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The Role of Public Food Delivery Mobile Applications in the Food Delivery Market: A Game Theory Model

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Abstract

Purpose: The study aims to assess the current status of domestic public food delivery apps and analyze the process through which sellers choose between private delivery apps and public delivery apps. This involves exploring strategies to achieve the original purpose of public food delivery apps, which is to enhance the small business owners income and promote consumer welfare by preventing the monopoly of private food delivery apps. **Research design, data and methodology:** the research methodology is based on a model that introduces adjustments for non-economic effects, considering the preferences of multi-homing consumers, to more realistically reflect the benefits of sellers' choices. For data analysis, real business performance data from 'Daeguro', 'Meokkaebi', and 'Somunnan Shop' were used. **Results:** The study revealed that if the market share of public delivery apps within a specific region increases beyond a certain level, the benefits for small-business sellers also increase. This leads to the strategic advantage of simultaneously using both delivery apps. Furthermore, the results exhibit a tendency similar to real social phenomena. **Conclusions:** This analysis confirmed the role of public food delivery apps in the domestic delivery app market and presents policy recommendations, including application integration and the implementation of exclusive public interest functions, to effectively fulfill this role.

Keywords : Delivery App, Platform Selection, Game Theory, Experimental Economics, Public Policy

JEL Classification Code : C15, C70, D78, H70, O38

1. Introduction[1]

After the COVID-19 pandemic, non-face-to-face consumption has increased, leading to a rapid growth of the delivery market in Korea. The development of delivery apps has provided consumers with a convenient consumption environment. However, with major players like 'BaedalMinjok', 'Yogiyo', and 'CoupangEats' occupying 97% of the delivery app market (No, 2022), issues of monopoly have emerged in the existing delivery app market, primarily led by private companies. In this context, private enterprises dominating the delivery app market and operating in a manner where they capture the majority of revenue, small business owners are burdened with concerns such as increased commissions and delivery costs. Additionally, consumers express dissatisfaction with high delivery fees.

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To address the problems in the delivery app market, various local governments have promoted the introduction of public delivery apps. In March 2020, Gunsan City's 'Baedal Myeongsu' became the first officially operated public delivery app nationwide (Lee, 2021). Public delivery apps are developed and operated directly by local governments or commissioned to private companies. They aim to provide benefits to small businesses by reducing intermediary fees and offering advantages like local currency and discount coupons to make it affordable for consumers (Park et al., 2022). In contrast to private delivery apps, which often charge commissions of over 20%, public delivery apps impose a maximum commission of 2%, resulting in significantly lower commission burdens (No, 2022). Moreover, public delivery apps offer various financial benefits, such as a 10% discount through local currency payments, providing discount coupons, or accumulating mileage by partially storing the order amount (Lee et al., 2022).

Despite these advantages, public delivery apps still face challenges such as a lack of diversity and quantity of participating businesses, as well as shortcomings in operational management and system administration. This leads to a suboptimal user experience (UX) and user interface (UI) (No, 2022). Especially with recent changes due to the endemic transition, activation of the dining-out industry, increased demand for packaged orders, and a decrease in delivery usage rates due to high delivery fees, the overall growth momentum of the entire delivery app market is slowing down (Choi et al., 2021). In this situation, public delivery apps still struggle to compete with private delivery apps. Some public delivery apps are discontinuing their services, and those that are operational have low user numbers. While the three major private delivery apps maintain a high market share and continue to grow, most public delivery apps still show low order rates and Daily Active Users (DAU) (Park et al., 2022). For instance, as of December 2022, Gyeonggi Province's public delivery app 'BaedalTeugGeub' has a market share in the 2% range in region, and there has been a decrease of approximately 200,000 users from 2022 to 2023.

In this research, we aim to address the issues of public delivery apps by reviewing previous studies related to delivery apps. We plan to utilize a game theory model to mathematically calculate real data and propose improvement measures for the policy direction of public delivery apps based on this analysis.

2. Literature Review

2.1. Delivery App Platforms and Current Status

2.1.1. Delivery App Platforms and Commissions

The fundamental structure of a delivery app is as above: when a consumer places a food order, the order app transmits the relevant information. Based on this, the restaurant prepares the food, and the delivery driver receives it to deliver it to the consumer. Depending on the pricing policy, the consumer and the restaurant pay a delivery fee to the delivery driver affiliated with the delivery app or delivery service. Separately, the restaurant pays a mediation fee to the delivery app. In this process, consumers can easily and quickly place orders by referring to various comparisons and reviews, while restaurants can receive more delivery orders.

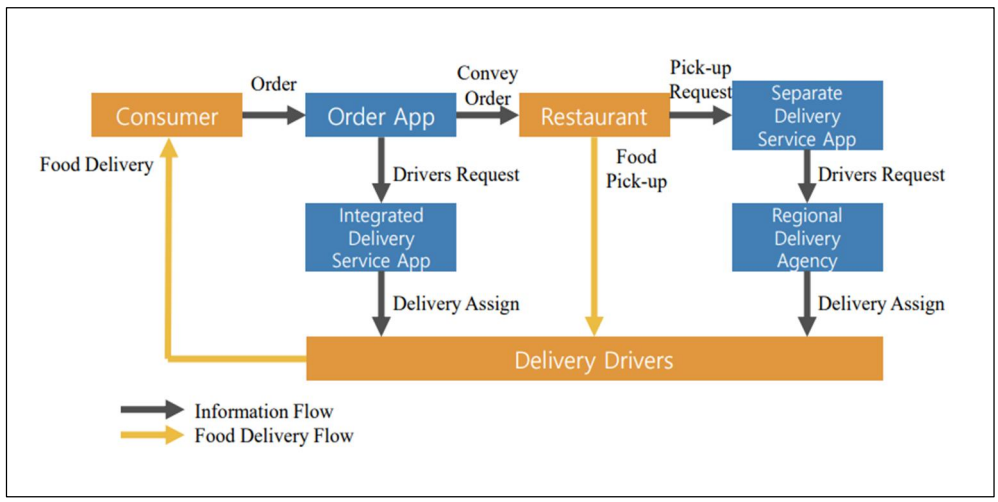

Figure 1: Structure Diagram by Type of Delivery App

According to Choi et al. (2021), private delivery apps utilize both integrated delivery service apps and separate delivery service apps, often incorporating various additional services within the app. On the other hand, public delivery apps mainly use separate delivery service apps that employ local delivery agencies. Additionally, public delivery apps, developed with the goal of preventing market monopolies and reducing the commission burden on small businesses, charge lower mediation fees compared to private delivery apps (Lee & Joo, 2021).

In reality, according to the 'Dining Industry Insight Report' by the Korea Agro-Fisheries & Food Trade Corporation (2022), the average commission per order for private delivery apps was found to be ₩2,874, with the majority of companies paying commissions ranging from ₩3,000 to ₩4,000. In contrast, the average commission per order for public delivery apps was lower at ₩1,545 compared to private delivery apps, and the range of fees paid was primarily between ₩1,000 and ₩2,000.

The commission structure of delivery app platforms also impacts platform usage and revenue. Imposing an upper limit on the commission rate charged to restaurants can protect against increased costs for food delivery customers, reduced earnings for food delivery drivers, and decreased profits for food delivery platforms (Liu, & Li, 2023). However, if the commission upper limit is excessively protective and further reduced, it may lead to worsening conditions for all participants in the food delivery market compared to a less aggressive commission upper limit, including increased costs for food delivery customers, reduced earnings for food delivery drivers, decreased profits for food delivery platforms, and decreased revenue for restaurants. Additionally, while saving on service fees does bring in more orders and revenue, the increased revenue cannot compensate for the decrease in service fees due to increased orders and additional delivery wage costs, resulting in a reduction in platform profits (Li & Liang, 2022). According to this research, a high market share does not guarantee maximum profits for the platform, and besides considering service fees collected from consumers, the fees collected by restaurants, which vary depending on the number of orders and the price per order, should also be considered.

2.1.2. Current Status of Domestic Delivery Apps

Despite significantly higher fees for private delivery apps compared to public delivery apps, private delivery apps dominate the ones predominantly used by restaurant businesses. According to a survey of restaurant businesses using delivery apps services, the utilization rates were highest for 'BaedalMinjok' (96.54%), 'Yogiyo' (60.69%), 'CoupangEats' (42.98%), and public delivery apps (18.14%) (Korea Agro-Fisheries & Food Trade Corporation, 2022). This indicates that both restaurant businesses and consumers overwhelmingly favor private delivery apps over public delivery apps.

While private delivery apps are limited to three apps - 'BaedalMinjok', 'Yogiyo', and 'CoupangEats', public delivery apps, by nature, exhibit diverse usage across different regions. The current status of operating public delivery apps is as follows. Table 1 is referenced from the 'Dining Industry Insight Report' by the Korea Agro-Fisheries & Food Trade Corporation (2022). Additionally, excluded are services that are currently not in operation.

Table 1: Status of Public Delivery Apps in Operation as of 2022 (Korea Agro-Fisheries & Food Trade Corporation, 2022)

Region		Public delivery application
Capital Region	**Seoul**	ZeroBaedalUnion, WeMefO, MammaMeogja, RoMarket
	Gyeonggi	BaedalTeuggeub
	Incheon	BaedalEeum
Chungbuk		Meokkaebi
Daegu		Daeguro
Gyeongbuk		Meokkaebi
Gyeongnam	**Jinju**	Baedal Jinju
	Gimhae	Meokkaebi
	Yangsan	Baedal Yangsan
	Changwon	Nubigo
Busan		DongbaekTong
Ulsan		UlsanPaedal
Jeonbuk	**Gunsan**	Baedal Myeongsu
	Namwon	Wolmaeyo
	Jeonju	JeonjuMasBaedal
Jeonnam		Meokkaebi
Gwangju		WeMefO

2.2. Factors Influencing the Choice of Delivery Apps

2.2.1. Factors Influencing Consumer Choice of Delivery Apps

As the delivery app market grows, recent studies have investigated the correlation between delivery app attributes and consumer choices and purchase intentions. Through these prior studies, we can identify which factors are crucial in consumer choices regarding delivery apps and use them as references for improvement.

According to Chen et al. (2023), utilitarian value has a complete mediating effect between perceived behavioral control and purchase intention. This suggests that factors such as ease of use, convenience, enjoyment level, and positive experiences will all influence consumers' purchase decision-making. Practical value becomes even more critical when considering anticipated future obstacles, such as consumers' past experiences and payment methods.

Therefore, operators of food delivery platforms must continuously optimize overall hardware and software quality and focus on user experience, specifically pleasurable value, to enhance consumers' purchase intentions.

Wang (2023) demonstrated through simulation analysis that increasing delivery prices can accelerate the evolution of restaurants towards cooperation with platform operators, but it can also delay consumers' evolution toward consuming on delivery platforms. Furthermore, he argued that providing various options or allowing consumers to choose different payment methods is crucial to increasing expected benefits for consumers using delivery platforms. Hence, to enhance consumers' expected benefits and, consequently, their intention to use delivery platforms, operators should offer diverse choices and enable consumers to select various payment methods.

Yuk (2022) asserted that improving the level of delivery app service quality can reduce the fatigue felt by consumers, leading o positive effects on usage intentions. Additionally, the convenience of the payment system has a positive impact on usage intentions. Therefore, stabilizing, speeding up, making accurate, and simplifying the payment system experience during delivery app use can lead to consumer satisfaction. The payment system appears to mediate between service quality and usage intentions; hence, reducing loading times during orders or simplifying payment operations can enhance payment convenience, leading to consumer satisfaction. In other words, users of food delivery platforms experience increased usefulness and reliability through continuous positive service experiences, ultimately contributing to sustained usage intentions for delivery apps.

Lee et al. (2022) conducted a study using the revised Importance-Performance Analysis (IPA) method, focusing on the delivery app ‘Meokkaebi’, a public delivery app in Gyeongbuk Province. The results showed that ‘accurate delivery of ordered items,’ ‘various payment methods,’ and ‘easy order/payment procedures’ were deemed most important in terms of relative importance. Satisfaction was highest for ‘order processing speed,’ followed by ‘adherence to promised delivery schedule,’ ‘accurate delivery of ordered items,’ and ‘easy order/payment procedures.’

Variables included in both the high relative importance and satisfaction areas were ‘order processing speed,’ ‘accurate delivery,’ ‘easy order/payment procedures,’ and ‘various payment methods.’ These factors indicate that these services provided by the public delivery app are convenient and satisfactory, requiring continuous maintenance and management to sustain their current state.

Variables requiring concentrated management and improvement due to high relative importance but low satisfaction include ‘restaurant detailed information,’ ‘coupon registration/use,’ ‘easy product change/procedure,’ ‘review information,’ ‘various discount coupons,’ ‘visual information,’ and a total of nine items. This signifies that the public delivery app's services in these aspects are insufficient and inconvenient compared to private delivery apps, requiring focused improvements.

Among the areas with both low relative importance and satisfaction, the item that the public delivery app should prioritize for improvement is “various registered restaurant information.” Since a higher number of registered restaurants allows smooth operations and broadens customers' choices, leading to increased satisfaction, continuous efforts are needed for attracting more businesses and promoting to address the relative lack of restaurants in the public delivery app. Additionally, the item "review/ discount events" was evaluated with low relative importance and satisfaction for the public delivery app compared to private delivery apps. Therefore, strategic planning for operational strategies that involve conducting review events commonly with private delivery apps or focusing on differentiation strategies such as discounts on delivery fees, instead of review events, is necessary to increase customer satisfaction.

Through these prior studies, it can be understood that the quality of delivery apps and user experience mainly influence consumer satisfaction and usage intentions. Particularly, in the case of the payment system, the diversity and convenience of payment methods have a positive impact on usage intentions. As the current public delivery app is rated highly in terms of satisfaction with the payment system, continuous efforts are needed to maintain high satisfaction. On the other hand, the diversity of participating businesses and the provision of business information are essential for consumer satisfaction, but these are areas where the public delivery app has been evaluated with low satisfaction. Hence, efforts should be focused on inducing the entry of businesses and providing detailed business and product information to consumers. Furthermore, to increase consumer intention to use the public delivery app, improvements in user experience are necessary.

2.2.2. Factors Influencing Small Business Owners' Choice of Delivery Apps

As observed in the factors influencing consumer choice of delivery apps, the diversity of participating businesses significantly impacts consumers' usage intentions. Therefore, it is crucial to identify and continually manage and improve the factors influencing small business owners' choice of delivery apps to increase the number of participating businesses.

According to a study by Lee (2021), small business owners in the food service industry trust delivery apps more

when they provide diverse and accurate information, have excellent app screen design, and operate a systematic system. Trust was found to have a significant impact on performance, and establishments that trust delivery apps experienced sustained or increased revenue, market share, and net profit after using the app.

Kwon et al. (2023) found that convenience, cost-effectiveness, and public interest among delivery app selection attributes positively influence the intention of self-employed restaurant owners to use public delivery app services. Among these attributes, public interest was perceived as the most important. The study also revealed that self-employed restaurant owners prefer direct promotion activities for public delivery apps over support from public institutions for fees or after-sales service-related matters.

Jiang and Deng (2014) studied how two sellers offering differentiated products could maximize profits on for-profit and open platforms. The results indicated that as the user base on open platforms increased or the fees on for-profit platforms rose, there would be an increase in investments in for-profit platforms to balance profits. Given the lack of discussions on public delivery apps in overseas contexts, this difference between the two platforms can be analogous to the distinction between private and public delivery apps, providing valuable insights.

Therefore, public delivery apps must enhance the convenience of app usage through providing diverse and accurate information, operating a systematic system, and having user-friendly UI. Emphasizing public interest, they need to establish themselves as trustworthy delivery apps. Additionally, the government should actively promote public delivery apps to increase awareness. If this encourages small business owners to use public delivery apps, the subsequent increase in adjacent businesses could eventually lead to consumer influx. As a result, once public delivery apps secure sufficient market share, it is expected that they will be able to contribute to the formation of a healthy delivery app market by expanding investment by small business owners in private delivery apps.

2.3. International Cases of Delivery Apps

2.3.1. Delivery App Market in the United States

Similar to the domestic market, private companies like ‘Doordash’ (66% as of January 2024) and ‘UberEats’ (23%) dominate the delivery app market in the United States. Although there are no public delivery apps operated by states or nations, regulations are in place to ensure that delivery app commissions do not exceed 30.0% of food prices. For instance, the New York City Council approved legislation that sets the commission cap for delivery services at 15%, and for add-ons like marketing, it's 5%, and for transaction fees, it's 3%. In the case of San Francisco City, restaurants should maintain the 15% commission cap even after the pandemic.

2.3.2. Delivery App Market in India

India's food delivery app market is dominated by ‘Zomato’ and ‘Swiggy’, with a combined market share of 100%, creating a duopoly. However, with the emergence of ONDC (Open Network for Digital Commerce), which imposes no commissions, both ‘Zomato’ and ‘Swiggy’ are facing declining profitability and stock prices.

Established in 2022, ONDC, operating as a non-profit organization, is an open network developed by the Indian government to encourage fair competition between large and small businesses and democratize the way digital commerce is conducted. ONDC serves as an integrated platform where products and services from various e-commerce platforms are displayed in the search results of the ONDC network app, facilitating seamless transactions between buyers and sellers, regardless of the registered platform. ONDC aims to address the challenges faced by small e-commerce businesses and direct-to-consumer (D2C) brands amidst the increasing dominance of giant e-commerce corporations.

Unlike traditional platforms, ONDC connects multiple buyers and sellers without the platform's direct intervention and imposes no commissions. Consequently, food delivery through ONDC is much more affordable than India's existing private delivery apps with commission rates ranging from 25 to 30%. Moreover, ONDC aims to lower entry barriers for small and medium enterprises (SMEs) and local businesses, enhancing interoperability between buyers and sellers across the platform.

2.3.3. Partnerships Between Local Governments and Delivery Apps in Japan

While Japan does not operate public delivery apps, during the COVID-19 period, the government and local governments encouraged the use of delivery services by partnering with private delivery app companies. For example, in Kobe City, a partnership with ‘UberEats’ offered benefits such as reduced usage fees and discount services to participating businesses and consumers. Tokyo City partnered with various delivery apps, including ‘D-Delivery’, ‘DeMaekan’, ‘UberEats’, and ‘Line Delima’, offering coupons and free delivery services to app users.

2.4. Crisis Factors of Public Delivery Apps

2.4.1 Poor Performance of Public Delivery Apps

According to Choi et al. (2021), a survey targeting businesses that have not joined public delivery apps, with

regards to their intention to join in the future, resulted in 97.1% responding negatively. In other words, the majority of small business owners do not feel the necessity of joining public delivery apps. The survey on the reasons for not using public delivery apps revealed that the most significant reason was low awareness (57.83%), followed by discomfort with screen layout and design, and difficulties in order and payment management, accounting for 4.44% and 4.05%, respectively. A satisfaction survey conducted on small businesses that have joined public delivery apps showed an overall satisfaction rating of 3.00 out of 5. The satisfaction with customer management was the highest at 3.05, while satisfaction with mediation, search, and recommendation services was the lowest at 2.77. The major issues perceived by these businesses regarding public delivery apps were low awareness (48.3%) and a low number of orders (26.7%). Complex app usage (23.3%) was also pointed out as a problem. On the other hand, the main reasons for joining public delivery apps were the absence of advertising expenses (43.3%), low sales commission (38.3%), and the use of local currency/vouchers (25.0%).

Furthermore, based on the Korean Consumer Agency's Service Quality Evaluation Model (KSEQ), a study by No (2022) showed that the satisfaction level of public delivery apps was relatively higher than that of private delivery apps. Among the reasons for usage, the availability of local currency, local vouchers, and local payment accounted for 34.3%, while low delivery fees represented 15.4%. However, despite high user satisfaction, the actual usage rate is low, with an average of 2.1 orders per day, and 57.73% of responses indicating one or fewer orders (Korea Agro-Fisheries & Food Trade Corp, 2022). Another study analyzing the perception of public delivery apps using big data showed that, excluding delivery-specific apps like ‘BaedalTeuggeub’ and ‘Meokkaebi’, public delivery apps nationwide have low visibility on social networks, almost absent from discussions outside relevant news (Park et al., 2022). This suggests that the low awareness of public delivery apps is influencing their low usage rates.

Due to the low usage rates, there are cases of public delivery apps terminating their services. For example, the ‘BaedalolGeoje’, a public-private partnership public delivery app in Geoje City, Gyeongnam Province, ceased its service in December 2022. One of the reasons for its failure was the lack of close cooperation between local authorities and private companies during service provision. Additionally, the initial number of affiliated stores, which was around 600, decreased to about 400 by the time of service termination, and the number of registered users only reached around 27,000 as of June 2022, accounting for 10% of Geoje City's total population. Daily order volume was around 300, leading to the discontinuation of the service due to its low utilization rate.

Another case is the public-private partnership public delivery app ‘Somunnan Shop’ in Chungnam Province, which terminated its service in May 2023. Although the app received positive responses from consumers in the early stages, there was a lack of proactive policy consideration at the provincial level for the sustained and stable provision of public delivery app services. Moreover, both the number of platform registered users and actual users were low, with around 50,000 app registered users, of which 60% had no actual ordering experience. While there was a significant short-term demand at the initial release, a low utilization rate persisted from the second half of 2022 to the first half of 2023. Furthermore, 30% of affiliated stores did not receive a single order.

Through these examples of failed public delivery apps, it becomes evident that consistently low utilization rates and issues in local government policies are major contributing factors to their failure. Therefore, to ensure the success of public delivery apps, it is crucial to improve customer and small business owner satisfaction, boost utilization rates, and provide necessary policy support during this process.

2.4.2. Violation of Private Service Issues

According to Public Data Act, public apps developed and provided directly by local governments should not provide services that overlap or compete with private services. Public delivery apps can be divided into those directly developed and provided by local governments and those supported through public-private partnerships. In the former case, if the public app infringes on private services, it falls under the category of post-adjustment targets. For example, Gunsan City's direct operation of the "BaedalMyeongsu’ in February 2022 violated the Act and was designated as a post-adjustment target by The Board of Audit and Inspection of Korea, leading to a recommendation to terminate the app. As a result, Gunsan City decided to transfer the operation and management authority of “BaedalMyeongsu” to the Gunsan Commercial Vitalization Foundation to maintain the service. In this way, consideration of the operating entity is essential when implementing public delivery apps.

2.4.3. Decrease in Local Currency Budgets

Local currency is a form of currency and vouchers issued by local governments. Some local governments started pilot projects in 2018, and card-type local currencies were officially introduced from 2019 (Ha et al., 2023). In 2019, local currencies amounted to ₩3.2 trillion, increasing to ₩13.2 trillion in 2020 and ₩23.6 trillion in 2021. The government subsidized part of the local currency discount amount. However, from 2022, the support amount began to decrease, and in 2023, the entire local currency budget was cut. After parliamentary agreement, ₩3.525 billion was

eventually allocated in support. The local currency budget for 2024 was initially entirely cut, but it was eventually confirmed at ₩3 trillion during the final deliberation (National Assembly Budget Office, 2024). However, the current policy direction is moving towards further reduction in the future.

This reduction in government support for local currencies may lead to a decrease in the use of public delivery apps. Especially for public delivery apps closely linked to local currency payments, the decrease in the issuance of local currencies may lead to a reduction in app usage. An example is the 'UlsanPay' based public delivery app 'UlsanPedal', which saw a significant drop in revenue after the suspension of 'UlsanPay' issuance. For 'BaedalTeuggeub', 70% of all payments were made through local currencies from December 2020 to January 2021 (Choi et al., 2021). Therefore, in a situation where expectations for government local currency budgets are difficult, unless local governments separately allocate budgets for local currencies, this can be a crisis factor for public delivery apps using local currencies as a means of payment.

2.5. Game Theory Related to Policy Formation

Luo and Ruan (2015) presented a game theory model for the formation of carbon emission trading prices between the government and companies. Considering the characteristics of carbon emission rights as non-standard goods, they set the behavioral strategies and price determination mechanisms of each entity and designed them mathematically. They quantified the results through a case study, emphasizing the importance of the government providing an appropriate initial value for carbon emission rights during the policy formation process.

Jensen et al. (2015) presented a game theory model for the herring fisheries crisis in the North East Atlantic. To explain real cases that cannot be explained solely by non-cooperative game models, they designed a cooperative game model and used statistically estimated values to calculate the results of each model. However, for some unexplained parts, they considered unquantifiable causes, such as the possibility of alternative fisheries and changes in opportunity costs due to regulation, and attempted qualitative analysis.

Wang and Yang (2024) established a game theory model for the competition in product sales between individual sellers and platform operators on online sales platforms. Analyzing changes in the behavior of two sellers based on consumer preferences and the competitive environment within the platform, they derived proposals for platform operations. In this model, consumer choices based on preferences were added as variables, allowing the mathematical expression of the point at which a consumer's selection of one seller's product occurs.

According to these previous studies, it is possible to evaluate and propose the direction of government policies through mathematical game theory models. Quantified results can be obtained with case studies or statistical estimates of the model, and if this does not explain real phenomena, the model can be modified in various ways. However, in cases where unexplained parts exist or information about quantified values is unavailable, qualitative analysis is attempted to complement the model.

3. The Model of Game and Solutions

3.1. Model Presentation

Recent delivery app platforms are experiencing an increase in users due to network effects between consumers and sellers. In light of this, we aim to identify factors that contribute to the expansion of public delivery app affiliated stores.

Until now, much of the research on public delivery apps has relied on surveys and polls. In contrast, there exists a significant number of researches that express platform choices using game theory (Wang & Yang, 2024; Schlicher et al., 2024; Li et al., 2021). Therefore, this study aims to integrate these two fields and establish a game theory model for the process of sellers selecting a delivery app platform. Focusing on the outcomes that each delivery app choice ultimately has on the seller, this research, with the goal of suggesting policy effects and activation strategies, sets up a game model.

This model may appear similar to an optimization problem, but it is more appropriate to view it as a cooperative game model. Seeking the optimal value for the objective function under given situations may seem similar in both cases, but in an optimization problem, the focus is on finding the optimal values without considering cooperation and interaction among players. On the other hand, in a cooperative game model, the choices of one player can interact with the choices of other players, potentially influencing the outcomes, and the goal is to collaborate to achieve the maximum benefit collectively.

A seller, in deciding whether to use each delivery app to maximize profit, may be considered making individual decisions. However, interpreting the choices of using or not using each app as decisions made by different players, it can be seen as a form of coalition, where both delivery apps collaborate to maximize the seller's profit (Churkin et al., 2021). This is based on the assumption of a nonempty core, ensuring that the final outcomes are distributed fairly to each player, leaving no reason for players to deviate from the common goal (Schlicher et al., 2024). Additionally, when

the seller is already using a private delivery app, such a choice influences the outcomes of selecting a public delivery app, and the same holds true in the opposite scenario. Furthermore, when using both simultaneously, total profit is different from the combined benefits from each delivery app. Hence, it can be considered that there is interaction among these choices.

The model presentation is as follows. Firstly, sellers aim to maximize their total profit by utilizing delivery apps (Jiang & Deng, 2014). The total profit is calculated based on monthly earnings through each app, considering a month as a standard period[1].

Next, sellers have the choice to use or not use private delivery apps, denoted as choice C_1= (0, 1), and the choice to use or not use public delivery apps, denoted as choice C_2 = (0, 1). Consequently, sellers have four possible choices(Jiang, & Deng, 2014): (C_1, C_2) = (0, 0), (1, 0), (0, 1), (1, 1).

The key components of this game model are as follows.

Table 2: Components of game theory

Variables	Explanation
C_1	Use of private delivery apps (including all)
C_2	Use of public delivery apps (respectively)
F_1[2]	Commission rate of private delivery apps (0 ~ 1), average of general policy commissions excluding delivery fees assumed to be the same for each delivery app
F_2	Commission rate of public delivery apps (0 ~ 1), using respective general commissions excluding delivery fees assumed to be the same for each delivery app
D	Overlapping usage amount of private and public delivery apps (₩)
X, Y	Ratio of overlapping usage amount between private and public delivery apps (X + Y = 1, X > 0, Y > 0)
R	Rate of seller-specific margin (0 ~ 1)
Average Total Accumulated Transaction Amount[3] (ATATA)	Average monthly sales of seller by all delivery apps ATATA = ₩18,319,700
Accumulated Transaction Amount (ATA)	Accumulated transaction amount for each public delivery app (₩)
Number of Affiliated Stores (NAS)	Number of affiliated stores for each public delivery app
Service Months (SM)	Service months for each public delivery app (Service end date or reference date - Service start date)
Accumulated Order count (AOC)	Accumulated order count for each public delivery app
Accumulated Members (AM)	Accumulated members for each public delivery app
Monthly Order Count (MOC)	Accumulated order count for each public delivery app divided by service months
Average Transaction Amount per order (perATA)	Accumulated transaction amount divided by accumulated order count (₩)
P	Current number of members for each public delivery app (variable)

Monthly Margin of Private Delivery Apps V_1 (₩)

$$= R \times (ATATA - \text{(ATA / NAS / SM)}) \quad (1)$$

Monthly Margin of Public Delivery Apps V_2 (₩)

$$= R \times (perATA \times MOC) \,/\, (NAS \times (P \,/\, AM)) \quad (2)$$

Total Profit for the Seller U (₩)

$$= V_1(1 - F_1)C_1 + V_2(1 - F_2)C_2 \quad (3)$$
$$-DR(1 - X)(1 - F_1)C_1C_2 - DR(1 - Y)(1 - F_2)C_1C_2$$

Average Total Accumulated Transaction Amount (ATATA), Accumulated Transaction Amount (ATA), Number of Affiliated Stores (NAS), and Service Months (SM) are variables publicly disclosed regarding the performance of private delivery apps. By multiplying the calculated results of these variables by an arbitrary value Rate of seller-specific margin (R), the monthly margin for private delivery apps can be estimated. On the other hand, variables primarily disclosed for the performance of public delivery apps include Average Transaction Amount per order (perATA), Monthly Order Count (MOC), Number of Affiliated Stores (NAS), Current number of members for each public delivery app (P), and Accumulated Members (AM). Multiplying the calculated results of these variables by R allows for the estimation of the monthly margin for public delivery apps.

If a seller simultaneously uses two types of delivery apps, consideration should be given to the duplicate revenue generated by consumers who use both delivery apps (Wang, & Yang, 2024). This duplicated revenue (D) is deducted from the total profit, and the possibility of a consumer selecting a specific type of delivery app for an order is assumed as X, Y. These values are then calculated and added back to the total profit. This approach enables the reflection of the multi-homing effect that may occur when using two types of delivery apps simultaneously.

3.2. The Analysis of the Model

The various scenarios and outcomes for each choice regarding the use of delivery apps are illustrated in the following table.

Table 3: Total profit U according to choice of seller

(C_1, C_2) Scenario	Results
(0, 0)	0
(1, 0)	$V_1(1-F_1)$
(0, 1)	$V_2(1-F_2)$
(1, 1)	$V_1(1-F_1)+V_2(1-F_2)$ $-DR(1-X)(1-F_1)-DRX(1-F_2)$

(0, 0) scenario implies that the seller cannot gain any profit through the delivery app. However, based on actual survey results[4], 69.13% of the total 3,000 restaurant businesses are not using delivery apps, requiring a model adjustment to explain this.

Both (1, 0) and (0, 1) represent the monthly profit obtained through each delivery app, deducting the respective app fees, which is the same as what the actual store receives. In this case, typically, $V_1 > V_2$, $F_1 > F_2$ hold. Unlike public delivery apps, choosing (1, 0) involves the risk of fee increases due to monopolies, potential issues such as delivery fee increases due to changes in pricing policies or a decrease in monthly app revenue due to the pandemic transition. On the other hand, choosing (0, 1) can result in higher total profit compared to the monthly revenue due to the low commission rate, but it faces the challenge of not having a significant monthly profit. Moreover, the risk increases if public app users leave due to factors such as a reduction in local currency budgets. From the seller's perspective, using the less convenient public delivery app compared to private ones may reduce operational efficiency, and from the government's perspective, the low profitability of the public delivery app may lead to increased financial expenditures.

For (1, 1), the seller simultaneously uses both types of delivery apps, securing various sales channels. Separating the part related to the overlapping usage amount (D) of the two types of delivery apps, it can be summarized as follows.

$$\begin{aligned} &-DR(1-X)(1-F_1)-DRX(1-F_2) \\ &\quad = -DR(1-F_1)+DRX(1-F_1)-DRX(1-F_2) \\ &\quad = -DR(1-F_1)-DRX(F_1-F_2) \end{aligned} \quad (4)$$

At this point, since R has a unique value for each seller, it can be observed that as the total overlapping amount D decreases and the ratio X of private delivery app usage in the overlapping amount decreases, the total profit U increases. This indicates that it is necessary to reduce the number of consumers who simultaneously use both types of delivery apps, and if both are used, the number of consumers who mainly use the public delivery app should increase.

However, the model in the previous analysis did not show a trend closely resembling the actual usage status. Therefore, recognizing the existence of reasons for choices that cannot be explained solely by economic factors (Honvári, 2004), we add correction factors. The use of delivery apps can be relatively freely influenced by factors such as the size of the store, location, and number of tables that affect the efficiency of operations (Mhlanga, 2018), allowing sellers to engage in activities such as food delivery and marketing. However, the usage methods and convenience between each delivery app differ (as per the public delivery app survey results), and there are separate costs and labor for entry and exit. In addition, consumers' perceptions and sellers' business methods have an intangible impact (app preferences by app), and even when all these results are perceived by sellers as equal to or higher than the existing choices, 'organizational inertia' that prefers the existing method or choice may emerge (Omidvar et al., 2023).

In various fields, research incorporates non-economic factors distinguished from economic factors, manifested in various forms such as non-economic variables (Ahmad et al., 2021), satisfaction (Mpinganjira et al., 2017), and drivers (Shahbaz et al., 2017). Therefore, in addition to total profit, we define all non-economic effects influencing choices as non-economic effect adjustment factors ($\partial_0, \partial_1, \partial_2, \partial_3$), each representing the influence appearing in non-usage, using private delivery app only, using public delivery app only, and simultaneously using both types of delivery apps, respectively.

Table 4: Total profit U according to choice of seller considering non–economic effect

(C_1, C_2) Scenario	Results
(0, 0)	∂_0
(1, 0)	$V_1(1-F_1)+\partial_1$
(0, 1)	$V_2(1-F_2)+\partial_2$
(1, 1)	$V_1(1-F_1)+V_2(1-F_2)$ $-DR(1-F_1)-DRX(F_1-F_2)+\partial_1+\partial_2+\partial_3$

In this case, we can explain the result of not using the delivery app (0, 0). The survey results indicate a low usage rate of delivery apps in certain sectors such as 'Institutional Cafeterias' (1.05%), 'Business Catering Services' (1.92%), and 'Bar' (8.51%). In these cases, it can be inferred that the operational methods of sellers are not well-suited for delivery services, as evidenced by the high value of $\partial 0$ (inappropriateness of sellers' operational methods for delivery services). Other sellers not falling into categories such as Korean restaurants (24.11%), foreign restaurants (42.58%), and other makeshift restaurants (56.3%) may have high $\partial 0$ due to premiumization strategies like restaurants, marketing effects based on store interior or location, and unique business methods.

In all four scenarios, non-economic effect adjustment factors can have both negative and positive values. Therefore, even if the benefits between each choice are equal or rankings frequently change, the actual choices occur relatively slowly due to non-economic effect adjustment

factors. In particular, according to the review of previous studies, ∂_2 may have a low value due to the low convenience of public delivery apps, and ∂_3 may have a low value due to the necessity of managing multiple delivery apps simultaneously, indicating a need for improvement.

3.3. Case Study

We would like to apply actual data from domestic public delivery apps to this model for a comparative analysis of the results. Three well-known public delivery apps, 'Somunnan Shop', 'Meokkaebi', and 'Daeguro', were selected based on the criterion that they provide complete data necessary for calculations at similar timeframe, despite showing different patterns in terms of region, Accumulated Transaction Amount, utilization rate, etc.

The operational status of public delivery apps is not systematically disclosed, and many local governments directly provide information to regional media, presenting it in the form of newspaper articles. Due to this reason, cases providing complete data were rare. Among them, apps that were announced or discontinued around the survey period of September 2022, which is close to the time of the survey for the actual utilization rate of the local public delivery app in the area (Korea Agro-Fisheries & Food Trade Corporation, 2022), were selected for comparison. All data were obtained from reputable newspapers in each region.

Subsequently, the total service duration for each was calculated, and based on this, the monthly averages of the remaining variables were determined. Using Meokkaebi as a reference, Somunnan Shop has a low ATA, services relatively distant areas, while Daeguro has a high ATA and services very proximate areas, and their actual utilization rates differ. Therefore, it was deemed suitable for evaluating the performance of the model.

Table 5: Actual Public Delivery App Data Required for the Game Model

Items	Somunnan Shop	Meokkaebi	Daeguro
Region	Chungnam	Gyeongbuk	Daegu
Service start date	2021. 7. 5	2021. 9. 9	2021. 8. 25
Service end date or Reference date	2022. 8. 31	2023. 4. 7	2023. 7. 31
Service month	14.07	19.17	23.5
Commission rate	1.70%	1.50%	2.00%
Accumulated Transaction Amount (ATA)	845,000,000	40,000,000,000	109,426,000,000
Number of Affiliated Stores (NAS)	1,042	11,817	15,816
Accumulated Members (AM)	17,479	200,000	473,574
Accumulated order count	32487 (for 9 month)	1,710,000	4,614,433
Average daily Accumulated order count[5]	4.33	1.51	3.47

We calculated the total profit brought about by the seller's choices for each public delivery app using the provided data. In this calculation, we assumed $\partial_1 + \partial_2 + \partial_3 = \partial = 0$, and set $F_1 = 0.097$[6]. The reason for using P as a variable in this case is that as the platform becomes more active with an increase in the number of members, the utilization rate is expected to rise. This, in turn, will simultaneously increase the number of affiliated stores and the average daily accumulated order count.

Table 6: Game model results based on actual public delivery app data (U)

Scenario	Somunnan Shop	Meokkaebi	Daeguro
(1, 0)	$16490643.67R$	$16383241.35R$	$16276834.76R$
(0, 1)	$3.24RP$	$0.87RP$	$0.61RP$
(1, 1)	$R(16490643.67 + 3.24P - D(0.903 + 0.08X))$	$R(16383241.35 + 0.87P - D(0.903 + 0.082X))$	$R(16276834.76 + 0.61P - D(0.903 + 0.077X))$
(1, 0) to (0, 1) Condition	$If\ P > 5089704.84$	$If\ P > 18831311.9$	$If\ P > 26683335.67$
(1, 0) to (1, 1) Condition	If $3.24P > D(0.903 + 0.08X)$	$If\ 0.87P > D(0.903 + 0.082X)$	$If\ 0.61P > D(0.903 + 0.077X)$

In reality, since most sellers are already using private delivery apps, we calculated the conditions under which the choice shifts from (1, 0) to (0, 1) or (1, 1). According to the (1, 0) to (0, 1) condition, it can be observed that the threshold value of P is significantly larger than the current AM. While it remains true that P must increase for the seller to exclusively use the public delivery app, an increase in P indicates higher awareness and activity for that delivery app. As a result, the average order quantity will also increase, leading to a larger coefficient for P. Therefore, in reality, there is a significant possibility of the choice for the public delivery app occurring before reaching the threshold value of P under the (1, 0) to (0, 1) condition. However, achieving this solely with P is realistically challenging, and there is a risk of facing criticism for excessive regulation of private delivery apps.

On the other hand, according to the (1, 0) to (1, 1) condition, P should increase or D and X should decrease. Therefore, as mentioned earlier, by increasing sufficient number of public delivery app members can achieve this. However, by reducing duplicate usage amounts with private delivery apps through exclusive services and convenience,

while simultaneously increasing the preference for public delivery apps, it can be achieved more easily.

When quantifying and calculating these results, if the numerical values of the two choices are the same, the seller's choice will be determined based on the non-economic effect adjustments. Among these adjustments, the value of ∂_3 seems likely to be positive due to the anti-monopoly effect of private delivery apps and the diversification of the seller's revenue channels. However, ∂_2 may have a negative value due to the current inconvenient UI/UX of the public delivery app.

Finally, the calculated results with arbitrary values assigned to the variables in Table 7 were compared and analyzed with the survey results[7] of the usage rates of each public delivery app in the local area. In this case, assuming $\partial_1 = \partial_2 = \partial_3 = \partial = 0$, $R = 0.5$, and P=Accumulated members on the reference date. And assuming users of the public delivery app are considered to use private delivery apps simultaneously, D is set as V_2/R. Additionally, an equal preference for each delivery app was assumed.

Table 7: The Results of the Game Model Using Arbitrary Values and the Actual Utilization Rate of the Local Public Delivery App in the Area

Scenario	Somunnan Shop	Meokkaebi	Daeguro
(1, 0)	8245321.84	8191620.68	8138417.38
(0, 1)	28315.98	87000	144440.07
(1, 1)	8258852.68	8233193.77	8207438.3
(1,1) result - (1,0) result	13530.84	41573.09	69020.92
Actual utilization rate of the public delivery app in the area (%)	13.04 (Chungnam)	49.25 (Gyeongbuk)	51.16 (Daegu)

The values of the (1, 0) scenario and (1, 1) scenario are larger, with Somunnan Shop, Meokkaebi, and Daeguro in that order. However, the values of the (0, 1) scenario are the opposite. Therefore, as the value of (0, 1) increases, it can be observed that the values of (1, 0) and (1, 1) decrease. In the case of using only private delivery apps, where the overall size of the delivery app market does not increase, if the size of the public delivery app increases, competition may arise in the market, leading to a potential decrease in the total profit that sellers using private delivery apps can obtain. Therefore, there may be a threshold point in the growth of public delivery apps that is crucial for offsetting the non-economic losses that may occur due to the monopoly of private delivery apps.

When we assume ∂=0, it was found that in all cases, sellers would use both private and public delivery apps simultaneously. Furthermore, the difference between the results of the (1, 1) scenario and the (1, 0) scenario is correlated with the utilization rate of the local public delivery app, having a correlation coefficient of 0.8902. Although the sample size is small, it can be considered that the benefits provided by the public delivery app have a significant correlation with the actual utilization rate. Additionally, assuming that the utilization rates of 'Meokkaebi' and 'Daeguro' are both 50%, the difference in their non-economic effect adjustments, $\partial_{Daeguro-Meokkaebi} = 69020.92 - 41573.09 = 27447.83$, can be estimated. Through this, it can be confirmed that non-economic effects indeed exist.

4. Discussion

The factors influencing a seller's choice of delivery app were confirmed through a game theory model, where the monthly revenue of the app and the non-economic effects of each app's use played a role. This mathematical model allowed us to verify that the utilization rate of each delivery app varies according to the sales scale provided by the public delivery app to the seller. When the sales scale of the public delivery app is significant in a region, the revenue generated by using only private delivery apps decreases due to competition between delivery apps. However, the additional revenue generated when using both apps simultaneously increases. This difference, which also has a significant correlation with the actual utilization rate of the public delivery app, indicates that as the sales scale of the public delivery app increases, the incentives for sellers to use it also increase. There are three reasons why using both types of delivery apps are considered a superior strategy compared to using only one.

Firstly, it is the low commission rate of the public delivery app. Therefore, as the ratio of consumers who use the public delivery app to order the same food among those who use both apps (Y) increases, sellers can obtain greater profits with the same revenue. Currently, there is no specific data or research results on this ratio (X, Y), but based on the revenue scale and previous studies, it is estimated that the value of Y will be very low. However, in the future, with increased competition from private delivery apps, there may be an increase in the value of Y, leading to a greater number of (0, 1) choices. Yet, this can raise financial burdens on the still unstable revenue structure of the public delivery app and may face policy risks where government intervention is criticized for hindering the growth of private enterprises.

Secondly, it is an exclusive service unique to public delivery apps. Unlike private delivery apps, which operate with relatively low motivation and may find it challenging to establish policy linkages with diverse services, public delivery apps, initiated with a public interest focus, currently offer various exclusive services such as local currency services and childcare card payment services. Exclusive

services that only public delivery apps can provide, compared to private ones, can increase the proportion (Y) of consumers using public delivery apps among those who engage in multi-homing. This, in turn, can decrease the amount (D) spent on using both types of delivery apps. The better these services are established, the greater the potential for profit for sellers.

Thirdly, it is the diversification of the sales structure. The diversification of the sales structure can provide several advantages in management. When there is a sudden change in consumer usage due to business problems or a decline in service quality of one delivery app, having the option to maintain operations through another app provides time to adapt to such crises. Additionally, depending excessively on one delivery app makes it difficult to respond to an increase in commission rates (F_1) or unfavorable policy changes for sellers.

Therefore, if the public delivery app engages in fair competition with private delivery apps at an appropriate level, it seems that both the profit and management stability of sellers will increase. For this, the public delivery app needs to implement functions that differentiate it from private delivery apps within the framework of public interest, reduce the overlapping amount (D) and increase preference among consumers by offering beneficial policy services. Activating the public delivery app requires thoughtful consideration and application to achieve its public goals while regulating the monopoly of private delivery apps effectively.

5. Conclusions

In this study, we analyzed the current status and issues of public delivery apps and explored factors that can increase affiliated stores inflow through game theory. Although the public-interest nature of public delivery apps and the positive effects that can arise from it are evident, if these issues are not adequately addressed, it seems challenging for them to function properly in the market. Therefore, potential solutions to address these issues are as follows:

Firstly, the integration of public delivery apps operated individually by each local government. Public delivery apps are developed and operated with local government budgets, but their profitability is lower compared to private delivery apps due to low commission rates. Moreover, to perform their public roles adequately, they need consistent operation with a steady budget for a certain period. Since the design of these apps is largely similar across different local governments, integrating them could reduce the redundant costs of app development and operation. Such budget savings can contribute to the sustainability of public delivery apps and help them avoid criticism for excessive market intervention. ‘Meokkaebi’ is an example where a private company receives support from local governments to develop/operate a public delivery app and has been selected as the public delivery app in 12 local governments. Operating in this way is cost-effective, and users can continue using the same app in different regions, enhancing convenience regardless of their location. Developing the app further in a direction that provides customized services for each region could leverage the unique characteristics of each area without the need for separate delivery apps for each local government. At this point, it seems helpful to benchmark the operating methods and strategies of India's ONDC.

Secondly, reducing dependence on local currency payments. The payment feature using local currencies is a significant advantage of public delivery apps. However, the risk of excessive spending on local government budgets arises due to the combination of low commission rates causing a decrease in actual food prices and the discounts through local currency payments. With the decrease in local currency budgets since 2022, public delivery app usage seems to be significantly affected, indicating excessive dependence. Therefore, developing services that can encourage consumers to use public delivery apps besides local currency payments is necessary. Some public delivery apps currently operate childcare card payment services, which can be seen as an exclusive service performing a public function. Various other services are possible as well. For example, introducing and promoting health food franchises that provide balanced nutrition for children, the elderly, and patients. Ensuring safe delivery for marginalized groups like children, women, and single-person households by establishing appropriate guidelines for delivery worker’s education and management. This can also contribute to improving the working environment safety for delivery industry workers. Additionally, developing a separate user mode for marginalized groups with low digital literacy, such as the elderly and low-income individuals, could enhance user experience (UX) and user interface (UI).

Thirdly, establishing a service format that does not violate the Public Data Act. To compete fairly in the market, public delivery apps, being a government policy implemented with government budgets, must comply with the Public Data Act. Selecting and operating a private operating company, as mentioned earlier, appears to be a good method. Furthermore, the development of the mentioned services should consider these aspects sufficiently.

At a time when the services of public delivery apps are increasingly being terminated due to recent operational challenges, this study comprehensively reviewed and

examined previous research and cases on the causes of such phenomena. One of the major contributors to these issues was identified as a lack of participating affiliated stores. To gain a better understanding of this, a game model regarding seller's choices of delivery apps was developed, shedding light on factors influencing public delivery app selection from the seller's perspective and highlighting positive effects. Based on the research findings, additional activation strategies were proposed. This holds significance in enabling underperforming public delivery apps to adequately fulfill their inherent role in the market. Additionally, unlike previous studies, when setting goals for these strategies, the introduction of mathematical models from game theory is deemed helpful in providing specific numerical values.

However, for most public delivery apps, the lack of specific financial records and performance data being publicly disclosed posed a challenge, limiting the complete application of game theory. Efforts should be directed towards overcoming these limitations by modifying models or encouraging transparency through the public disclosure of information by local authorities, thereby fostering more active research on public delivery apps. Moreover, if surveys or new variables are developed to estimate non-economic effect, which significantly influence seller choices, it appears that predictive capabilities for such decisions could be enhanced. Furthermore, the development of game models premised on consumer choices and competition among delivery apps could provide a more multifaceted examination of the phenomenon.

In conclusion, considering the unique circumstances that initiated this policy in the backdrop of COVID-19, sustaining efficacy and performing its role in the future requires additional policy research and service development. This is essential to prove positive impacts on consumers, franchisees, and the restaurant and delivery app market, while maintaining policy legitimacy.

References

Ahmad, B., Ciupac-Ulici, M., & Beju, D.-G. (2021). Economic and non-economic variables affecting fraud in European Countries. *Risks (Basel), 9*(6), 1–17. https://doi.org/10.3390/risks9060119

Ashraf, S., & Bardhan, A. K. (2023). Optimal resource allocation strategies of competing new online delivery platforms using the Bass diffusion model. *Annals of Operations Research*. 1-20. https://doi.org/10.1007/s10479-023-05410-6

Chen, H., Liang, C., Liao, S., & Kuo, H. (2020). Consumer attitudes and purchase intentions toward food delivery platform services. *Sustainability (Basel, Switzerland), 12*(23), 1-18. https://doi.org/10.3390/su122310177

Choi, S., Jeong, J., Park, I., & Kim, M. (2021). A Study on Cooperative Partnership between Food Delivery Platform and Small Business. *Journal of SME Policy, 2021*(18), 1-162. https://kiss.kstudy.com/Detail/Ar?key=3938855

Churkin, A., Bialek, J., Pozo, D., Sauma, E., & Korgin, N. (2021). Review of Cooperative Game Theory applications in power system expansion planning. *Renewable & Sustainable Energy Reviews, 145*, 111056. https://doi.org/10.1016/j.rser.2021.111056

Ha, H., Choi, J., & Kim, J. (2023). Analysis of the Impact of Changes in Local Currency Policy on Consumption Activation: Focusing on the case of 'Dong Baek Jeon' in Busan. *The Journal of Information Systems, 32*(3), 117–132. https://doi.org/10.5859/KAIS.2023.32.3.117

Honvári, J. (2004). The economic and uneconomic aspects of the decision regarding the migration of the individual. *Periodica Polytechnica. Social and Management Sciences, 12*(2), 203-209. https://pp.bme.hu/so/article/view/1668

Jensen, F., Frost, H., Thøgersen, T., Andersen, P., & Andersen, J. (2015). Game theory and fish wars: The case of the Northeast Atlantic mackerel fishery. *Fisheries Research 172*, 7-16. http://dx.doi.org/10.1016/j.fishres.2015.06.022

Jiang, X., & Deng, S. (2014). Seller Investment Incentive on Heterogeneous Platforms Under Competition. *International Journal of u- and e- Service, Science and Technology (IJUNESST), 7*(5), 39–50. http://dx.doi.org/10.14257/ijunesst.2014.7.5.04

Kim, M. (2022). monopoly of Delivery Apps and Government Response: From the Perspective of Public Value Theory. *Journal of Korean Association for Policy Sciences, 26*(3), 109-131. http://dx.doi.org/10.31553/kpsr.2022.9.26.3.81

Korea Agro-Fisheries & Food Trade Corporation. (2022). *Dining Industry Insight Report. (3rd quarter)*. 1-35. https://www.atfis.or.kr/fip/front/M000000298/board/view.do?articleId=4585&pageIndex=1&searchType=0&pageKeyword=

Kwon, S., Yu, L., & Kim, H. (2023). The Effect of Selection Attributes of Public Delivery Apps and Support for Public Institutions on the Intention of Restaurant Service Providers to Use Public Delivery Apps. *The International Journal of Advanced Smart Convergence, 12*(1), 173-183. http://dx.doi.org/10.7236/IJASC.2023.12.1.173

Lee, C. (2021). A study on the Selection Attributes of Delivery Applications of Small Business in the Food Service Industry, Trust and Performance in the Pandemic Era : Focused on Comparison of Public Delivery Applications and Private Delivery Applications. *Journal of Foodservice Management Society of Korea, 24*(3), 297-317. http://doi.org/10.47584/jfm.2021.24.3.297

Lee, S., & Joo, S. (2021). Analysis of Public Delivery App Policy Formation Process and Policy Implications through Kingdon's Multiple Streams Model. *Social Economy & Policy Studies, 11*(3), 99–132. http://doi.org/10.22340/seps.2021.08.11.3.99

Lee, S., Han, S., & Nam, J. (2022). A Study on Public Delivery App Using Revised IPA. *Journal of Tourism Enhancement, 10*, 77-93. https://doi.org/10.35498/kotes.2022.se3.77

Li, H., & Liang, J. (2022). Service pricing strategy of food delivery platform operators: A demand-supply interaction model. *Research in Transportation Business & Management 45*(C), 100904. https://doi.org/10.1016/j.rtbm.2022.100904

Li, Y., Li, F., Yang, S., Wu, Y., Chen, H., Sharif, K., & Wang, Y. (2021). MP-Coopetition: Competitive and Cooperative Mechanism for Multiple Platforms in Mobile Crowd Sensing. *IEEE Transactions on Services Computing, 14*(6), 1864–1876.

https://doi.org/10.1109/TSC.2019.2916315
Liu, Y., & Li, S. (2023). An economic analysis of on-demand food delivery platforms: Impacts of regulations and integration with ride-sourcing platforms. *Transportation Research Part E, Logistics and Transportation Review, 171*, 103019. https://doi.org/10.1016/j.tre.2023.103019
Luo, A., & Ruan, Z. (2015). A Simply Carbon Pricing Model between Government and Enterprises based on Game Theory. *International Journal of u- and e- Service, Science and Technology(IJUNESST), 8*(7), 71-78. http://dx.doi.org/10.14257/ijunesst.2015.8.7.07
Mhlanga, O. (2018). Factors impacting restaurant efficiency: A data envelopment analysis. *Tourism Review, 73*(1), 82-93. http://dx.doi.org/10.1108/TR-07-2017-0109
Mpinganjira, M., Roberts-Lombard, M., & Svensson, G. (2017). Validating the relationship between trust, commitment, economic and non-economic satisfaction in South African buyer-supplier relationships. *The Journal of Business & Industrial Marketing, 32*(3), 421-431. https://doi.org/10.1108/JBIM-04-2015-0073
No, U. (2022). *Survey on the Usage Patterns of Delivery Apps*. Korea Consumer Agency. 1-78. https://www.kca.go.kr/smartconsumer/sub.do?menukey=7301&mode=view&no=1003469655
Omidvar, O., Safavi, M., & Glaser, V. (2023). Algorithmic Routines and Dynamic Inertia: How Organizations Avoid Adapting to Changes in the Environment. *Journal of Management Studies, 60*(2), 313-345. https://doi.org/10.1111/joms.12819
Park, B., Nam, J., & Kim, Y. (2022). A Study on the Perception of Public Delivery App Using Big Data Analysis: Focused on Text-Mining. *The Journal of Industrial Innovation, 38*(4), 204–217. http://doi.org/10.22793/indinn.2022.38.4.018
Schlicher, L., Dietzenbacher, B., & Musegaas, M. (2024). Stable streaming platforms: a cooperative game approach. *Omega (Oxford), 125*, 103020. https://doi.org/10.1016/j.omega.2023.103020
Seo, S., & Kim, E. (2022). A Study on the Minimization of Local Capital Outflow Using Local Government Public Application. *Journal of International Trade and Insurance, 23*(5), 91-106. https://doi.org/10.22875/jiti.2022.23.5.006
Shahbaz, M., Bhattacharya, M., & Ahmed, K. (2017). CO2 emissions in Australia: economic and non-economic drivers in the long-run. *Applied Economics, 49*(13), 1273–1286. https://doi.org/10.1080/00036846.2016.1217306
Wang, H. (2023). The construction of the strategy selection behavior of online food delivery platform based on the tripartite evolutionary game model. *Asia Pacific Management Review, 28*(3), 316-326. https://doi.org/10.1016/j.apmrv.2022.12.004
Wang, Z., & Yang, T. (2024). Research on the Product Positioning Strategy of the Independent Seller under Platform Encroachment. *Systems (Basel), 12*(1), 36. https://doi.org/10.3390/systems12010036
Yuk, H. (2022). Relationship between Service Quality, App Tiredness, Payment System, and Intention to Use, Perceived by Food Delivery App Service Users. *Culinary Science & Hospitality Research, 28*(6), 106-116. https://doi.org/10.20878/cshr.2022.28.6.011

Endnotes:

1. Korea Agro-Fisheries & Food Trade Corporation. (2022). Dining Industry Insight Report. (3rd quarter). p.17. [Table 10] The Nationwide Status of Public Delivery Apps.
2. In Luo, A., & Ruan, Z. (2015). A Simply Carbon Pricing Model between Government and Enterprises based on Game Theory, We referred to the process where the final profit U, including the outcomes of participants' choices, is determined based on the values V perceived by each participant in the game.
3. No, U. (2022). Survey on the Usage Patterns of Delivery Apps. Korea Consumer Agency. p.19. [Table 2-10] Current Status of Fees and Charges for Major Domestic Delivery Apps.
4. No, U. (2022). Survey on the Usage Patterns of Delivery Apps. Korea Consumer Agency. p.63. Survey Results on the Utilization of Delivery Apps among Small Business Owners in 2022.
5. Korea Agro-Fisheries & Food Trade Corporation. (2022). Dining Industry Insight Report. (3rd quarter). p.11. [Fig 1] Delivery Platform Usage Status.
6. Korea Agro-Fisheries & Food Trade Corporation. (2022). Dining Industry Insight Report. (3rd quarter). p.19. [Fig 11] Daily Average Order Count by Public Delivery App.
7. No, U. (2022). Survey on the Usage Patterns of Delivery Apps. Korea Consumer Agency. p.19. [Table 2-10] Current Status of Fees and Charges for Major Domestic Delivery Apps.
8. Korea Agro-Fisheries & Food Trade Corporation. (2022). Dining Industry Insight Report. (3rd quarter). p.18. [Fig 8] Regional Public Delivery App Usage Status.