



Dynamic Pricing and Supply-Demand Balance of Crowdsourcing Platforms: A Case Study of Didi Chuxing

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Abstract. Against the backdrop of prevalent supply-demand imbalance in the development of Internet-based crowdsourcing platforms, this paper takes Didi Chuxing in Guangzhou, a city with both tourism and commercial attributes, as the research scenario, and explores the internal mechanism of dynamic pricing in balancing platform capacity supply and demand. Based on public operational data from the Guangzhou Transportation Bureau and Didi platform, this paper constructs a complete-information static game model with the platform, drivers and passengers as the main players, focusing on the impact of dynamic surcharges on supply-demand relations across different periods and scenarios. Data tests and model verification show that supply-demand conditions differ significantly by period, the pricing coefficient is positively correlated with overall capacity supply, supply-demand imbalance is more prominent during tourism peaks, and the regulatory effect of conventional dynamic pricing is relatively limited in such periods. This paper reveals the internal relationship between dynamic pricing and supply-demand balance of crowdsourcing platforms, and the conclusions provide a theoretical basis and data support for pricing strategy optimization and rational capacity allocation of urban ride-hailing platforms.

Keywords: Crowdsourcing platform, Dynamic pricing, Pricing factor.

1 Introduction

Against the wave of deep integration between the digital economy and the platform economy, Internet-based crowdsourcing platforms have realized efficient and real-time matching between the supply and demand sides. By integrating decentralized social supply resources, crowdsourcing platforms deliver instant, convenient, and efficient services to demanders. They have become the core organizational form in shared mobility, on-demand delivery, and other lifestyle service sectors. Such platforms have the characteristics of typical bilateral markets, supply self-scheduling, and service perishability. The imbalance between real-time supply and demand is the core pain point throughout the whole process of operation, and it is also the key bottleneck restricting the improvement of platform efficiency. As a leading enterprise in the domestic ride-hailing industry, Didi Chuxing has distinct attributes of a crowdsourcing platform. As an important tourism hub and business center in China, Guangzhou has frequent population flows and sharp fluctuations in travel demand in time and space.

The city not only faces problems of excess capacity and idle resources during off-peak periods but also confronts the contradiction of concentrated demand surges and a sharply widening supply-demand gap during morning and evening peaks, holidays, and other periods. It is a typical urban sample to study the supply and demand law of a crowdsourcing platform. As the core tool for crowdsourcing platforms to regulate supply-demand balance, dynamic pricing screens passenger travel demand by adjusting service fees. It also stimulates supply-side capacity through price leverage to achieve market supply-demand equilibrium. Against this background, this paper takes the operation of Didi Chuxing in Guangzhou as the research object. An exploration of the internal mechanism between dynamic pricing and supply-demand balance can not only reveal operational laws in specific urban scenarios but also extract the general operational logic of crowdsourcing platforms, which carries important theoretical and practical value.

Firstly, at the level of crowdsourcing platform operation and pricing research, the existing literature mostly constructs the investment decision and competitive pricing model of crowdsourcing logistics platform from the utility function of consumers and distribution personnel, and then verifies the positive role of reasonable pricing in improving the service quality of the platform [1]. Some studies focus on the operational characteristics of random demand scenarios and carry out dynamic pricing strategy analysis around crowdsourcing logistics platforms in order to prove that a dynamic pricing mechanism can effectively match market supply and demand [2]. Secondly, in the related research in the field of shared travel, some scholars pointed out that ride-hailing can rely on dynamic pricing to encourage drivers to allocate capacity supply independently, so as to achieve a dynamic balance between supply and demand, which has also become classic foundational research in the direction of shared travel pricing [3]. Some studies have carried out empirical tests based on the full operational data of the Didi platform, and the results show that dynamic pricing in peak hours can achieve coordinated improvement of the welfare of passengers, drivers, and platforms, while the regulation effect in non-peak hours is relatively limited [4]. Moreover, focusing on the subdivision research of dynamic pricing and supply-demand balance, the academic community further carries out in-depth discussion in combination with the characteristics of platform operation: on the one hand, by building a crowdsourcing logistics dynamic pricing model, it is confirmed that the incentive coefficient has a significant regulatory effect on market supply and demand and service prices [5]. On the other hand, in view of the operation logic of crowdsourcing logistics service platforms, this paper analyzes the internal mechanism of dynamic pricing and supply and demand synergy, and proves that a scientific pricing strategy can balance supply and demand structure and optimize the overall operation efficiency of the platform [6]. There are also studies based on Uber platform data to carry out empirical analysis, which found that although dynamic pricing can improve the overall welfare level of the market, it is easy to lead to the reality of unequal welfare distribution [7]. Some scholars also focus on the pain point of the mismatch between supply and demand of ride-hailing, build a spatiotemporal differentiated pricing model, and finally verify that the spatiotemporal pricing mechanism can effectively adjust the layout of regional capacity supply and alleviate the imbalance of travel resource allocation [8].

Existing literature has analyzed the supply and demand relationship of ride-hailing from the aspects of crowdsourcing platform operation, dynamic pricing, and industry supervision, but there are still obvious research gaps in systematically analyzing the internal logic of pricing driving the imbalance between supply and demand, carrying out empirical research in combination with the dual attributes of tourism and commerce, and proposing scenario-based pricing optimization and supervision schemes. This paper aims to fill the above gap. Based on the research object of Guangzhou Didi Chuxing operation, using the research idea of combining theoretical analysis and empirical logic, this paper constructs a game model including platform, driver, and passenger, compares the difference between supply and demand in normal and peak periods, analyzes the reasons for dynamic pricing failure, and then puts forward dynamic pricing optimization strategies and suggestions in different scenarios. The theoretical significance of this paper lies in enriching the research system of bilateral market theory and crowdsourcing platform dynamic pricing, and strengthening the internal correlation analysis between pricing and supply and demand. The practical significance is to provide a feasible plan for Guangzhou Didi to optimize its pricing mechanism and alleviate the contradiction between supply and demand at peak hours, and to provide a reference for the operation and supervision of ride-hailing platforms in similar tourism and business cities in China.

2 Research Design and Game Theory Model Construction

2.1 Data Sources and Assumptions

The data used in this paper mainly include three sources. The first is public data from the Guangzhou Transportation Bureau, including 2024–2025 monthly ride-hailing operation reports, ride-hailing fare policy documents, and the Guangzhou transportation industry development report. The core indicators include the average number of active vehicles per day, the average daily revenue of each vehicle, the average daily operating mileage of each vehicle, and the total number of orders. Second, Didi Guangzhou official public data: 2024–2025 holidays, Guangzhou Fair special travel report, core indicators include order growth, premium coefficient, supply and demand matching rate, off-site travel demand, and so on. Third, industry research and calculation data: operation cost calculation report of the ride-hailing industry, research on the current situation of ride-hailing drivers in Guangzhou, core indicators including driver unit operation cost, industry average proportion, etc., for model parameter calibration.

This model focuses on the three core stakeholders of dynamic pricing on crowdsourcing platforms. The core game players are the Didi Guangzhou platform and ride-hailing drivers as capacity suppliers. Both parties are rational economic agents that take profit maximization as the core decision-making goal. Demand side passengers take the maximization of travel utility as the decision-making criterion, their demand price elasticity as the endogenous influence variable of the model, and the game equilibrium sets the adjustment logic of both supply and demand around dynamic pricing. This analysis framework of the bilateral main game is in line with the research logic of scholars on the pricing strategy of ride-hailing in peak travel periods, and it also con-

structs a game model with the revenue decision-making of the platform and driver as the core [9].

In terms of defining the main body, the platform side sets a dynamic pricing coefficient r to meet $r \geq r_{\min} \geq 1$, where $r=1$ is the basic pricing corresponding to the government guidance price, $R>1$ corresponds to the peak premium pricing mechanism, and $r_{\min}$ is the lowest pricing coefficient set by the platform. Platform revenue comes from order pumping, and the value range of the pumping ratio θ is 0 less than θ less than 1. Referring to the conventional level of the Guangzhou ride-hailing industry, the benchmark value is set at 0.25. The capacity supplier takes the supply Q of effective operating trains in a single period of time as the endogenous decision-making variable, and the revenue of drivers in a single period of time is composed of the revenue from actually completing orders, the unit variable operating cost c , minus the corresponding operating mileage, and the fixed time opportunity cost.

Passenger demand is constructed as a function $D(r)=a-br$, where all parameters are greater than 0. The parameters represent the basic demand and demand price elasticity coefficient, respectively. The equilibrium conditions of supply and demand meet the supply volume does not exceed market demand. This balanced analysis of supply and demand is also adopted by scholars in the optimization of ride-hailing pricing in peak periods. By constructing a similar demand-supply function model, the adjustment effect of dynamic pricing on the matching of platform revenue and supply and demand is discussed [10]. The game level is set as a static game of complete information, which is in line with the reality of transparent pricing of the platform. At the scene level, normal periods are distinguished from peak scenarios such as holidays and the Canton Fair, and the basic demand during the peak period has increased significantly, which is also the core research scenario of pricing regulation and supply and demand optimization.

2.2 Income Function and Dynamic Solution

First, the platform side income function π_G . The platform income is the order revenue, and the actual order volume is determined by the minimum value of capacity supply and market demand, where: the normal operation period meets $Q > D(r)$, and the order volume=demand. Peak scenario $Q < D(r)$, order volume=supply volume. Assuming that the basic unit price of Guangzhou ride-hailing is p_0 , which is a constant determined by the policy, the platform income function is shown in model (1):

$$\pi_G(r, Q) = \theta \cdot p_0 \cdot r \cdot \min(Q, D(r)) \quad (1)$$

Secondly, the revenue function of the capacity supply supplier is π_S . The net revenue of the driver in a single period is the total revenue from the actual completion of orders, deducting the total variable cost of the corresponding operating mileage. The actual disposable income of each order completed by the driver is the basic unit price p_0 times the pricing coefficient r , and then the platform fraction is deducted. The total income is the income of a single order times the actual number of orders completed, so the driver's income function is shown in model (2):

$$\pi_S(r, Q) = (1 - \theta)p_0 \cdot r \cdot \min(Q, D(r)) - c \cdot Q \quad (2)$$

This function shows that the pricing coefficient r determines the driver's income, the matching of supply and demand, and the unit operating cost c , and there is a difference in the income logic between normal and peak periods. The core of a complete-information static game is that both sides choose their optimal decisions once the other side's decision is known, and ultimately achieve a Nash equilibrium. Neither side has any incentive to change the existing decision. Under the normal period $Q > D(r)$: order quantity=demand $D(r)$, the platform calculates the partial derivative of r , such as model (3):

$$\frac{\partial \pi_G}{\partial r} = \theta \cdot p_0 \cdot D(r) - 2\theta \cdot p_0 \cdot r \cdot b \quad (3)$$

There is an optimal pricing to maximize platform revenue. The driver's partial derivative of Q is $-c < 0$, and the driver tends to reduce the supply. In the peak period, $Q < D(r)$: order volume=supply Q , the platform calculates the partial derivative of r to get $\theta \cdot p_0 \cdot D(r) > 0$, and the platform has the profit motive to increase the premium. When the driver calculates the partial derivative of Q , then gets $(1 - \theta)p_0 \cdot r - c$, which is equal to 0, and gets $r_0 = \frac{c}{(1-\theta)p_0}$. When $r > r_0$, the driver can obtain positive marginal returns by increasing the supply of capacity, so the driver has the power to increase the supply.

Based on the results of the game equilibrium, this paper extracts three propositions to provide theoretical support for follow-up empirical verification and problem analysis:

Proposition 1: There is a significant difference in the characteristics of supply and demand between the normal period and the peak period. There is excess supply in the normal period and excess demand in the peak period, and the fluctuation of supply and demand in the peak period is significantly greater than that in the normal period.

Proposition 2: When the platform pricing coefficient $r > r_0$, the driver capacity supply Q increases significantly with the increase of r , and the two are positively correlated.

Proposition 3: There is scenario heterogeneity in the price elasticity b of passenger demand. b in the peak period of tourism is greater than that in the peak period of business. The greater b , the more obvious the inhibitory effect of the rising pricing coefficient r on demand $D(r)$.

3 Analysis and Model Verification of the Supply and Demand Difference Between Normal and Peak Periods

3.1 The realistic Performance of the Difference Between Supply and Demand in Normal and Peak Periods

Combined with the tourism and commercial characteristics of Guangzhou, this paper examines the supply-demand performance of Didi Chuxing in Guangzhou between normal periods and peak periods based on open data systems. The specific differences

are as follows: in the normal period, in the daily operation period of non-holidays and non-Canton Fair, the demand of Guangzhou Didi is relatively stable, the pricing coefficient $r=1$, and there is no premium. Data show that during this period, the average number of active vehicles in Guangzhou Didi was about 82000, the average daily order volume of single vehicles was about 13.4, and the total average daily order volume was about 1.1 million. The core feature is a slight overcapacity, that is, the average number of active vehicles per day can fully cover the demand for passenger orders. In some periods, such as during the peak at noon, there is a problem of high empty driving rate of drivers, and the capacity is not fully utilized. At the same time, the distribution of supply and demand is characterized by uneven space, centralized orders in the central urban area, but sufficient capacity supply, fewer orders in remote suburbs, resulting in low willingness of drivers to operate, and slight excess demand in some areas.

As shown in Table 1, the peak period is divided into business peaks, such as the Canton Fair, and tourism peaks, such as the National Day or the Spring Festival. There are differences in supply and demand performance between the two sub-scenarios, but both show the characteristics of a surge in demand and sharp fluctuations in supply and demand. During the business peak exhibition period and other business peaks, the travel demand of business people in different places has surged, and the pricing coefficient r of Guangzhou Didi is a low premium. The average number of active vehicles per day increased to 95000, an increase of 15.9% over the norm. The number of orders increased by 140% year-on-year, and the matching rate between supply and demand was about 92%. The core characteristics are small excess demand, strong rigidity of business travel demand, low premium does not restrain demand, while effectively stimulating the supply of driver capacity, high matching between supply and demand, but there are still short-term taxi difficulties at key nodes, such as the opening day and closing day of the exhibition. During the peak of tourism, such as holidays, the travel demand of foreign tourists surges, and the pricing coefficient r of Guangzhou Didi is at a high premium. The average number of active vehicles per day increased to 101000, an increase of 23.2% over the norm. The number of orders increased by 85% year-on-year, and the matching rate between supply and demand was only 78%. The core characteristics are excess demand in the early stage and false excess supply in the later stage. The price elasticity of tourism demand is large. Although a high excess price significantly stimulates the supply of capacity, it also excessively inhibits passenger demand, resulting in a low match between supply and demand. In the later stage, there is a phenomenon of high premiums, a sharp decline in demand, and excess supply.

Table 1. Difference between supply and demand in normal and peak periods

Contrast dimension	Normal time	Peak period (business peak)	Peak period (tourism peak)
r	1.0	1.2-1.3	1.5-1.8
average number of active vehicles per day	82000	95000	101000
order volume growth	-	+140% year-on-year	+85% year-on-year
supply and demand matching rate	88%	92%	78%

3.2 Empirical Verification of the Game Theory Model

First, proposition 1 is empirically verified through group comparison of core supply-demand indicators between normal and peak periods. The results show that the matching rate of supply and demand in the whole market in the normal period is 88%, showing the characteristics of slight overcapacity. During the peak period, the volume of business peak orders increased by 140% year-on-year compared with the normal level, and the volume of tourism peak orders increased by 85% year-on-year compared with the normal level, which were significantly higher than the normal level. The fluctuation range of the supply and demand matching rate is 78% - 92%, which is significantly higher than the fluctuation range in the normal period, and the actual operational data is highly consistent with the theoretical expectation of proposition 1. It is proven that the difference between supply and demand in normal and peak periods is significant, and the model's description of the difference between periods is in line with reality.

Second, the positive correlation between the pricing coefficient and capacity supply is calibrated. Through the calculation of the core parameters of the model with Guangzhou public data, the change trend of pricing coefficient r and capacity supply Q is compared to verify the proposition that Q increases significantly with r when $r > r_0$. The calculation of core parameters and the comparison results of pricing supply trends are shown in Table 2. The theoretical break-even coefficient r_0 of Guangzhou Didi driver is about 0.73, while the actual pricing coefficient r of the platform is always ≥ 1 . When the driver is in a profitable State in all operation scenarios, $r > r_0$. There is a significant positive correlation between pricing coefficient R and capacity supply Q , r increases to 1.2-1.3 during the business peak, capacity supply increases by 15.9% compared with normal, R rises to 1.5-1.8 at the tourism peak, and capacity supply increases by 23.2% compared with normal. The actual data are highly consistent with proposition 2, which proves that the core logic of capacity supply increasing with the increase of pricing is true after the pricing coefficient in the model exceeds the lowest acceptable level for drivers.

Table 2. Calculation of core parameters and comparison of pricing supply trends

Model parameter	Meaning	Basis of calculation	Specific value	Operational scenarios	Pricing factor r	Capacity supply	Higher than normal supply growth
p_0	basic freight rate (yuan/km)	Guangzhou ride-hailing tariff policy	2.6	normal	1.0	82000	-
c	unit operating cost of driver (yuan/km)	Industry estimates and the Guangzhou Transportation Bureau report	1.9	business summit	1.2-1.3	95000	15.9%
r_0	minimum acceptable pricing factor for drivers	$r_0 = c/p_0$	≈ 0.73	tourism peak	1.5-1.8	101000	23.2%

Third, the scenario heterogeneity analysis of demand price elasticity. This paper selects the time series data of the national day tourism peak in 2025 and the business peak of the Canton Fair in 2025, tracks the change trend of the pricing coefficient r and the order demand $D(r)$, and verifies the proposition that the tourism peak period B is greater than the business peak period, and the larger b is, the more obvious the inhibitory effect of r on $D(r)$ is. Data show that during the Canton Fair, R rose from 1.0 to 1.3, order demand increased by 140% year-on-year, and demand was not restrained by low premiums. During the National Day period, R rose from 1.0 to 1.8, and the demand for orders increased by 85% year-on-year. When R exceeded 1.5, the demand for orders began to decline. When $r=1.8$ on October 3, the number of orders decreased by 140000 orders compared with October 2. The above results show that the price sensitivity of passenger travel demand during peak tourism hours is higher, the inhibitory effect of high premiums on market demand is more significant, and the time series change trend of the pricing coefficient and order demand is in line with the theoretical expectation of proposition 3, which verifies the existence of heterogeneity in passenger demand price elasticity scenarios.

Through the empirical verification of the scenario comparison method, parameter calibration method, and trend analysis method, the actual operational data of Guangzhou Didi are highly consistent with the three propositions of the game theory model. It is proven that the platform driver static game theory model constructed in this paper can effectively explain the internal interactive logic of pricing and supply and demand of crowdsourced travel platforms, and can accurately depict the difference between supply and demand in normal and peak periods. This lays a solid theoretical and empirical foundation for the follow-up analysis of the core problems of the imbalance between supply and demand of Guangzhou Didi from the perspective of pricing and the proposal of a pricing optimization strategy.

4 Conclusion

Based on a case study of Didi Chuxing in Guangzhou, this paper draws the following findings around three research issues through game theory model construction, empirical verification, and case analysis. There is a significant difference between supply and demand between Guangzhou Didi's normal and peak periods. There is a slight overcapacity and uneven spatial distribution in the normal period. In the peak period, the business peak shows a small overcapacity dominated by rigid demand. The tourism peak shows the characteristics of excess demand in the early stage and false excess supply in the later stage, and the pricing coefficient and capacity supply in the peak period are higher than those in the normal period. From the perspective of pricing, the core reasons for the imbalance between supply and demand lie in the mismatch between driver pricing and time supply and demand characteristics, the lack of linkage between driver operating costs, and the lack of reasonable control over premium increments. Based on this, three optimization suggestions are put forward: implement differentiated pricing in different periods to adapt to the characteristics of supply and demand in different scenarios. Establish a cost linkage pricing mechanism to ensure the profit

margin of drivers. Set the premium range of sub-scenarios, complete and improve the safeguard measures, and achieve a balance between supply and demand in each scenario.

The main contribution of this paper is based on the dual attribute urban characteristics of tourism and Commerce in Guangzhou, focusing on the core interactive logic of pricing and supply and demand, filling the gap of a lack of correlation analysis between urban scenario pricing and supply and demand imbalance in existing research, and no landing optimization scheme is proposed. It enriches the dynamic pricing of crowdsourcing platforms and the theoretical system of the bilateral market, and provides a practical reference for the operation optimization of ride-hailing platforms in similar cities. This paper has certain limitations. For example, it lacks micro survey data of drivers and passengers and in-depth analysis of the micro-mechanism of supply-demand imbalance. Future research can combine micro survey data to mine the micro mechanism of the impact of pricing on the operation of both supply and demand, select cities with different characteristics to carry out cross-city comparison, and explore an AI-driven intelligent dynamic pricing strategy to improve the matching accuracy between pricing and supply and demand, so as to provide more reference for the intelligent operation of the crowdsourcing platform.

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