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Does Covid-19 Change the Effect of Competition on Price Discrimination in U.S. Airline Industry?

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Abstract: This paper seeks to examine the relationship between price discrimination and market competition before and after the outbreak of Covid-19 in the US busiest flight route, from Los Angeles airport, LAX to New York airport, JFK as a representation of the U.S. airline market. Scholars hitherto have long been focused on the effect of market concentration on price dispersion. There are two main conflicting theories that determine the relationship, the monopoly effect, and the branding effect. We analyze the air lane from Los Angeles to New York in two time periods, one from 2018 to 2020, and the other from 2020 to 2022 to see if Covid-19 changes the dominance of one effect over the other. The results of our study show that market competition has a positive effect on price discrimination during the pre-Covid period while revealing a negative effect on price discrimination after the outbreak. We conclude from the results that the branding effect dominates the LAX-JFK market before Covid-19, which means that higher competition increases the capability of a firm to charge different prices for different segments of customers whereas the monopoly effect overturns after the Covid-19 pandemic.

Keywords: airline industry, brand effect, competition, Covid-19, monopoly effect, price discrimination

1. Introduction

Price discrimination is an extensively used selling strategy. The traditional definition of price discrimination is to charge different prices for the same goods based on the consumers' evaluation so that buyers can extract the consumer's surplus as much as possible. The difference in price cannot be explained by the cost difference (Investopedia). It's common to see price differences in the airline ticket markets. The tickets price between different months, weeks, days, and even between seats may be different. Extensive studies about price discrimination have focused on the airline industry given the rich data set and numerous discriminatory pricing strategies used in the market. Scholars have argued that the existence of price discrimination indicates an imperfectly competitive market because competitive companies have less discretion in controlling the price, whereas monopolists are better to make optimal responses in pricing games [1]. In an oligopoly, the strategy of price discrimination will put the firms in a less profitable situation since they are not able to reach a consensus on solving the profit-maximizing problems given too many market constraints. Thus, there is an extremely high possibility that the discriminatory profits will be lower than the uniform profits [2]. It is not hard to imagine that a company will benefit less from price discrimination if every other company decides to do

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price dis- crimination but is not sure about what pricing strategy others would use rather than using a uniform price [3]. Therefore, these competitive firms would like to avoid the discriminatory situation. We refer to this outcome as the result of the monopoly effect, where a firm gains more market power and market competition becomes less intensive, the power to price discriminate increases.

Nevertheless, there exists a contradictory theory that is based on consumers' brand preferences, meaning that the willingness to pay for a particular brand will result in a positive effect of competition on price difference [4]. Borenstein and Rose first focused on airline industries' price dispersion and competition and made credible analyzes of this literature [5]. In Borenstein's model, when the intensity of brand preferences is different between customers, competition will facilitate price discrimination because firms categorize customers based on their intensity of preferences to produce larger price differences [6]. This result of the pricing strategy based on consumer preferences is referred to as the brand effect. They found a dominance of brand effect in the airline industry, especially customers with business purposes remain a higher loyalty to a particular brand than customers with traveling purposes even if there exist lower ticket prices produced by other firms. Brand loyalty is so important to the business. According to the Harvard Business Review in 2020, firms with higher customer preference and loyalty can reach the five times returns to shareholders in 10 years and their revenues tend to grow almost 2.5 times faster than the competitors. Thus, it's impractical to simply have an answer whether the monopoly effect or brand effect dominates the market. As there has been no agreement on the dominance of the two opposing theories, scholars continue examining the relationship between price discrimination and competition.

However, as we all know that the outbreak of Covid-19 changed everything. Travel bans and lockdown policies halt the whole tourism market. According to Bloomberg in 2022, more than 60 airlines around the world filed for bankruptcy, were liquidated, or ceased operations during the pandemic. Even though the covid-19 is under control in most countries now, the aviation or other transport service industry still could not recover. Many companies gave the option to work from home, largely eliminating the need for business travel. The economic recession brought by the pandemic and the difficulty to travel abroad further weaken the numbers of leisure travelers. It's undeniable that Covid-19 made an irreversible change to the airline industry. Therefore, we wonder if companies would vary their pricing strategy after the pandemic. To be specific, we would only focus on the effect of market competition on price discrimination.

Literature in airline industry is reviewed and discussed in the second section, and in the third section, we will explain the data set, variables used and the method specification. Section four provides empirical results and section five concludes. Further discussion and other implication are explored in last section.

2. Literature Review

2.1. Price Discrimination in the Airline Industry

There are numerous price discrimination techniques the airline industry uses in order to extract the heterogeneity in consumer surplus. The most common way to investigate price discrimination is to separate them into three degrees of price discrimination:

1. First-degree price discrimination means selling the goods to the buyer at the maximum price they are willing to pay.

2. Second-degree price discrimination means selling goods at different prices depending on the quantities customers buy.

3. Third-degree price discrimination means selling goods at different prices de- pending on the social group of customers [7].

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It's almost impossible to see first-degree price discrimination in real life be- cause firms need to acquire detailed personal information of customers so that they can charge the maximum price. However, the specific data of customers can hardly be acquired. Second and third-degree price discrimination appears more frequently in our daily life. The price difference we usually encounter in the airline industry is third-degree, separating the customers into different demographics [8]. Versioning is one type of second-degree price discrimination, which means providing different versions of a product with different prices [9]. In the aviation industry, companies always provide different quality air tickets. The flexible tickets, with which customers can change or cancel their flight tickets without additional costs, are more expensive, while the restricted tickets with no flexibility usually have lower charges. Sometimes, customers can buy a ticket that requires a Saturday night stay, a rule that requires travelers to stay on Saturday night at the destination. Steen and Sorgard [10] pointed out in their study that it was less likely for customers with business purposes to spend Saturday night at the destination than those with traveling purposes because they would rather choose to stay at home during weekends. Another example is frequent flyer programs. It's an honor program firms provide for customers to accumulate flying miles that can be later redeemed for free tickets or class upgrades. Nako [11] found that the frequent flyer program strongly impacted customers with business purposes from the empirical results on American, United, and Delta, the three dominant airline companies in the United States. The purpose of this program is to create brand loyalty to the customers. The high traveling frequency of businesspeople creates an incentive for business travelers to choose this program for convenience and free awards.

2.2. The Relationship Between Market Competition and Price Discrimination

Several studies have examined the effect of market competition on price discrimination, but they reached different conclusions. Borenstein and Rose [5] studied the price difference of airline tickets in response to the market competition on the same route. By analyzing the 11 major United States airlines in 1986, they found out that price discrimination will become greater as the competition between companies on the same route increases. In addition, they mentioned that companies that have computer reservation systems (CRS) exhibit greater price discrimination than the ones that don't. CRS makes the aviation industry more effective in market segmentation. Nowadays, CRS is the most essential tool in travel agencies, which helps companies to manage and retrieve travel information related to hotel rates, airline fares, and so on. Since they only analyzed one specific year, so they used a cross-sectional analysis of ticket prices between airline carriers and used Gini coefficients to represent price dispersion. In their regression, they used the Herfindahl index as the measure of market concentration. The positive coefficient of market competition is statistically significant and it indicates that as competition increases, the price dispersion becomes greater. Therefore, this result suggests a dominance of brand effect.

Hayes and Ross [12] further improved the model from Borenstein and Rose [5] by adding two more variables, the Atkinson index, and entropy in addition to Gini coefficients to measure the price dispersion. The reason to include the additional two measures is to illustrate the consistency of the statistical results rather than compare the suitability of these three variables. We will further discuss the use of the Gini variable in the following sections. They reached a similar result to Borenstein and Rose by investigating the data in the 1990s. Thus, the inclusions of the Atkinson index and entropy aren't the determinants of the model. So, for the simplicity of my model, I will only keep the Gini coefficients as the measurement of price discrimination. The only difference is that the effect of competition on price discrimination appears to be smaller than the sample Borenstein and Rose used in 1986. Besides, they found that the bankruptcy of carriers play an important role in price discrimination. Therefore, I need to include a variable that indicates whether the carrier is bankrupt or not in a certain period.

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In regard to the findings of Borenstein and Rose, Gerardi and Shapiro [8] construct a 13-years panel data from 1993 to 2006, focusing on nine major carriers in the United States. They used both cross-sectional and panel analysis. In addition to using the Herfindahl Index to measure the concentration, they built another general model that replaced the Herfindahl Index as the number of carriers operating in one specific route. In the cross-section analysis between different routes, they were able to replicate Borenstein and Rose's results. However, their finding on the panel analysis contradicts the one provided by Borenstein and Rose. Gerardi and Shapiro concluded that the increase in competition reduces price discrimination. Specifically, they classified routes into leisure and business routes and found that price discrimination would be more affected in business routes rather than leisure routes.

2.3. Impact of Covid-19 on the Airline Industry

The airline business is one of the industries that were devastated by Covid-19. In Zotova and Yu's economic research [13], they used the data from DB1B to test for the effect of pandemics on ticket fares in the United States. Numerous states imposed a lockdown policy and set traveling constraints. They found a dramatic decrease in demand brought by Covid-19 which gave the airline industry an unprecedented hit on stock and revenues. Furthermore, they expected that it's possible that the demand for air travel would never return to the levels before the pandemic, even though the world is currently smooth into a post-pandemic period where people return to normal and start traveling. The IATA report in 2020, it was shown that the airline industry's revenue passenger kilometers fell by more than 90%. The high reduction in demand and revenue triggered several airline companies' bankruptcies. Not only do the airline companies' operating strategies change significantly, but the behavior of customers in purchasing airline tickets also varies. In Jacques and Santiago's studies (2021), they concluded that because of unpredictable risk, customers tend to delay their purchasing date, preferring to buy tickets closer to their departure time. The transformation of customer behaviors causes companies to impose new pricing strategies.

Previous empirical studies have examined the relationship between price dis- crimination and the competitiveness of the market. However, there is no study trying to examine if the particular relationship will change after the outbreak of covid-19. Therefore, based on all the existing studies, we then develop a question about how Covid-19 changes the carriers' pricing strategies on the LAX-JFK flight route in response to the effect of market competition.

3. Data

The data we used is from the Airline Origin and destination survey (DB1B) on the Bureau of Transportation's online collection of databases, including ticket prices, itinerary information like departure and destination airports, and passengers' numbers and airline classes. DB1B is a sample that collects 10% of all the reporting domestic airline tickets quarterly. Since we want to see whether covid-19 changed the effects of competition on price discrimination. Therefore, we select the time period from the first quarter of 2018 to the fourth quarter of 2019 as the pre-Covid period and the first quarter of 2020 to the first quarter of 2022 as the post-Covid period. We only examined the airline route between Los Angeles International Airport (LAX) to John F. Kennedy International Airport (JFK) because according to the Official Airline Guide (2021), the global travel data provider, LAX to JFK is the busiest flight route in the domestic USA market. In addition, we noticed that during covid, numerous carriers announced that they heavily cut capacity in response to the low demand, and almost about 70% of domestic airlines were suspended. However, because of both business and traveling importance of the route between Los Angeles and New York, this domestic route still operated normally after the outbreak. Also, DB1B only contains 10% data, and as a result, several

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unpopular routes could not be included. Therefore, choosing the LAX to JFK would be representative of our analysis. Besides, in order to maintain the consistency of the data, we excluded the first class and business class fare tickets, and the ticket price was less than $30. We only included the domestic and non-stop flight between Los Angeles and New York. The 10 carriers included in our study are Delta (DL), American Airlines (AA), JetBlue (B6), Alaska Airlines (AS), Hawaiian Airlines (HA), Qantas (QF), United Airlines (UA), Royal Jordanian (RJ), Iberia (IB), and Royal Air Maroc (AT).

3.1. Gini Coefficients

We measured the price inequality using the Gini coefficient of ticket prices, by following Borenstein and Rose's [5] study. The Gini coefficient serves as a measure of inequality. It is calculated by using the area above the Lorenz curve divided by the area both below and above the Lorenz curve. According to the use of Gini coefficient in price dispersion given by Borenstein and Rose, it gives twice the expected absolute difference between two prices that are drawn at random. The average Gini coefficient for the pre-Covid data is 0.22, so it suggests that the expected absolute fare difference is 44 percent of the mean ticket price for two randomly selected ticket fares. While the average Gini coefficient for the period after the outbreak is 0.23, slightly higher than the pre-Covid one. This mean number is quite like the results of 0.22 generated by Gerardi and Christopher [8], the average Gini coefficient of all domestic routes in 2006, implying that the trend of price dispersion has been fairly stable since 2006. Thus, the route between LAX to JFK is an appropriate and reasonable data sample.

3.2. Market Competition

In our model, we followed the discussion by Berry [14], using the logarithm of the number of firms operating in the route between LAX and JFK to approximate the market size and competition. When talking about the issue of market power, it's common to assume that price discrimination increases under the theory of monopoly. Since the flexibility of charging different prices to different segments of customers arises in monopolies or oligopoly's markets. Companies are able to increase the price to customers who are willing to pay more and lower the price to the marginal customers [7]. Thus, if the monopoly effect dominates the market, in our analysis, there will be a negative correlation between numbers of carriers and price dispersion. By contrast, the power of branding is another influencing determinant we need to consider. Branded companies have more controls on manipulating their products' price since they create their own market [15]. If the company's brand has a higher influence on the customers' demand and behavior than the monopoly effect, then we can expect a positive correlation between numbers of carriers and price difference. The content in Table one provide a brief summary of each year's variable statistics. From the statistics, there is a strong difference of the average ticket price before and after Covid-19, almost about $100 price difference. The average Gini coefficient stays the same in 2019 and 2021.

Table 1: Brief summary of each year's statistic.

Year	Category	Number
2018	Average numbers of carriers	6.3
	Average ticket price	505.71
	Average Gini coefficient	0.2042
	Max numbers of carriers	7
	Min numbers of carriers	6

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Table 1: (continued).

2019	Average numbers of carriers	6
	Average ticket price	578.21
	Average Gini coefficient	0.2239
	Max numbers of carriers	7
	Min numbers of carriers	5
2020 (additional information)	Average numbers of carriers	5.56
	Average ticket price	467.80
	Average Gini coefficient	0.2328
	Max numbers of carriers	6
	Min numbers of carriers	5
2021	Average numbers of carriers	6.88
	Average ticket price	455.57
	Average Gini coefficient	0.2254
	Max numbers of carriers	8
	Min numbers of carriers	6

3.3. Model Specification

We didn't follow Borenstein and Rose's model that analyzes the changes in the competition across different routes in one period. Instead, we want to perform panel analysis on the cross-sectional time-series data to see the difference in competitive composition in the air lane from LAX-JFK over two periods, one period before Covid-19 and the other after Covid-19, using a fixed-effects model. In order to control for variables that vary over time and vary over different carriers, we include carrier dummies and time dummies in our panel analysis. As Gerardi and Shapiro discussed, the Gini coefficient is limited between zero and one. Therefore, we followed their strategy to take the log-odd ratio of Gini coefficient Glogd, given by Glogd = ln(Git)/ (1 - ln(Git)), so that the number is not only limited between 0 and 1. Our dependent variable,ln Nt, is the log of the total number of carriers operating on the LAX - JFK route. It is used for measuring the market competition The model is:

$$G_{it}^{logd} = \beta_0 + \beta_1 * \ln N_t + \alpha * B_{it} + v_t + w_t + u_{it} \quad (1)$$

where i denotes a single carrier, t denotes the time period, and ln denotes the natural log. The carrier fixed effects is controlled with vt; the time invariant effects is controlled with wt; Bit denotes the dummy variables that indicates if the particular carrier is bankrupt or not in the particular quarter and the uit is the error term. In addition to use the number of carriers as the measurement of market competition, we include market share variable for robust check derived from Geradi and Shapiro's analysis [8]. We tested that market share variable is strongly correlated with the number of carriers operating on the route. Ameri- can Airline, United Airline, and Delta compose almost 50% share of the airline markets. In our sample, we have Quantas, Iberia, Royal Jordanian, and Royal Air Maroc, forign airlines operating in united states' domestic route, which only have limited market shares comparing to the dominant united states' airlines. Market share variable, ln MRKit, is calculated by the percentage of passengers operated by one carrier on the LAX - JFK route in one quarter period. The complete model is:

$$G_{it}^{logd} = \beta_0 + \beta_1 * \ln N_t + \beta_2 * \ln MRK_{it} + \alpha * B_{it} + v_t + w_t + u_{it} \quad (2)$$

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4. Empirical Results

We separately performed the panel analysis from 2018 to 2019, 8 quarters of the pre-Covid period, and from 2021 to the middle of 2022, 6 quarters post- Covid period, while excluding the 2020 year. We provide both the statistics of models with and without a robust check of market share. The results are presented in Table 2 and 3. It is shown that there is a statistically significant positive coefficient of the number of carriers at a 1-percent significance level before Covid-19. The result during the Pre-covid period is consistent with the finding by Borenstein and Rose [5]. A positive relationship between competition and price discrimination serves as evidence of the dominance of brand effect. We can interpret the result that before Covid-19, customers remain a high loyalty to the airline brands. Therefore, as the competition increases, loyal customers would still pre- fer the brand they are used to rather than choosing other airlines with lower prices offered. However, we find that after the outbreak, the coefficient of the number of carriers, ln Nt, turns into a negative sign and it is statistically significant at a 1-percent significance level. This result implies the dominance of the monopoly effect as traditional textbooks would expect, when the competition increases, the price dispersion becomes less. It's completely opposite of the finding from analyzing data from 2018-2019. The negative coefficient result coincides with the finding of Geradi and Shapiro on data from 1993 to 2006. We provide panel estimates, one without a market variable and the other includes this variable. The coefficient of ln MRKit is both statistically significant and positive at a 1 percent significance level in both periods. Subsequently, the coefficient of the number of carriers becomes slightly higher in absolute value in the complete model, resulting in a stronger correlation, but doesn't change the sign and significant level of the coefficient of the number of carriers.

Table 2: Panel estimates without MRK variable.

Period	Term	coefficient	std.error	statistic	p.value
Pre-Covid	*lnNt*	0.114380***	0.002283	50.096	0.000
Post-Covid	*lnNt*	-0.046429***	0.000899	-51.61	0.000

Table 3: Panel estimates with MRK variable.

Period	Term	coefficient	std.error	statistic	p.value
Pre-Covid	*lnNt*	0.1152***	0.0021	54.363	0.000
	lnMRKit	0.01722***	0.00019	88.2508	0.000
Post-Covid	*lnNt*	-0.04482***	0.00084	-52.8300	0.000
	lnMRKit	0.01356***	0.00018	71.8751	0.000

5. Discussion

There are a few limitations to our study. Our exploration of the relationship between price discrimination and competition is not exhaustive. We focus only on one specific route from the busiest US route, LAX-JFK. Though we discuss in the previous section that the route is quite representative of big metropolitan routes, it is impossible to generalize to the whole US airline industry. Also, the limited open data source hinders the completeness of our study. The DB1B data only contains 10% of the ticket prices of whole domestic US airlines. It doesn't include other information that helps us identify price discrimination such as the ticket date, the channel to buy the

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recorded tickets, flight numbers, and so on. Therefore, we are only able to measure the overall competitiveness and market share of carriers without determining the specific pricing strategies airlines use. Besides, we don't take the peak loading pricing into account because of the un- certainty of demand and the limitation of data. The peak loading pricing could also affect our estimations of the coefficients. In Borenstein and Rose's study [5], they examined the question of peak-load pricing. However, they still encountered the problem of direct control for stochastic peak loading pricing. Therefore, our study about price discrimination and market competition needs further examination and investigation to determine if we are able to generalize the results to the whole airline industry. An extended and rigorous model following the studies provided by Borenstein and Rose [5], and Hayes and Ross [12] is possible guidance for our future work.

6. Conclusion

In this study, instead of using the cross-sectional analysis given by Borenstein and Rose [5], we use panel regression which removes the carrier-specific fixed effect and time-invariant effect. We use the data on the flight route between LAX and JFK from two time periods, one before and one after Covid-19, this study finds that during the pre-Covid period, as the degree of market competition gets higher, the price discrimination also increases. We further interpret the result as a brand effect, while during the post-Covid period, the results show a negative correlation between market competition and price discrimination, interpreted as a monopoly effect. This enables us to see the impact of Covid-19 on Air- line industry. The significant sign change of the estimated coefficient in the two time periods can be rationalized by the outbreak of Covid-19. The pandemic brings the whole world's economy into recession. When the economic downturn hit, people are not willing to spend extra money on daily expenses and luxury goods. The decline in average ticket prices also reflects the damage to the airline industry brought by the recession. In addition, we notice that large increase of work from home jobs and popularity of using online communication platform for business purposes. As a result, the business travelers dramatically decrease even though most industries are gradually recovering. As we discuss before, the business travelers are the main crowds who hold high brand loyalty and the loss of these customers not only hit the airline demands but also gives companies less incentive to price discriminate based on brand preference. Especially, LAX- JFK is one of the busiest metropolitan routes that contain both large numbers of business and leisure travellers. That's possibly why the brand effect diminishes after Covid and monopoly effect starts to dominate the market in this particular route. The empirical results imply that the theories of price discrimination are conditional on certain circumstances. Using a traditional textbook explanation of the relationship between price discrimination and competition may not be sufficient or accurate in the real-world industry.

References

[1] *S. Colombo, "Discriminatory prices and the prisoner dilemma problem,"*
[2] *Annals of Regional Science - ANN REG SCI, vol. 46, pp. 397–416, 04 2011.*
[3] *K. S. Corts, "Third-degree price discrimination in oligopoly: All- out competition and strategic commitment," The RAND Journal of Economics, vol. 29, no. 2, pp. 306–323, 1998. [Online]. Available: http://www.jstor.org/stable/2555890*
[4] *L. A. Stole, "Chapter 34 price discrimination and competition," ser. Hand- book of Industrial Organization, M. Armstrong and R. Porter, Eds. Else- vier, 2007, vol. 3, pp. 2221–2299.*
[5] *A. Chandra and M. Lederman, "Revisiting the relationship between com- petition and price discrimination," American Economic Journal: Microeco- nomics, vol. 10, no. 2, pp. 190–224, May 2018.*
[6] *S. Borenstein and N. Rose, "Competition and price dispersion in the u.s. airline industry," Journal of Political Economy, vol. 102, pp. 653–83, Aug. 1994.*

DOI: 10.54254/2754-1169/15/20230862

[7] S. Borenstein, "Price discrimination in free-entry markets," The RAND Journal of Economics, vol. 16, no. 3, pp. 380–397, 1985.

[8] H. R. Varian, "Chapter 10 price discrimination," Handbook of Industrial Organization, vol. 1, no. 7, pp. 597–654, 1989.

[9] K. Gerardi and A. Shapiro, "Does competition reduce price disper- sion? new evidence from the airline industry," Journal of Political Economy, vol. 117, no. 1, pp. 1–37, 2009. [Online]. Available: http://www.jstor.org/stable/10.1086/597328

[10] K. L. Combs, "Shapiro, carl and hal r. varian (1998). information rules: A strategic guide to the network economy," The Journal of Technology Transfer, vol. 25, pp. 250–252, 2000.

[11] F. Steen and L. Sørgard, "Price discrimination in the airline industry," 2004.

[12] S. M. Nako, "Frequent flyer programs and business travel," 1992. [Online].

[13] Available: https://repository.upenn.edu/dissertations/AAI9308634

[14] K. J. Hayes and L. B. Ross, "Is airline price dispersion the result of careful planning or competitive forces?" Review of Industrial Organization, vol. 13, no. 5, pp. 523–541, 1998. [Online]. Available: http://www.jstor.org/stable/41798821

[15] I. Zotova and P. Yu, "Impact of covid-19 on airline pricing," 2021.

[16] S. T. Berry, "Estimation of a model of entry in the airline industry," Econo- metrica, vol. 60, no. 4, pp. 889–917, 1992.

[17] C.Finkle. (2019) The power of branding. [On- line]. Available: https://brandmarketingblog.com/articles/branding- definitions/power-of-branding/ Accessed: 2022-07-26