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Research article

When does a freemium business model lead to high performance? — A qualitative comparative analysis based on fuzzy Sets

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ABSTRACT

Existing research has neglected to explain why freemium business models lead to differentiated performance or what accounts for the difference in their revenue models. This study investigates how the configuration effect of freemium business models promotes performance and explores the different ways through which freemium business models, their dynamic capabilities, and environmental uncertainty interact to achieve high performance. The fuzzy set qualitative comparative analysis (fsQCA) approach was used to test the conceptual model with data from 45 freemium business model apps. From empirical evidence on the relationship between freemium business models, dynamic capabilities, and environmental uncertainty, the study finds that (1) bundled and fragmented freemium business models are fundamental performance drivers. However, they work only in combination with dynamic capabilities and environmental uncertainty. Moreover, the bundled and fragmented freemium business models have complementary rather than substitution relationships. (2) For companies with bundled and fragmented freemium business models, high sensing and seizing capabilities are critical to achieving high performance. A high bundled freemium business model, high sensing capability, and a lack of fragmented freemium business models and seizing capability can lead to high performance, regardless of reconfiguration capabilities and environmental uncertainty. (3) Under high environmental uncertainty, offering fragmented freemium business models with or without a bundled freemium business model will lead to high performance if they have high sensing, seizing, and reconfiguring capabilities. This study can provide systematic decision support for achieving high performance through freemium business models and the configuration of dynamic capabilities under environmental uncertainty.

1. Introduction

The freemium business model is popular on digital platforms because it provides the base product for free, where users can pay for premium content and features after adopting the base product [1,2]. For instance, the share of freemium apps on the Apple App Store rose from 25 % in 2009 to over 80 % in 2022. Additionally, App Store subscriptions increased from 745 million in 2021 to 900 million in 2022. The freemium business model differentiates the performance of different apps. Renren, Shrimp Music, QQ Farm and WeChat,

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NetEase Cloud, Arena of Valor, and other apps show strong contrasts in performances. Most apps use freemium business models. The success mode of the freemium business model lies in a small percentage of freemium users spending money on premium upgrades, and there are significant differences in the amount of money spent by freemium users [1]. Compared to paid products, freemium products must attract a disproportionately large user base to generate revenue and capture value [2]. For instance, Arena of Valor is a multiplayer online battle royale (MOBA) game app. Arena of Valor allows players to purchase props and coupons based on their interests. Tencent Conference has a bundled freemium business model app, whose functional modules are bundled and sold to bring differentiated performance to companies.

A previous study has primarily focused on the impact of business models on performance [3]. Companies may improve performance by increasing value creation ("expanding the pie"), value capture ("gaining a larger share"), or both [4]. A recent debate has focused on how firms can improve performance by recombining resources, capabilities, and environmental uncertainty into systems of interrelated design elements [3]. The link between freemium business models, dynamic capabilities, environmental uncertainty and performance may not be clear. However, how freemium business models lead to performance requires further research. On the one hand, research has shown that consumers perceive that digital-intelligent technologies make privacy riskier and doubt the privacy security of free products, which in turn is detrimental to performance [5]. On the other hand, data-driven learning theory suggests that companies use techniques such as machine learning to analyze large amounts of data to identify patterns of past behavior modes to predict and improve the accuracy of their offerings [6]. It is unclear whether the influence of the freemium business model on high performance is greater in volatile market environments or technological environments [7]. The resource-based view and the dynamic capabilities theory suggest that the dynamic capabilities of firms help them cope with constant external change [8,9]. Jantunen et al. (2012) consider the relationship between dynamic capabilities and performance to be multivariate [10]. With the introduction of the freemium business model, how value is created and captured, and how multiple actors are connected, become key influencers of performance [11]. As new technologies evolve, customer needs become more heterogeneous and diverse, and uncertainty in the external environment increases. Environmental uncertainty is characterized by the unpredictability of markets and technologies [12].

Both environmental uncertainty and dynamic capabilities are essential for freemium business models, which in turn lead to high performance, more sustainable development, and greater competitiveness. However, the existing literature rarely considers these factors from a systems perspective [5]. Freemium business models do not ensure high performance for all companies in different environments [4]. Hence, configuration analysis is needed to elucidate the performance of different combinations of freemium business models, dynamic capabilities, and environmental uncertainties. Existing studies have limited conditional attribution to local lock-in, ignored the equivalent effects under different configurations, and failed to provide diverse but equivalent paths for companies to improve in other contexts, tailored from their own and environmental realities [13,14]. The studies have failed to reveal whether the established conditional factors exert a synergistic impact on a given enhancement or improvement path to a more flexible framework that unifies the mediating and moderating effects and captures complementary dependent facets. Established attribution theories focus on the details of the elements, ignoring the existence of equivalent paths leading to high performance and the fact that the independent net effect of a single factor often has limited explanatory power for the outcome, thus restricting the possibility of high performance from freemium business models. The studies further explain the "multiple contingencies." The question of how to deal with trade-offs between multiple and different needs is therefore a key point and has led researchers to call for a new approach that takes into account configurational patterns, equifinality, and multiple contingencies [15]. This study provides evidence on how freemium business models, dynamic capabilities and environmental uncertainty can be matched to improve performance.

Rather than statistics based on linear algebra, our study uses qualitative comparative analysis (QCA) methods to characterize the correlation between data structure and firm performance outcomes. Our scientific approach moves from looking at the single effects of data characteristics to analyzing combinations of multiple variables associated with high business performance. This study argues that freemium business models require dynamic capabilities and hypothesizes that higher performance can be achieved when freemium business models, dynamic capabilities, and environmental uncertainty interact. Therefore, the research objective of this study is to determine how different combinations of freemium business models, dynamic capabilities, and environmental uncertainty lead to higher performance. This study focuses on the freemium business model due to the significant alterations in its business model in the digital intelligence environment. We divide the freemium business model into bundled and fragmented business models and identify predictors of success. Specifically, we propose a portfolio path to success and higher performance for the freemium business model with different configurations of the freemium business model, dynamic capabilities, and changes in environmental uncertainty. This study does not use traditional multivariate analysis techniques to test the research hypotheses. It uses fuzzy set qualitative comparative analysis [14].

In this study, 45 app firms with freemium business models were selected in the top 500 free apps charts of the App Store. In addition, fsQCA is used to explore how dynamic capabilities can be configured to achieve high performance in freemium business models in highly uncertain external environments. This study has the following three potential contributions: (1) it proposes an integrated framework to analyze when freemium business models lead to high performance while considering the interdependence of various factors. Thus, this study enriches the freemium business model theory by examining the complex mechanisms of antecedent conditions [1]. The interaction between the freemium business model, dynamic capabilities, and environmental uncertainty is elucidated. (2) The findings reveal multiple pathways leading to high and non-high performance, where different conditions can theoretically explain the differences in performance that freemium business models bring to firms. (3) The interaction mechanism between freemium business models, dynamic capabilities, and environmental uncertainty is explored. Our study explores the notion of multiple realizations and provides evidence of how freemium business models, dynamic capabilities, and environmental uncertainty align for success.

2. Theoretical background

2.1. Freemium business model

As an emerging business model, the freemium business model has received considerable attention from business research in recent years [16]. Freemium combines "free" and "premium," i.e., offering a free basic version of the product and a fully paid version. It is often used by companies that are trying to increase the size of their user base and benefit from network effects [17]. The freemium model has received widespread attention domestically and globally, and scholars have examined its effectiveness in the context of piracy [18]. There are also drivers to tap consumers to try the free version [19]. By following a new behavioral logic, companies can use freemium business models to create value for multiple subjects and other stakeholders [20,21]. Enterprise value capture in established freemium models arises from two main aspects. On the one hand, it increases the conversion rate of free users to paid users by enhancing network effects. In the study of freemium business models, the network effect of increasing the user base and improving conversion rates [22]. As more and more digital services are made available to users through various channels, users are more willing to try free products to alleviate the uncertainty associated with digital products. Freemium models increase a company's user retention rate and alleviate the uncertainty of digital products for users [23]. On the other hand, freemium models benefit from advertisers by enhancing network effects to increase user size. In the digital gaming market, freemium offerings are often broken down into separately priced features or services in the form of advertising as supplemental revenue, creating an additional driver to explore value creation and value capture [24]. In an established study, the freemium model is not only used as an advertising strategy but also as the best menu pricing for advertisers [25].

Freemium business models are popular among digital platform companies in categories including mobile app stores and video games [26]. In existing studies in which firms used freemium models as a marketing strategy to improve value capture, firms traded off between increasing the number of paying subscribers to gain subscription revenue and increasing the number of basic subscribers to gain advertising sponsorship revenue [27]. On the one hand, it increases the conversion rate of free users to paid users by enhancing network effects. In the App Store study, enhanced network effects amplify the leader's advantage over followers, increasing the user base and increasing conversion rates [28]. As more digital services are made available to users through various channels [29], users are more willing to try free products and ease the uncertainty that comes with digital products [30]. Freemium strategies can both increase user retention for companies and lead to higher levels of profitability. On the other hand, it benefits advertisers by increasing the free user base through enhanced network effects. In the digital gaming market, freemium offerings are often broken down into separately priced features or services in the form of advertising as additional revenue, creating an additional driver to explore value creation and value capture [31]. In an established analysis, the freemium strategy is not only used as an advertising strategy but also as the best advertiser-facing menu pricing [32]. As an advertising strategy, gaining revenue from consumers and advertisers is the best way to add value for free [33].

2.2. Dynamic capabilities

As organizations build dynamic capabilities and innovate faster, they are more easily configured to achieve high performance through freemium business models [34]. The routine-based view identifies resource acquisition, ownership, and use as the main reasons for differences in sustainable performance among firms [35]. Unique resource characteristics such as value, rarity, inimitability, and irreplaceability drive the process of value creation and use [36]. The routine-based view explains that differences in the profitability of firms cannot be eliminated quickly and stem from unavailable and competing heterogeneous and fixed resources [37]. The routine-based view embodies two roles in the development of dynamic capability theory. On the one hand, it identifies the basic unit of the firm, i.e., the resource; on the other hand, it links the resource to value creation by adding value to the capability. The routine-based view regards practices (defined as patterns of repeated activities) as the genetic makeup of the firm, which can select or deselect practices based on environmental conditions and performance feedback [38]. Teece (2007) argues that dynamic capabilities include perceptual capabilities, seizing capabilities, and reconfiguring capabilities [8].

Existing studies have used dynamic capabilities to explain why firms create significantly different economic values [39]. Barreto (2010) argues that dynamic capabilities contribute to firm performance [40]. However, this association is complex [40]. Existing research remains unclear as to the conditions and mechanisms under which the positive effects of dynamic capabilities on performance are realized [40]. In addition, whether freemium business models are more conducive to performance under stability or environmental uncertainty requires further analysis [41]. For example, existing research suggests that the practical model of dynamic capabilities varies with market dynamics [42,43]. Helfat and Peteraf (2009) showed that sensing and seizing capabilities indirectly affect performance more than reconfiguring capabilities [44].

2.3. Environmental uncertainty

Performance relies on business models and dynamic capabilities from within the company, and environmental dynamics from outside [12]. Environmental uncertainty is a vital weighting factor affecting business activities, business innovation, and performance. Firms first face the challenge of an unpredictable future due to uncertainty in the external environment, as reflected in technological changes, customer value propositions, product diversification needs, and raw material supply and demand [45]. Resource dependence theory suggests that environmental uncertainty stems from a lack of control over external resources [46]. On the other hand, the information-based theory attributes this to the difficulty of understanding and accessing external information [47]. The emergence of a

new technology often requires a more extended period for adoption and more significant capital investment. Thus, compared to market changes, short-term technological changes are slower and less observable [48].

In a high uncertainty environment, employees generally have a high sense of crisis and urgency and believe innovation is necessary. While changes in the external environment challenge enterprises, they also provide opportunities and support for freemium business models [30]. When technology is not rapidly updated and customer demand is relatively stable, companies can achieve profitability by committing to meet customers' needs, utilizing existing resources, and deepening the implementation of business processes. When companies are in a highly dynamic environment, existing technologies and products in the industry tend to become obsolete, and companies need to innovate to survive and develop [35]. The more dynamic the market demand, the easier it is for a brand new niche market to emerge and for a specific market demand to split into two or more. Companies that can seize this market opportunity to innovate their business model can gain access to the niche market, break the existing competitive range, and achieve super profits [19]. Luo et al. (2018) argue that the more turbulent the external environment changes, the more Schumpeterian rents business model innovation brings to the firm, and the more excellent the performance [49]. The high level of technological uncertainty means that companies must adapt their business activities in time to respond to more complex and novel technologies [50]. Under environmental uncertainty, companies can improve performance by transforming to match market trends [40].

2.4. Configurational framework

The freemium business model affects both the consumer's perception of value and the revenue generated by the business. Dynamic capabilities and environmental uncertainty are important factors affecting firm performance. Freemium business models alone are not sufficient to achieve high performance, but they are effective when used in specific combinations with other factors. The systems approach considers how a firm's freemium business model interacts with key episodic events, rather than viewing freemium business models as isolated contributors to firm performance [3,18]. Although scholars agree that firms' high performance results from the co-evolution of internal and external environmental factors, the research is generally limited to exploring the driving factors at the organizational level, thus ignoring the critical role of environmental uncertainty and dynamic capability in the freemium business model. Owing to the complex combinations of antecedents, multiple pathways through which enterprises can realize freemium business models are often available, which are difficult to examine using traditional methods.

In summary, this study argues that bundled and fragmented freemium business models may complement all other factors to promote high app performance. Adopting a configuration perspective helps us examine multiple configurations that can achieve high performance in parallel, which can provide analysis beyond traditional correlation-based approaches [51]. Therefore, this study uses methods such as the configuration perspective and QCA to answer the question of how the configuration effect of bundled and fragmented freemium business models with dynamic capabilities and environmental uncertainty can generate high performance [52]. Thus, we introduce a configurational framework and argue that high performance depends not on a single condition but on interactions between the freemium business model, dynamic capability, and environmental uncertainty. Thus, the bundled and fragmented freemium business models, sensing capability, seizing capability, reconfiguring capability, and environmental uncertainty should be considered to enable enterprises and achieve high performance (Fig. 1).

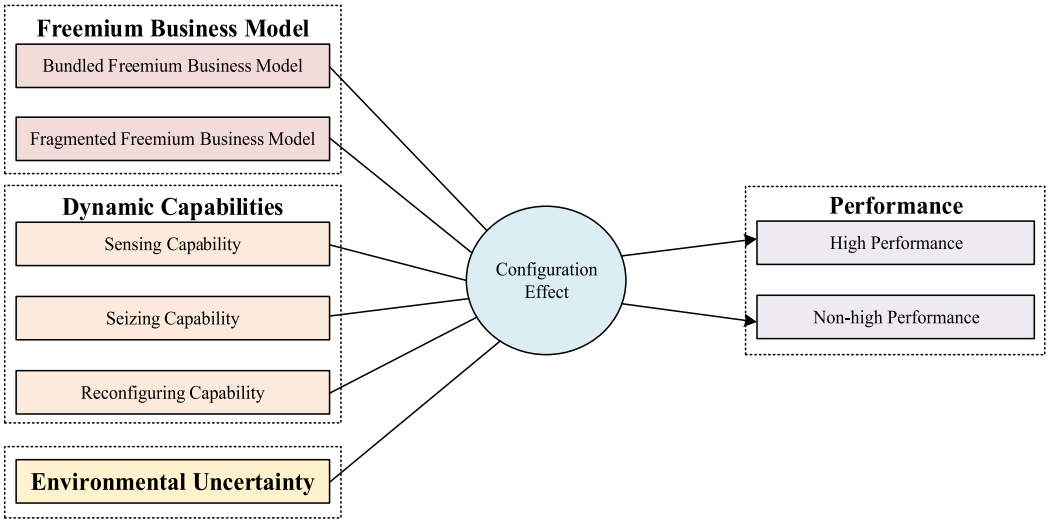

Fig. 1. Conceptual framework diagram.

3. Study design

3.1. Research methodology

The group perspective aims to portray the influence of interdependence and co-interaction between antecedent conditions on the results, which gives a new way of thinking to solve the problem of analyzing the marginal "net effect" of the independent variables on the dependent variable based on the independence, unidirectional linear relationship and causal symmetry of the independent variables in traditional regression methods. FsQCA is one of the QCA research methods based on set theory and using Boolean operations to conceptualize the antecedent conditions and the corresponding outcomes of the study as 0–1 values, which can be obtained as conditionally necessary or mutually exclusive relationships between sub-sets and satisfy the needs of group analysis. Essentially, fsQCA analyzes a set of relationships; it conceptualizes cases as unique combinations of characteristics and draws comparisons between all the predictors and the outcome of interest. FsQCA has recently attracted much attention in innovation and entrepreneurship [53]. The freemium business model is intricately linked to the challenges of corporate innovation and strategic transformation, while environmental uncertainty phenomena are well-suited for analysis using the fsQCA approach. The fsQCA approach is particularly suitable for studying complex causal relationships and multiple interactions and helps to analyze causal complexity problems such as multi-cause concurrency, causal asymmetry, and equivalence [54]. This approach has recently attracted much attention in the innovation field. Furthermore, the fsQCA approach is suitable for corporate innovation and strategic change [55]. Therefore, fsQCA is suitable for determining the complex necessity and adequacy relationships between freemium business model and performance. First, fsQCA is outcome-oriented. It can identify whether specific conditions are necessary for achieving an outcome. A path analysis can address complexity by identifying the combinations of factors leading to a single outcome. Second, fsQCA can examine causal asymmetry at high and not-high levels of high performance. FsQCA uses membership degree assignments, which improves the research quality. It is more case-oriented and enables a more detailed explanation of the causal factors. Therefore, we apply a fsQCA in our study.

3.2. Sample and data source

The Apple App provides an environment where paid and free apps coexist, competing with each other for the same user resources and attention [1,5,56]. First, app stores (and the broader digital goods industry) make economic sense [57]. Secondly, the Apple App Store publicly provides rich data: free, paid, and best-seller charts. The selected sample data points must meet the following characteristics: 1) The app has a freemium business model. 2) The app has improved its performance through a freemium business model. 3) The app ranks high on the Apple App Store free charts. Forty-five randomly sampled data points from the free list in the App Store are used as samples, where each app is used as a sample point, and 45 sample cases are finally determined (see Table 1). Some of the data could be obtained by crawling publicly available data on the Apple App Store using Python techniques. Other data was obtained through surveys and interviews. The data sources are divided into two parts, which are field research and official publication information. To gather up-to-date information, we utilized search engines and databases such as Baidu and Google, ensuring the authenticity and validity of the data. The reliability and validity of diverse data sources were further validated through triangulation. The description of each case is about 35 pages long (300,000–500,000 words), thus providing qualitative data about freemium business models and ensuring the diversity of the research data by collecting readily available supplementary materials.

3.3. Measurement of variables

(1) Measurement

Outcome variable: performance, measured using the Zott and Amit (2008) scale [58]. These are rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Antecedent variables: bundled freemium business model and fragmented

Table 1
Case apps.

	Case apps		
Tencent meeting	Baidu	QQ Mail	Mango TV
Pinduoduo	Meituan	WPS Office	Budoduo
Quark	12,123 Traffic Control	ICBC China Industrial and Commercial Bank	Tencent Video
Taobao	NetEase Cloud Music	National Anti-Fraud Center	Soul
Trill	Wooden fish	Hypic	Tmall
Alipay	Tomato Novel	Digital RMB	China mobile
WeChat	Ele.me	UC browser	Renren video
QQ	Colorful Widget	Zhihu	QiDianReader
DingTalk	Kuaishou	Boss Zhipin	Huya Live
Jingdong	Poizon	Arena of Valor	Dongchedi (Autos)
Xiaohongshu	Bilibili	Baidu map	Zhangshang Life
Gaode Maps			

freemium business model. The correlation matrix and summary statistics are shown in Table 2. The measurement of the freemium business model draws on the research instrument of Tidhar and Eisenhard (2020) [1], with each question item shown in Table 3. We used the scale tools of Tidhar and Eisenhard (2020) to measure the freemium business model in six topics [1]. Each topic contains five items. These are rated on a four-point scale (1 = strongly disagree; 2 = partially disagree; 3 = normal; 4 = partially agree; and 5 = strongly agree). The measurement of the three dimensions of dynamic capabilities (sensing, seizing, and reconfiguring capabilities) draws on the research tools of Surmeier (2020) and Mahmud et al. (2020) [59] [60]. Measurement of environmental uncertainty draws on Chen and Tian (2022) [12], with each question item shown in Table 3. Additionally, a five-point Likert scale to code each dimension, thus reducing subjective bias (see Table 3). The scale design in this study was based on established research results, and scholars and business personnel were invited to discuss and evaluate the relevance and representativeness of question items to ensure the questionnaire's content validity.

(2) Conditional configuration analysis

First, data descriptive statistical analysis was performed. Descriptive statistical analysis using SPSS 26.0 software found that the bundled freemium business model, fragmented freemium business model, sensing capability, seizing capability, reconfiguring capability, environmental uncertainty, and performance had some positive and significant correlations, tentatively indicating a single positive correspondence between the antecedent variables and performance. Second, data reliability testing was performed. Due to the limited sample size, we conducted a variance-rotated principal component analysis on the questionnaire items related to two dimensions of the freemium business model and three dimensions of dynamic capabilities, environmental uncertainty, and performance. The study data were obtained by scoring the case materials. The Harman one-way test was performed to analyze the variance explained by the first factor in the unrotated case, which was <0.4. Thus, the homogeneity bias was not considered severe. Then, reliability analysis was conducted, suggesting that Cronbach's alpha coefficient and combined reliability (CR) values for all variables were >0.7, indicating high internal consistency and high reliability of the scale. In the validity test and validity analysis of each construct using exploratory factor analysis, the Kaiser-Meyer-Olkin (KMO) sampling appropriateness measures were all >0.7. The factor loadings of each variable ranged from 0.517 to 0.998, and the average extracted variance (AVE) of each variable was >0.5, with good questionnaire convergent validity, indicating that the scale has high validity.

3.4. Calibration

The calibration process involves converting various variables into sets of membership. For instance, the value of 0 is the nonmembership level, while that of 1 is the membership level. A fundamental element of the neo-configurational perspective is the measurement of cases' set memberships through calibration that reflects meaningful standards and captures variation directly relevant to the research question and the target set of cases. To further carry out fsQCA analysis, the scores of each construct need to be calibrated to assign an ensemble affiliation score. An essential step before a fuzzy set analysis is calibrating the variables into set memberships. The researcher uses three thresholds, or anchor points, that determine the cases' degree of set membership in each causal and outcome condition used in the study. The membership scores fall between 0 and 1, where (close to) 0 implies full nonmembership and (close to) 1 full membership. This method uses percentiles of the sample when substantive knowledge is not available [61]. While the use of qualitative anchors such as "strongly agree," "neither agree nor disagree," and "strongly disagree" may intuitively align with the calibrations of "fully in," "neither in nor out," and "fully out," respectively, a thorough examination of sample response distributions casts doubt on this assumption. In fact, the data tend to indicate that such a correspondence may not hold due to potential range restrictions or other response biases [62]. While quantitative data is often used as the basis for measuring ensemble affiliation, qualitative thresholds used in calibration are still derived from theory and evidence. Researchers must also reconcile the conceptual anchors with the actual distribution of the sample. Based on the descriptive statistics of the data along with existing literature practices, all variables involved in fuzzy sets are calibrated in this study. Since the minimum and maximum aggregated values of the individual constructs rarely, if ever, reached close to the theoretical ends. Three threshold breakpoints are used to set the

Table 2
Correlation matrix and summary statistics.

	Bundled freemium business model	Fragmented freemium business model	Sensing capability	Seizing capability	Reconfiguring capability	Environmental uncertainty	Performance
Bundled freemium business model	1						
Fragmented freemium business model	0.606**	1					
Sensing capability	0.373*	0.403**	1				
Seizing capability	0.249	0.402**	0.430**	1			
Reconfiguring capability	0.583**	0.551**	0.353*	0.386**	1		
Environmental uncertainty	0.391**	0.452**	0.448**	0.720**	0.494**	1	
Performance	0.341*	0.391**	0.616**	0.500**	0.283	0.497**	1

Table 3
Reliability and validity test of the questionnaire.

Dimensionality	Scales	Test of reliability	Test of validity		
		Cronbach's α	Std. loadings	CR	AVE
Bundled freemium business model	The business adds more value through one (or several) premium sales (from which it gets value).	0.850	0.855	0.957	0.815
	The enterprise adds new products, services, and information combinations that bring new experiences.		0.898.		
	The company offers free modules and specific paid modules to customers.		0.930		
	It is difficult for the company to separate high-quality functions and sell them separately.		0.882		
	The enterprise has many interrelated and reinforcing characteristics.		0.841		
	Users of the enterprise often combine the use of hypermodularity.		0.998		
Fragmented freemium business model	The company creates value with free products and then adds more value with many "fragmented" upsell products.	0.911	0.900	0.947	0.753
	The company's diverse product features can be sold separately.		0.930		
	The business user can choose to upsell according to their interests and willingness to pay.		0.918		
	The purchased products offered by the business are depleted after use.		0.937		
	The free products the business offers are often complex and can support modular purchases.		0.900		
	The company offers free modules and optional paid modules to customers.		0.558		
Sensing capability	The company is vigilant and sensitive to new opportunities.	0.768	0.875	0.867	0.687
	The company is susceptible to changes in customer needs and preferences.		0.869		
	The firm can keep a close eye on the behavior of its competitors.		0.735		
Seizing capability	The company has clear roles and responsibilities in acquiring new resources and knowledge.	0.729	0.745	0.848	0.652
	When employees make mistakes or missteps, colleagues do not blame them but learn from them.		0.840		
	The enterprise can obtain high-quality resources at a lower cost.		0.833		
Reconfiguring capability	The enterprise can adjust the resource mix according to internal and external environmental changes.	0.775	0.899	0.786	0.562
	The various departments of the enterprise collaborate effectively.		0.782		
	The company can design feasible solutions to problems based on existing resources.		0.517		
Environmental uncertainty	The company is in an industry where new products and services are updated quickly.	0.729	0.834	0.848	0.651
	The market behavior of the firm's main competitors is challenging to predict.		0.845		
	The preferences and needs of the firm's consumers become unpredictable.		0.737		
Performance	The company has a high financing capacity.	0.722	0.876	0.845	0.651
	The company has a higher market share growth rate than its peers.		0.910		
	The number of products or services launched by the enterprise.		0.599		

calibration: set to the 75th percentile, 50th percentile, and 25th percentile of the number of cases, and set to fully affiliated, crossover, and fully unaffiliated anchor points. Therefore, we set the thresholds at 0.75 (fully in), 0.50 (crossover point), and 0.25 (fully out). All items were assessed such that the global average of all firms from all industries should be close to the middle point of the scale. We calibrated the freemium business model, dynamic capabilities, and environmental uncertainty based on the scales used in the data collection. Equation (1) shows the calibration model. n is the number of questions for the aggregate variable and Answer (k) is the result given by the respondent based on a Likert scale for statement k. The answer (k) is the number of questions for the aggregate variable. However, when the calibration method is based on the largest sample, the average (or median) and minimum value, when some knowledge is available. We have some substantial knowledge about scale anchors. When some knowledge is available, the

Table 4
Calibration.

Condition	Fully out	Calibration	Fully in
		Crossover point	
Bundled freemium business model	2.8	3.2	3.8
Fragmented freemium business model	2.8	3.5	3.8
Sensing capability	3	3.3	4
Seizing capability	2.3	2.7	3
Reconfiguring capability	2.3	2.7	3.3
Environmental uncertainty	2.3	2.7	3.3
Performance	2.3	3	3.3

anchor point should be determined according to the sample distribution. For example, we have calibrated the maximum observation value (3.3) of the complete performance. Following the same principles, we specify three benchmarks for each variable, as shown in Table 4, and calibrate each corresponding fuzzy set.

$$Calibration = (0,5/2n) * \sum_{1 \le k \le n} \mathrm{sum}(\mathrm{Answer(k)}) - 0.25 \quad (1)$$

4. Analysis

4.1. Necessity conditions analysis

Before performing specific path analysis, check whether any single condition requires high performance. Before conducting a specific path analysis, it is useful to check whether any single condition is necessary for high performance. If the consistency coefficient is above 0.9, the prerequisite can usually be considered to be necessary for the result. Before conducting a specific path analysis, it is essential to check whether any single condition is necessary for high performance. The consistency and coverage of each antecedent condition were calculated using fsQCA 3.0 software, as shown in Table 5. If the consistency coefficient is higher than 0.9, the antecedent conditions can typically be considered necessary for the results [63]. The consistency coefficients for all conditions are below 0.9 at high and non-high performance levels, indicating that a single condition is not required for high performance. The realization of all individual conditional variables on performance (high and low performance) were all below 0.9, which does not constitute nor approximate a sufficiently necessary condition to satisfy the prerequisite criteria for the prerequisite criteria for the construct test. Therefore, a configuration perspective is needed for profiling.

4.2. Conditional configuration analysis

Herein, fsQCA 3.0 software was used to analyze. In this study, the configuration was explored for achieving high performance. We also use PRI (proportional reduction in inconsistency) to further filter the truth of the reliable link with the result. We set the original consistency to $\geq$0.8, PRI consistency to $\geq$0.7, and the case frequency threshold to 1 according to the research specification and used fsQCA 3.0 software to conduct the adequacy analysis based on truth tables. Since configurations with a PRI score lower than 0.5 may be inconsistent, we comprehensively analyzed the case details and data distribution and adjusted the four rows of data to 0. We identified the causal combinations of predictor variables and outcomes of interest by constructing truth tables, and collated the combined constructs of achieving high/non-high performance as shown in Table 6. Then, Ragin's (2008) logic scheme was used to summarize the eight pathways from a theoretical perspective [53]. Next, the truth table was constructed to identify cause and effect combinations of the predictor variables with the outcome of interest. The ● describes the core causal condition (present). The ⊗ describes core causal condition (absent). The ● describes peripheral causal condition (present). The ⊗ describes peripheral causal condition (absent). These four models show an agreement of more than 0.8, which is sufficient to produce the result. We then further summarized the eight paths from a theoretical perspective using Ragin's (2009) logical scheme [53].

By constructing a truth table to identify causal combinations of antecedent variables and outcome variables, four configurations for achieving high performance were compiled, as shown in Table 6. This study stands to benefit from the neo-configurational perspective is research on freemium business models. Configuration H1 is BBMI*FMBI*SC*CC*~RC. Configuration H2 is BBMI*FMBI*SC*CC*~RC*EU. Configuration H3 is FMBI*SC*CC*RC*EU. Configuration H4 is BBMI*~FMBI*SC*~CC. The abbreviation (~) is the logical operator to describe the absence of the condition. The new configuration extension of this study can explain how different configurations of classification characteristics can cause different levels of performance. Configuration H1: Bundled freemium business model, fragmented freemium business model, sensing capability and seizing capability must be present. Thus, sensing capability and seizing capability are important motivations for high performance. With or without environmental uncertainty, having a high bundled freemium business model, a high fragmented freemium business model, a high sensing capability, and a high seizing capability leads to high performance even if there is a lack of reconfiguring capability. This path explains about 34.5 % of the high performance cases, of

Table 5
Necessity analysis of single conditions.

Antecedent condition	High performance	Non-high performance
High bundled freemium business model	0.717	0.657
Non-high bundled freemium business model	0.365	0.359
High fragmented freemium business model	0.671	0.645
Non-high fragmented freemium business model	0.396	0.370
High sensing capability	0.751	0.725
Non-high sensing capability	0.395	0.367
High seizing capability	0.711	0.652
Non-high seizing capability	0.415	0.407
High reconfiguring capability	0.538	0.711
Non-high reconfiguring capability	0.726	0.536
High environmental uncertainty	0.720	0.666
Non-high environmental uncertainty	0.419	0.407

Table 6
Core and peripheral conditions for achieving high performance/non-high performance.
(1) Configurations for high performance

Antecedent condition	High performance				Non-high performance			
	H1	H2	H3	H4	NH1	NH2	NH3	NH4
Bundled freemium business model	●	●	Y	●		⊗	⊗	●
Fragmented freemium business model	●	●	●	⊗		⊗	⊗	●
Sensing capability	●	●	●	●	⊗	⊗	⊗	⊗
Seizing capability	●	●	●	⊗	⊗	●	●	⊗
Reconfiguring capability	⊗	⊗	●		⊗	⊗	⊗	⊗
Environmental uncertainty		●	●		⊗		●	
Consistency	0.857	0.838	0.959	0.908	0.918	0.742	0.751	0.818
Raw coverage	0.345	0.363	0.311	0.092	0.450	0.210	0.213	0.192
Unique coverage	0.015	0.032	0.010	0.051	0.214	0.001	0.019	0.030
Overall solution consistency	0.825						0.814	
Overall solution coverage	0.440						0.662	

●core causal condition (present); ⊗core causal condition (absent); ●peripheral causal condition (present); ⊗peripheral causal condition (absent).

which about 1.5 % can be explained only by this path. Configuration H2: Bundled freemium business model, fragmented freemium business model, sensing capability, seizing capability and environmental uncertainty must be present. With high environmental uncertainty, even if there is a lack of reconfiguring capability, having a high bundled freemium business model, a high fragmented freemium, high sensing capability and high seizing capability can lead to high performance. This path explains about 36.3 % of the high performance cases, of which about 3.2 % can be explained by this path only. Configuration H3: Fragmented freemium business model, sensing capability, seizing capability, reconfiguring capability and environmental uncertainty must be present. With high environmental uncertainty, having a high fragmented freemium business model, high sensing capability, high seizing capability, and high reconfiguring capability can lead to high performance, regardless of a bundled freemium business model. This path explains about 31.1 % of the high performance cases, of which about 1 % can be explained by this path only. Configuration H4: Bundled freemium business model and sensing capability must be present. With high reconfiguring capability and environmental uncertainty, having a high bundled freemium business model, high sensing capability, and even in the absence of fragmented freemium business model and seizing capability can lead to high enterprise performance. This path explains about 9.2 % of the high performance cases, of which about 5.1 % can be explained only by this path. A mutual substitution effect exists between the fragmented freemium business model and sensing capability in the two pathways dominated by the bundled freemium business model. This context of a high bundled freemium business model and sensing capability structuring can facilitate enterprises to achieve high performance by exploring new opportunities, increasing their existing capabilities, creating new capabilities or fully using internal and external capability configurations.

For the bundled freemium business model, the H4 configuration reveals that if a company has a high bundled freemium business model, along with a high sensing capability, with or without environmental uncertainty or the reconfiguring capability, even if the company currently lacks the fragmented freemium business model and the seizing capability, it can deliver high performance for the company. Bundled freemium business models focus on a high perception of management and practice. Bundled freemium business models require the company to be innovative in its business model, provide new combinations of products and services, and continuously innovate in its business. Regarding customer and upstream/downstream relationships, the business must bring new participants together and offer novel incentives to transaction participants, providing unprecedented diversity and variety. Connecting participants to deals in novel ways encourages the discovery of new participants and business models. This places a demand on firms' sensing capabilities, which facilitate the perception and discovery of new opportunities.

For the fragmented freemium business model, the H3 configuration reveals that under high environmental uncertainty, with or without the bundled freemium business model, if the firm has a high fragmented freemium business model, high sensing capability, high seizing capability, and high reconfiguring capability, it will bring high performance for the firm. This implies that fragmented freemium business models have dynamic capabilities of high sensing, seizing, and reconfiguring. The fragmented freemium business model is simple from the user's perspective because it requires lower inventory costs for business model participants. From the business point of view, the fragmented freemium business model requires a reduced number of errors in execution, modular customization based on customer interests, transparent transactions, and verifiability of information flow, logistics, services, etc. This requires high sensing, seizing, and reconfiguring capabilities.

From H1, it follows that having a high bundled freemium business model, high fragmented freemium business model, high sensing capability, and high seizing capability simultaneously will bring high performance to the firm even if it lacks reconfiguring capability. It can be seen from the H2 results that there are both bundled freemium business models and fragmented freemium business models, but when the fragmented freemium business model is stronger than the bundled freemium business model, high environmental uncertainty will bring high performance. However, when a firm's fragmented freemium business model is more robust than its bundled freemium business model, together with high environmental uncertainty, it leads to high performance. In a high uncertainty environment, the sensing capability of enterprises will make them perceive a high sense of crisis and urgency and consider innovation very necessary. While changes in the external environment challenge enterprises, they also provide opportunities and support for business model innovation.

For example, the bundled freemium business model of Tencent Meeting, an app, focuses more on improving sensing and seizing capability, sensing changes in market demand, and identifying core value propositions. Customers need to pay for membership to purchase bundled function modules and get several functions such as meeting length, number of participants, recording and playback functions, moderator privileges, and security features in a bundle. Tencent has strengthened its seizing capabilities and innovated its revenue model. With high environmental uncertainty, it has focused on a high sensing capability and high capturing capability configuration, and its freemium business model has achieved high performance even if it ignores reconfiguring capabilities.

(2) Configurations for non-high performance

The core condition of insufficient awareness of the freemium business model is the absence of a bundled and fragmented freemium business model. Consequently, high performance cannot be achieved. By constructing a truth table to identify the causal combinations of antecedent variables and outcome variables, four combinatorial configurations for achieving non-high performance were compiled, as shown in Table 6. The core conditions of insufficient awareness of dynamic capability are the absence of sensing capability and reconfiguring capability, and thus high performance cannot be achieved. Configuration NH1 is ~SC*~CC*~RC*~EU. Configuration NH2 is ~BBMI*~FMBI*~SC*CC*~RC. Configuration NH3 is ~BBMI*~FMBI*~SC*CC*~RC* EU. Configuration NH4 is BBMI*FMBI*~SC*~CC*~RC. Configuration NH1: In the absence of high sensing capability, high seizing capability, high reconfiguring capability, and high environmental uncertainty, with or without bundled freemium business models and fragmented freemium business models, also lead to non-high performance. Configuration NH2: Seizing capability must be present. In the absence of high bundled freemium business models, high fragmented freemium business models, high sensing capability, and high seizing capability, even with seizing capability, can lead to non-high enterprise performance. Configuration NH3: Seizing capability and environmental uncertainty must be present. In the absence of high bundled freemium business models, high fragmented freemium business models, high sensing capability, and high seizing capability, even with seizing capability and environmental uncertainty, can lead to non-high enterprise performance. Configuration NH4: Bundled freemium business model and fragmented freemium business model must be present, and the absence of seizing capability. With or without environmental uncertainty, even with a high bundled freemium business model and a high fragmented freemium business model, a lack of high sensing capability, seizing capability, and reconfiguring capability can lead to non-high enterprise performance.

According to NH1, NH2 and NH3 can all explain that only bundled and fragmented freemium business models cannot bring high performance. According to NH1, it can be concluded that a lack of high dynamic capabilities and high environmental uncertainty, with or without bundled and fragmented freemium business models, can lead to non-high performance. According to NH2, it follows that regardless of environmental uncertainty, a firm can deliver non-high performance if it lacks high bundled and fragmented freemium business models, high sensing capabilities, and high seizing capabilities, and even if it has seizing capabilities. According to NH3, it follows that if high bundled and fragmented freemium business models, high sensing capability, and high seizing capability are lacking, even with seizing capability and environmental uncertainty, it can lead to non-high performance. This further illustrates that bundled and fragmented freemium business models are complementary rather than substitutes. Having bundled and fragmented freemium business models may lead to high performance, while having only reconfiguring capabilities and environmental uncertainty may lead to non-high performance even if the firm facilitates the discovery of new technologies and opportunities using environmental uncertainty and the restructuring of resources. NH4 shows that a lack of high sensing, seizing, and reconfiguring capabilities can lead to non-high performance regardless of environmental uncertainty, even with high bundled and fragmented freemium business models. For example, bundled freemium business models emphasize value creation by increasing the value of use, i.e., providing potential customers and partners with something that can meet their needs in a novel way. However, capturing the newly created value requires companies to establish design mechanisms that focus on value capture, which places demands on their sensing, seizing, and reconfiguring capabilities.

Companies create value with free products and add more value with many “fragmented” modules of upsell products to capture value. The fragmented freemium model is suitable for complex free apps with a wide range of product features that can be sold individually in modular form. For the customer, these features are generally consumable. Further, the purchases are exhausted after

Table 7
Core and peripheral conditions for achieving high performance/non-high performance.

Antecedent condition	High performance				Non-high performance			
	H1	H2	H3	H4	NH1	NH2	NH3	NH4
Bundled freemium business model	●	●		●		⊗	⊗	●
Fragmented freemium business model	●	●	●	⊗		⊗	⊗	●
Sensing capability	●	●	●	●	⊗	⊗	⊗	⊗
Seizing capability	●	●	●	⊗	⊗	●	●	⊗
Reconfiguring capability	⊗	⊗	●		⊗	⊗	⊗	⊗
Environmental uncertainty		●	●		⊗		●	
Consistency	0.711	0.809	0.818	0.813	0.873	0.898	0.838	0.826
Raw coverage	0.538	0.549	0.158	0.457	0.213	0.115	0.363	0.090
Unique coverage	0.099	0.054	0.021	0.013	0.041	0.030	0.037	0.024
Overall solution consistency	0.837						0.803	
Overall solution coverage	0.691						0.497	

use. Because of its flexibility, the fragmented freemium model allows users to choose their own upsells based on their interests and willingness to pay. For example, Arena of Valor, a MOBA game app, has props and game coupons that can be purchased based on players' interests. For the fragmented freemium model, sensing capability is crucial, and it is more important to improve customers' perceptions through customized products, services, and solutions rather than focusing more on reconfiguring capabilities. Arena of Valor brings high value-added revenue to the company due to its fragmented freemium model because of the importance of personalization and the perception of users' needs.

4.3. Robustness checks

Robustness checks were performed on the QCA results using standard methods. Common methods include adjusting the calibration threshold, changing the consistency threshold, adding or deleting cases, changing the frequency threshold, and adding other conditions [12]. We referred to the above methods and used the ensemble relationship and fit difference of the configuration proposed by Schneider and Wagemann (2012) as the judgment criteria [64]. First, we increased the proportional reduction in inconsistency (PRI) threshold from 0.7 to 0.8 and found that H1–H4 and NH1–NH4 were still supported. Secondly, two more cases were randomly selected and eliminated. The obtained configurations are largely consistent with the existing configurations, and the combined constructs that achieve high/non-high performance are collated in Table 7, indicating that the study results remain robust.

5. Discussion and conclusions

5.1. Research conclusions

This research delves into the interplay between distinct configurations of freemium business models, dynamic capabilities, and environmental uncertainty to performance outcomes. The study extends our understanding of freemium business models and dynamic capabilities by exploring potential routes to achieve high performance using fsQCA. This study endeavors to address how different combinations of freemium business models, dynamic capabilities, and environmental uncertainty affect performance. In our study, four different configurations that contribute to performance are identified.

1) Bundled and fragmented freemium business models are a fundamental driver of enterprise performance and are necessary to bring about high enterprise performance, but they can only work in combination with dynamic capabilities and environmental uncertainty. Bundled and fragmented freemium business models alone, dynamic capabilities alone, and environmental uncertainty alone do not provide the necessary conditions for high enterprise performance. Having a high bundled freemium business model, along with high sensing capabilities, with or without reconfiguring capabilities and environmental uncertainty, can deliver high enterprise performance even with the lack of fragmented freemium business models and seizing capabilities. If a company has high fragmented freemium business models, high sensing capabilities, high seizing capabilities, and high reconfiguring capabilities, it will achieve high performance with or without bundled freemium business models and high environmental uncertainty. Bundled freemium business models and fragmented freemium business models are core elements of enterprise performance, but by themselves they do not guarantee high performance. To achieve this, companies also need to have dynamic capabilities and environmental uncertainty. For bundled freemium business models, firms need to have high bundled freemium business models and high sensing capabilities. In this case, the firm can achieve high performance even if other factors are missing. This suggests that bundled freemium business models and sensing capabilities are one of the key elements to achieving high performance. For the fragmented freemium business model, firms need to have high environmental adaptability. Under high environmental uncertainty, firms need to have high fragmented freemium business model, high sensing capability, high seizing capability, and high reconfiguring capability. This will help firms to seize opportunities and achieve high performance in the face of market changes. This suggests that fragmented freemium business models and dynamic capabilities are key elements in achieving high performance in the face of environmental uncertainty. Thus, bundled freemium business models and fragmented freemium business models are core elements of firm performance, but they need to be combined with dynamic capabilities and environmental uncertainty to truly achieve high performance. Enterprises need to take these factors fully into account when formulating their strategies to achieve optimal business objectives and performance.
2) The bundled freemium business model and the fragmented freemium business model are complementary rather than substitutes. The mechanism of the configuration effect of the freemium business model and performance is explored from the configuration perspective. It is concluded that bundled freemium business models and fragmented freemium business models are necessary to obtain high performance results. The antecedent conditions such as sensing capabilities, seizing capability, and reconfiguring capability assume differentiated roles in each configuration type, and business model innovation theory, value theory, and dynamic capability theory provide theoretical support. The bundled freemium business model and the fragmented freemium business model complement each other and work together to promote high enterprise performance. From a group perspective, these two models have important associations between firm innovation and firm performance. It is found that bundled freemium business models and fragmented freemium business models are critical for firms to achieve high performance. To effectively implement these models, firms must possess the prerequisite capabilities, including sensing capability, seizing capability, and reconfiguring capability. Notably, these capabilities vary across models, necessitating tailored development and enhancement based on a company's unique characteristics. The theoretical frameworks of business model innovation theory, value theory, and dynamic capability theory provide a theoretical foundation for the implementation of these models. The theory of business model innovation helps enterprises

to develop new horizons and innovatively create value; the theory of value guides enterprises to find the most suitable way to create value in different business models; and the theory of dynamic capabilities emphasizes the flexibility of enterprises to respond in the changing market environment to achieve sustainable competitive advantage. Therefore, bundled freemium business models and fragmented freemium business models are the keys for enterprises to succeed in market competition. By improving antecedent conditions such as sensing capability, seizing capability and reconfiguring capability, and applying the guidance of business model innovation theory, value theory and dynamic capability theory, enterprises can better realize business model innovation and improve enterprise performance.

3) High sensing capability and high seizing capability are crucial for bundled freemium business models and fragmented freemium business models to achieve high enterprise performance. Having high bundled freemium business models, high fragmented freemium business models, high sensing capabilities, and high seizing capabilities will lead to high performance even if companies lack reconfiguring capabilities. To achieve high enterprise performance, high sensing capability is more critical for bundled freemium business models. Suppose a company has a high bundled freemium business model along with high sensing capabilities. In that case, it can contribute to high performance regardless of the availability of reconfiguring capabilities and environmental uncertainty, even if it lacks a fragmented freemium business model and capturing capabilities. The important role of high sensing and seizing capabilities on firm performance is when the firm has a bundled freemium business model and a fragmented freemium business model. The important role of high sensing capability on firm performance is particularly evident when the firm possesses a high bundled freemium business model. In this case, even if an enterprise currently lacks fragmented freemium business models and seizing capabilities, it can still achieve high performance as long as it possesses high bundled freemium business models and high sensing capabilities. Therefore, enterprises need to focus on the improvement of their perceptual and seizing capabilities in order to achieve superior success in market competition.
4) Under high environmental uncertainty, with or without a bundled freemium business model, fragmented freemium business models lead to high performance as long as there is high sensing capability, high seizing capability, and high reconfiguring capability. Under high environmental uncertainty, having both a high fragmented freemium business model and a low bundled freemium business model, or only a high fragmented freemium business model, with or without a bundled freemium business model, will also lead to high performance for the company. Under high environmental uncertainty, having a high sensing capability and a high seizing capability with both bundled and fragmented freemium business models can lead to high performance even without reconfiguring capability. Under high environmental uncertainty, the choice of fragmented freemium business models is beneficial to improving performance. In contrast, bundled freemium business models require firms to provide new combinations of products and services, new value propositions, and novel incentives to transaction participants, which makes it challenging for firms to balance efficiency and novelty enhancement under high environmental uncertainty. Under high environmental uncertainty, technological and market environments are more dynamic, and companies can use their high sensing, seizing, and reconfiguring capabilities to perceive technological and market changes, search for information, identify market opportunities, acquire resources, and use them to update their business models, which is conducive to improving quality and efficiency, eventually improving performance. In highly uncertain environments, fragmented freemium business models demonstrate strong adaptability. Enterprises that can simultaneously possess high sensing, seizing, and reconfiguring capabilities can achieve high performance by improving operational efficiency and quality through flexible business model adjustments and resource allocation, even without the assistance of bundled freemium business models. In the case of high environmental uncertainty, enterprises can adopt a hybrid model that retains the flexibility of a fragmented freemium business model while leveraging the advantages of a bundled freemium business model. This model requires enterprises to be highly sensing and seizing capabilities to quickly identify opportunities, integrate resources, and strike a balance between the two business models in a dynamic technology and market environment.

5.2. Theoretical contributions

First, based on the perspectives of freemium business models, dynamic capabilities, and environmental uncertainty, we constructed a theoretical model of when a freemium business model leads to high performance and conducted a configurational analysis, thus revealing the influence mechanism for freemium business models. Most research has thus far focused on organizational factors such as resources. We extend this research by exploring the mechanisms via which a freemium business model leads to high performance from a holistic perspective. This study reveals that bundled freemium business models and fragmented freemium business models are complementary relationships rather than substitution relationships, responding to established research that questions the relationship between bundled freemium business models and fragmented freemium business models. This study reveals that if a firm lacks high bundled and fragmented freemium business models, high sensing capability, and high seizing capability, even with seizing capability and environmental uncertainty, it can lead to non-high performance. In this study, fsQCA, which combines the advantages of qualitative and quantitative research, is applied to construct different sets of states that achieve high and non-high performance for bundled and fragmented freemium business models. By interpreting both theoretical and practical implications, we further integrate business model innovation theory-related research. Our findings support those of Tidhar and Eisenhardt (2020), who suggest focusing on the synergistic effect between bundled freemium business models and fragmented freemium business models [1].

Second, based on the configuration effect, this paper explores how the configuration effect of freemium business models can contribute to high performance. It identifies four equivalent paths for freemium business models to create high performance, expands the research related to business models, and, to some extent, responds to the inconsistent research on the impact of business model innovation on performance in existing studies and the conflict between theory and reality of business models leading to high

performance. In exploring whether the freemium business model positively affects performance, the existing literature attempts to extensively capture empirical studies on whether the freemium business model leads to high performance. Eg: organizational design [65], technical endowments, environmental factors, and dynamic capabilities. The research has taken a stand-alone perspective on the boundary conditions under which the freemium business model affects performance. They do not focus on the complex causal mechanisms of multiple factors and how they act on performance through "multiple concurrencies" and "different paths." The factors that have been studied are mostly linear. Most of the factors in the existing studies are analyzed linearly. Thus, strong causal or correlated attribution leads to synergistic effects among the condition elements and the possibility of equivalence among different configurations. This study integrates business model innovation theory, dynamic capability theory, and environmental uncertainty theory to explore how the configuration effect of the freemium business model affects performance. It is an in-depth interpretation of the freemium business model to achieve high performance in new contexts.

Third, this study examines how bundled freemium business models, fragmented freemium business models, and different dynamic feature configurations are related to performance. This study also contributes to the literature on dynamic capabilities by validating possible approaches to achieve high performance through fsQCA. Dynamic capability configurations exist mainly in studies on their conceptualization [8], with a lack of empirical studies. This study lays the foundation for empirical support for this view. It is more important for firms to have sensing and seizing capabilities to deliver high performance from bundled and fragmented freemium business models. It echoes Helfat and Peteraf's (2009) suggestion that sensing and seizing capabilities indirectly affect performance more than reconfiguring capabilities [44].

Last, fragmented freemium business models lead to high performance under high environmental uncertainty. Under high environmental uncertainty, having both a high fragmented freemium business model and a low bundled fragmented freemium business model, or only a high fragmented freemium business model, with or without a bundled fragmented freemium business model, also leads to high performance. A high level of technological uncertainty for firms means that firms can adapt their business activities through novel technologies, which facilitates firms to increase transactions and production to be able to cope with more complex and novel technologies, thereby opening up opportunities.

6. Strengths and limitations

The critical contribution of this study is the use of QCA to understand and investigate when a freemium business model leads to high performance. Although some valuable conclusions have been obtained from this study, there are still limitations. First, the case sample used in this study is 45 apps from the free list of the Apple App Store, and whether the success paths of other freemium business model apps to achieve high performance present different characteristics needs to be further investigated. Study samples are relatively small. Therefore, the verification measurement has some restrictions to a certain extent. However, incorporating more samples will lead to better development. Due to the minimum cases, conditions cannot be formed widely. Secondly, the lack of control variables limits the possibility of summarizing the results in other circumstances. Third, this study follows a sampling research mindset in selecting the sample, and there may be bias in our sample selection. While we acknowledge this limitation, we also note the assumption that fsQCA does not rely on probability distributions, which may alleviate this concern [19]. Last, realistic factors such as TMT perceptions and entrepreneurship may influence performance. In the future, the configuration effect of entrepreneurship can be incorporated based on the top-echelon theory. Therefore, future research is recommended to have a larger sample size to explore more factors.

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Data will be made available on request.

Additional information

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CRediT authorship contribution statement

Yanying Shang: Writing – review & editing, Writing – original draft, Software, Data curation, Conceptualization. **Junfeng Jiang:** Writing – review & editing, Visualization, Validation, Investigation, Funding acquisition, Data curation. **Yamin Zhang:** Validation, Supervision, Resources, Investigation. **Ruochen Zhang:** Visualization, Supervision, Software, Resources, Investigation. **Peiqing Liu:** Data curation.

Declaration of competing interest

"No potential conflict of interest was reported by the authors."

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Appendix A. Supplementary data

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