Research on the Development of the Aviation Market in the Multi-Airport System Under the Pandemic

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Abstract: With the outbreak of the Covid-19 pandemic, aviation hubs around the world have been severely impacted. After nearly three years of repeated pandemic outbreaks, the recovery of multiple aviation markets in one city has shown different characteristics. This paper analyzes and evaluates the hub competitiveness of the multi-airport systems in London, New York, and Beijing under the impact of the pandemic by establishing a data model, summarizes the recovery law of international aviation hubs, and puts forward measures and suggestions for the future development of international hub aviation market.

Keywords: Pandemic; Aviation Hub; Multi-Airport System; Market Recovery

1. Introduction

Since the outbreak of the Covid-19 pandemic at the end of 2019, the international aviation market has been greatly impacted, and the multi-airport system represented by London, New York, and Beijing has been affected to varying degrees. Comparing the data in 2019 and 2021, these typical airport groups show different characteristics and recovery trends. This paper intends to establish a data analysis model from the changes in passenger volume, cargo and mail volume, international share, transit share, and main base airlines to evaluate changes in the competitiveness of international aviation hubs, and to sort out the law of hub airport recovery. This paper intends to establish a data analysis model from the changes in passenger volume, cargo and mail volume, international share, transit share, and main base airlines to evaluate changes in the competitiveness of international aviation hubs, and to sort out the law of hub airport recovery. It proposes countermeasures and suggestions for the development of international aviation hubs in the future under the continued impact of the pandemic, so as to promote gradual recovery and sustainable development of the global civil aviation airport industry.

2. Methodology

2.1 Research and Analysis Implementation Path

Hub Airport Competitiveness Evaluation System

Picture 1 Research Roadmap

2.2 AHP Analytic Hierarchy Process and Expert Score

The method of combining AHP analysis hierarchy process and expert scoring is used to determine the weight of the evaluation index of the competitiveness of the hub airport. Analytic Hierarchy Process is a systematic and hierarchical decision analysis method to decide the relative importance or priorities, while the expert scoring method is to judge the importance of the elements in the matrix based on the experts' professional knowledge and experience. Therefore, AHP and expert scoring method is a combination of objective and subjective methods.

3. Data Analysis and Modeling

3.1 Overview of London, New York, and Beijing Airport Groups

The London airport group mainly includes Heathrow Airport (LHR), Gatwick Airport (LGW), and Stansted Airport (STN). In 2019, the number of passengers was 80.89 million, 46.58 million and 28.14 million respectively. Heathrow Airport is 22 kilometers from central London, Gatwick Airport is 52 kilometers south of central London, and Stansted Airport is 48 kilometers northeast of central London.

The New York airport group mainly includes JFK International Airport (JFK), Newark International Airport (EWR), LaGuardia Airport (LGA), and the throughput in 2019 was 62.55 million, 46.34 million and 31.08 million respectively. JFK International Airport is located in the southeast of Queens, New York City, 29 kilometers away from the city center; Newark International Airport is located in New Jersey, about 29 kilometers away from the center of New York City; LaGuardia Airport is located in Queens, north of Long Island, New York, 15 kilometers from the city center.

The Beijing airport group mainly includes Capital International Airport (PEK) and Daxing International Airport (PKX). In 2019, the passenger throughputs were 100.01 million and 3.14 million respectively. Daxing International Airport was put into operation in September 2019, with a planned target passenger volume of 45 million in 2021 and 72 million in 2025. Capital International Airport is located in Shunyi District, northeast of Beijing, 25 kilometers away from the city center; Daxing International Airport is located in Daxing District, south of Beijing, 46 kilometers away from the city center.

Table 1 Basic overview of the three major airport clusters

City	Airport	Position	2019 [10,000 people]	Major Airlines
London	LHR	Hub airport and international gateway	8089	British Airways
	LGW	OD airport mainly	4658	British AirwaysEasyJet
	STN	Low cost airport	2814	EasyJetRyanar
New York	JFK	Hub airport and international gateway	6255	Delta Airlines JetBlue Airways
	EWR	Hub airport and international gateway	4633	United Airlines
	LGA	OD short-haul businessairport	3108	Delta Airlines American Airlines
Beijing	PEK	Large international hub	10001	Air China Hainan Airlines
	PKX	Large international hub	314	China SouthernAirlines Eastern AirlinesChina United Airlines

3.2 Competitiveness evaluation system of hub airports

By sorting out and defining the characteristics and concepts of international hubs, combined with the factors that industry organizations measure airport hub capabilities, and taking into account airport connectivity, operation scale, network structure, and airline collaboration, a hub airport competitiveness evaluation system is established. The first-level indicators are divided into two categories: hub scale indicators and hub structure indicators. The scale indicators are divided into two categories: business scale and

route scale.

Specifically, three indicators are used to evaluate passenger throughput, cargo and mail throughput, and number of navigation points. Structural indicators are divided into two categories: international access and hub cooperation, which are specifically evaluated by the share of international passengers, the proportion of transit passengers, and the share of base airlines.

Through the AHP analysis hierarchy process and expert scoring method, the weight of each index is determined, and the evaluation and scoring are carried out after date are collected. By comparing the values in 2019 with the values in 2021, we can judge the degree of recovery of the hub airport after the pandemic, analyze the recovery path of the multi-airport system under the pandemic, and explore the development direction of the hub airport in the post-pandemic era.

Table 2 Competitiveness evaluation system of hub airports

Level I indicator	Level II indicator	Level III indicators (6)	Weight
Scale index	Business scale	Passenger throughput	0.2
		Cargo and mail throughput	0.2
	Route scale	Number of navigation points	0.2
Structural index	International access	Share of international passengers	0.15
	Hub cooperation	Proportion of transit passengers	0.15
		Share of base airlines	0.1

3.3 Data collection and collation

Obtain the operation index data of hub airports through multiple industry platforms to ensure a unified data caliber. Obtain passenger throughput, cargo and mail throughput, and international passenger volume data through the ACI annual report, obtain route point data and main base airline share data through the OAG platform, and obtain the proportion of transit passengers through the IATA platform.

Data comparability processing: Considering the large gap between the land areas of the UK, the US and China, London airport will be significantly higher than New York and Beijing airports in terms of international passenger share. Therefore, many London airports choose intercontinental passenger share instead of international passenger share, making the data of the three airport groups more comparable.

Table 3 London Airport Cluster 2019 and 2021 Operational Data Sheet

Year	**2019**			**2021**		
Index	LHR	LGW	STN	LHR	LGW	STN
Passenger throughput (10,000 people)	8,089	4,658	2,814	1,939	626	714
Cargo and mail throughput (10,000 tons)	167	12	24	140	1	27
Year	**2019**			**2021**		
Number ofwaypoins	222	259	207	228	183	188
International (Intercontinental) Passenger Share	94%（43%）	93%（20%）	94%（3%）	91%（39%）	80%（14%）	0%
The proportionof transit passengers	23%	4%	0%	15%	1%	0%
First AirlineShare	50%	44%	72%	48%	59%	80%

First Airline	BA	U2（EasyJet）	FR（Ryanair）	BA	U2	FR

Table 4 New York Airport Cluster 2019 and 2021 Operational Data Sheet

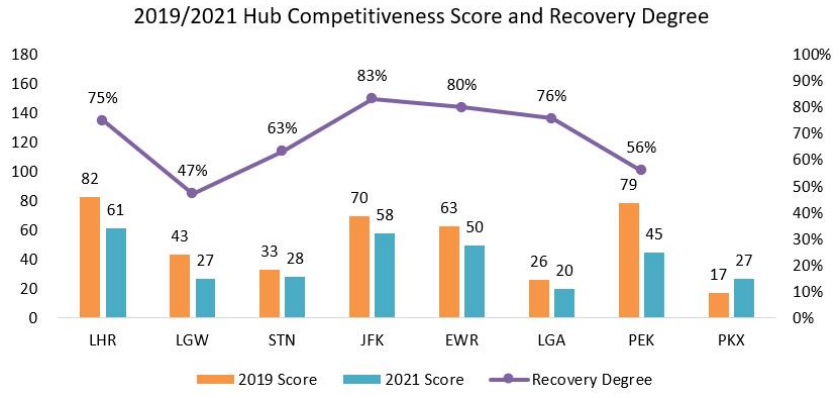
Year	2019			2021		
Index	JFK	EWR	LGA	JFK	EWR	LGA
Passenger throughput (10,000 people)	6,255	4,634	3,108	3,098	2,916	1,566
Cargo and mail throughput (10,000 tons)	131	81	1	150	84	1
Number of waypoints	202	214	89	179	178	89
International (Intercontinental) Passenger Share	55%	31%	7%	42%	23%	2%
The proportion of transit passengers	15%	19%	9%	11%	12%	6%
First Airline Share	36%	70%	45%	37%	66%	47%
First Airline	DL	UA	DL	DL	UA	DL

Table 5 Operating data sheet for two games in Beijing in 2019 and 2021

Year	2019		2021	
Index	PEK	PKX	PEK	PKX
Passenger throughput (10,000 people)	10,001	314	3,264	2,505
Cargo and mail throughput (10,000 tons)	196	1	140	19
Number of waypoints	275	107	182	141
International (Intercontinental)Passenger Share	24%	3%	1%	0%
The proportion of transit passengers	11%	3%	4%	8%
Year	2019		2021	
First Airline Share	41%	47%	61%	36%
First Airline	CA	KN	CA	CZ

3.4 Data processing results

According to the data model calculation, among the three multi-airport system research objects, the top four airports in terms of hub competitiveness in 2019 are Heathrow Airport, Capital International Airport, JFK Airport, and Newark Airport, and the top four airports in terms of hub competitiveness in 2021 are Heathrow Airport, JFK Airport, Newark Airport, and Capital International Airport. In terms of the degree of recovery of hubs, the degree of recovery of American airports is relatively high, and the degree of recovery of JFK Airport, Newark Airport, and LaGuardia Airport ranks in the top three, reaching 83%, 80%, and 76% of the degree of recovery, the degree of recovery at London Airport is second, the recovery of the Capital International Airport is low.



Picture 2 Comparison chart of hub competitiveness evaluation results

3.5 Analysis of the impact of the pandemic on the multi-airport aviation market

3.5.1 The overall division of labor and positioning of multiple airports has not been fundamentally reversed

The London airport group has basically formed a multi-airport system with Heathrow Airport as the international hub, Gatwick Airport as the international gateway, and Stansted Airport as the low-cost auxiliary support. The New York airport cluster has two core airports, JFK and Newark Airport, as the international aviation hubs, and LaGuardia Airport as the domestic aviation hub. Each airport has formed a market development pattern with reasonable positioning and clear division of labor, which is mainly reflected in dislocation operation and complementary advantages. Different airports have their own emphasis on the route network market. Each airport has its own independent operating market, and the overlapping markets also maintain their respective advantageous areas, effectively avoiding excessive competition.

The overall division of labor and positioning before and after the pandemic has not been fundamentally reversed. London Heathrow Airport mainly operates in the international aviation market, and the share of international flights before and after the pandemic is basically stable at around 90%, the share of intercontinental flights is basically stable at around 40%; the share of international flights at JFK and Newark Airport in New York remains at around 50%-30%, and the overall division of labor at major airports has not changed significantly compared with before the pandemic.

3.5.2 The recovery speed of the main base airlines plays a leading role in the overall recovery level

After the pandemic, airlines tend to give priority to resuming flights at the main base airport. For example, in the London airport group, the recovery rate of British Airways' main base Heathrow Airport is 34%, while the recovery rate at Gatwick Airport is only 4%; the recovery rate of EasyJet's flights at Gatwick Airport is about 27%, significantly higher than Stansted Airport's 17%. Among London airport clusters, low-cost airlines Ryanair and EasyJet tend to have relatively high levels of flight recovery.

The share of airlines at Newark Airport in New York is highly concentrated. The main base airline is United Airlines, and the London Heathrow British Airways has more than half of the flights. The degree of recovery of United Airlines and British Airways basically determines the overall recovery level of the airport.

3.5.3 The US and UK international markets have recovered to a relatively high degree, while the recovery of China's international routes lags behind.

During the pandemic, affected by the different border policies of different countries, the recovery degree of the international market of different airports showed great differences. In 2021, the international market structure of hub airports in the London and New York airport clusters will recover as much as 70%-90%, much higher than the 4% recovery rate of Beijing Airport. In the recovery of the international market, short-haul routes with close economic and trade relations generally recover faster, and intercontinental routes lag behind. The share of international passengers at London Heathrow Airport dropped by about 3 percentage points, the share of intercontinental passengers dropped by about 4 percentage points, the share of international flights at major New York airports dropped by about 10 percentage points, and the share of international passengers at Capital International Airport dropped by as much as 23 percentage points.

3.5.4 The "dual hubs" in Beijing have not yet formed a scale, and the development direction of the market hubs will be adjusted in stages during the pandemic

Under the influence of the pandemic, Daxing Airport, which opened in September 2019, suffered a freefall before reaching a certain scale. Affected by Beijing's border policy, from 2020 to 2021, Beijing will focus on the development of the domestic market, focusing on the construction of domestic express lines and the construction of domestic inter-airline transfers, and actively carry out

domestic route network optimization and adjustment. During the pandemic, affected by the restrictions on international flights, the development direction of the two international hubs in Beijing has been adjusted from international to domestic.

4. Conclusion

4.1 The aviation market should focus on the development of structural diversity to improve resilience against risks

During the development of aviation hubs and the operation of the multi-airport system, passenger and cargo, domestic and international, transit and non-stop, have become the choices for differentiated positioning. The functional positioning and route network layout of different airports directly affect the resilience against market changes during the pandemic. In the post-pandemic era, the freight market has timely filled the lack of accessibility in the passenger market. The general recovery trend of the civil aviation passenger market is from domestic to international, from short to long distances, and from near to far economic and political relations. In the recovery process of intercontinental routes, hub airlines will play an important role; in the recovery process of short-haul international routes, low-cost airlines will have a relative competitive advantage.

Under the circumstances of repeated pandemic breakouts and uncertain border policies of various countries, the recovery process of aviation hubs may have twists and turns and face greater uncertainty. In order to better enhance the resilience of large airports to deal with global risks, the development of the aviation market should pay more attention to the development of structural diversity, and implement the development strategy of simultaneous passenger and cargo development, balanced domestic and international development, and direct and transit networks.

4.2 The hub airports should strengthen the strategic synergy with the main base airlines to enhance the competitiveness of the hubs

The operation and recovery of airlines is crucial to the overall development of the civil aviation industry. Under the pandemic, airline network changes and market recovery of various airports are mainly driven by airlines, while airlines are more inclined to concentrate limited resources on the main base airport. During the two-year period when the covid-19 pandemic raged around the world, in the case of shrinking business volume and vacant assets, the financial performance of airlines continued to suffer losses or limited improvement, and faced the pressure of survival and development. Many airlines have made adjustments to actively save themselves, optimized the fleet structure, and sought financial support. When the market demand is relatively limited, airlines are more inclined to concentrate resources on base airports to produce scale effect.

When the pandemic rebounds in some areas, airlines can quickly respond to market changes and deploy transport capacity in a timely manner to minimize losses. Under the market regulation mechanism, the layout of the airport route network mainly depends on the airlines. Therefore, the airports should pay more attention to the market strategy of the base airlines and strengthen the close cooperation with the airlines that fit into their strategic goals.

4.3 At different stages of market recovery, airports should formulate flexible adjustment plans for development strategies

In the post-pandemic era, the passenger transport market is characterized by the gradual recovery and adjustment of domestic, short-haul international and intercontinental routes, and the development of passenger and cargo is complementary and mutually beneficial. The increasingly diversified and personalized travel demands of passengers, the continuous upgrading of the consumption structure, and the flexible adjustment of the development strategy in stages will be an important opportunity to achieve the market recovery and development. From the perspective of the "14th Five-Year Plan" of civil aviation, based on the strategic basis of domestic aviation demand, differentiated market segments such as boutique express lines, red tourism, sinking markets, elderly markets, and low-cost airlines have great potential for deep cultivation. Under the new normal, there are many uncertainties in the civil aviation market, which requires all airlines to be innovative, follow national strategies, differentiate the market, stimulate market vitality with high-quality and diversified service products, and formulate flexible adjustment plans for different market recovery stages, so as to

promote the steady recovery and sustainable development of the civil aviation industry.

4.4 Under the "one city, multiple airports system", we should promote multi-airport synergy and complementary advantages through differentiated market positioning

In a multi-airport system, different airports need to have different divisions of labor and differentiated market positioning, so as to effectively distinguish the target passenger group and the target airline market, and promote synergy and complementary advantages between airports. On the one hand, the types of major airlines operated by each airport are different, and there are differences in operations such as hub-based full-service airlines and point-to-point low-cost airlines; on the other hand, a relatively independent airline market is formed, with only limited overlap and a market that maintains their respective comparative advantages. In addition, it is necessary to reflect the characteristics of different airports through the differences in airline or airport service prices and service products, so as to provide passengers with a variety of experiences. Through differentiated positioning, fierce direct competition can be reduced, and the overall competitiveness of the multi- airport system can be better improved, thereby promoting the stable and orderly development of the industry.

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