on a single dimension, thereby failing to capture how distinct types of coupling relationships uniquely and collectively shape performance outcomes within a multi-actor, power-asymmetric platform ecosystem. To address this gap, this study draws upon and extends a tripartite framework of cultural value coupling, complementary asset coupling, and physical system coupling [26]. This disaggregated approach allows for a more precise examination of distinct alignment mechanisms. Furthermore, by situating this framework within the specific context of platform-led entrepreneurial ecosystems, we address the unique power asymmetries and governance dynamics that distinguish these systems from generic entrepreneurial or innovation networks, thereby offering a more context-sensitive theoretical model. To empirically substantiate this framework, this study employs large-sample survey data rather than the simulation, mathematical derivation, and case-based methods that have dominated micro-level coupling research [27,28], thereby providing a more robust and generalizable test of these relationships.

2.1.3. Formal Platform Governance

In the context of platform-led entrepreneurial ecosystems, startups and related stakeholders form a networked organizational model that transcends traditional market relationships and hierarchical corporate structures. Within this network, nodes exhibit cooperative and synergistic relationships conducive to the ecosystem's overall development, as well as competitive relationships that may lead to conflicts. The key to platform governance is to ensure that participants in the platform ecosystem do not exploit information asymmetry or incomplete contracts for private gain. Its core objective is to facilitate interactive cooperation, resolve conflicts, and ultimately form a value network.

Formal platform governance refers to the explicit definition of the rights, obligations, supervision procedures, reward and penalty decisions, and expected deliverables of platform ecosystem participants through formal means such as contracts [29]. It encompasses institutional arrangements for both task coordination and benefit distribution [30,31], aiming to achieve two primary objectives: reducing opportunistic behavior in inter-firm collaboration [32] and coordinating cross-organizational resources for optimal allocation [33].

2.2. Hypothesis Development

2.2.1. Coupling and Startup Performance

Coupling elements are the core content and elements that contribute to the formation of the coupling relationship between systems or subjects, and can be regarded as the "bond" that connects the coupling relationship. Drawing on the framework of Yang and Xu [26], this study examines three dimensions of coupling: cultural value coupling, complementary asset coupling, and physical system coupling.

(1) Cultural Value Coupling and Startup Performance

The alignment of collective cognitive factors such as values, vision and goals determines whether in-depth collaboration can be achieved among stakeholders. For startups, constrained by limited resources and scale, the pursuit of short-term gains at the expense of long-term development is common, and they may even engage in actions detrimental to the overall interests of the platform ecosystem. Shared values and common goals enhance inter-organizational identity, which in turn increases the willingness and capability of other entities within the platform ecosystem to communicate and exchange with startups [34]. Furthermore, as an implicit shared institutional logic, cultural value coupling guides and constrains the behavior of all participants [35]. This reduces coordination costs, curbs unhealthy competition, and drives collective value creation across the entire platform ecosystem.

Therefore, the following hypothesis is formulated:

H1a: *Cultural value coupling is positively related to startup performance.*

(2) Complementary Asset Coupling and Startup Performance

Within the platform ecosystem, complementary asset coupling manifests as the flow of resources and capabilities between platform enterprises and startups across supply chains, channels, investment and financing, and technology.

On the one hand, the resource agglomeration nature of platforms makes them value networks rich in complementary assets. Although the high-risk nature of startups usually reduces their attractiveness to external high-quality resources, the support of platforms can serve as a positive signal released to the market, promoting the spontaneous flow of scarce resources to startups [36]. Startups, in turn, feed technological innovations in niche fields back to platform enterprises. The resource exchange between these two entities directly enhances product implementation efficiency, thereby driving improvements in startup performance.

On the other hand, due to their low social recognition, startups face difficulty in proving their strength through past performance and can hardly establish legitimacy independently in the short term, often facing the risk of entrepreneurial failure. In contrast, platform enterprises usually possess a higher level of legitimacy by virtue of their extensive interactions with actors such as governments, suppliers, and customers throughout their operations.

Through complementary asset coupling, ecosystem participants establish a joint maintenance mechanism for shared assets such as brand reputation and user traffic. This fosters positive reputational effects, enabling startups to benefit from the legitimacy spillovers of platform enterprises. Consequently, startups can rapidly expand their market presence and achieve enhanced performance outcomes.

Therefore, the following hypothesis is formulated:

H1b: *Complementary asset coupling is positively related to startup performance.*

(3) Physical System Coupling and Startup Performance

Physical system refers to the foundational technical architecture underpinning collaborative product development, encompassing elements such as network platforms, hardware devices, and modular architecture rules. Serving as the symbiotic interface between entities, physical system transcends geographical constraints to integrate ecosystem resources, providing digital channels for the exchange of materials, information, and value among participants. It constitutes an essential tool and vehicle for realizing value co-creation within platform-led entrepreneurial ecosystems.

The key to physical system coupling lies in achieving unified technical standards. Based on standardized APIs and platform interfaces, physical system coupling integrates platform ecosystem participants into the ecosystem through a modular structure, forming a loosely coupled network architecture [37]. This structure facilitates modular integration among independently operated submodules [38], enabling participants to deeply embed themselves in various platform activities [39]. Consequently, it fully mobilizes resources across modules, enhances collaboration among entities, and helps startups improve performance.

Furthermore, through the modular interface design of the platform ecosystem network, core internal knowledge can be separated from shared peripheral knowledge, reducing startups' concerns about provoking vicious competition and opportunistic behaviors from other participants. This enhances the willingness for knowledge transfer [40], fosters collaboration and value co-creation, and ultimately improves startup performance.

Thus, we hypothesize the following:

H1c: *Physical system coupling is positively related to startup performance.*

2.2.2. Moderating Role of Formal Platform Governance

Within a platform-led entrepreneurial ecosystem, formal platform governance regulates and constrains participant behavior by relying on the platform to introduce formal management measures. Coupling across types connects participants in the platform ecosystem into a community of shared interests. When all members collaborate toward long-term goals, value co-creation can be achieved. However, if some participants engage in opportunistic behavior for short-term gains, a "tragedy of the commons" may arise, leading to value co-destruction. In these ecosystems, the platform assumes a dominant governance role by leveraging its leadership position to constrain speculative behavior through mandatory formal mechanisms. This is a key feature that distinguishes it from general entrepreneurial ecosystems. Therefore, when coupling and formal platform governance work in tandem, they compensate for the shortcomings of relying solely on relational governance. This restricts partners from using information asymmetry for personal gain, prevents damage to startup performance caused by the destruction of platform value, and thereby improves startup performance.

In addition, the institutionalized effect of formal platform governance provides credibility assurance for all relevant parties, which not only alleviates concerns about the uncertainty of entrepreneurship, but also provides a basis for the protection of rights and interests. This enhances the willingness of suppliers, users and other service entities to cooperate with startups, fosters mutual trust, and helps startups obtain more resources.

Therefore, the following hypotheses are proposed:

H2a: *Formal platform governance positively moderates the relationship between cultural value coupling and startup performance.*

H2b: *Formal platform governance positively moderates the relationship between complementary asset coupling and startup performance.*

H2c: *Formal platform governance positively moderates the relationship between physical system coupling and startup performance.*

3. Research Methodology

3.1. Data and Sample

The study aims to explore the pathways through which platform enterprises empower startups, targeting employees of startups within such platform-based ecosystems in China. Given the absence of a publicly accessible sampling frame for startups within these closed or semi-closed platform ecosystems, we combined convenience and snowball sampling. This approach was a feasible strategy for accessing this specific population. To mitigate potential bias, we distributed the survey through multiple distinct channels and applied rigorous data-cleaning procedures to remove invalid responses. Sample size determination references general requirements for structural equation modeling analysis [41]. To ensure analytical robustness, the plan is to collect no fewer than 400 questionnaires to account for potential data missingness or invalid responses.

We limit startups to pioneering SMEs that have been established for less than eight years, are characterized by innovative businesses, constantly seek market opportunities, and are willing to take high risks. Considering both the time required for enterprises to become profitable [42] and the enterprise life cycle [43], the 8-year threshold effectively covers the developmental stages from gestation to adolescence. This aligns with mainstream entrepreneurship research [44,45], ensuring the theoretical basis and comparability of sample selection.

In the survey, questionnaires were distributed through multiple channels to relevant managers of startups established within the past eight years and affiliated with platforms such as Xiaomi, Tencent, and ByteDance. These platform enterprises were selected based on three criteria: publicly recognized entrepreneurial support or incubation programs, at least five years of operation to ensure stable ecosystem governance, and cross-sector involvement. We distributed 450 questionnaires, with 404 returned, yielding a total response rate of 89.78%. Among these, 46 were treated as invalid due to issues such as identical responses across all items and abnormally short completion times. Ultimately, 368 valid questionnaires were collected, representing an effective response rate of 91.09%.

The basic information of the enterprises in the aforementioned 368 responses is summarized, resulting in the descriptive statistical analysis of the sample as presented in Table 1.

In terms of response measurement, the questionnaire employs a five-point Likert scale, where values 1 to 5 represent progressively increasing levels of agreement from “strongly disagree” to “strongly agree,” with 3 denoting a neutral stance.

Table 1. Descriptive statistics.

Feature	Category	Frequency	Percent
Year Established	1 Year or Less	72	19.57
	2–3 Years	97	26.36
	4–5 Years	103	27.99
	5–8 Years	96	26.09
Number of Employees	1–20	19	5.16
	21–50	82	22.28
	51–100	138	37.50
	101–200	77	20.92
	>200	52	14.13
Industry	High-tech Industries	238	64.67
	Other Industries	130	35.33
Gender	Male	168	45.65
	Female	200	54.35
Education Level	Associate Degree or Below	56	15.22
	Bachelor's Degree	182	49.46
	Master's Degree	98	26.63
	Doctoral Degree	32	8.70
Position	Founder	35	9.51
	Senior Management	74	20.11
	Middle Management	119	32.34
	Junior Management	140	38.04

3.2. Study Variables

Startup performance serves as the dependent variable in this study. As objective financial data for early-stage startups is often unavailable or unreliable, we adopted a well-established subjective performance measurement approach, using perceptual evaluations from senior team members [46]. Generally, measuring startup performance encompasses three dimensions: short-term profitability financial indicators, long-term growth indicators, and innovation capability. Lumpkin and Dess [47] employed metrics such as sales growth and market share to measure startup performance, representing both profitability and growth dimensions. Simsek and Heavey [48] assessed startup performance achievement by examining sales growth and market share growth relative to primary competitors. Frank et al. [49] measured startup performance using the growth of innovative products or services and market share, where new product launches effectively represent both the firm's adaptability to its environment and its own growth potential.

Coupling elements are the independent variables in this study. At the micro level, a representative study is that of Li and Liu [50], who categorized innovation system coupling into four dimensions: physical system coupling, knowledge base coupling, management system coupling, and cultural value coupling. They developed corresponding measurement scales to assess the degree of complementarity and compatibility among industry–academia–research partners. Cao and Song [34] adapted this scale, validating its reliability and validity, making it the primary measurement tool for this study. Furthermore, integrating case studies and interview findings, and considering the practical variations in coupling types between startups and other entities within platform-led entrepreneurial ecosystems, we categorize the coupling between startups, platform enterprises, and other startups within the ecosystem into three dimensions: cultural value coupling, complementary asset coupling and physical system coupling. Notably, the operationalization of each coupling dimension incorporates items that assess the focal startup's alignment with two distinct referents: the platform enterprise, and other entrepreneurial firms within the

ecosystem. This dual-referent design is theoretically warranted because a platform-led entrepreneurial ecosystem constitutes a networked value system in which value co-creation depends not only on vertical linkages with the hub platform but also on horizontal complementarities among peer participants [9,10]. Measuring only startup-platform coupling would capture bilateral dependence while neglecting the broader ecosystem embeddedness that characterizes this organizational form.

Moderating variable. The core of formal platform governance is to promote the interaction and cooperation among participants within the platform ecosystem and the resolution of conflicts, so as to form value networks. It mainly uses formal means such as signing contracts to clarify the rights and obligations of platform ecosystem participants, supervision procedures and reward and punishment decisions, and the results to be delivered [29]. Drawing upon Hoetker and Mellewigt's [51] research on how platform governance facilitates the realization of platform duality, and incorporating the characteristics of platform enterprises within platform-led entrepreneurial ecosystems, this study sets up four items to measure formal platform governance.

Control variable. A comprehensive analysis of existing research indicates that the performance of startups is often influenced and confounded by factors such as firm size, firm age [52], and the industry to which the firm belongs [53]. Therefore, we adopt these widely accepted conclusions and incorporate them as control variables in the analysis. Considering data availability and reliability, the study uses total employee count as the metric for firm size. For data analysis, total employee count is categorized into five levels: the values 1 to 5 represent 1–20, 21–50, 51–100, 101–200, and more than 200 employees, respectively. In addition, regarding the industry classification of startups, excessive categorization may hinder statistical analysis. Therefore, drawing on existing scholarly approaches, the study classifies industries into high-tech and other industries. Additionally, since industry type is a categorical variable, dummy variable treatment is required. Specifically, using other industries as the reference category (assigned a value of 0), a dummy variable for high-tech industries is constructed and assigned a value of 1.

Detailed information on the scales is provided in Appendix A.

3.3. Reliability and Validity Analysis

To ensure that the survey data were suitable for empirical analysis, we applied IBM SPSS Statistics (Version 26) and IBM SPSS Amos (Version 26) to test the reliability and validity of the 368 sample responses. In terms of reliability, we focused primarily on Cronbach's α and CITC values. For validity, we employed confirmatory factor analysis (CFA) to measure the construct validity of the sample data, including convergent validity and discriminant validity. First, the model fit was examined using key indices, which included absolute and relative indicators [54]. Absolute indicators comprised χ^2/df, RMSEA, and GFI, while relative indicators included TLI, IFI, and CFI. Subsequently, convergent validity and discriminant validity were specifically examined. Convergent validity was tested using AVE and CR. For discriminant validity, the square root of AVE was compared with the correlation coefficients between variables.

As shown in Table 2, the Cronbach's α coefficients of all variables are greater than 0.7, and the CITC value for every item exceeds 0.5. Furthermore, the α value would decrease if any item were deleted, indicating that the coupling scale, startup performance scale and formal platform governance scale all passed the reliability test.

Table 2. Reliability test results.

Variable	Mean	Std. Deviation	CITC	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Cultural Value Coupling	3.86	1.140	0.757	0.898	0.914
Complementary Asset Coupling	3.76	1.213	0.789	0.900	0.918
Physical System Coupling	3.63	1.168	0.771	0.906	0.920
Startup Performance	3.75	1.165	0.600	0.853	0.868
Formal Platform Governance	3.69	1.141	0.742	0.847	0.881

Further CFA was conducted on each variable, yielding the results shown in Table 3. The χ^2/df ratio is less than 3, and the RMSEA value is below 0.08. Additionally, the GFI, TLI, IFI, and CFI values all exceed 0.9, indicating good model fit for each item. Moreover, the standardized factor loadings are above 0.4 and are statistically significant at the $p < 0.001$ level. The AVE values are greater than 0.5, and CR values are above 0.6. Consequently, all scales demonstrate strong convergent validity.

Table 3. Model fit and convergent validity test.

Latent Variables	Standardized Factor Loading	AVE	CR	Fit Indices
Cultural Value Coupling	0.799	0.639	0.914	$\chi^2/df = 2.235$ RSMEA = 0.058 GFI = 0.925 TLI = 0.962 IFI = 0.968 CFI = 0.968
Complementary Asset Coupling	0.832	0.692	0.918	
Physical System Coupling	0.811	0.658	0.920	
Startup Performance	0.804	0.647	0.943	$\chi^2/df = 1.239$ RSMEA = 0.026 GFI = 0.983 TLI = 0.995 IFI = 0.996 CFI = 0.996
Formal Platform Governance	0.806	0.650	0.881	$\chi^2/df = 1.236$ RSMEA = 0.025 GFI = 0.997 TLI = 0.998 IFI = 0.999 CFI = 0.999

Next, we analyze the discriminant validity among the variables. Specifically, discriminant validity is examined by comparing whether the square root of each variable's AVE is greater than its correlation coefficients with other variables. If the former exceeds the latter, it is determined that the variable exhibits good discriminant validity. As shown in Table 4, the square roots of the AVE values on the diagonal are all greater than the correlation coefficients between the variables off the diagonal, indicating that the scale has good discriminant validity. Meanwhile, the results also reflect correlations among these variables, which can further empirically test the theoretical hypotheses.

Table 4. Discriminant validity test.

Variables	Cultural Value Coupling	Complementary Asset Coupling	Physical System Coupling	Startup Performance	Formal Platform Governance
Cultural Value Coupling	0.800				
Complementary Asset Coupling	0.508 **	0.832			
Physical System Coupling	0.547 **	0.568 **	0.811		
Startup Performance	0.640 **	0.674 ***	0.647 **	0.804	
Formal Platform Governance	0.491 **	0.600 ***	0.504 **	0.679 **	0.806

Note: ** indicates $p < 0.01$. *** indicates $p < 0.001$.

3.4. Robustness Check

We implement corresponding measures during questionnaire design and measurement to mitigate common method bias. These includes completing questionnaires anonymously and enhancing the precision of measurement items. Consequently, common method bias was effectively controlled at its source.

Since all items in the questionnaire were completed by the same respondent at the same time, potential common method bias remains a concern. Hence, the study employs Harman's single-factor test to examine common method bias as recommended by Podsakoff et al. [55], specifically conducting EFA on all measurement items in this research. According to the obtained unrotated factor analysis results, the variance contribution rates of all factors do not exceed the 50% threshold, indicating that no single factor explains the majority of the variance. Therefore, this study does not exhibit severe common method bias.

4. Empirical Analysis and Discussion

4.1. Coupling and Startup Performance

Table 5 presents the results of hierarchical regression analysis examining the impact of coupling on startup performance. Model 1 tests only the influence of control variables on startup performance. Model 2 builds upon Model 1 by incorporating independent variables to examine the effects of cultural value coupling, complementary asset coupling, and physical system coupling on startup performance.

First, the VIF values for both models are less than 10, indicating no multicollinearity issues among the variables. The DW value of 1.956 is close to 2, suggesting no serial correlation in the regression models. Furthermore, the residual scatterplot analysis confirms the model meets the assumption of homogeneity of variances.

Model 1 exhibits a goodness-of-fit with $R^2 = 0.032$ and an F-value of only 3.082. While firm age positively influences startup performance, firm size and industry of the firm show no significant effect on startup performance. Analysis of Model 2 indicates that the overall model fit is satisfactory, and all three types of coupling significantly influence startup performance. Specifically, the regression coefficient for cultural value coupling on startup performance is 0.283 ($p < 0.001$), indicating a significant positive correlation between cultural value coupling and startup performance. Thus, hypothesis H1a is supported. The regression coefficient for complementary asset coupling is 0.307 ($p < 0.001$), indicating that complementary asset coupling is positively related to startup performance, thereby supporting H1b. Similarly, the regression coefficient for physical system coupling is 0.271

($p < 0.001$), indicating a significant positive correlation with startup performance, which confirms hypothesis H1c.

Table 5. Hierarchical regression analysis for startup performance.

Variables	Startup Performance	
	Model 1	**Model 2**
Control Variable:		
Firm Size	−0.060	−0.044
Firm Age	0.142 *	0.060
Industry of the Firm	−0.092	−0.053
Independent Variable:		
Cultural Value Coupling		0.283 ***
Complementary Asset Coupling		0.307 ***
Physical System Coupling		0.271 ***
Model Statistics:		
R^2	0.032	0.514
Adjusted R^2	0.021	0.503
F	3.082 *	49.138 ***
Maximum Value of VIF	1.004	1.545
Durbin–Watson (DW) Value	-	1.956

Note: *** indicates $p < 0.001$, * indicates $p < 0.05$.

4.2. The Moderating Effect of Formal Platform Governance

The study employed Hayes' Process Model 1 [56] for validation analysis. Using the Bootstrap method, 5000 repeated samples are taken to obtain parameter estimates. Specifically, it examines whether formal platform governance moderates the direct path from independent variables to the dependent variable (startup performance), i.e., the direct effect. All continuous variables are centered to reduce multicollinearity, and all models control for firm size, firm age, and industry of the firm.

The test results are presented in Table 6. In Model 3, formal platform governance positively moderates the relationship between cultural value coupling and startup performance ($\beta = 0.143$, $p < 0.001$), confirming H2a. In Model 4, formal platform governance positively moderates the relationship between complementary coupling and startup performance ($\beta = 0.126$, $p < 0.001$), confirming H2b. In Model 5, formal platform governance positively moderates the relationship between physical system coupling and startup performance ($\beta = 0.144$, $p < 0.001$). Therefore, H2c is supported.

Table 6. Direct effect moderation.

Variables	Interaction Term (X * Formal Platform Governance) →Startup Performance		
	Model 3	**Model 4**	**Model 5**
Independent Variable (X):			
Cultural Value Coupling	0.143 ***		
Complementary Asset Coupling		0.126 ***	
Physical System Coupling			0.144 ***

Note: * denotes the interaction term between X and Formal Platform Governance, *** indicates $p < 0.001$.

5. Conclusions

The interdependent and mutually influential coupling relationships among entities constitute an important feature of these ecosystems and are an essential manifestation of

the system's ecological nature. In this study, hypotheses H1a, H1b, and H1c are supported by data, indicating that coupling has a significant positive impact on startup performance.

Based on shared values, entities within the platform ecosystem are willing to collaborate with one another and believe that their counterparts will prioritize the overall interests of the platform, thereby fostering mutual success. Thus, cultural value coupling reduces collaborative friction and accelerates resource integration within the ecosystem. Additionally, the initial motivation for entities to join the platform ecosystem is to obtain the resources needed for strategic development or entrepreneurial success. Under the influence of complementary asset coupling, platform enterprises and startups directly improve the efficiency of product implementation through resource exchange. Finally, physical system coupling reduces the cost of collaboration among entities through technical support and solves the contradiction between specialized division of labor and system coordination. The joint role of these three types of coupling elements promotes the formation of symbiotic coupling relationships among entities, and ultimately realizes value co-creation to improve startup performance.

Formal platform governance also positively moderates the relationship between the three types of coupling and startup performance. In the platform-led entrepreneurial ecosystem, coupling elements foster the formation of interdependent interest communities among participants, and promote resource sharing and value co-creation. However, in the absence of effective constraints, opportunistic behavior by individual actors may trigger the "tragedy of the commons", resulting in overall value loss. The formal platform governance provides support for curbing opportunistic behavior and safeguarding the interests of startups through clear institutional norms and allocation of rights and responsibilities, thus strengthening the positive impact of coupling on their performance.

While robust within our sample, their interpretation must be anchored in the unique institutional context of China's platform economy. China features highly mature, multi-sided platform ecosystems that function as powerful private regulators within their respective domains. In this environment, where the broader public legal and regulatory framework for digital business is still evolving, the platform's own formal governance mechanisms often substitute for external institutional safeguards. This makes the trust and credibility engendered by formal platform governance exceptionally salient. Consequently, the strong synergistic effects between coupling and governance we observe may manifest differently in more established market economies, where robust public legal systems could partially fulfill the institutional functions that platform-specific rules perform in our study.

These findings offer a theoretical extension to recent platform scholarship. Liu et al. [57] delineate the complementor's dilemma as an inherent tension between growth aspirations and focal actor dependency, yet stop short of specifying mitigation mechanisms. Our study addresses this lacuna by demonstrating that multidimensional coupling, specifically cultural alignment, asset complementarity, and system integration, functions as an actionable mechanism through which startups navigate dependency risks without relinquishing ecosystem benefits. Similarly, Wang et al. [58] examine governance and user behavior as exogenous constraints shaping complementor innovation strategies. We advance this inquiry by revealing that the coupling–governance interplay reconfigures this strategic calculus: under robust formal governance, coupling does not suppress autonomous innovation but rather channels it toward value co-creation that simultaneously serves startup and ecosystem objectives. Thus, whereas prior research identifies tensions and trade-offs inherent in platform participation, our contribution lies in theorizing and empirically validating the relational and institutional configurations that enable startups to actively shape their ecosystem positioning for enhanced performance outcomes.

Additionally, the non-significant effects of control variables, specifically firm size and industry classification, warrant further theoretical interpretation. The finding that industry type does not significantly affect startup performance challenges traditional industrial organization logic, and further differentiates our study from traditional strategy research, which often finds strong industry effects. A plausible explanation lies in the nature of platform-led ecosystems. As meta-organizations, platforms provide standardized digital infrastructure and market access that effectively flatten industry-specific liabilities. Once embedded in a mature ecosystem, the performance depends more on coupling intensity and governance maturity than on whether it is high-tech or not. The platform's resource pool substitutes for industry-specific externalities, attenuating the direct impact of industry classification on performance. This suggests that in the context of mature platform ecosystems, the platform effect, manifested through coupling and governance, may supersede or neutralize traditional industry boundaries, a proposition that warrants further investigation.

5.1. Managerial Implications

In order to transform the key significance of our research into an operable framework, we have proposed an ecosystem engagement matrix. As shown in Figure 1, the framework uses the two key dimensions (the degree of coupling and governance maturity) derived from the study to provide clear strategic recommendations for the three key actors: startups, large enterprises, and policymakers.

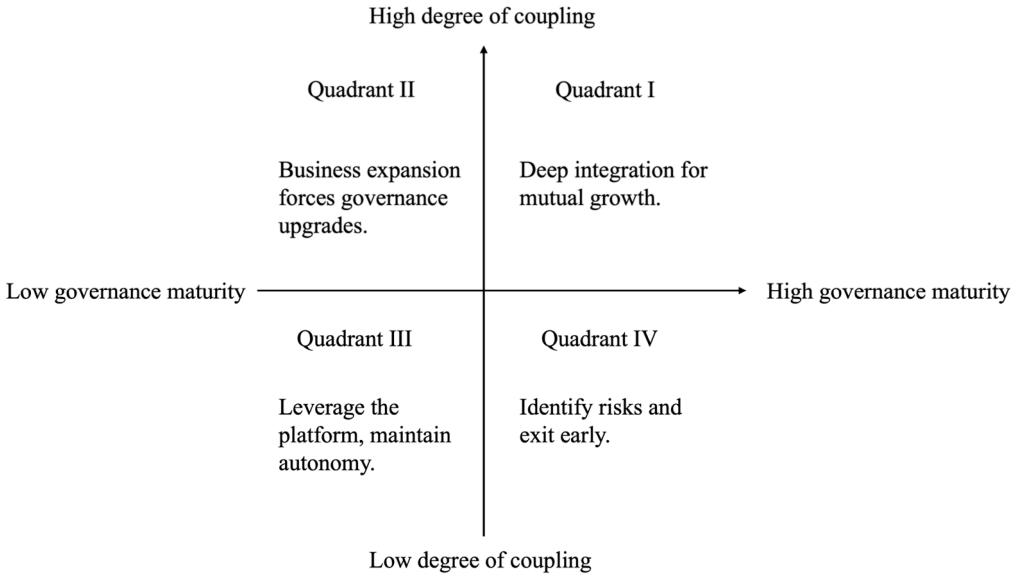


Figure 1. Ecosystem engagement matrix.

For startups, it is essential to prioritize integration into the platform ecosystem, rather than relying solely on policy support. Although subsidies and tax incentives can provide short-term relief, their effects are often unsustainable and may even lead to resource mismatch. When choosing a target platform, startups need to carefully evaluate the degree of coupling with the platform enterprise and the platform ecosystem. When the value orientation is compatible and highly complementary, the possibility of obtaining entrepreneurial resources will be significantly increased. In practice, startups should give priority to entering the ecosystem with perfect governance and high coupling, i.e., Quadrant I, integrate core APIs, establish dedicated ecosystem teams, and focus on quarterly product iterations. Simultaneously, risk management is essential to limit single-platform revenue dependency within acceptable bounds. In high coupling but low governance contexts (Quadrant II),

startups should adopt a phased entry strategy to validate business viability using standardized modules, avoiding deep customization in the early stages. Additionally, it is necessary to establish a strong contract guarantee mechanism and risk isolation measures, such as creating independent departments to undertake related ecosystem businesses, thereby preventing platform governance issues from impacting the parent company. Resource allocation must match coupling intensity: core innovations belong in tightly coupled environments, while modular offerings fit looser connections. Importantly, startups should avoid deep engagement in low-coupling, low-governance ecosystems (Quadrant IV).

For large enterprises building platform ecosystems, the strategic objective is to establish and sustain Quadrant I conditions. This requires both deepening coupling with key partners and advancing governance maturity. Before scaling, governance frameworks must be solidified, especially when high coupling exists. Policy incentives should be leveraged not for broad subsidies, but to lower collaboration barriers for high-potential startups, thereby strengthening the ecosystem's foundation and attractiveness.

While the government offers numerous support policies encouraging large enterprises to assist startups, many existing consortia and incubators function as policy-driven "artificial ecosystems". These entities are dominated by large enterprises, whose strategic choices tend to prioritize internal gains over collective benefits. Such asymmetries often lead to suboptimal outcomes. Hence, for policymakers, support should shift from direct startup subsidies or artificial alliance-building toward enabling and recognizing large enterprises that cultivate well-governed, high-coupling ecosystems, i.e., Quadrant I. Within such ecosystems, advanced public goods should be prioritized: digital infrastructure, interoperability standards, and talent mobility frameworks all merit targeted support. Conversely, in Quadrant III, the government must strengthen antitrust regulation and support industry associations in establishing universal technical standards for platform access. In Quadrant IV, it should leverage credit information platforms to establish risk early-warning systems, implement a veto power against platforms with low governance standards during subsidy fund reviews, and impose legal penalties for malicious delinquency and similar misconduct.

5.2. Limitations and Future Recommendations

As noted in the discussion of our findings, the Chinese context represents both a strength and a boundary of this study. Future research could test the generalizability of our findings through cross-cultural comparisons, specifically examining how variations in legal systems and market maturity moderate the interplay between coupling and formal governance.

While this study treats inter-subject coupling as a static predictor of performance within the 8-year startup lifecycle, its intensity likely follows a dynamic trajectory. Specifically, as a startup matures from the "gestation" stage (0–3 years) to the "adolescence" stage (3–8 years), the optimal coupling strategy may shift from tight coupling to a more balanced form. In the gestation stage, startups typically lack legitimacy and complementary assets, necessitating tight coupling with the platform leader to secure essential resources and survive. However, once they enter the adolescence stage, excessive tight coupling risks transforming into platform lock-in or overdependence, potentially hindering their pursuit of strategic autonomy and scale-up. At this point, the coupling intensity may need to evolve from a rigid, hierarchical dependency toward a more symbiotic yet loosely coupled modular collaboration. Future research could incorporate dynamic capability theory to explore how startups effectively interact with platform ecosystems at various lifecycle stages. This would involve deeper analysis of empowerment pathways and underlying mechanisms, thereby enhancing the timeliness and explanatory power of theoretical models.

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Institutional Review Board Statement: This study invited employees from multiple startup companies to complete an anonymous online questionnaire regarding their companies' business operations. Participation was entirely voluntary, with participants accessing the survey via a distributed link. Prior to beginning the questionnaire, participants were informed of the research purpose, relevant study details, and that proceeding to complete the questionnaire would constitute their informed consent. Participants retained the right to withdraw from the survey at any point during the process. According to the *Bioethics and Safety Act* (Act No. 21065, partially amended on 1 October 2025) and its *Enforcement Rule of Bioethics and Safety Act* (Ordinance of the Ministry of Health and Welfare, No. 1115, partially amended on 2 June 2025) in the Republic of Korea, ethical review is exempted for research if it involves anonymous participants, does not collect personally identifiable information (PII) or sensitive data, and poses minimal risk to participants. Therefore, formal IRB approval was not required for this study.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated during and/or analyzed during the current study are available from the author on reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. The formal scale was generated after removing unreasonable items, i.e., after the pre-test.

Variable	Item	Item Source
Startup Performance	EP1 Compared to the industry average, our company's net profit margin is higher. EP2 Compared to the industry average, our company's market share is higher. EP3 Compared to the industry average, our company's operating costs are lower. EP4 Compared to the industry average, the capital turnover rate of our company is faster. EP5 Compared to the industry average, the growth rate of our company's market share is faster. EP6 Compared to the industry average, the growth rate of our company's net profit is faster. EP7 Compared to the industry average, the number of patents filed by our company is greater. EP8 Compared to the industry average, the number of new products or services developed by our company is greater. EP9 Compared to the industry average, the development speed of new products or services in our company is faster.	[47–49,59,60]

Table A1. *Cont.*

Variable	Item	Item Source
Cultural Value Coupling	CVC1-1 Our company highly identifies with the corporate values of the platform enterprise. CVC1-2 Our company highly identifies with the corporate values of other entrepreneurial firms within the platform. CVC2-1 Our company shares a common vision and goals with the platform enterprise. CVC2-2 Our company shares a common vision and goals with other entrepreneurial firms within the platform. CVC3-1 Our company and the platform enterprise follow similar behavioral norms. CVC3-2 Our company and other entrepreneurial firms within the platform follow similar behavioral norms.	[26,34,50]
Complementary Asset Coupling	CAC1-1 The platform enterprise possesses complementary assets (e.g., distribution channels, customers, supplier relationships, etc.) required for our company's entrepreneurial success. CAC2-1 Our company and the platform enterprise are complementary and compatible in terms of knowledge, technology, and other aspects. CAC2-2 Our company and other entrepreneurial firms within the platform are complementary and compatible in terms of knowledge, technology, and other aspects. CAC3-1 Our company and the platform enterprise are interdependent and mutually influential in areas such as brand, reputation, user traffic, etc. CAC3-2 Our company and other entrepreneurial firms within the platform are interdependent and mutually influential in areas such as brand, reputation, user traffic, etc.	
Physical System Coupling	PSC1-1 Our company is well-matched with the platform enterprise in terms of hardware equipment. PSC1-2 Our company is well-matched with other entrepreneurial firms within the platform in terms of hardware equipment. PSC2-1 Our company achieves excellent compatibility with the platform enterprise in software aspects such as information flow. PSC2-2 Our company achieves excellent compatibility with other entrepreneurial firms within the platform in software aspects such as information flow. PSC3-1 Our company can effectively align with the platform enterprise regarding architectural rules. PSC3-2 Our company can effectively align with entrepreneurial firms within the platform regarding architectural rules.	

Table A1. *Cont.*

Variable	Item	Item Source
Formal Platform Governance	FPG1 The platform our company operates on has established relevant criteria for enterprises to enter and exit. FPG2 The platform our company operates on has implemented a reward and punishment system to regulate and standardize the behavior of enterprises within the platform, clarifying their rights and obligations. FPG3 The rules established by the platform our company operates on are fair and transparent, which can enhance entrepreneurial enterprises' trust in the platform rules. FPG4 The platform our company operates on promotes collaborative cooperation among enterprises through contracts.	[29,51]

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