

The impact of direct air transportation link cross Taiwan Strait on air passengers transportation of China mainland, Taiwan, Hong Kong and Macao

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Abstract

With the trend of global trade to be an integral whole, the requirement of economic development and the change of political situation between China mainland and Taiwan, the air transportation cross the Taiwan Strait will be open gradually. The opportunities and challenges have been taken by the adjustment of cross-strait air transport policy and the realization of the normalization of air transportation.

Taken air passengers transportation as an example, firstly, this paper reviews the history of cross-strait air transportation and the operation under the cross-strait air transport policy in each period. Secondly, due to the change of cross-strait air passenger transport flow influences on the air transportation cost of relevant carriers and the throughput of relevant airports, we analyze the impact of the cross-Straits direct air transportation links on airlines and airports of not only China mainland and Taiwan, but also Hong Kong & Macao, the previous transit airports. Finally, due to the particularity and significance of the cross-strait air transport policy for the market, we introduce a dummy variable to explain it and to analyze its impact on the air transportation in different periods quantitatively.

Keywords: direct air transportation link; air passenger transportation; air passenger traffic demand

1 Introduction

The air transportation between China mainland and Taiwan had been banned over half a century, which due to some political and historical reasons. However, with the trend of global trade to be an integral whole, the requirement of economic development and the change of political situation between China mainland and Taiwan, the air transportation cross the Taiwan Strait will be open gradually. The managers and operators of air transportation for each side of strait should make production planning to satisfy the demand of air transport market, subject to avoiding extravagance of excess supply.

The opportunities and challenges have been taken by the adjustment of cross-strait air transport policy and the realization of the normalization of air transportation. Up to now, 27 airports and 8 airports have been opened respectively for each side of the strait for passenger air transportation. Therefore, it's necessary to analyze the air passenger transport market demand for the managers and operators to make plan for airline schedule and capacity arrangement in each periods with different degree of open air transportation policy. While, with the open of direct routes linking the China mainland and Taiwan and regular air flights for the normalization of air transport operations, more and more attentions have been paid to the study on the market demand of cross-strait air transport.

Taken air passengers transportation as an example, firstly, this paper reviews the history of cross-strait air transportation and the operation under the cross-strait air transport policy in each period. Secondly, due to the change of cross-strait air passenger transport flow influences on the air transportation cost of relevant carriers and the throughput of relevant airports, we analyze the impact of the cross-Straits direct air transportation links on airlines and airports of not only China mainland and Taiwan, but also Hong Kong and Macao, the previous transit airports. Finally, due to the particularity and significance of the cross-strait air transport policy for the market, we introduce a dummy variable to explain it and to analyze its impact on the air transportation in different periods quantitatively.

2 Background

Across the Taiwan Strait, China mainland and Taiwan own the same history, language and cultural background, but different economic system and social environment. Due to the politics divergence and history reason, the air transport had been banned for more than half a century. However, with the trend of global trade to be an integral whole, the requirement of economic development and the change of political situation between China mainland and Taiwan, the air transportation cross the Taiwan Strait will be open gradually.

The route has been changed with direct air transportation link cross Taiwan Strait (Figure 1). It's not necessary to make the round of Hong Kong or Macao for the airplanes cross the straits, however, to fly straightly from the airports of mainland to that of Taiwan. While, the flight delivery process of civil air control authority can be interchanged directly.



Figure 1-The illustration of routes before and after change

The process of air transportation cross the Taiwan Strait open can be concluded as follows:

a. ———Feb. 2003: Before connected

In this period, the air transport had been banned, and the passengers and cargo had to transfer in Hong Kong airport or Macao airport.

In Oct. 27th 2002, the chairman of ‘Association of Taiwan Businessmen in China’ and celebrities suggested charter flights directly in spring festival in 2003 for Taiwan businessmen who had invested in mainland. In Oct. 30th, the response of Taiwan Affairs Office of mainland said it was willing to take active measures to achieve, and the airlines in mainland hoped to participate, according to the principle of equality and mutual benefit.

b. Feb. 2003——June 2006: Spring Festival charter flights

With the effort of both sides, the first Spring Festival charter flights (16 flights) were achieved in 2003, but only by 6 Taiwan airlines for Taiwan businessmen with one way flights, only Shanghai airport of Mainland, and had to make the round of Hong Kong airport or Macao airport with no pick-up and drop-off.

However, the first Spring Festival charter flights in 2004 had not been achieved, due to some political reasons.

In 2005, the second Spring Festival charter flights (48 flights) were achieved, with no stop in Hong Kong airport or Macao airport. The Beijing airport and Guangzhou airport of mainland were added besides Shanghai airport. The second Spring Festival charter flights carried only with Taiwan businessmen and their relatives. It was the first time for airplanes of mainland to fly to Taiwan.

In 2006, the Spring Festival charter flights (72 flights) were achieved, with each 6 airlines of each side of the strait for both directions, and round of Hong Kong flight information region.

c. June 2006——July 2008: Traditional Festivals charter flights

In June.14th 2006, the technical and professional agreement of traditional festivals charter flights was achieved. The charter flights were extended from spring

festival to Chinese traditional festivals (Tomb-sweeping Day, Dragon-boat Festival, Mid-Autumn Festival, Spring Festival), which was planned to fly 96 flights for Spring Festival, 24 flights for the other festivals, in total 168 flights.

From Sep.29th to Oct.8th in 2006, the first Mid-Autumn Festival charter flights (24 flights) were achieved, with 6 airlines of each side of the strait for both directions.

Before and after 14 days of Spring Festival in 2007, the 4th Spring Festival charter flights (96flight) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung.

Before and after 7 days of Tomb-sweeping Day in 2007, the first Tomb-sweeping Day charter flights (42flights, 7000trips) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung by 11 airlines in total.

From Jun.12th to 28th in 2007, the first Dragon-boat Festival charter flights (42flights) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung by 11 airlines in total.

From Sep.18th to Oct. 2nd in 2007, the first Mid-Autumn Festival charter flights (48flights) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airport of Taipei by 12 airlines in total.

From Feb.2nd to 6th and 11th to 15th in 2008, the 5th Spring Festival charter flights (94flights) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung by 12 airlines in total.

From Apr.2nd to 8th in 2008, the 2nd Tomb-sweeping Day charter flights (38flights) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung by 11 airlines in total.

From Apr.2nd to 8th in 2008, the 2nd Dragon-boat Festival charter flights (38flights) were achieved, with the airports of Beijing, Shanghai, Guangzhou and Xiamen in mainland and the airports of Taipei and Kaohsiung by 11 airlines in total.

From Sep.7nd to 21st in 2008, the 3rd Mid-Autumn Festival charter flights (32flights) were achieved, with the airports of Shanghai and Xiamen in mainland and the airport of Taipei by 8 airlines in total.

d. July 2008—Dec. 2008: Weekends charter flights

In 2008, the situation of cross strait has changed. In June 13th, Association for Relations across the Taiwan Strait and Strait Exchange Foundation signed <The Summary of Charter Flight for Taiwan Strait>, which discussed and decided that the time for charter flight is from Friday to next Monday (4 days for a week in total), and would be executed since July 4th in 2008.

In mainland, the airports of Beijing, Shanghai, Guangzhou, Xiamen and Nanjing were available, and Chengdu, Chongqing, Hangzhou, Dalian, Guilin Shenzhen and so on would be available according to the market demand. 8 airports of Taoyuan, Kaohsiung, Taichung and Songshan etc were available in Taiwan.

It was agreed to execute 36 charter flights at the beginning of Weekends Charter Flights and would be added according to the market demand, in which, less than 9 charter flights between Taiwan and Shanghai (PVG) and less than 6 charter flights between mainland and Taichung.

e. Dec. 2008—Aug. 2009: Normalizing Chart Flights

In Nov. 4th 2008, Association for Relations across the Taiwan Strait and Strait Exchange Foundation signed <The agreement of air transport for Taiwan Strait>, in which the north air route between mainland and Taiwan was opened. It has been the first time for air traffic control officers to exchange directly for 60 years.

In air passenger transportation of Taiwan Strait, 16 airports of Chengdu, Chongqing, Hangzhou, Dalian etc were added in mainland. It was agreed to execute less than 54 charter flights in a week, in which less than 20 charter flights between Taiwan and Shanghai (PVG). The flight plan would be adjusted according to the market demand.

f. Sep. 2009—Now : Scheduled Flights

In Apr. 26th 2009, Association for Relations across the Taiwan Strait and Strait Exchange Foundation signed <The supplementary agreement of air transport for Taiwan Strait>, in which both sides of airlines can operated Scheduled Flights or Charter Flights between 27 airports in mainland and Taiwan.

In air passenger transportation of Taiwan Strait, in mainland, 6 airports of Hefei, Herbing, Nanchang and etc is added, and 136 scheduled flights are executed in a week by 9 airlines; in Taiwan, the airports of Taoyuan and Kaohsiung are selected from 8 airports opened to air transport of Taiwan Strait, and 107 scheduled flights are executed in a week by 5 airlines, while, 28 normalizing chart flights are executed in a week in the 6 other airports. It is more convenient for air travel passengers of Taiwan Strait from scheduled flights.

3. Economical Analysis – Impact Analysis

The foreseeable realization of the normalization of cross-strait air transportation and Cross-strait trade and cultural exchanges more convenient, these will promote cross-strait passenger air service and Hong Kong and Macao's role as a gateway and a bridge played cross-strait air transport will be gradually diluted. On the one hand, cross-strait direct transportation can save time and reduce business costs and improve competitiveness of enterprises; on the other hand, with the changes in transportation routes and reduce of transportation policies restrictions, passenger traffic and cargo flow will grow rapidly in short time. Therefore, the cross-strait direct flights brings new opportunities and challenges of air transport managers, airlines and airports.

3.1 The impact of cross-strait direct flights on the airlines

Survey shows that the mainland - Taiwan passenger flights are mainly composed by three parts, the first of those who invest or do business, which in 2008 flew to mainland China for the purpose of doing business has reached nearly 100 million people, the second is for visiting friends and relatives and the third for the purpose of tourism.

Implementation of the policy of cross-strait direct flights on the mainland and Taiwan is a great opportunity for development. The most direct effect is to reduce the cost of airline transportation. Avoiding transfer process and the flight time savings are two major factors which change cost of cross-strait transportation. These factors will reduce consumption of aviation fuel, reduce aircraft taking off and landing cost and

increase aircraft utilization ratio. As a result, the cross-strait direct flights will save air transport costs of airlines, thereby accelerating the flow rate of business capital and improve the competitiveness of airlines. Moreover, with the deepening of cross-strait direct shipping policies, large number of potential passengers and cargo will gradually emerge; this will promote the growth of airline traffic.

The impact of cross-strait direct flights, first of all, to the China mainland's airlines, mainland China - Taiwan route will be one of the largest and most profitable air routes. From the point of route distribution in China mainland, due to currently residing in the mainland, more than one-third of the people of Taiwan live in the Jiangsu and Shanghai, about a quarter live in the Pearl River Delta region, in addition to some live in the Fujian Province, so airlines operating these routes within the region will benefit directly and obviously.

Second, the impact of the cross-strait direct flights for the airlines in Taiwan, Taiwan's air transport is mainly in the international route, domestic transport business volume are relatively small due to the impact of small islands and mountains. In recent years, due to Taiwan's economic downturn, and the development of highways and high-speed railway, the majority of airport traffic continuous decline, the airports and airlines face many difficulties. From 2001 to 2006, passenger flights suffered average 6.5% annual reduction. In early 2007, the opening of the Taiwan High Speed Rail, which is fatal blow to the Taiwan airlines. From January to October 2007, the air passenger traffic decreased by 25% comparing with the same period of last year, especially in Taiwan's western route reductions as high as 49.6%. For airlines, is increasingly difficult to survive, the implementation of cross-strait direct policy can effectively alleviate the traffic declining status.

Finally, the impact of the cross-strait direct flights on the Hong Kong and Macao airlines, the cross-strait routes is developing, mainland-Hong Kong and Macao routes and Hong Kong and Macao to Taiwan routes, the traffic loss is sharpen, this also means that airlines in Hong Kong and Macao must seek new traffic growth against their own development planning and network and service advantage. It should be aware that part of Hong Kong and Macao are part of the airline's shares of mainland

Airlines, these airlines suffer less.

With the process of realization of cross-strait direct transportation, the airlines in the three places (mainland, Taiwan, Hong Kong and Macao) will continue to adjust the route network structure driven by the aim of maximum benefits. A large number of air transport literature has been derived that through the development of air transportation network, after the early stage of development when the initial route network is point to point, the air network will grows to become a "dog bone" type of hub-spoke, as shown in below Figure 2(a) and (b). In addition, the airline would continuously adjust the capacity allocation of resources, based on the new market conditions under cross-strait direct flights policy, improve operational efficiency under alliance strategy.

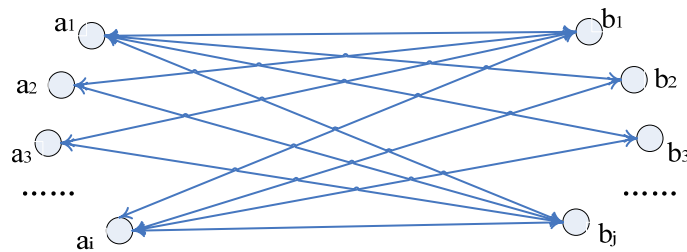


Figure 2 (a)-The point to point air network



Figure 2 (b)-The "dog-bone" type of hub-spoke air network

3.2 The impact of cross-strait direct flights to the airport

Implementation of the policy of cross-strait direct flights on the mainland and Taiwan in terms of the relevant airport, is a great opportunity for development. The most direct effect is the growth of throughput and increase of utilization ratio.

First of all, the mainland airports which were selected for the direct cross-strait direct flights destinations; have new growth point brought by the policy. Among them, the most benefits are Xiamen Gaoqi International Airport and Guangzhou Baiyun

Airport, relevant research institute expected an increase of 25% and 15% throughput of the two airport respective brought by the direct flights policy. In addition, some mainland airports which have geographical advantage under direct flights policy, can make use of opportunities for cross-strait direct flights, and continuously adjust the route network structure, speed up the process of building Asia hub airport and the regional hub airport.

Second, the direct flights policy brings more impact to the Taiwan's airports. Taiwan's Airports possess good geographical advantage and has always been considered ideal for the development of air transport nodes. According to statistics, in Asia, including Shanghai, Taipei, Seoul, Tokyo, Hong Kong, Manila, Singapore, Sydney, Wellington, it is 2 hours and 55 minutes in average to fly from Taipei airport to the other eight, the average time is the shortest amongst these airports, which means that the Taipei Airport has the geographical advantage to become a transfer metropolis. The Taiwan's airport has been brilliant achievements; however, due to impact of Taiwan's economic and social development, Taiwan's airport is faced with two of the following dilemma:

On the one hand, the throughput of the Taiwan's airport is in the stage of downward trend, and most of the airport face difficulties in operation. From the airport's air traffic volume, only Taoyuan, Taipei, Kaohsiung and Magong can reach average daily movements more than 100 airplanes; Pingtung, Green Island, Orchid Island, Wangan, Nanami Matsu Beigan and the Hengchun are lower than 10 airplanes, there is insufficient air traffic, and airport facilities idle seriously. Taoyuan airport as Taiwan's largest airport, its performance is poor. In order to promote the development of Taoyuan airport, the local government in recent years, proposed the "Taoyuan International Airport special regulations," the aim of this regulation is to give Taoyuan a high degree of professional autonomy and management, to promote local economic and social development, so that to further enhance its position of Asia-Pacific major airports. In 2006 Taiwan has 18 civil airports, only Taoyuan and Kaohsiung Songshan made profits and the remaining 15 airports are suffering losses, and the amount of loss is high. Of course, the purpose of construction of some airport does not for the traffic

demand, but because of the pressure of local elected officials, local governments hope that the opening of the airport was honored as their performance. In this circumstance, the throughput can not satisfy minimum operational threshold, as a result, the managements face many difficulties.

On the other hand, air route is suffering fierce competition with highway and high-speed rail. In 1997, Taiwan flight reached its peak (37.39 million person-trips), followed, due to the recession of economy, especially with the rapid improvement of highway system and high-speed rail system, as a result, in 2006, when the air traffic in Taiwan decreased to 17.36 million person-trips. The opening of high-speed railway in 2007 led to more pronounced decline in Taiwan's air travel, Taipei - Taichung and Taipei - Chiayi flights have been suspended, as compared with the peak in 1997, the island's airline passenger traffic suffered a recession of 65%.

The cross-strait direct flights brings new opportunity to Taiwan's airports, it brings benefits not only shorten the travel time and lower flight costs, but more important, it will promote connection of cross-strait economic and trade, especially mainland China Tourists can travel to Taiwan directly, this will benefit rapid development of Taiwan's tourism industry, as a result, promote Taiwan's development of the airport. To achieve cross-strait direct flights has great significance on expanding the scope of the Taiwan airport radiation, attracting more air passenger traffic and improving the airport's financial situation.

After the direct flights, from the view of passenger flow generation mechanism, the mainland - Taiwan's throughout consist of original transfer and the new traffic induced thereby. Newborn induced will directly enhance the throughput of the airport in Taiwan. From the view of purpose of passenger traveling, due to Taiwan and mainland China speak same language, have similar living habits, the price of tourism in mainland is cheap, relatively close distance, coupled with great efforts to develop tourism in mainland China in recent years, the number of tourists between the two sides will surge, so as to produce new growth point to the air transport industry.

The direct flights will expand the radiation scope of the Taiwan's airport, the Airport as an aviation transport network nodes, has the function of convergence of

different modes of transport, passenger and cargo. After the direct flights, hinterland resources will link more closely between Taiwan and mainland China. Taiwan's airport could expand radiation scope, and with its extensive international route network, to attract a large number of transit of passengers and cargo. Taiwan is in the geographical axis of Asia-Pacific region, the advantageous industries are research and design, manufacture, assembly, production management, international marketing, along with the acceleration of globalization and international division of labor, cross-strait direct flights will further consolidate Taiwan's airport as the role of Asia-Pacific air transport central hub.

In addition, direct flights can also bring new economic benefits to airports in Taiwan. The airports, which were selected as direct destinations, will obtain the direct economic benefits by increasing the throughput. Those none-direct destinations' direct benefits are limited, but because of direct flights promote cross-strait personnel exchanges, in particular, Taiwan tourism opening to mainland, will lead to rapid development of some Taiwan's tourism airport.

Finally, to Hong Kong and Macao which in the past played the role of transit airport, although the cross-strait direct flights will be reduced the transit amount for past mainland China – Taiwan air traveling, but compared to the total number of flights the airport transit, the reduction is relatively limited. On the other hand, the policy will ease the current tense and busy in Hong Kong and Macao airports and reduce flight pro-resistance phenomenon. Hong Kong and Macao could focus on the productivity of other routes, to improve the efficiency of airport operations.

From a long-term perspective, Hong Kong and Macao airport operators are more optimistic about long-term benefits of cross-strait direct flights. Hong Kong Airport has been recognized from many years ago on the cross-strait direct flights impact and made relevant plan in early stage. With the implementation of the policy of direct flights, cross-strait relations have become closer and the development of Pearl River will aviation market will further develop, short-term losses can be offset, and also to bring greater benefits to Hong Kong International Airport. In the past, Macao International Airport mainly served as passenger transfer point, but in 2004 started to

use its advantages to construct "end of the airport", transit passengers' account for the proportion of the total passenger traffic dropped from 70% before 2004, to end of 2008 at 39%.

3.3 The impact of cross-strait direct flights on the air transport industry

Besides the impact of cross-strait direct flights on the airlines and airports, the impact of cross-strait direct flights is positive on the level of air transport industry.

3.3.1 The analysis based on economic theory

Based on economic theory, it can be analyzed that the supply efficiency of civil air transport can be increased and more social benefit can be obtained by cross-strait direct flights, which can be illustrated by Figure 3.

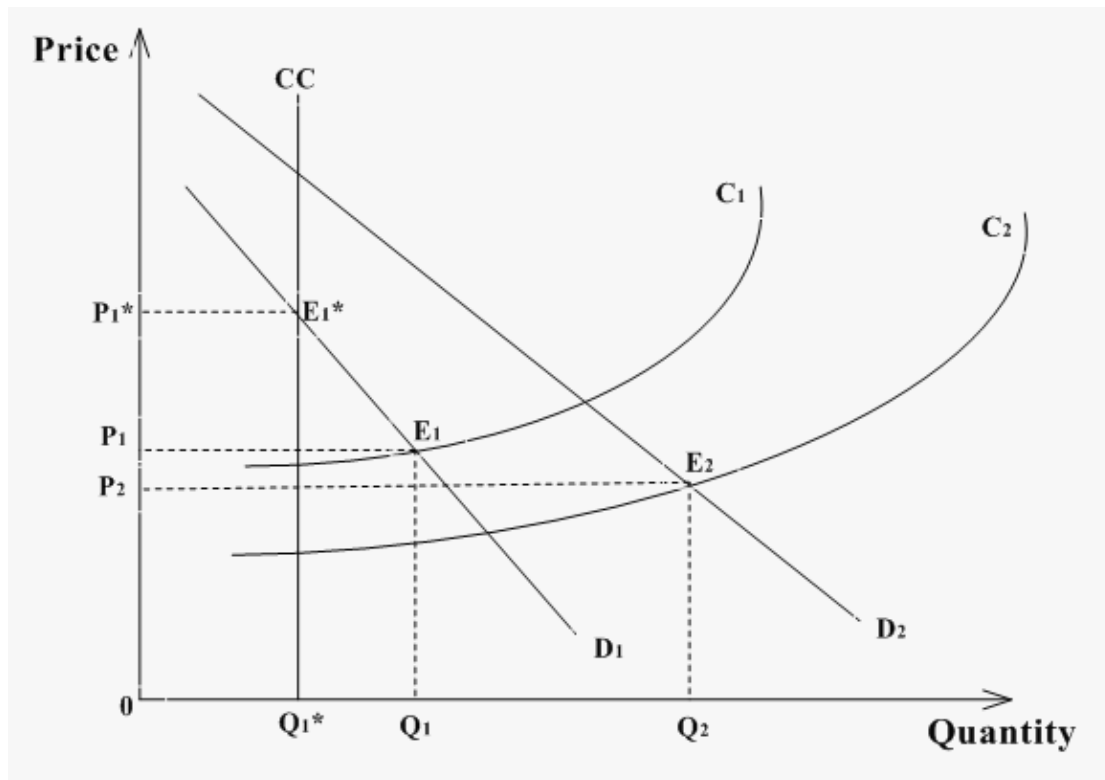


Figure 3- The economic analysis illustration of cross-strait direct flights

In the Figure 3., the quantity of air transport between Taiwan Strait is illustrated as axis of X, the produce price is illustrated as axis of Y, the demand curve for air transport between Taiwan Strait under the 'pre-open' is assumed linear and shown as D_1 , the produce price, which for simplicity is assumed to rise more than linearly with quantity, as C_1 . According to the economic theory, the equilibrium point E_1 is the intersection point of curve D_1 and curve C_1 , with the equilibrium quantity Q_1 and

the equilibrium produce price P_1 . However, in fact, the policy restricted to the air transport quantity before the cross-strait direct flight, as curve CC . Under the policy constrain, the actual equilibrium point E_1^* is the intersection point of curve CC and curve C_1 , with the actual equilibrium quantity Q_1^* and the actual equilibrium produce price P_1^* . With the step of cross strait direct flights, the policy restraint is loosing, as the curve CC moved to the right with a wide margin, which don't constrain the quantity and produce price. By cross strait direct flights, the produce price is lowed and the demand is increased, which is illustrated by curve C_2 and curve D_2 . The new equilibrium point E_2 is the intersection point of curve D_2 and curve C_2 , with the new equilibrium quantity Q_2 and the new equilibrium produce price P_2 . Form the Fig. X., it can be seen that the new equilibrium quantity Q_2 is larger than the actual equilibrium quantity Q_1^* , which means the supply efficiency is increased; it can be seen that the social benefit from the air transport industry(the area of quadrilateral $OQ_2E_2P_2$) is more than that after cross-strait direct flights(the area of quadrilateral $OQ_1^*E_1^*P_1^*$), which means more social benefit is obtained by cross-strait direct flights.

3.3.2 The analysis based on arithmetical model

Based on economic theory, it can be analyzed that the positive impact of cross-strait direct route is more than the sum of negative impact of the original flying routes.

With the review of literature, the researches of air transport between mainland and Taiwan are not much on travel demand forecast or more than a decade ago, which focused on the hypothetical policy of cross-strait direct flights and is different from the practical situation.

Therefore, based on the literature of the process of cross-strait direct flights and the 'open sky' in Europe and America, an arithmetical model is built to analyze the passenger travel demand between mainland and Taiwan. In the model, a variable of 'open' policy is introduced to show the influence factor of the 'open' policy.

The most useful travel demand forecast is regression analysis. Rengaraju et al (1992) forecasted the travel demand among cities in India with regression analysis. Button and Samantha (2000) discussed the impact of open sky on the air transport, and analyzed the most helpful degree of open. Tongzon (1995) analyzed the freight

forecast with regression analysis to discuss the relationship between performance and efficiency of seaport. Seabrooke et al (2002) analyzed the freight forecast with regression analysis to locate in the future.

This study takes air passenger transport as an example to forecast the travel demand of ‘Mainland-Hong Kong& Macao’, ‘Hong Kong& Macao-Taiwan’ and ‘Mainland- Taiwan’ with multiple regression. With the historical data, the arithmetical model to analyze the passenger travel demand forecast of the flight routes is built.

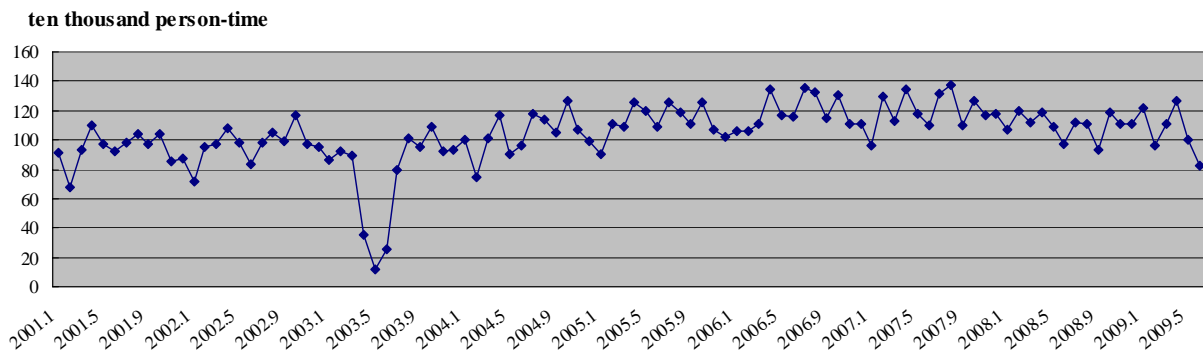


Figure 4 (a)-The data series of air traffic volume of ‘Mainland- Hong Kong& Macao’

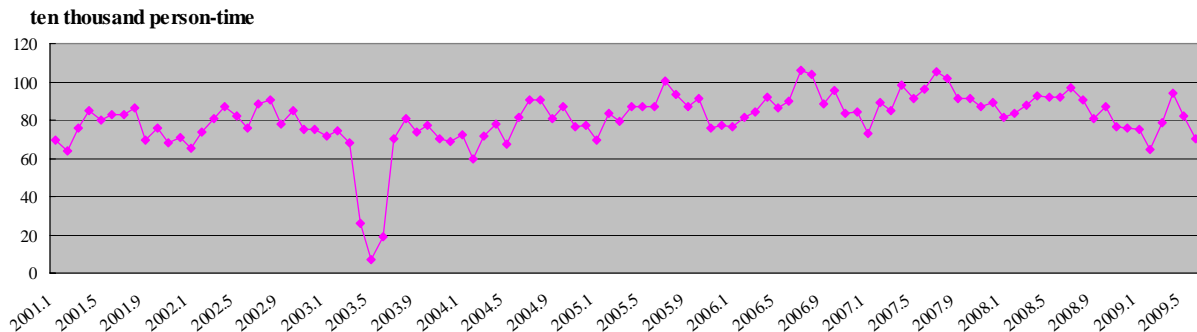


Figure 4 (b)-The data series of air traffic volume of ‘Hong Kong& Macao -Taiwan’

First, the Figure 4(a) and (b) show the traffic of ‘Mainland- Hong Kong& Macao’ and ‘Hong Kong& Macao -Taiwan’, from which the seasonal fluctuations can be found clearly. Due to the relationship of ‘Mainland-Taiwan’ with ‘Mainland- Hong Kong& Macao’ and ‘Hong Kong& Macao-Taiwan’, the traffic demand of ‘Mainland-Taiwan’ must be change with season. Therefore, the series of data is normalized handling to statistic, analyze and forecast with the base unit time is ‘year’.

Then, according to the literature review, the air traffic volume is related to the

regions' tertiary outputs, population, and tourism resource and so on. Based on the researches, the regions' tertiary outputs and population are taken as independent variables to forecast the air traffic demand, which is dependent variable in the model. After fitted, it can be found the series of independent variables and in each air routes conforms to the logarithm model. Moreover, the piecewise variable Δ is introduced to represent the policy of cross-strait direct flights, which is the important factor to influence the dependent variable.

$$\ln(y_{ij}) = \alpha_{ij} + \beta_{ij}^1 \ln(x_i^{GDP3}) + \beta_{ij}^2 \ln(x_j^{GDP3}) + \beta_{ij}^3 \ln(x_i^{PZ}) + \beta_{ij}^4 \ln(x_j^{PZ}) + \beta_{ij}^5 \ln(\Delta) + \varepsilon_{ij}$$

Hereinto: y_{ij} represents the data series of traffic volume of air route between region i and region j ; α_{ij} represents the constant series in the regression analysis; x_i^{GDP3} represents the data series of tertiary outputs of region i , x_i^{PZ} represents the data series of population of region i ; Δ represents the policy variable of cross-strait direct flights; β_{ij}^k represents the weighting of the k th independent variable to the traffic volume between region i and region j ; ε_{ij} represents the stochastic disturbance to the traffic volume between region i and region j ; $k = 1, 2, \dots, 5$;

$$i, j = \begin{cases} 1 & \text{mainland} \\ 2 & \text{HongKong \& Macao} \\ 3 & \text{Taiwan} \end{cases} \quad i < j ;$$

By the year equivalent data series of air traffic volume of the air routes, the data series of independent variables, the models are calibrated at 95% confidence level. And the calibrated results are as follows:

(1) When $i = 1, j = 2$: 'Mainland- Hong Kong& Macao'

Table 1-The calibrated results of 'Mainland- Hong Kong& Macao'

Parameter	Calibrated Results	t State
β_{12}^1	0.01957	2.71986
β_{12}^2	0.47314	2.55030

$R^2 = 96.82\%$;

β_{12}^3	17.53605	5.06278	$\bar{R}^2 = 91.52\%$;
β_{12}^4	-8.93474	-3.33648	
β_{12}^5	-0.01508	-2.91066	$Sig.F = 0.00141$
α_{12}	-134.65992	30.70210	

(2) When $i = 2, j = 3$: 'Hong Hong Kong& Macao'

Table 2-The calibrated results of 'Hong Hong Kong& Macao'

parameter	Calibrated results	t State	
β_{23}^1	1.37725	3.19324	$R^2 = 96.21\%$;
β_{23}^2	0.87375	-1.62676	
β_{23}^3	-22.33241	-4.23506	$\bar{R}^2 = 89.91\%$;
β_{23}^4	49.57361	3.71013	
β_{23}^5	-0.03486	-4.14196	$Sig.F = 0.00112$
α_{23}	-232.52942	-3.31335	

(3) When $i = 1, j = 3$: 'Mainland-Taiwan'

Table 3-The calibrated results of 'Mainland-Taiwan'

parameter	Calibrated results	t State	
β_{13}^1	5.96032	-18.99724	$R^2 = 99.55\%$;
β_{13}^2	12.07461	7.91445	
β_{13}^3	621.43409	16.83251	$\bar{R}^2 = 98.81\%$;
β_{13}^4	-897.12396	-11.05128	
β_{13}^5	3.61570	13.48960	$Sig.F = 0.00428$
α_{13}	-412.78724	-2.18132	

The indexes above pass the statistic test, which shows the models are efficient and can be used to forecast the air traffic demand of three air routes. The forecast models with calibrated results are as follows:

$$\ln(y_{12}) = -134.65992 + 0.001957 \ln(x_1^{GDP3}) + 0.473414 \ln(x_2^{GDP3}) + 17.53605 \ln(x_1^{PZ}) - 8.93474 \ln(x_2^{PZ}) - 0.01508 \ln(\Delta)$$

$$\ln(y_{23}) = -232.52942 + 1.37725 \ln(x_2^{GDP3}) + 0.87375 \ln(x_3^{GDP3}) - 22.33241 \ln(x_2^{PZ}) + 49.57361 \ln(x_3^{PZ}) - 0.03486 \ln(\Delta)$$

$$\ln(y_{13}) = -412.78724 + 5.96032 \ln(x_1^{GDP3}) + 12.07461 \ln(x_3^{GDP3}) + 621.43409 \ln(x_1^{PZ}) - 897.123961 \ln(x_3^{PZ}) + 3.61570 \ln(\Delta)$$

From the models above, it can be concluded that air transport open policy of Taiwan Strait is negative to ‘Mainland- Hong Kong& Macao’ and ‘Hong Kong& Macao-Taiwan’ air routes by eliminating their growth of air the air traffic demand (-0.01508, -0.03486), while, the policy is positive to ‘Mainland-Taiwan’ air route by eliminating its growth of air the air traffic demand (+3.61570). Besides, upon the calibrated results, the positive influence is much larger than the sum of negative influence ($3.61570 > (-0.01508) + (-0.03486)$).

4. Conclusion

With the trend of global trade to be an integral whole, the requirement of economic development and the change of political situation between China mainland and Taiwan, the air transportation cross the Taiwan Strait will be open gradually. The opportunities and challenges have been taken by the adjustment of cross-strait air transport policy and the realization of the normalization of air transportation.

Taken air passengers transportation as an example, firstly, this paper reviews the history of cross-strait air transportation and the operation under the cross-strait air transport policy in each period. Secondly, due to the change of cross-strait air

passenger transport flow influences on the air transportation cost of relevant carriers and the throughput of relevant airports, we analyze the impact of the cross-Straits direct air transportation links on airlines and airports of not only China mainland and Taiwan, but also Hong Kong & Macao, the previous transit airports. Finally, due to the particularity and significance of the cross-strait air transport policy for the market, we introduce a dummy variable to explain it and to analyze its impact on the air transportation in different periods quantitatively.

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