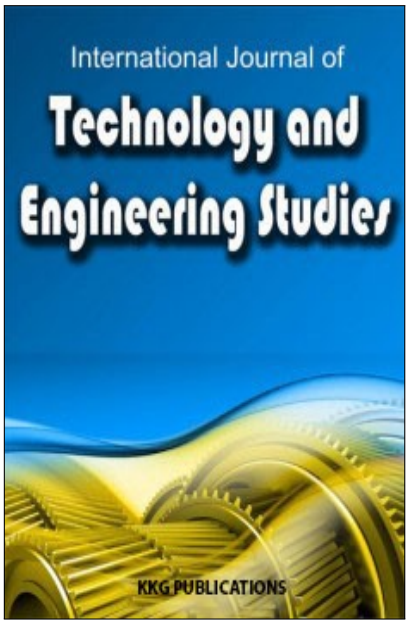

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An Empirical Evaluation for Passenger Markets Before and After Open-Sky Policy between Taiwan and Japan

HUA-AN LU [1], KUNG-DON YE [2], MING-CHEN CHANG [3]

[1, 2, 3] Department of Shipping and Transportation Management, National Taiwan Ocean University, Keelung, Taiwan

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AN EMPIRICAL EVALUATION FOR PASSENGER MARKETS BEFORE AND AFTER OPEN-SKY POLICY BETWEEN TAIWAN AND JAPAN

HUA-AN LU [1], KUNG-DON YE [2], MING-CHEN CHANG [3*]

[1, 2, 3] Department of Shipping and Transportation Management, National Taiwan Ocean University, Keelung, Taiwan

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Abstract. The purpose of this study is to evaluate the impact of their open-sky policy on the passenger markets in terms of numerical performance on tourism and air transport. This study gathered two kinds of data to examine and test for evaluating the effects of open-sky policy on the tourism and air transport markets. The first kind of data is collected from the Taiwan Tourism Bureau for tourists. The second kind of data comes from the Civil Aeronautical Administration (CAA) of Taiwan for air transport. Analysis data are counted in months between January 2009 and September 2014. The analyzed results of descriptive statistics from the officially published data in Taiwan reveal that Taiwanese tourists traveling to Japan were higher than the number of Japanese coming to Taiwan after performing the open-sky policy. However, the Chow-test results show significant differences before and after this policy on the two markets. Furthermore, the Taiwanese airlines had a greater performance growth than Japanese airlines on transport markets, including flight frequencies, numbers of new open operational airports, passenger market shares, etc. However, both Taiwanese and Japanese airlines still less use the fifth freedom to extend their services. The evaluation approach proposed by this study is suitable for other open sky markets to examine the real effects by empirical data.

INTRODUCTION

Air traffic freedom is an important resource for a country to develop its air transport network. Based on the Chicago Conference in 1944, bilateral Air Service Agreements (ASAs) between two countries affect available flights and passenger and cargo markets. Open-sky policies were a trend over the world during these two decades. In recent years, Taiwan government also signed open-sky agreements with different countries, such as the total deregulation with Japan on March 31, 2013.

Air transport markets between Taiwan and Japan are quite mature. Airports in Japan also play a main transit role on transpacific routes for Taiwanese airlines. However, available airports have limited airlines to operate before deregulation. The scope of open sky between Taiwan and Japan consists of two stages. First, open airports except in Tokyo region are with no flight and operator restrictions from September 10, 2011 onwards. Second, further open Narita and Haneda airports in Tokyo region from March 31, 2013 on.

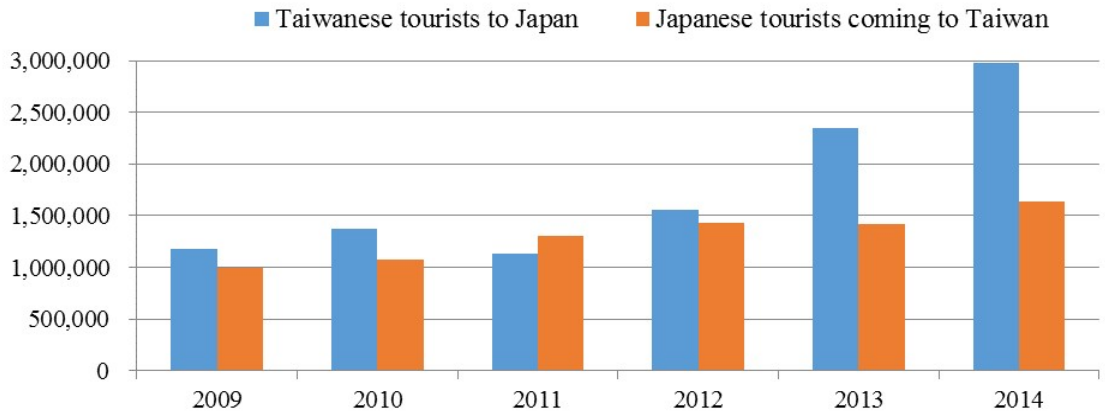

Fig. 1. Annual numbers of tourists between Taiwan and Japan (Source: Taiwan Tourism Bureau)

*Corresponding author: Ming-Chen Chang
†Email: s24324471@hotmail.com

As shown in Figure 1, a clear growth of the Taiwanese tourists to Japan from 2012 to 2014 is shown. Taiwanese tourists travelling to Japan have reached 2,971,846 in 2014, almost double compared with 2011. On the other hand, Japanese tourists travelling to Taiwan seem not have the same growth in the same period. In another way, air transport data show that Taiwanese airlines originally handled 11 routes except Narita and Haneda airports and consecutively operated into new airports after open-sky policy work. However, Japanese airlines did not have the same steps. These phenomena motivated this study to examine the effects of open-sky policy on tourism and air transport markets in terms of empirical data before and after deregulation.

The number of tourists may not entirely represent the potential changes of demand in air transport but depend on the inputs of air transport resources. The effects on tourism and air transport markets due to the open-sky policy have to be distinguished. Furthermore, the growths of these two markets attributed to potential trends or deregulation effects must be clarified, too. From the operation perspectives, the deployment alterations of airlines for both sides also require to be examined. Hence, the purposes of this study are listed as follows:

1. To evaluate whether the open sky policy between Taiwan and Japan has a significant effect on the flow of tourists for these two countries;

2. To evaluate the effects of air transport traffic between Taiwan and Japan; and

3. To evaluate the effects of airline operations including numbers of operators, operating airports, flight frequencies, passenger market shares, and the utilization of fifth freedom.

LITERATURE REVIEW

Open sky policy is previously worked in developed countries, especially in Europe and America. More studies devoted to assess the influence of this policy. This section reviews some efforts from perspectives of USA, Europe, and other countries.

Open Sky Policy in U.S.

Open sky policy began from the idea of USA. The US Departure of Transportation has a discussion of the different ticket prices between the signed open sky policy and non-signed country. Comparing the prices of different routes during 1996 to 1999, including Atlantic, European, and the area under restriction, it is found that the price of all routes was getting low, and the largest decrease in price was in Europe. Brattle Group also analyzed the economic impact of open sky policy between EU and US, with the data analysis of capital of airlines, the passenger traffic volumes, and so on. They found that open sky policy had the synergy of price.

[1] examined the impact of the bilateral aviation framework on passenger air transport service imports focusing on the US and Japan. The US promoted liberalization under its Open Skies framework from the 1980s, while Japan supported phased-in liberalization under the traditional bilateral air services framework. The numbers of US and Japanese citizens flying on foreign carriers had increased.

[2] estimated economic impacts of the open sky policy between the US and EU. Open sky policy may generate several millions of additional passengers: approximately 26 million in the markets currently constrained over five years due to the removal of output. The cargo market was also estimated to increase 1 to 2 in percentage. In total, the increased level of traffic will require the creation of around 70,000 new jobs (at current levels of productivity) by the end of the five year period, with a further 1,800 to 10,000 thousand new jobs created due to pricing efficiencies.

[3] thought open sky policy was a market-based strategy. Consumers had a positive attitude to this policy. The open sky policy between the US and EU had a benefit to entire air transportation market, but some airlines closed under the competitive market. Airlines still didn't operate in some route after open sky. All these show the two sides of effects of open sky policy.

[4] explored the markets currently regulated by an "Open Skies" agreement, which eliminated all restrictions on the frequency of flights, the aircraft flown, and the fares charged on transborder routes. Although there was evidence that consumers have benefited from the Open Skies agreement, there was also evidence that many passengers had chosen to avoid transborder services, and instead fly from airports in US border cities and cross the border by surface transportation. Results show a substantial amount of leakage estimated at over 4.7 million passengers for 2008.

Open Sky Policy in Europe

[5] indicated the actual situation in the air transport liberalization process of Germany and the potential way of how it may develop into an extensively liberalized airline market. The starting point was the liberalization of the European and the north Atlantic air transport market. These markets revealed positive results so that further liberalization of other markets was desirable.

[6] explored the impacts of open sky scenario on Hamburg airport and in general for Germany. The passenger traffic, aircraft movements and revenue of airport were used to analyze the changes of airports in Germany. Results show that not all German airports would profit from an Open Sky policy in the same way. The bigger and hubbing airport got more

advantages than other airports. A key result of the "Open Sky" policy was the increase of passenger numbers while aircraft movements decreased. Air transport therefore became more efficient. In addition, this means that environmental effects, like noise and air pollution can be expected to be positively affected. In general, the open sky policy has an economic impact on Germany that is expected.

[7] explored the potential impact of the open-sky policy between the US and the EU to Ireland. With the analysis data and SWOT analysis, they found the policy was beneficial to the tourism in Ireland and the passengers.

Open Sky Policy in Other Countries

[8] explored the open sky policy between the countries of Association of South-East Asian Nations (ASEAN). Member countries differed widely in terms of their GDP per capita, their sizes, aviation policies and the strength of their aviation industries. Granted these differences, several possibilities for facilitating the move were examined. These included taking an economic approach to aviation negotiations, liberalizing within sub-regional groupings, a staged framework of liberalization, and increasing the scope for low-cost carriers to compete, possibly through development of secondary markets.

[9] attempted to derive policy indices to quantify the restrictiveness of the aviation regimes in the Asia-Pacific region and used the indices to establish the relationships between people movement and liberalization in policy. Singapore and Australia have the most liberalized environment in this region. The passenger traffic is much more than other countries. The less restricted and liberalized air transport policy brought benefits to tourism development.

METHOD AND MATERIALS

For evaluating the effects of open-sky policy on the tourism and air transport markets, this study applies two kinds of data to examine and test. The first kind of data are collected from the Taiwan Tourism Bureau for tourists. The second kind of data come from the Civil Aeronautical Administration (CAA) of Taiwan for air transport. Analysis data are counted in months between January 2009 and September 2014. According to the tourism report in Taiwan, tourists travelling from Taiwan to Japan showed an obvious growth due to the low exchange rate policy of Japanese government. This study eliminates the possibility of its impact. Data before November 2011 are attributed to that of before deregulation because Taiwanese airlines started to change their operations from December 2011. The hypothesis and test methods of this study are listed as Table 1.

TABLE 1
HYPOTHESES OF STATISTICAL TESTS

Hypothesis	Test method	Data
H_0^1. There is no significant difference between original regulation and open-sky policy.	t-test for a population mean	Numbers of both side tourists. Numbers of both side passengers.
H_0^2. There is no significant difference in monthly distribution of two groups.	The signed rank test for two means	Monthly air transport operation.
H_0^3. There is no significant difference in two similar time series regression model.	Chow-test	Time series regression of tourists. Time series regression of passengers.

Three test methods are briefly described as the following: t-test for a population mean To investigate the significance of the difference between an assumed population mean μ_0 and a sample mean $\bar{x}$ Here, meanμ_0 from a population before open-sky policy, a sample of size n is taken after open-sky policy for mean $\bar{x}$.

(2) The signed rank test for two means To investigate the significance of the difference between the means of two similar shaped distributions, the difference between pairs of observations is formed and ranked irrespective of sign. Where ties occur, the average of the corresponding ranks is used. Then each rank is allocated the sign from the corresponding difference. The sum of ranks with a positive sign and the sum of ranks with a negative sign are calculated. The statistic T tests the smaller of these two sums. When the value of T is less than the critical value, the null hypothesis of equal population means is rejected.

Chow-test The Chow test is most commonly used in time series analysis to test for the presence of a structural break. In program evaluation, the Chow test is often used to determine whether the independent variables have different impacts on different groups. Build up a time series regression model of the research period, data before open-sky policy as first group and that after open-sky policy as second group. Let S_c be the

sum of squared residuals from the combined data, S_1 be the sum of squared residuals from the first group, and S_2 be the sum of squared residuals from the second group. N_1 and N_2 are the number of observations in each group and k is the total number of parameters. Then, the Chow test statistic follows the F distribution with k and $N_1 + N_2 - 2k$ degrees of freedom. This statistic is defined as follows:

$F = \frac{[S_c-(S_1+S_2)]/k}{(S_1+S_2)/(N_1+N_2-2k)}$

RESULTS ANALYSIS

Tourists between Taiwan and Japan

The trends of tourists between Taiwan and Japan are shown in Figure 2 in monthly data. Taiwanese tourists travelling to Japan revealed an obvious growth from March 2013, while dissimilar trends were on the anti-direction. The peak month of Taiwanese tourists travelling to Japan is July. Japanese tourists to Taiwan appear in March.

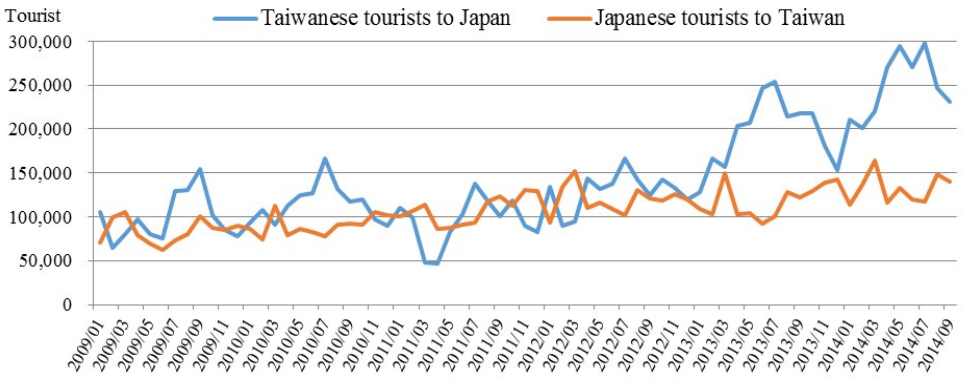

Fig. 2. Monthly number of tourists between Taiwan and Japan (Source: Taiwan Tourism Bureau)

Tests for Taiwanese Tourists to Japan

Using t-test for the hypothesis H_0^1, population mean μ_0 = 103226.63 before open sky and the mean of tourists after open sky $\bar{x}$= 183308.50, n_1 = 34,s = 59480.15, t = 22.89. Critical value $t_{34:0.05}$ = 1.691. RejectH_0^1, the means of Taiwanese tourists before and after open sky are significantly different.

Whole analysis duration: $y_c = 77.954x_c - 3E + 06$

Before open sky: $y_1 = 3.91x_1 - 54494$

After open sky: $y_2 = 169.3x_2 - 7E + 06$

With Chow-test [10] [11] as shown in Figure 3, whereS_c = 10575.215, S_1 = 3562.419. N_1 = 35, $S_(2)$= 833.005, N_2 = 34, k = 1, the statistic value F = 94.2, and critical value F(1, 69) = 3.979. Results of Chow-test also reject H_0^3.4 Trends of Taiwanese tourists to Japan are significantly different before and after open-sky policy.

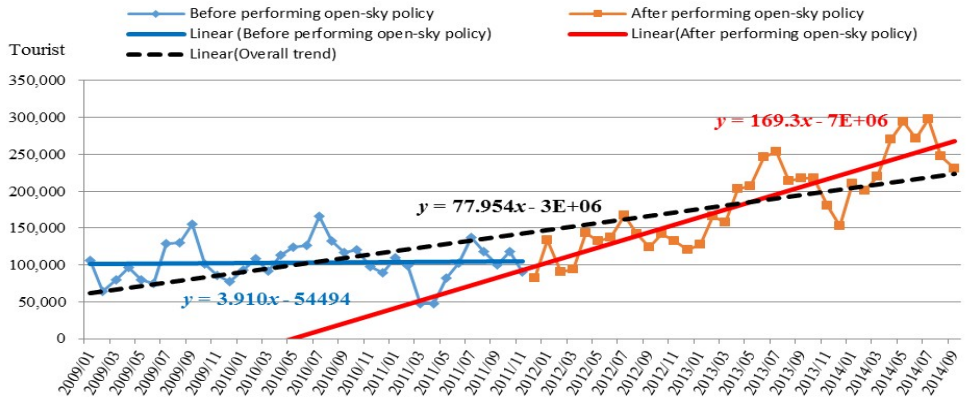

Fig. 3. The trend of Taiwanese tourists travelling to Japan

Tests for Japanese Tourists to Taiwan

The average Japanese tourists to Taiwan were 92,766 before the open-sky policy performing. After the open-sky agreement performing, the average tourists grew to 122,718 in average with a growth rate of 32%.

Using t-test for the hypothesis H_0^1, population mean $_0$ = 92765.71 before open sky and the mean of tourists after open sky $\bar{x}$= 122718.35, n_1 = 34,s = 17585.96, t = 28.95. Critical value $t_{34:0.05}$ = 1.691. H_0^1 was rejected because means of Japanese tourists before and after open sky are significantly different.

Regression models for three kinds of duration were projected as follows:

Whole analysis duration: $y_c = 27.698x_c - 1E + 06$

Before open sky: $y_1 = 32.53x_1 - 1E + 06$

After open sky: $y_2 = 17.26x_2 - 59173$

With Chow-test as shown in Figure 4, whereS_c = 11942.152, S_1 = 2157.694. N_1 = 35, S_2= 2982.505, N_2 = 34, k = 1, the statistic value F = 88.66, and critical value F(1, 69) = 3.979. Results of Chow-test also reject H_0^3. Trends of Taiwanese tourists to Japan are significantly different before and after open-sky policy.

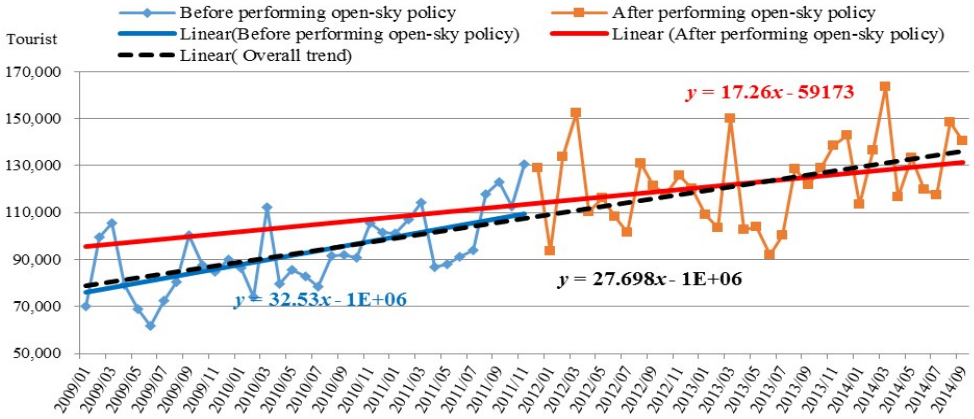

Fig. 4. The trend of Japanese tourists coming to Taiwan

Analysis of Air Transport Traffic and Operations

Tests for Passenger Traffic

Total passengers on Taiwan and Japan routes without directional classification are growing from 14,169,002 to 21,396,250 with a growth rate of 51%. Figure 5 shows the average numbers in each month for passengers before and after performing the open-sky policy.

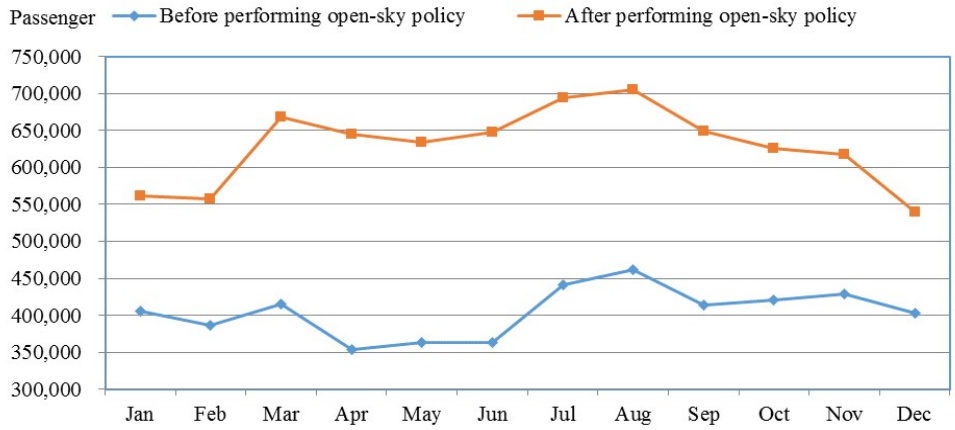

Fig. 5. Average monthly passengers on Taiwan and Japan routes

The hypothesis H_0^1, where mean of bi-directional passengers before open sky μ_0 = 317684.17, n = 34, mean of passengers after open sky $\bar{x}$ = 524040.71, s = 101479.46, t = 11.86. Critical value $t_{34:0.05}$ = 1.691. $H_0^1$was rejected because means of air transport passengers before and after open sky are significantly different.

Regression models for three kinds of duration were projected as follows:

Whole analysis duration: $y_c = 192.05x_c - 7E + 06$

Before open sky: $y_1 = 52.29x_1 - 2E + 06$

After open sky: $y_2 = 316.5x_2 - 1E + 07$

With Chow-test as shown in Figure 6, whereS_c = 4738.329, S_1 = 3003.245. N_1 = 35, S_2 = 345.859, N_2 = 34, k = 1, the statistic value F = 27.732, and critical value F(1, 69) = 3.979. Results of Chow-test also reject H_0^3. A growth rate of bi-directional passengers after performing open-sky policy is higher than that of before performing.

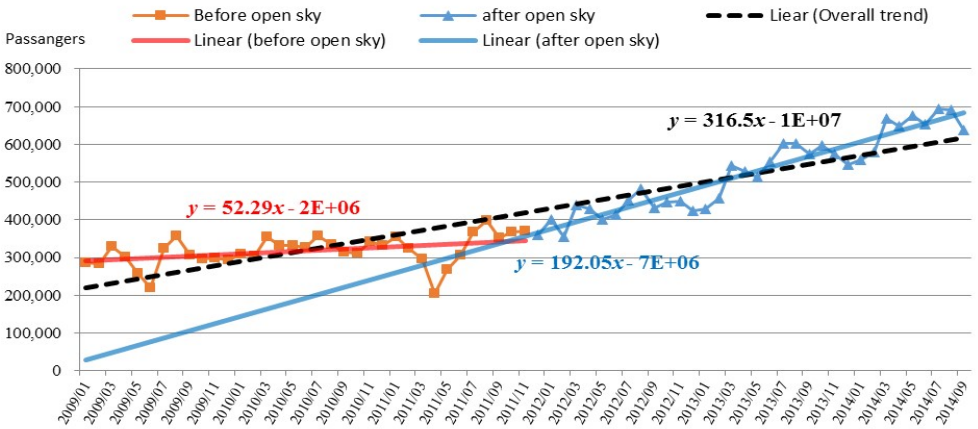

Fig. 6. Trend of passengers between Taiwan and Japan

Market Shares Analysis

This study used air transport traffic data to examine the market shares of Taiwanese and Japanese airlines as shown in Figure 7. Before open-sky policy performing, Taiwanese airlines enjoyed 53% market share, Japanese airlines making 25%, and other airlines in 22%. After the open-sky policy performing, total passengers have grown. The market shares also change in different ways. Taiwanese airlines received 61%, Japanese airlines reducing to 21%, and other airlines only 17%. The reason of these results is owing to Taiwanese airlines handling more traffic of passengers about twice than before. Relatively, the growth in Japanese and other airlines is lower.

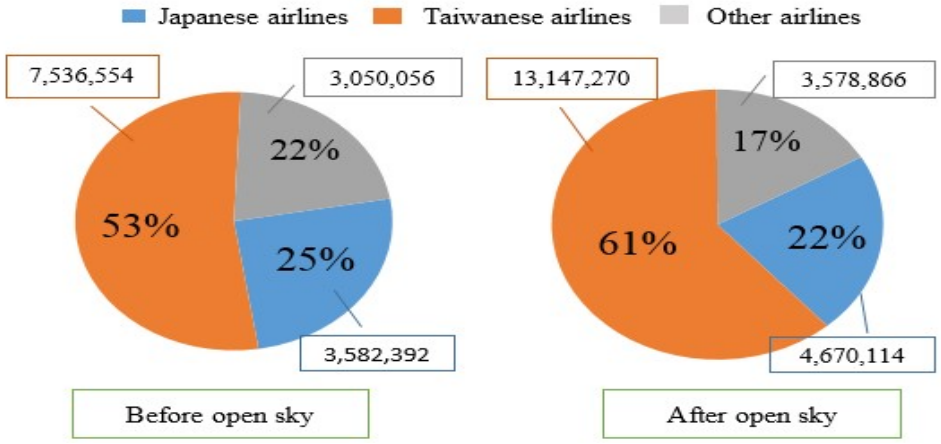

Fig. 7. Market shares of Taiwanese and Japanese airlines

Flight Frequencies Analysis

This study used the signed rank test for each month to examine the open-sky policy effects on flights frequencies provided by Taiwanese airlines. As shown in Table 2, X is the mean of flights before performing open-sky policy, while Y is the mean after performing open-sky policy. The minus signs are 12 and plus signs are 0, rank of the plus sign is 0 (T value). The critical value T_{12},0.05=13. Reject the null hypothesis H_0^2. Taiwanese airlines provided flights growth in range of 55% to 107%. The growth rates for average flights provided by Japanese airlines range from 21% to 52% as shown in Figure 8.

TABLE 2
THE SIGNED RANK TEST OF PASSENGER MONTHLY MEAN LIST UNDER DIFFERENT OPERATORS

Taiwanese Airlines												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
X	1077.7	1023.3	1059.3	1005.7	1048.3	961.3	1082	1103	1063.3	1098.7	1112	1048
Y	1767	1586.7	1831.7	1954	2033	1971.3	2245	2191.3	2103	1963.5	1852.5	1714.3
X-Y	(689.3)	(563.3)	(772.3)	(948.3)	(984.7)	(1010)	(1163)	(1088.3)	(1039.7)	(864.8)	(740.5)	(666.3)
Rank	(3)	(1)	(5)	(7)	(8)	(9)	(12)	(11)	(10)	(6)	(4)	(2)
Japanese Airlines												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
X	619.7	523.7	616.7	578	557	552	599.6	598.7	575	601	639	624.5
Y	810.7	768	846.3	820	847.7	819.7	866.3	844	843.7	811	773	778
X-Y	(191)	(244.33)	(299.67)	(272)	(290.67)	(267.67)	(266.67)	(245.33)	(268.67)	(210)	(134)	(153.5)
Rank	(3)	(6)	(5)	(11)	(12)	(9)	(8)	(7)	(10)	(4)	(1)	(2)

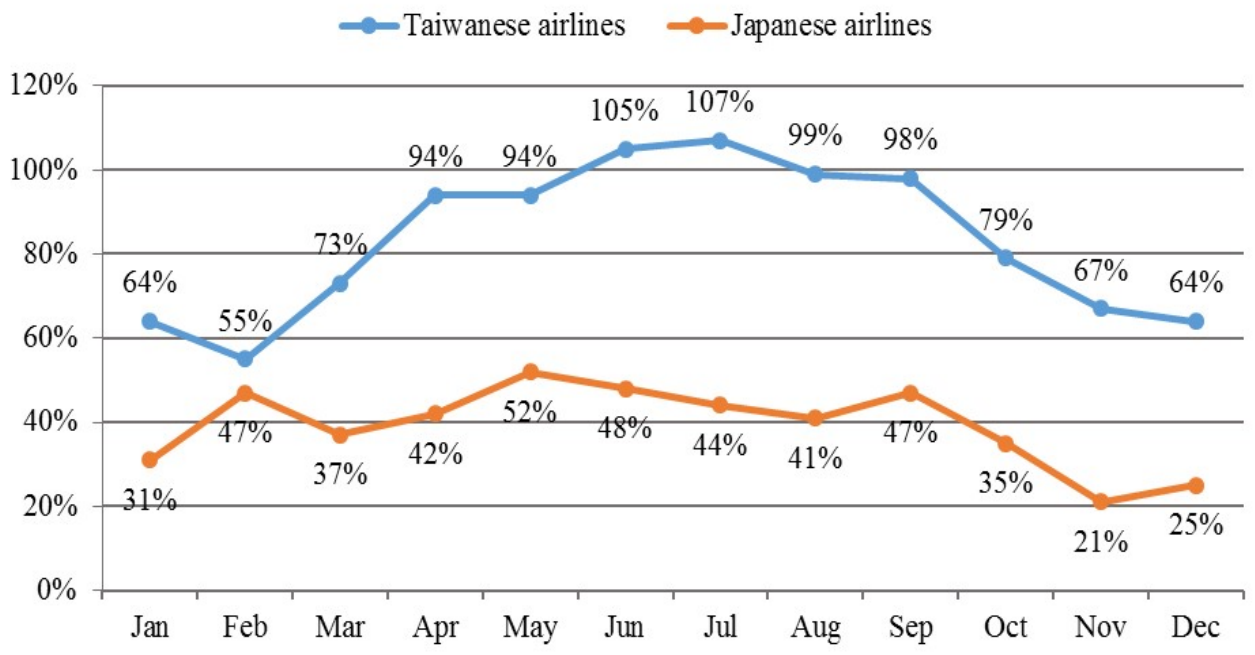

Fig. 8. The growth rate of average flights by month

Analysis for Fifth Freedom Rights

In the view of whether airlines operate a flight transit through Japan to other airports the published data show the routes and flights per week from 2009 to 2013 as in Table 3. China Airlines provided new route (TPE-OSA-NYK) for 6 flights per week in 2011. However, only 3 routes were left to keep running in 2013. Taiwanese airlines operated more fifth freedom rights. In general, both Taiwanese and Japanese airlines still less use the fifth freedom to extend their services.

TABLE 3
THE SCHEDULED FLIGHTS PASS THROUGH JAPAN

Year	Original airport	Stop 1	Destination	Flights/ week	Total flights/week
2009	TPE	TYO	SFO	7	37
	TPE	TYO	HNL	17	
	TPE	TYO	PDX	7	
	TPE	OSA	LAX	6	
2010	TPE	TYO (NRT)	SFO	7	24
	TPE	TYO (NRT)	HNL	10	
	TPE	TYO (NRT)	DTT	7	
2011	TPE	OSA	NYK	6	44
	TPE	TYO (NRT)	DTT	14	
	TPE	TYO (NRT)	HNL	10	
	TPE	TYO (NRT)	SFO	14	
2012	TPE	OSA	NYK	6	34
	TPE	TYO (NRT)	DTT	14	
	TPE	TYO (NRT)	HNL	14	
2013	TPE	OSA	NYK	6	34
	TPE	TYO (NRT)	DTT	14	
	TPE	TYO (NRT)	HNL	14	

CONCLUSION AND RECOMMENDATIONS

This study has evaluated the impact of the open-sky policy between Taiwan and Japan to the passenger markets in terms of numerical performance on tourism and air transport. Some conclusions can be summarized as follows:

(1) The Taiwanese tourists travelling to Japan are significantly growing after performing the open-sky policy. The analyzed results of descriptive statistics from the officially published data in Taiwan reveal that the growth of Taiwanese tourists travelling to Japan was higher than the number of Japanese coming to Taiwan after preforming the open-sky policy.

(2) The open-sky policy has impact on air transport of Taiwan and Japan. Some stable and sizable routes may attract low-cost carriers to join the market. Two Japanese low-cost carriers have brought the settling of Taiwanese low-cost carrier. Such as Tigerair Taiwan and V air, both of them joined the route of TPE-NRT after 2015.

(3) The significant growth occurs on developing new routes. Taiwanese airlines developed several new routes since the open-sky policy. The number of connecting Japanese airports grew from 11 to 22 in 2014, twice than in 2009. Taiwanese airports are also open for Japanese airlines since the open-sky policy. These results provide customers more options than before.

(4) The difference of market shares and operating performance between Taiwanese airlines and Japanese airlines is obvious.

The evaluation approach proposed by this study is suitable for other open sky markets to examine the real effects by empirical data.

Declaration of Conflicting Interests

It is hereby declared that no competing interests either financial or non-financial are present in the current work.

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