LIFTING THE VEIL: WHAT DRIVES PLATFORM-OWNER ENTRY IN SECOND-HAND PRODUCT TRADING PLATFORMS?

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ABSTRACT

With the rapid development of the platform economy, platforms are evolving beyond their traditional role as intermediaries to actively participate in transactions. Platform-owner entry refers to the practice of platforms directly providing products or services. Grounded in coopetition theory, this study investigates the determinants influencing platform-owner entry in the context of second-hand trading platforms. Based on empirical analysis of secondary data from a leading second-hand trading platform in China, the findings reveal that platforms are more likely to enter markets characterized by higher product prices and greater popularity, aiming to maximize profits. Furthermore, platforms enter to balance supply and demand, thereby addressing customers' product needs. While prior research has predominantly focused on platform-owner entry in first-hand trading platforms, this study bridges a critical gap by examining the unique dynamics of second-hand trading platforms, including the dual roles of complementors and the distinctive attributes of second-hand products. The findings underscore the complementary role of platform-owner entry in the coopetitive relationship between platform owners and complementors. This study provides meaningful insights for future research and practical guidance for second-hand trading platform operators, enabling them to develop effective entry strategies that support sustainable platform growth.

Keywords: Platform-owner entry; Platform economy; Second-hand trading platforms; Complementor

1. Introduction

In recent years, with the development of the platform economy, platform-owner entry has become a significant issue for both platform operators and scholars, who must consider how to balance the interests of complementors and the platform itself toward sustainability. Platform-owner entry refers to the dual role of platforms as both

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intermediaries and product suppliers by offering products and services directly, which is significantly related to the sustainable development of the platform (Zhu and Liu, 2018).

Second-hand trading platforms, as a result of green consumption and internet development, have become a new scenario to study platform-owner entry on the basis of diverse attributes and characteristics. C2B2C is the particular model adopted by second-hand trading platforms. Complementors sell their own items to the platform. The platform then provides product inspection, processing, maintenance, and refurbishment services to resell the renewed products to customers.

Existing studies have examined the effects of platform-owner entry on complementors and customers. However, they have only focused on first-hand trading platforms (Jiang et al., 2011; Qi et al., 2024; Wen and Zhu, 2019). The determinants and mechanisms of second-hand product trading platform owners' entry decisions are still uncertain. We have incorporated the characteristics of second-hand trading platforms in the study of platform-owner entry as further innovation and advancement. Due to the uniqueness of product attributes, the role of complementors, and the platform positioning of second-hand platforms, the factors that influence platform-owner entry are more complex and varied, essential not only for balancing demand and supply but also for nurturing relationships with complementors. To deepen the understanding of the mechanism of platform-owner entry, this study aims to explore "what factors may drive the determination of platform-owner entry within the context of C2B2C second-hand trading platforms?"

The distinction between second-hand and first-hand trading platforms provides valuable insights into the determinants and objectives of platform-owner entry. On first-hand trading platforms, such as Amazon Books, complementors are typically professional merchants with well-established supply channels, enabling them to efficiently meet customer demands by providing relevant products. However, when platform owners enter the market by offering similar products, conflicts over profitability may arise, potentially straining relationships with these complementors. In contrast, complementors on second-hand trading platforms are individual product owners whose inventory is inherently unpredictable in both category and quantity, as it depends on the availability of their personal used items. As a result, customer demands may not always be adequately met through the offerings of these complementors alone. This creates a need for platform-owner entry to address gaps in supply and fulfill customer needs through strategic product replenishment.

Furthermore, unlike first-hand trading platforms that merchants and customers are two distinct groups, individuals on C2B2C second-hand platforms can both sell and purchase products. Complementors on C2B2C second-hand platforms play dual roles as both product suppliers and customers. Consequently, conflicts with platform owners over product supply could erode their loyalty as customers, ultimately impacting the overall profitability of the platform. As a result, the drivers of platform-owner entry into second-hand trading platforms are more dynamic, requiring platform owners to carefully evaluate profitability when devising entry strategies.

Unlike first-hand trading platforms, where both platform owners and complementors exclusively offer brand-new products, the items supplied by complementors on second-hand trading platforms are used products. In contrast, platform owners provide first-hand items. These differences in product conditions, pricing strategies, and availability significantly influence relationships with complementors, which in turn affects platform owners' entry decisions.

Zhu (2019) categorizes the motivations for first-hand trading platform-owner entry into two main aspects: "gaining profits" and "improving service quality." "Gaining profits" pertains to factors that drive profit generation, while "improving service quality" encompasses factors that enhance service delivery and improve customer experiences. Building on the unique characteristics of C2B2C second-hand trading platforms, this research adopts coopetition theory as the foundation for studying the drivers of platform-owner entry. The C2B2C model places greater emphasis on balancing product supply with customer demand. Beyond "gaining profits," this study refines its focus by shifting from "improving service quality" to "fulfilling customers' product needs." In the context of second-hand trading platforms, "fulfilling customers' product needs" refers to factors that address customer requirements for product quality, quantity, and variety available on the platform. Based on data from a leading C2B2C second-hand book trading platform in China, this study provides valuable insights for future research on platform-owner entry and offers practical guidance for second-hand trading platform operators. These findings enable operators to develop effective entry strategies that foster sustainable platform growth.

2. Literature Review

When second-hand trading platforms first emerged, researchers primarily focused on analyzing their characteristics and the mechanisms underlying various business models, such as B2C, C2C, and C2B2C. As the entry of platform owners became a defining feature of these platforms, attention shifted to investigating its multifaceted effects on platform participants, including both positive and negative impacts. This shift highlighted the need to maintain strong relationships between platforms and their complementors, prompting researchers to examine the determinants of platform-owner entry and uncover the drivers behind these strategic decisions.

This literature review synthesizes existing research to provide a comprehensive foundation for the study. It reflects the importance of understanding how platform owners navigate entry decisions within second-hand trading platforms and align their business models with sustainability goals.

2.1. C2B2C Second-hand Product Trading Platforms

Driven by sustained economic growth, the popularity of second-hand product trading has continued to rise. Coupled with advancements in information technology (IT) and the ongoing transformation of business models, the trade of second-hand products has opened up new opportunities for e-commerce platforms (Padmavathy et al., 2019). Second-hand products are defined as goods that have been previously used and are now available for resale (Rahman and Makkonen, 2022). These products can be traded through online platforms, creating or enhancing value by extending their life cycle. For instance, Amazon has specifically developed a module for trading used products on its B2C e-commerce platform (Baldivia and Chowdhury, 2024). Furthermore, peer-to-peer (P2P) or customer-to-customer (C2C) platforms have gained increasing popularity for the exchange of second-hand goods (Parguel et al., 2017). As proposed by Ding et al. (2020), a sharing platform should integrate the P2P model with the B2P (business-to-person) model by offering self-fulfillment products. This involves the platform's direct participation in acquiring and leasing products to consumers, thereby enhancing service availability and potentially boosting profitability. As a result, the C2B2C model has emerged as the standard for second-hand trading platforms, involving users as both suppliers and customers.

In general, C2B2C platforms act as intermediaries between individual sellers and buyers, providing a marketplace for used goods while ensuring trust, security, and convenience in transactions. Research by Hsu and Wang (2008) highlights the importance of trust in online marketplaces, noting that C2B2C platforms utilize reputation systems, advanced technology, and social bonds to foster customer confidence. However, these platforms continue to face challenges such as counterfeit goods and transaction disputes. Reddy et al. (2022) argue that robust verification processes and platform intervention policies are crucial for maintaining platform integrity. Platform-owner entry, as a form of intervention, has been shown to effectively reduce the risk of fraud in transactions (Zhu and Sun, 2018).

Given the nature of the C2B2C business model, platform owners must thoroughly understand the platform's characteristics and the trading behaviors of participants to develop strategies and policies that support long-term sustainability. Shashi et al. (2024) found that factors such as product durability and price fairness significantly influence second-hand trading behaviors. Additionally, trust, social influence, and social interactions play a key role in shaping customer behavior (Jang and Kim, 2023; Khan and Tao, 2023; Luo et al., 2023).

Complementors, who form the foundation of the seller base, are vital for addressing the "chicken-and-egg problem" and creating value by attracting more customers (Huang et al., 2022; Hagiu and Spulber, 2013; Hein et al., 2020). On C2B2C second-hand platforms, complementors embody a prosumer attribute—they can supply used items while also purchasing goods from other complementors. This dual role significantly influences the trust and participation of both sellers and buyers in second-hand product transactions. Consequently, the dual effect of complementors becomes a critical factor for platform owners when considering market entry strategies.

2.2. Impacts of Platform-owner Entry

Product suppliers and customers, as key participants in two-sided networks, are fundamental drivers of platform transactions, significantly influencing a platform's sustainability and profitability (Dou et al., 2020). Therefore, decisions regarding platform-owner entry must be made with careful consideration of their potential impact on these critical stakeholders.

Platform-owner entry can have a significant impact on customers, as the introduction of new products or services often leads to increased popularity. For example, Li and Agarwal (2017) observed that Instagram, operated by Facebook, experienced a rapid surge in downloads compared to smaller social applications on the Facebook platform. Similarly, in the gaming industry, Cennamo et al. (2018) found that games developed by console manufacturers often become blockbuster hits among players. This increase in popularity typically results in higher customer engagement and greater platform usage. These findings suggest that platform-owner entry can initially enhance customer engagement, making it an important strategic consideration when entering the market.

Moreover, the effects of platform-owner entry extend beyond customers to complementors, who can experience both positive and negative impacts. On the positive side, platform owners often have more resources to foster innovation. For example, Cennamo et al. (2018) show that games developed by console manufacturers can introduce innovative gameplay, offering new opportunities for third-party developers. But, the entry of platform owners can also threaten complementors' development. Parker and Van Alstyne (2017) note that if complementors believe they cannot recover their investments, they may avoid joining the platform. If platform-owner entry reduces complementors' profitability through direct competition, they may leave the platform. Furthermore, Zhu and Liu (2018) found that

Amazon's entry could discourage complementors from selling rival products, while Wen and Zhu (2019) observed that Android's own apps can reduce the appeal of third-party apps, causing developers to focus on unaffected or new apps. Thus, when considering platform-owner entry, it is crucial to balance the benefits of innovation and resource access with the potential negative effects on complementor participation and customer choice, to ensure sustainable platform growth.

The decision to enter the platform market is multifaceted, requiring a careful balance between attracting customers and potentially deterring complementors. Understanding the multidimensional impacts on both complementors and customers is crucial for making decisions about platform-owner entry.

2.3. Determinants of Platform-owner Entry

With the growth of the platform economy, platform owners have become critical to the sustainable development of platforms. Due to both internal and external factors, many platform owners decide to enter existing markets for various reasons. To maintain a balance between competition and cooperation with complementors for long-term sustainability, exploring the determinants of platform-owner entry has become a significant issue. Previous research has primarily focused on profitability motives, service quality, customer trust, and strategic objectives as key drivers of platform-owner entry.

One key motivation is profitability through the provision of products and services by the platform itself (Ding et al., 2020). According to Zhu (2019), product sales and product ratings are two major factors influencing platform owners' decisions to enter markets for profit-gaining purposes. Based on data from Amazon.com, Zhu and Liu (2018) found that Amazon entered approximately 3% of the platform's total product offerings, and most of these products had high sales and positive ratings.

Moreover, platform service quality is crucial for fostering customer loyalty (Lu et al., 2012; Eid, 2011). When the products and services offered by complementors fail to meet the full range of customer needs, platform owners may choose to enter the market directly. By doing so, they aim to provide their own products, particularly in categories where fraud risks are high, thereby addressing unmet customer demands (Wen and Zhu, 2019). Additionally, platforms with stronger reputations and higher brand awareness typically inspire greater customer trust (Eid, 2011). Leveraging this trust, platform owners can attract a broader customer base when they enter the market with their own products. This desire to strengthen customer loyalty often motivates platform owners to enter the market. For example, Google has developed its own apps in the App Market to fill gaps by offering a variety of high-quality products and services to meet customer needs (Wen and Zhu, 2019). Similarly, JD.com has entered product categories prone to fraud to reduce customer risk and enhance trust.

The decision to enter the market is also influenced by the platform owners' broader strategies. Hagiu and Wright (2015) found that platform owners with vertical integration are more likely to enter the market to reduce coordination costs with partners. Lee (2013) argues that when a platform is expanding its market share, it typically focuses on serving complementors and avoids direct competition. However, when a platform recognizes the growth potential of a market, it may enter to adjust its recommendation system based on resource allocation and sign exclusive agreements with complementors to prevent them from rapidly growing or switching to competing platforms.

Additionally, platform-owner entry is often driven by the goal of stimulating innovation among complementors (Wen and Zhu, 2019). When the products and services provided by complementors become subpar and stagnant, platform owners may enter the market to encourage innovation through competition and pressure. For instance, Google's entry into the photo app market boosted the demand for third-party photo apps and incentivized developers to update their offerings (Foerderer et al., 2018).

A summary of the determinants of platform-owner entry is presented in Table 1.

Table 1: Literature Review on Determinants of Platform-owner Entry

Category of Determinants of Plaform-owner Entry	Determinants	Key findings	Platform	Source
Profitability	Sales	Platform owners tend to enter the market of products with high sales and ratings to increase profitability.	B2C & C2C	Zhu and Liu, 2018
	Ratings			
Service Quality	Fraud Elimination	Platform owners tend to enter the market of commodity categories that are susceptible to fraud, aiming to mitigate risks.	B2C	Zhu and Sun, 2018
	Customer Needs Fullfillment	Platform owners tend to enter the market of products that cannot meet customer demands.	B2C	Wen and Zhu, 2019
Trust Issues	Customer Trust	Platform-owner entry tends to improve customers' overall trust and loyalty to the platform.	B2C	Eid and M. I., 2011
	Customer Loyalty			
Strategic Motivation	Degree of Vertical Integration	Platforms that are vertically integrated often facilitate platform-owner entry to reduce costs.	B2B	Hagiu and Wright, 2015
	Innovation Activation	Platform-owner entry aims to activate innovation and product variety.	B2B & B2C	Wen and Zhu, 2019
	Market Growth (Recommendation System and Resource Allocation)	Platform owners tend to enter markets with potential growth to better balance the resources and power dynamics.	B2C	Lee, 2013

2.4. Summary

Based on the literature review, although previous studies have addressed C2B2C second-hand platforms and platform-owner entry decisions, a research gap remains at the intersection of these two areas. Existing research on the effects of platform-owner entry has primarily focused on first-hand trading platforms.

However, the unique features of C2B2C second-hand platforms, such as the role of complementors and the characteristics of the products, have not been fully considered in the context of platform-owner entry. On second-hand trading platforms, platform owners typically enter the market by offering new, first-hand versions of products, while complementors trade used items as second-hand goods. Consequently, the impacts on participants may differ on second-hand platforms, potentially influencing the drivers and motivations behind platform-owner entry in ways that are distinct from those in first-hand markets. Moreover, due to complementors' dual roles and the inconsistent supply of used products as individual second-hand item owners, platform-owner entry may affect both the supply and demand sides in different ways, shaping the factors driving the platform-owner entry.

These characteristics of C2B2C second-hand platforms suggest that the decision-making process for platform-owner entry can be further explored within a more dynamic context, offering valuable insights for both scholars and platform operators.

Building on Zhu's (2019) research, this study analyzes the determinants of platform-owner entry, focusing on 'gaining profits' and 'fulfilling customers' product needs.' Specifically, the study incorporates product price and popularity as key factors influencing profitability. Additionally, the study applies demand and supply theory to introduce product demand and supply as new factors relevant to meeting customers' product needs—especially important in the context of second-hand product trading. Therefore, this study provides a unique research context and perspective on platform-owner entry in second-hand trading platforms.

3. Research Hypothesis

Based on the unique characteristics of second-hand trading platforms, the theoretical framework differs from that of first-hand trading platforms. Unlike first-hand platform-owner entry, which is primarily competition-oriented, second-hand platform-owner entry is driven by the need to complement supply while avoiding direct competition.

Co-opetition theory serves as the theoretical foundation for all hypotheses and the selection of related factors, emphasizing the intentions behind platform-owner entry for the purpose of complementation (supplementing supply).

The essence of co-opetition theory lies in achieving mutual benefits while minimizing conflicts of interest.

According to the conceptual framework in Figure 1, the determinants of platform-owner entry in second-hand trading platforms are analyzed from two perspectives: profit generation and fulfilling customer product needs (Zhu, 2019). This study identifies four key factors influencing the platform owner's decision to enter a market: product price, popularity, demand, and supply. Furthermore, the moderating effect of product condition diversity is also examined.

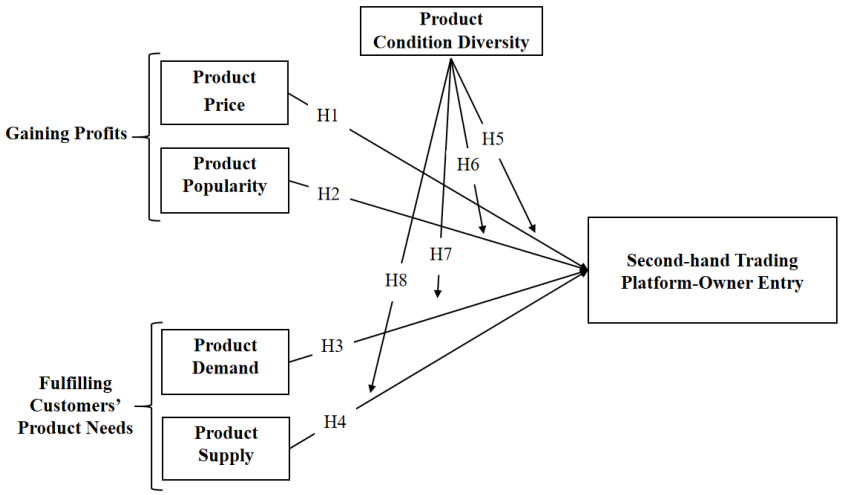

Figure 1: Conceptual Framework

3.1. Determinants in Gaining Profits

3.1.1 The Relationship Between Product Price and Platform-owner Entry

Second-hand products are priced differently depending on their condition. Based on price discrimination theory, to avoid direct competition with complementors, price is regarded as a means to differentiate target customer groups based on their willingness to pay, which may influence platform-owner entry.

On second-hand trading platforms, customers' purchasing intentions are significantly driven by economic factors, as they seek affordable products to reduce costs (Chad and Isbanner, 2024). Complementors, in response, tend to offer lower-priced items to align with customers' purchasing behaviors.

Platform owners can strategically differentiate customer groups, particularly by targeting high-priced product segments. This strategy enables platform owners to avoid direct competition with complementors, who primarily serve cost-sensitive customers. By selectively engaging with higher-priced product categories, platform owners can effectively maintain relationships with complementors, ensuring their loyalty as both suppliers and customers. This approach, in turn, supports the profitability of trades within the complementor network.

Moreover, platform owners can earn additional profits by providing first-hand versions of high-priced products without compromising complementors' profits. As a result, platform owners tend to enter high-priced markets with the goal of generating profits. Accordingly, we propose the following hypothesis:

H1: Product price has a positive relationship with platform-owner entry.

3.1.2 The Relationship Between Product Popularity and Platform-owner Entry

The popularity of products reflects customers' preferences toward the product, which influences the need for product supply. In this context, popularity is associated with product ratings and sales (Zhu, 2019). A higher rating indicates that a product has better quality and a good reputation among customers (Chevalier and Mayzlin, 2006; Li et al., 2019). Higher sales can signify strong demand and high customer preference based on the product's features (Li et al., 2021).

Due to the instability of complementors' supply, popular items may occasionally be out of stock, preventing customers from making purchases. Based on the Resource-Based View (RBV), platform owners typically have access to more resources and established supply channels compared to complementors (Shi et al., 2023). This advantage allows platform owners to replenish stock and ensure a stable supply of trendy products, particularly those with higher sales and ratings, thereby creating greater business opportunities.

Moreover, based on platform algorithms, popular products typically receive a higher exposure rate on the platform,

which can amplify the network effect through word-of-mouth (Chevalier and Mayzlin, 2006). Customers can easily notice the product and develop trust in its quality, leading to an increased willingness to purchase.

Consequently, by focusing on products with higher popularity, the platform can generate greater profits by complementing products with higher sales and ratings, which serves as a motivation for platform-owner entry. Accordingly, this study proposes the second hypothesis:

H2: Product popularity has a positive relationship with platform-owner entry.

3.2. Determinants in Fulfilling Customers' Product Needs

3.2.1 The Relationship Between Product Demand and Platform-owner Entry

The balance between customer demands and platform supply is the foundation of customer satisfaction, which is crucial for the sustainable development of the platform (Heikkilä, 2002). Turnover days refer to the number of days between when a product is listed on the platform and when it is purchased by a buyer (Qi et al., 2023). Fewer turnover days indicate that a product is sold more quickly after being listed on the platform.

Based on the Demand and Supply theory, product turnover days represent the demand level for products. Products with fewer turnover days indicate higher demand, which requires more frequent supply. However, complementors on second-hand trading platforms are individual owners of second-hand items without stable inventories. The unpredictability and uncertainty of supply from complementors can lead to fluctuations in product availability, which may not always align with customer demands. This mismatch between supply and demand can occur due to these inconsistencies.

To meet customer demand for these products, platform owners may enter the market to maintain the balance between customer demand and product supply by providing first-hand products to replenish the product supply. In this way, platform owners can ensure a sufficient supply for products in high demand and avoid profit conflicts with complementors based on differences between first-hand and second-hand versions in terms of price and condition.

Thus, the entry of platform owners into the second-hand market with respect to products with fewer turnover days (higher demand) is driven by complementation. Accordingly, this study proposes the third hypothesis:

H3: Product demand has a positive relationship with platform-owner entry.

3.2.2 The Relationship Between Product Supply and Platform-owner Entry

In order to maintain a high level of customer satisfaction, platform owners should ensure that the supply of products on platforms meets customer demand. On the second-hand trading platform, the supply level depends on the availability of second-hand products for sale in the market, which is related to product age. Product age refers to the length of time since the product was first launched on the market (Argente and Yeh, 2022).

Based on the Demand and Supply theory, newly launched products with a lower product age often have limited availability in second-hand versions, and their price advantage is not significant. This typically results in low supply. Therefore, relying solely on the supply of second-hand versions may not satisfy customer demand, leading to a situation where demand exceeds supply. As a result, platform owners may enter the market to supplement the supply of these products by providing first-hand versions. This can lead to a complementary relationship with complementors to better fulfill customers' product needs, without harming complementors' interests. Accordingly, this study proposes the fourth hypothesis:

H4: Product supply has a negative relationship with platform-owner entry.

3.2.3 Moderation Effect of Product Condition

Product condition refers to the state or quality of a product, particularly in terms of its appearance, functionality, and overall usability (Ghose et al., 2005). For second-hand products, there are usually diverse conditions available for the same product based on the product's degree of wear, age, maintenance, and any potential repairs, which determine whether it is classified as fine or medium. Condition diversity refers to the range of different quality levels or states into which a second-hand product can be classified. Higher condition diversity allows consumers to choose products based on their preferences for quality, appearance, functionality, and price, offering options that cater to different budgets and expectations.

Based on market segmentation theory, product condition diversity can enhance market coverage by offering products in varying conditions, allowing platforms to effectively cater to the distinct needs of different consumer segments. In a second-hand marketplace, greater condition diversity typically leads to a wider range of potential buyers, as it can satisfy both price-sensitive customers and those seeking higher-quality or newer items. In this way, platform owners can approach more potential customers who may prefer first-hand products. Thus, a product with greater condition diversity has a larger market potential, which may enhance the platform owner's motivation to enter the

market. Therefore, higher condition diversity can strengthen the platform owner's intention to enter the market for products with higher prices, popularity, demand, and lower supply.

Accordingly, the hypotheses are proposed as follows:

H5: Condition diversity can strengthen the positive relationship between product price and platform-owner entry.

H6: Condition diversity can strengthen the positive relationship between product popularity and platform-owner entry.

H7: Condition diversity can strengthen the positive relationship between product demand and platform-owner entry.

H8: Condition diversity can strengthen the negative relationship between product supply and platform-owner entry.

4. Research Setting and Data Analysis

4.1. Research Setting

This study is based on a large domestic second-hand book trading platform in China. The webpage is shown in Figure 2. The applied business model is C2B2C. Complementors sell second-hand books to the platform at prices determined by the platform. After the books are refurbished by the platform, they are released on the trading platform for customers to purchase. The platform introduced a self-operated service for brand-new books on April 14, 2020. This means that the platform owner supplies new books and sells them directly on the platform. We have gathered the overall transaction data for all books from May 25, 2017, to April 14, 2020, to explore which characteristics of books the platform is more likely to prioritize for its self-operated services.

Figure2: Screenshot of Web Page

This study collected a total of 5,998 books, which generated 1,129,562 transaction records up to April 14, 2020. Book details, including price, rating, product age, and other relevant data, were extracted from the book detail page. Sales data, obtained by accessing transaction records, were used to calculate the sales volume and turnover days of the books. This study employed a two-step approach to address missing data. First, book information with missing fields such as price, rating, sales, and product age was removed. Second, turnover days were calculated based on the transaction data, and books with outlier data or missing turnover days were excluded. The dataset ultimately contained 4,323 valid observed values, ensuring the quality and usability of the data.

4.2. Key Variables

Table 2 shows the description of each key variable:

Table 2: Description of Key Variables

Variables	Type of Data	Unit	Description
Platform-owner Entry	0-1 variable	N/A	Whether the platform owner offers the brand-new version of books after April 14, 2020. (1 means Yes; 0 means No)
Price	Numerical Value	RMB (Yuan)	Original Price of the Book
Sales	Numerical Value	Copy	The total number of copies of a book that have been sold over a specific period of time
Rating	Numerical Value	Point	The score to a book given by readers. (Use Douban.com to rate each book)
Turnover Days	Numerical Value	Day	The number of days between when a book is listed on the platform and bought by a buyer
Product Age	Numerical Value	Month	Number of months between book publication date and 2020-04
Condition Diversity	Numerical Value	N/A	the range of different quality levels or states that a book can be classified into.
Discount	Numerical Value	%	The reduction in the original price for promotions

The platform started as a second-hand book trading platform and launched its self-operated service on April 14, 2020. The platform-owner entry is the dependent variable in the model, which is a binary variable with 0 or 1. For the specific entry case of each book, the value of 1 means that the platform owner has entered the new book market after April 14, 2020, while the value of 0 means that the platform owner has not entered the new book market. Once the platform owner enters the market for a book, the book's display page will be prominently labeled as 'Brand New Product'.

Turnover days, as one of the explanatory variables in this study, measure the average number of days between the sale and purchase of all the copies of the same book. The book details page on the platform includes detailed records of transactions, including when a book is sold or bought by a specific user. The time recorded for the seller's sale is when the book was sold by a seller to the platform. Similarly, the time recorded for the buyer's purchase is when the order and payment are made by a buyer on the platform. It reflects the alignment between supply and demand. Therefore, we can calculate the turnover days accordingly. This study includes all trading records before April 14, 2020 (the time when the platform-owner entry first began) to calculate turnover days for a book, which can avoid the possible endogeneity between platform-owner entry and turnover days of books. One issue is the inability to track specific book transactions based on the trading data. For instance, we cannot identify which user purchased a particular copy of a book on any given day following its sale by which seller. This study employed a retrospective approach. We organized the trading records in chronological order, from the oldest to the newest, categorizing them into two columns based on the transaction type (buy or sell). Subsequently, we paired the earliest sell record with the earliest buy record. Then we calculated the number of days between these records and repeated this process for subsequent transactions. Finally, we calculated the book's turnover days by calculating the average turnover days for all the copies of the same book.

Moreover, this study obtains the publication date of each book. Using April 2020 as the reference month, we calculated the number of months between the date when each book was published and the reference month. Then we used it as the observed value of the variable 'product age'. For example, for a book published in October 2018, the product age is calculated as 'April 2020 minus October 2018, which equals 18 months'. The greater the interval, the older the product is.

4.3. Descriptive Analysis and Correlation Analysis

The descriptive analysis and correlation analysis are presented in Table 3 and Table 4.

Table 3: Descriptive Analysis

Variables	Observations	Mean	Std	Min	Max
Platform-owner Entry	4,323	0.0708	0.256	0	1
Price	4,323	4,791	3,836	130	106,000
Sales	4,323	114.1	247.0	1	5,952
Rating	4,323	8.025	0.816	2.800	9.900
Turnover Days	4,323	63.32	57.46	1	515.2
Product Age	4,323	84.41	72.93	3	721
Condition Diversity	4,323	0.465	0.362	0	1
Discount	4,323	5.710	2.895	2.200	76

Table 4: Correlation Analysis of Variables

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Price	1						
[2] Sales	0.138***	1					
[3] Rating	0.043***	-0.048***	1				
[4] Turnover Days	0.126***	0.0150	0.102***	1			
[5] Product Age	-0.119***	-0.077***	-0.062***	-0.080***	1		
[6] Condition Diversity	0.031**	-0.196***	-0.037**	0.205***	-0.105***	1	
[7] Discount	-0.182***	-0.246***	0.032**	0.187***	0.153***	0.298***	1

Through correlation analysis, we found that although there were significant correlations between some of the variables, none of the correlation coefficients exceeded the 0.6 threshold, which indicates that initially, the problem of multicollinearity in our model is not significant. In order to explore this issue in depth, we tested for multicollinearity using variance inflation factors. All VIFs were below 2 (mean VIF = 1.13), indicating no serious multicollinearity concerns. The VIF results are shown in Table 5.

Table 5: Variance Inflation Factors (VIF) Analysis

Variables	VIF	Tolerance
Price	1.10	0.909173
Rating	1.09	0.916485
Sales	1.10	0.911220
Turnover Days	1.07	0.933838
Product Age	1.23	0.814729
Condition Diversity	1.10	0.905268
Discount	1.19	0.840134
Mean VIF	1.13	

4.4. Empirical Mode and Data Analysis

We have employed the probit regression method to test the hypotheses and use stepwise regression to investigate the effects of the control variable "Discount," independent variables "Price," "Sales," "Rating," "Turnover Days" and "Product Age", and moderating variable "Condition Diversity". The empirical model is presented in Equation (1), and the detailed data analysis results are shown in Table 6.

$$\ln \frac{P(Platform-owner\ Entry=1)}{1-P(Platform-owner\ Entry=1)} = \beta_0 + \beta_1 Price + \beta_2 Sales + \beta_3 Rating + \beta_4 Turnover\ Days + \beta_5 Product\ Age + \beta_6 Price\_Condition\ Diversity + \beta_7 Sales\_Condition\ Diversity + \beta_8 Rating\_Condition\ Diversity + \beta_9 Turnover\ Days\_Condition\ Diversity + \beta_{10} Product\ Age\_Condition\ Diversity + \beta_{11} Condition\ Diversity + \beta_{12} Discount + \varepsilon \quad (1)$$

4.5. Analysis of Regression Results

The dependent variable is "Platform-owner Entry," and the relevant regression analysis results are shown in Table 6. Model 1 includes only the control variable "Discount." Model 2 adds the independent variables "Price," "Sales," and "Rating". Model 3 further includes the moderating variable "Condition Diversity" and its interaction terms with "Price," "Sales," and "Rating". Model 4 adds the independent variables "Turnover Days" and "Product Age" on the basis of Model 1. Model 5 further adds the moderating variable "Condition Diversity" and its interaction terms with "Turnover Days" and "Product Age". Model 6 is the full model.

Table 6: Regression Outcomes

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Price		0.000***	0.000***			0.000***
		(0.000)	(0.000)			(0.000)
Sales		0.000**	0.001***			0.002***
		(0.000)	(0.000)			(0.000)
Rating		0.307***	0.243***			0.353***
		(0.040)	(0.051)			(0.059)
Turnover Days				-0.005***	-0.004***	-0.004***
				(0.001)	(0.001)	(0.001)
Product Age				-0.010***	-0.010***	-0.012***
				(0.001)	(0.001)	(0.002)
Condition Diversity			-0.646		0.211**	-1.490*
			(0.573)		(0.088)	(0.768)
Price × Condition Diversity			0.000			0.000
			(0.000)			(0.000)
Sales × Condition Diversity			-0.002***			-0.002***
			(0.000)			(0.000)
Rating × Condition Diversity			0.137**			0.219**
			(0.070)			(0.091)
Turnover Days × Condition Diversity					0.002	0.004**
					(0.002)	(0.002)
Product Age × Condition Diversity					0.000	-0.001
					(0.002)	(0.003)
Discount	0.019***	0.018***	0.023***	0.069***	0.070***	0.077***
	(0.006)	(0.006)	(0.006)	(0.014)	(0.014)	(0.014)
Constant	-1.578***	-4.336***	-4.127***	-1.050***	-1.166***	-4.329***
	(0.042)	(0.333)	(0.422)	(0.089)	(0.107)	(0.499)
Observations	4,323	4,323	4,323	4,323	4,323	4,323
Pseudo R^2	0.0018	0.0602	0.0805	0.1385	0.1400	0.2222

Notes:
1.*** p<0.01, ** p<0.05, * p<0.1
2.Dependent variable is Platform-owner Entry

Model 6 presents our full model with all hypothesized main effects and interaction terms. The results demonstrate strong support for our theoretical framework regarding platform-owner entry decisions, with an overall model fit of Pseudo R^2 = 0.2222.

First, regarding the main effects, we find that product characteristics significantly influence platform-owner entry decisions. Specifically, product price and popularity (rating and sales) share a significant positive relationship with platform-owner entry, supporting H1 and H2. Turnover days share a significant negative relationship with platform-owner entry. Therefore, the result means that platform owners tend to enter the market of products with higher demand, supporting H3. Product supply, measured with product age, shares a significant negative relationship with platform-owners entry, supporting H4.

Second, regarding the moderating effect, the results indicate that condition diversity does not significantly moderate the relationship between product price and platform-owner entry, thereby not supporting H5. In terms of product popularity, condition diversity exhibits a significant negative moderating effect on the relationship between sales and platform-owner entry and a significant positive moderating effect on the relationship between rating and platform-owner entry, partially supporting H6. Additionally, condition diversity significantly and positively moderates the relationship between demand (turnover days) and platform-owner entry, supporting H7. However, as condition diversity does not significantly moderate the relationship between product age and platform-owner entry, H8 is not supported. The results of the hypothesis test are shown in Table 7.

Table7: Results of Hypothesis Test

H1: Product price has a positive relationship with platform-owner entry.	Supported
H2: Product popularity has a positive relationship with platform-owner entry.	Supported
H3: Product demand has a positive relationship with platform-owner entry.	Supported
H4: Product supply has a negative relationship with platform-owner entry.	Supported
H5: Condition diversity can strengthen the positive relationship between product price and platform-owner entry.	Not Supported
H6: Condition diversity can strengthen the positive relationship between product popularity and platform-owner entry.	Partially Supported
H7: Condition diversity can strengthen the positive relationship between product demand and platform-owner entry.	Supported
H8: Condition diversity can strengthen the negative relationship between product supply and platform-owner entry.	Not Supported

4.6. Robustness Check

This section presents the robustness check conducted in this study, utilizing alternative measurements, sensitivity analysis and outlier-robust probit estimation.

4.6.1 Alternative Measurement

To ensure the reliability of our findings, we employed an alternative measurement by using the median value of the book's turnover days instead of the mean. As shown in Table 8, the results remain highly consistent with those in Table 6. All hypothesized relationships (H1 – H8) retain their directions and statistical significance. These consistent results of alternative measurement can further reinforce the robustness of our findings.

Table 8: Alternative Measurement for Robustness Checks

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Price		0.000***	0.000***			0.000***
		(0.000)	(0.000)			(0.000)
Sales		0.000**	0.001***			0.002***
		(0.000)	(0.000)			(0.000)
Rating		0.307***	0.243***			0.356***
		(0.040)	(0.051)			(0.059)
Turnover Days				-0.004***	-0.004***	-0.003***
				(0.001)	(0.001)	(0.001)
Product Age				-0.010***	-0.010***	-0.012***
				(0.001)	(0.001)	(0.002)
Condition Diversity			-0.646		0.220**	-1.458*
			(0.573)		(0.091)	(0.770)
Discount	0.019***	0.018***	0.023***	0.070***	0.071***	0.078***
	(0.006)	(0.006)	(0.006)	(0.014)	(0.015)	(0.014)
Price × Condition Diversity			0.000			0.000
			(0.000)			(0.000)
Sales × Condition Diversity			-0.002***			-0.002***
			(0.000)			(0.000)
Rating × Condition Diversity			0.137**			0.215**
			(0.070)			(0.091)
Turnover Days × Condition Diversity					0.002	0.003*
					(0.002)	(0.002)
Product Age × Condition Diversity					0.001	-0.001
					(0.002)	(0.003)
Constant	-1.578***	-4.336***	-4.127***	-1.094***	-1.214***	-4.391***
	(0.042)	(0.333)	(0.422)	(0.089)	(0.109)	(0.497)
Observations	4,323	4,323	4,323	4,323	4,323	4,323
Pseudo R^2	0.0018	0.0602	0.0805	0.1381	0.1397	0.2222

Notes:
1.*** p<0.01, ** p<0.05, * p<0.1
2.Dependent variable is Platform-owner Entry

4.6.2 Sensitivity Analysis

In addition to the alternative measurement, we conducted a sensitivity analysis to verify the robustness of our results, as shown in Table 9. Specifically, we perturbed three variables with relatively large standard deviations and ranges by increasing each with 10%, including price, sales, and turnover days. Compared to our findings in Table 6, the sensitivity test results demonstrate that all hypothesized relationships (H1 – H8) remain consistent, indicating that our findings are robust to moderate changes in key variables.

Table 9: Sensitivity Analysis for Robustness checks

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Price		0.000***	0.000***			0.000***
		(0.000)	(0.000)			(0.000)
Sales		0.000**	0.001***			0.001***
		(0.000)	(0.000)			(0.000)
Rating		0.307***	0.243***			0.353***
		(0.040)	(0.051)			(0.059)
Turnover Days				-0.004***	-0.004***	-0.003***
				(0.001)	(0.001)	(0.001)
Product Age				-0.010***	-0.010***	-0.012***
				(0.001)	(0.001)	(0.002)
Condition Diversity			-0.646		0.211**	-1.490*
			(0.573)		(0.088)	(0.768)
Discount	0.019***	0.018***	0.023***	0.069***	0.070***	0.077***
	(0.006)	(0.006)	(0.006)	(0.014)	(0.014)	(0.014)
Price × Condition Diversity			0.000			0.000
			(0.000)			(0.000)
Sales × Condition Diversity			-0.002***			-0.002***
			(0.000)			(0.000)
Rating × Condition Diversity			0.137**			0.219**
			(0.070)			(0.091)
Turnover Days × Condition Diversity					0.002	0.003**
					(0.001)	(0.002)
Product Age × Condition Diversity					0.000	-0.001
					(0.002)	(0.003)
Constant	-1.578***	-4.134***	-3.891***	-1.336***	-1.450***	-4.388***
	(0.042)	(0.322)	(0.418)	(0.073)	(0.091)	(0.491)
Observations	4,323	4,323	4,323	4,323	4,323	4,323
Pseudo R^2	0.0018	0.0602	0.0805	0.1385	0.1400	0.2222

Notes:
1.*** p<0.01, ** p<0.05, * p<0.1
2.Dependent variable is Platform-owner Entry

4.6.3 Outlier-robust Probit Estimation

To address potential concerns about outliers, we performed an outlier-robust probit estimation by trimming 1% of extreme values from three key independent variables: price, sales, and turnover days, which exhibit large standard deviations and high variability. As shown in Table 10, the results remain largely consistent with our main findings. All key relationships retain their hypothesized directions and statistical significance, further demonstrating the robustness of our results.

Table 10: Outlier-robust Probit Estimation for Robustness checks

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Price		0.000***	0.000***			0.000***
		(0.000)	(0.000)			(0.000)
Sales		0.001***	0.002***			0.003***
		(0.000)	(0.000)			(0.000)
Rating		0.315***	0.245***			0.340***
		(0.043)	(0.060)			(0.068)
Turnover Days				-0.004***	-0.006***	-0.005***
				(0.001)	(0.001)	(0.001)
Product Age				-0.010***	-0.010***	-0.013***
				(0.001)	(0.001)	(0.002)
Condition Diversity			-0.175		0.025	-1.830**
			(0.690)		(0.116)	(0.882)
Discount	0.019***	0.067***	0.076***	0.093***	0.095***	0.130***
	(0.006)	(0.012)	(0.013)	(0.016)	(0.018)	(0.030)
Price × Condition Diversity			-0.000**			-0.000*
			(0.000)			(0.000)
Sales × Condition Diversity			-0.003***			-0.003***
			(0.000)			(0.001)
Rating × Condition Diversity			0.132			0.261***
			(0.081)			(0.100)
Turnover Days × Condition Diversity					0.003*	0.004**
					(0.002)	(0.002)
Product Age × Condition Diversity					0.001	-0.003
					(0.002)	(0.003)
Constant	-1.578***	-5.255***	-5.174***	-1.166***	-1.200***	-4.927***
	(0.042)	(0.351)	(0.501)	(0.093)	(0.118)	(0.579)
Observations	4,323	4,204	4,204	4,237	4,237	4,120
Pseudo R^2	0.0018	0.1231	0.1416	0.1428	0.1445	0.2683

Notes:
1.*** p<0.01, ** p<0.05, * p<0.1
2.Dependent variable is Platform-owner Entry

Through alternative measurements, sensitivity analysis, and outlier-robust probit estimation, we have strengthened the robustness of the results of hypothesis test related to H1, H2, H3, H4, H6, and H7 in our study. The results confirm that product price, product popularity, product demand, and product supply are key drivers of platform-owner entry in second-hand product trading platforms. Moreover, condition diversity significantly moderates the impacts of product popularity (sales, rating) and product demand (turnover days) to platform-owner entry. These approaches offer additional evidence and help mitigate potential biases and limitations that could result from relying solely on a single measurement or dataset.

5. Result Discussion and Implications

5.1. Result Discussion

In contrast to previous studies of platform-owner entry in first-hand trading platforms, which are primarily competition-driven, this study specifically examines the determinants of platform-owner entry in the more dynamic context of second-hand trading platforms. Co-opetition theory serves as the theoretical foundation, emphasizing the uniqueness that platform owners enter the market to avoid direct competition and facilitate complementation. Based on the unique characteristics of second-hand trading platforms, including the roles of complementors and the nature of supplied products, the determinants of platform-owner entry are analyzed for the purposes of "Gaining Profits" and "Fulfilling Customers' Product Needs." Moreover, we have employed price discrimination theory, resource-based view (RBV), the theory of demand and supply and market segmentation theory to develop hypotheses regarding product price, popularity, demand and supply as well as the moderation effect of condition diversity (Brandenburger & Nalebuff, 2021; Cohen, Elmachtoub & Lei, 2022; Cullen & Farronato, 2021).

Based on the results, to avoid direct competition with complementors offering affordable second-hand items, price differentiation emerges as an important strategy. By targeting markets specifically for higher-priced products, platform owners can attract customers seeking newer or premium alternatives without undermining complementors' interests. This approach allows the platform to generate profits while maintaining healthy relationships with complementors offering used goods.

Product replenishment is vital in second-hand trading platforms due to the fluctuating and often unreliable inventories of individual complementors, especially for products prone to frequent stockouts. Since complementors are typically individual product owners with limited stock, platform owners tend to enter the market for products with higher popularity and lower product age (supply). These products are more likely to run out of stock quickly, making their consistent availability essential for maintaining both customer satisfaction and the platform's reputation for reliability.

Regarding product demand, the results show that products with higher demand (fewer turnover days) can drive platform-owner entry. Short turnover periods indicate high demand for a product. To address the supply inconsistencies of complementors, platform owners tend to enter by providing first-hand versions, ensuring sufficient supply for high-demand items. This strategy helps maintain supply stability without compromising complementors' interests and aligns product availability with customer expectations.

Moreover, products with higher condition diversity can motivate platform owners' entry intentions toward those products with higher demand and higher ratings. Products with shorter turnover days and higher ratings are usually popular products with higher demand. Higher condition diversity can attract a larger customer base by fulfilling customers' different needs regarding the products' conditions and prices. In this way, a larger customer base can bring more traffic to new products, which can effectively increase profits while ensuring the alignment of product supply with customer demand.

However, the results show a significant negative moderating effect of condition diversity on the relationship between sales and platform-owner entry, which is contrary to the hypothesis. The possible reason is that second-hand products with high sales and condition diversity can effectively meet customer needs for varying product conditions and prices. Introducing first-hand versions alongside these products may overwhelm customers and complicate their decision-making process, which may negatively influence second-hand transactions. As a result, platforms tend to avoid entering the market for products with high sales and diverse conditions in the meantime.

Based on the unique characteristics of second-hand trading platforms, this study addresses a gap in existing research on first-hand trading platforms. It emphasizes the complementary role of platform-owner entry within the co-opetition relationship between platform owners and complementors. The findings highlight the key factors driving platform-owner entry in second-hand markets, demonstrating how platform owners strategically avoid direct competition while generating profits and complementing the supply provided by complementors. These insights provide valuable guidance for future studies on platform-owner behaviors within second-hand trading platforms.

5.2. Practical Implications

Our research delves into the key factors that drive platform owners to enter the second-hand trading market. These findings are not only insightful for academic purposes but also hold practical significance for the operators of these platforms. To gain a deeper understanding of the factors influencing platform owners' entry into the market, operators can be guided to formulate strategic policies that affect entry behavior, based on the demand and supply levels of second-hand products. Platform operators can encourage platform-owner entry behavior for the purpose of supplementing the supply of those products with higher prices, greater popularity, higher demand and lower supply.

Moreover, platform operators can encourage complementors to provide more products in diverse conditions with the purpose of attracting more customers, especially for products with higher ratings and shorter turnover periods. At

the same time, operators can also control platform-owner entry for products that are crucial to complementors' profitability, ensuring a balanced and beneficial marketplace for all stakeholders. By doing so, operators can more effectively maintain a sustainable relationship between platform owners and complementors, which can significantly enhance the network effect by attracting potential complementors and satisfying customers' needs. Ultimately, these insights empower operators to make informed decisions that drive the success and resilience of their second-hand trading platforms.

6. Limitation and Future Research Perspectives

6.1. Limitation

This study focuses on second-hand books. Although books are considered products with multifaceted attributes, including both physical appearance (tangible) and inner content (intangible), the study's focus is narrow, with books as the sole product. This may limit the generalization of the study's findings to all types of products, especially those where the quality attribute significantly influences the functional attribute, such as electronic devices or furniture. Therefore, future research could broaden the scope by examining second-hand trading platforms that facilitate a diverse range of product categories. By doing so, researchers can explore how the determinants of platform-owner entry may vary across different product categories, thereby enhancing the external validity and practical applicability of the research.

6.2. Future Research Directions

By analyzing the characteristics of platform-owner entry, future studies can identify its determinants and assist platform owners in formulating corresponding entry strategies. However, it is also crucial for platform owners to assess the long-term impact of their entry on platform development. This includes evaluating whether there is an overall increase in profits, whether the platform's brand value is affected, and whether complementors' dependence on the platform is reduced. Exploring the long-term impact of platform-owner entry requires tracking platform operations over an extended period. Changes in platform profit margins and the number and activities of complementors can be observed one year or more after the platform owners' entry. Additionally, the long-term impact can be evaluated more comprehensively by combining surveys and interviews with the platform's complementors and users.

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