The growing influence of low-cost carriers in Northeast Asia and its implications for a regional single aviation market

Abstract

This paper provides an overview of the development of the low-cost carrier (LCC) sector in China, Japan, and South Korea. It is the first paper that documents LCC contributions to the passenger traffic and cheaper fares in Northeast Asia (NEA)'s intra-markets. We argue that a single aviation market can facilitate the growth of the LCC sector, which in turn will make a significant contribution to the NEA connectivity, mobility, and integration. In addition, with a single aviation market, NEA countries can adopt a proactive, unified approach in negotiating air transport agreements with the major aviation partners to maximize the interests of this region as a whole, which will further provide valuable growth opportunities for the LCCs.

Keywords: Northeast Asia; Single aviation market; Low-cost carriers; Passenger traffic; Open skies

1. Introduction

Air transport is a significant sector in China, Japan and South Korea: in 2017 the three countries ranked the 2nd, 6th and 8th, respectively in the world in terms of total ton-kilometers performed.[1] The size of the aviation market of the three countries in total is comparable with that of the United States (US) and the European Union (EU). However, the overall market share of the low-cost carrier (LCC) sector in this region is well below the world's average.[2] In 2018, the domestic LCC penetration rates measured by the number of seats in China, Japan and Korea were 10%, 17%, and 53%, respectively. These three figures for the international services were 14%, 26% and 35% (CAPA, 2019). Although LCCs are a relatively new phenomenon in Northeast Asia (NEA),[3] there have been a growing body of literature examining the development and influence of the LCCs in this region. However, most of the studies only examine a single country's LCCs with a focus on the domestic market. For example, Zhang and Lu (2013) explored the impact of China's LCC on the passenger traffic flow. Fu et al. (2015) considered LCC's entry decision and competition strategies in China and claimed that LCC is still not a game changer due to their limited presence in the domestic market. Studies on Korean LCCs concentrate on their impact on the tourism industry. Chung and Whang (2011) found that Korean LCCs generate new travel demand to Juju Island. Research on the Japanese LCCs emphasizes that the well-developed high-speed rail (HSR) system does not give much survival space to LCCs in the domestic market (Hanaoka, 2018).[4] However, studies on the NEA LCCs' international services are rare. In particular, research into the impacts of LCCs on the international routes linking China, Japan, and Korea is lacking. This research aims to fill this gap by examining the impacts of LCCs on the airfares and traffic flows between these three countries. We present an argument that a single aviation market in NEA can benefit from and contribute to the growth of a strong LCC sector.

2. LCC development and air transport integration in NEA

[1] In this paper, the word "China" refers to Mainland China. Thus unless specifically indicated, Hong Kong and Macau – the two Special Administrative Regions of China – and Taiwan are excluded. Similarly, the word "Korea" refers to South Korea.
[2] In 2018 LCCs carried about 31% of the world total of scheduled passengers (CAPC, 2019). Korea has had a higher LCC penetration than the world average in both domestic and international markets.
[3] Depending on the context, NEA in this paper can refer to Northeast Asia or Northeast Asian.
[4] See similar points made on HSR-LCC interactions in China by Wang et al. (2017).

There were limited commercial air transport services in China before 1980 as civil aviation was part of the air force. Formed in the late 1980s, China's state-owned "big three", namely, Air China, China Eastern and China Southern have been the backbone of the air transport industry. Gradual liberalization in this sector resulted in many local airlines being established in the 1990s. Private carriers were allowed to launch services in 2005 and Spring Airlines, an LCC, was one of the first batch of private carriers. It was the only LCC in China prior to 2013. In 2014, China's aviation regulator, Civil Aviation Administration of China or CAAC, released the "Guiding Opinions on Promoting Low Cost Aviation Industry Development". For the first time, the aviation authorities acknowledged the significant role played by LCCs in the nation's economy. In the following years, more than 20 new carriers were established including LCCs. Some of the existing carriers rebranded themselves as LCCs during this period such as China United Airlines. At the end of 2018 there were 45 state-owned airlines and 15 private airlines. The big three commanded a domestic share of about 64%, followed by Hainan Airlines, the fourth largest carrier in China. The LCC sector consists of seven players and their influence remains limited in the domestic market (Yu et al., 2019).

For a long time, Japan's air transport industry had been based on three major carriers, Japan Airlines (JAP), All Nippon Airways (ANA) and Japan Air System (JAS). JAL merged with JAS in 2002. The LCCs did not appear until 1998 when Skymark Airlines and Air Do (which was then called Hokkaido International Airlines) emerged in the Japanese domestic market (Zhang et al., 2008). However, Hanaoka (2018) argues that these two carriers together with Solaseed Air and Star Flyer that were established in the 2000s are at most a hybrid of LCCs and full service carriers (FSCs). The genuine LCCs in the Japan market were only present in 2012 when Peach Aviation and Jetstar Japan launched their services. One of the main reasons of the slow growth of the Japanese LCC sector has been attributed to the limited available departure and arrival time slots at Tokyo's Haneda Airport. The LCCs can only depart and land at this airport between 11pm to 6am (Hanaoka, 2018). Unlike the US and EU where LCCs can use cheaper secondary airports, there is a scarcity of secondary airports in metro areas in Japan, which limits the Japanese LCCs' ability of achieving lower costs (Murakami, 2011). Jiang and Li (2016) note that high-speed rail (HSR) in Japan predated LCCs by a long period of time. The first modern HSR "Shinkansen" began operations on the Tokyo-

Osaka route with a speed of 210 kph in 1964 and now the HSR network has a total length of 2764 km, linking all major metropolitan areas. This has given HSR an extra strategic advantage over LCCs (see also Wan et al., 2016). However, Jiang and Li believe that if LCCs were given a period of time to develop, they might have a chance to survive and prosper.

Before 1988, Korean Air (KE) was the only carrier in Korea. Asiana was introduced in 1988 to increase efficiency and productivity in air transport (Oum and Yu, 2012). Following the adoption of a liberal air transport policy in Korea, from 2006 to 2010, a number of LCCs were formed including Jeju Air, Jin Air, Air Busan, Eastar Jet, and T'way. These LCCs quickly gained dominant status in Korea's domestic market forcing Korean Air and Asiana to create their own LCCs and shift their focuses on international markets. The emergence of Korean LCCs has made a significant contribution to the tourism industry, particularly to the Jeju Island tourism.

Over the last two decades, there has been an increasing interest in economic cooperation among the three countries in general, and in liberalization and integration in air transportation in particular. Ongoing negotiations for a free trade agreement in Northeast Asia (NEA) including China, Japan and Korea have been taking place. Encouraging developments in air transport have been observed: Korea has signed an open-skies agreement with China's Shandong and Hainan provinces in 2006; Korea and Japan inked an open-skies deal in 2010; China concluded an open-skies agreement with Japan in 2012; expanded bilateral air services between China and Korea were implemented in 2019 in the advent of the opening of Beijing Daxing Airport; triangle shuttle services were launched among Shanghai's Hongqiao airport, Seoul's Gimpo airport and Tokyo's Haneda airport and these airports are considered as the "domestic" airports in their respective countries. Despite these important progresses, the regional air transport market is fragmented and restricted, owing to an array of laws and regulations and other barriers that prohibit the free flow of travelers, goods and service providers.

The single aviation market concept has been well embraced in the EU and the Association of Southeast Asian Nations (ASEAN). These two blocs have signed open-skies agreements with other countries on behalf of their member states. With competition occurring not only at the country level but also at the bloc level, an efficient and integrated air transport system becomes critical, owing to its role in improving the competitiveness of regional industrial bases. An investigation of the LCC development in NEA and its impacts will generate significant policy implications supporting the idea of creating an integrated NEA aviation market.

The rest of the paper is structured as follows. Section 3 gives an overview of the current status of NEA LCCs, followed by the demand and price equation models presented in section 4. Section 5 presents the empirical results. Section 6 discusses the need to create of a single aviation market in NEA and the role of LCCs in integrating NEA. The last section concludes.

3. Descriptive analysis of the NEA LCCs: an overview

The data used for this research are obtained from IATA Airport Intelligence Services. The sample contains 1193 international routes between China, South Korea and Japan. We extract the average annual route-level airfare and traffic data for the period from January 2009 to January 2019. The routes with annual passengers below 1000 are dropped from the sample.[5] It should be noted that some routes did not have air services in some periods and thus the sample is unbalanced.

Table 1 summarizes the LCCs providing services in the NEA intra-markets. In 2019, Japanese LCCs had the lowest numbers of scheduled flights and seats. Japan's largest LCC, Peach Aviation, had only 6867 flights in the NEA intra-market, less than half of those offered by Spring Airline, the largest LCC of China. Jetstar Japan is the second largest LCC in Japan with Qantas and JAL being its main shareholders. As JAL is smaller than ANA, Jetstar's main focus has been Japan's domestic market to complement JAL's network. In contrast, as ANA's subsidiary, Peach believed that its main opportunity is in the international market (CAPA, 2018). Apart from Spring, other Chinese LCCs had only limited international services in NEA. This is because other LCCs are relatively new and it is difficult for them to gain the rights to serve international markets at this stage. As noted earlier, Korean LCCs have dominated their domestic market with the total LCC share exceeding 50%. Jeju Air is the largest Korean LCC with a fleet of 39 aircraft in 2019 and it has the heaviest presence in the NEA intra-market. Other Korean LCCs have also deployed a significant amount of capacity on the routes to China and Korea due to the relatively small size of the domestic market. However, the average passenger load factor of Chinese LCCs was the lowest while Japanese LCCs could achieve a much higher load factor. The numbers of scheduled flights and seats of Korean LCC are substantially higher than those of the other two

[5] The number of passengers is the sum of the movements of both directions of the route.

countries' LCCs. Table 1 also suggests that most NEA LCCs have a parent airline. The major FSCs in Korea and Japan have launched their LCCs. In China, China Eastern and Hainan have also invested in LCCs while Air China and China Southern still show little interest in setting up their own LCCs.

Table 1 Total scheduled flights and seats of NEA LCCs in 2019

Country	Airline Code	Airline Name	Key shareholder and/or parent airline	Number of flights	Number of Seats	Load factor	Domestic Flight Share	Main Hub
China	9C	Spring Airlines	Shanghai Spring International Travel service	15622	2502332	55.52%	2.33%	Shanghai Hongqiao Airport
	KN	China United Airlines	China Eastern Airlines Group	682	83204	96.70%	1.52%	Beijing Nanyuan Airport
	PN	West Air Co Ltd	Hainan Airlines Group	178	26878	62.72%	1.30%	Chongqing Airport
	8L	Lucky Air Co. Ltd.	Hainan Airlines Group	296	36112	98.84%	1.78%	Kunming Airport
	Total			**16782**	**2649202**	**57.47%**		
Japan	GK	Jetstar Japan	Qantas, Japan Airlines	413	74340	57.91%	4.17%	Tokyo Narita Airport
	MM	Peach Aviation Limited	ANA, First Eastern Investment Group and INCJ	6867	1236060	70.92%	2.79%	Osaka Kansai Airport
	Total			**7280**	**1310400**	**70.18%**		
Korea	BX	Air Busan	Asiana Airlines	13474	2387447	72.61%	-	Busan Gimhae Airport
	ZE	EASTAR JET Co. Ltd	Privately owned, not listed	9387	1745982	65.20%	-	Jeju Airport
	7C	Jeju Air	Jeju Air	24099	4578554	65.17%	18.82%	Jeju Airport
	LJ	Jin Air	Korean Air	11710	2384734	69.21%	12.51%	Jeju Airport
	RS	Air Seoul	Asiana Airlines	5964	1085448	81.87%	0.01%	Incheon International Airport
	TW	T'way Air Co. Ltd	KDIC, YeaRimDang Publishing	16512	3120768	63.80%	11.67%	Seoul Gimpo Airport
	Total			**81146**	**15302933**	**67.87%**		

Figure 1 shows the bilateral passenger traffic between the NEA countries. From 2009 to 2019, an upward trend can be observed for each country-pair. The traffic volume between China and South Korea was the largest during the period 2012-2017. However, from 2016, passenger flows between China and Korea were affected by political disputes between the two countries and recorded a huge drop in 2017. During the same study period, the bilateral traffic between China and Japan steadily increased, which surpassed those between China and Korea in 2017. This can partly ascribed to the open skies agreement signed between China and Japan in 2012. The Japan-Korea traffic volume became the largest from 2017 and kept the momentum until 2019. As can be seen from the figure, the bilateral traffic distributions among the three countries are relatively even, indicating that travels between these countries are quite intense.

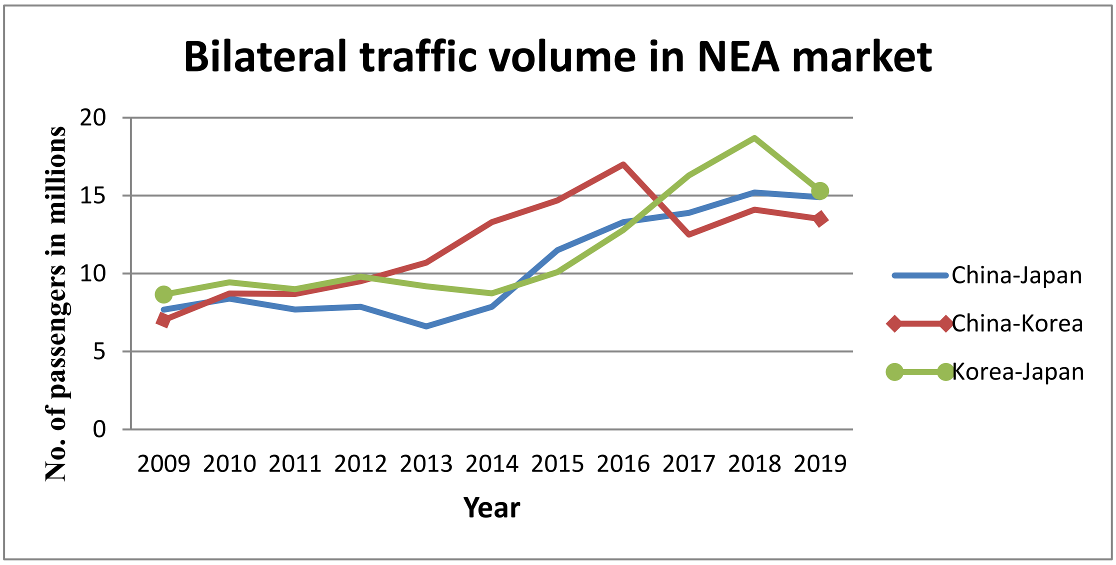

Fig. 1 Traffic volume in the NEA intra-market

Figure 2 shows that on the international routes linking the three NEA countries, FSCs' passenger traffic experienced a moderate increase from 2009 to 2019. In 2019, FSCs carried five million more passengers than in 2009. However, a negative increase can be observed in 2013 and 2017. In contrast, the number of passengers carried by LCCs recorded a much higher growth rate during the same period. The number of passengers transported by LCCs in 2019 was about 212 times larger than that in 2009. In the year to January 2019, the passenger traffic of LCCs accounted for approximately 45% of those carried by FSCs, indicating that LCCs in the NEA intra-market have played an increasingly significant role.

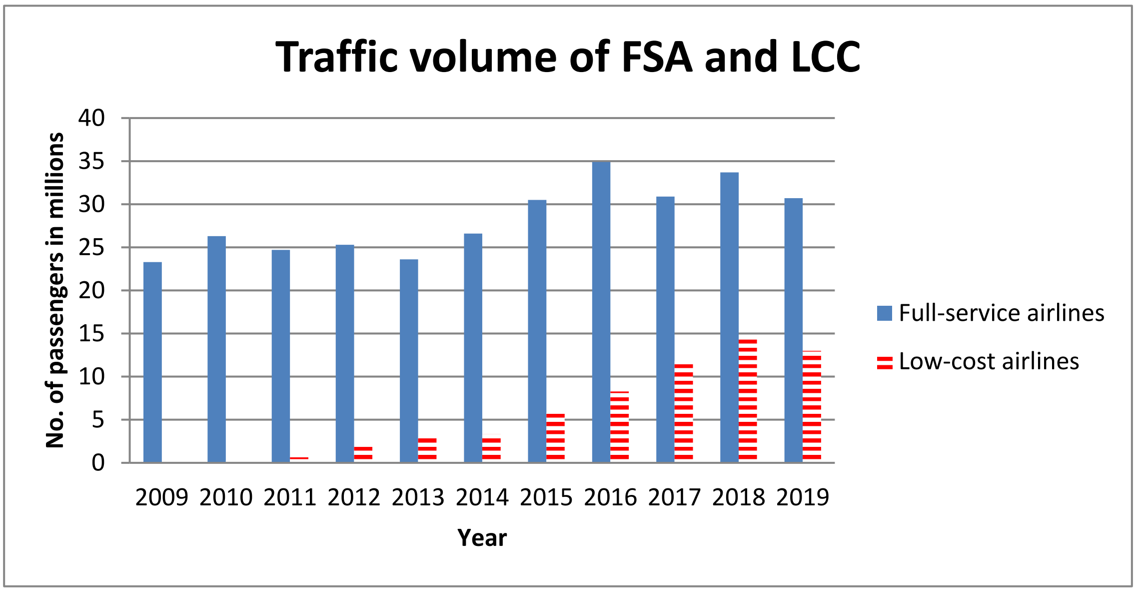

Fig. 2 Comparison of FSA and LCC traffic in NEA international markets

Figure 3 shows that on the international routes between the three countries, Korean LCCs grew at a much faster pace than their counterparts in China and Japan, particularly from 2014 to 2018. The Korean LCCs carried far more traffic than those of Japan and China, probably because they commenced international services in this region from 2009; while LCCs from China and Japan started operating in the NEA international markets from 2011 and 2012, respectively. The Chinese LCCs experienced a rapid increase in 2014 and 2015 and the traffic carried remained stable in recent years. The Japanese LCCs caught up in 2018 and the number of passengers carried was only slightly lower than that by the Chinese LCCs.

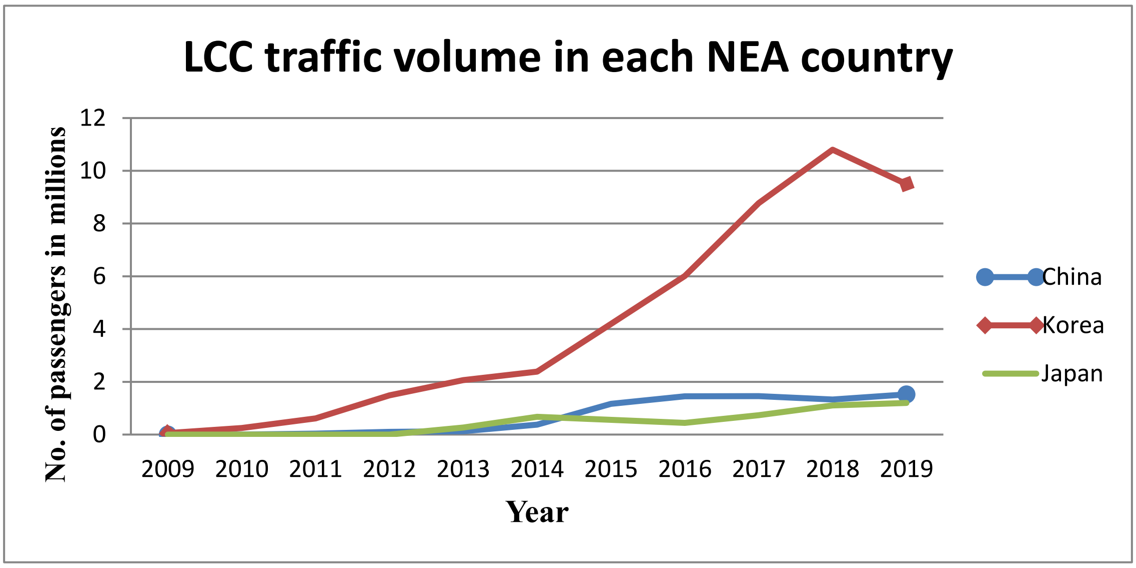

Fig. 3 Traffic volume by LCCs in each NEA country

Figure 4 to Figure 6 report the number of flights between China, Japan and Korea operated by the major FSCs. As can be seen from the figures, Air China and China Eastern recorded a decrease in the number of flights between China and Korea in recent years, which is consistent with the trend shown in Figure 1. In the China-Japan market, China's big three reported a steady increase while Japan Airlines showed a decreasing trend in the number of flights. Interestingly, JAL and ANA substantially cut their flights in the Japan-Korea market. It is likely that Korean LCCs have driven back Japan's two FSCs in this market. In fact, the top-two LCCs in this market are Korea's Jeju and Jin Air. In general, on the international routes to and from Japan, foreign LCCs have a much higher presence than the Japanese LCCs. It appears that both LCCs and FSCs have devoted a significant proportion of their capacities in the NEA market. An open skies arrangement in this region can result in significant welfare improvement not only to price-sensitive passengers, but also to price-insensitive travelers.

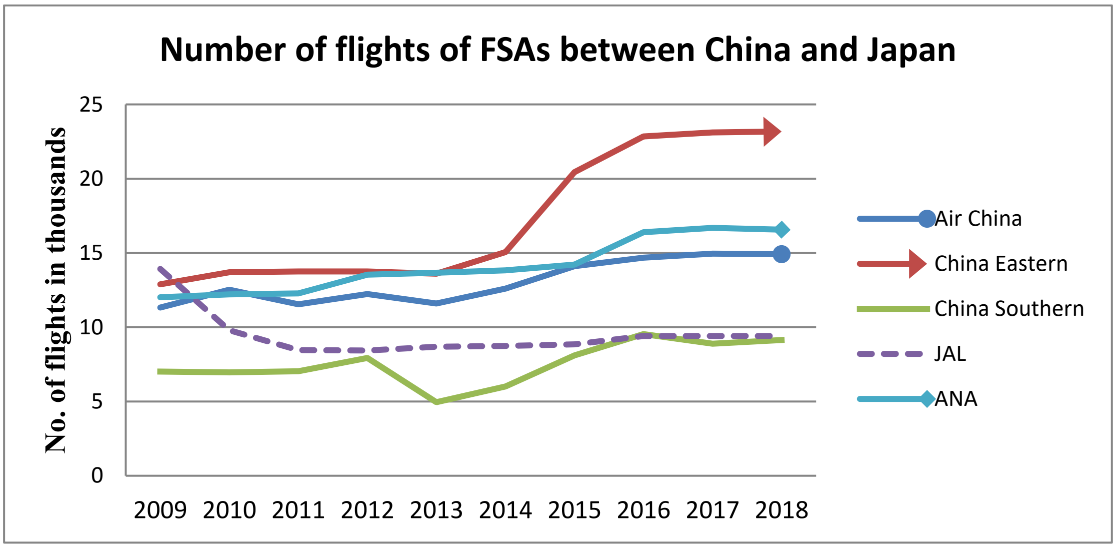

Fig.4 Number of FSC flights between China and Japan

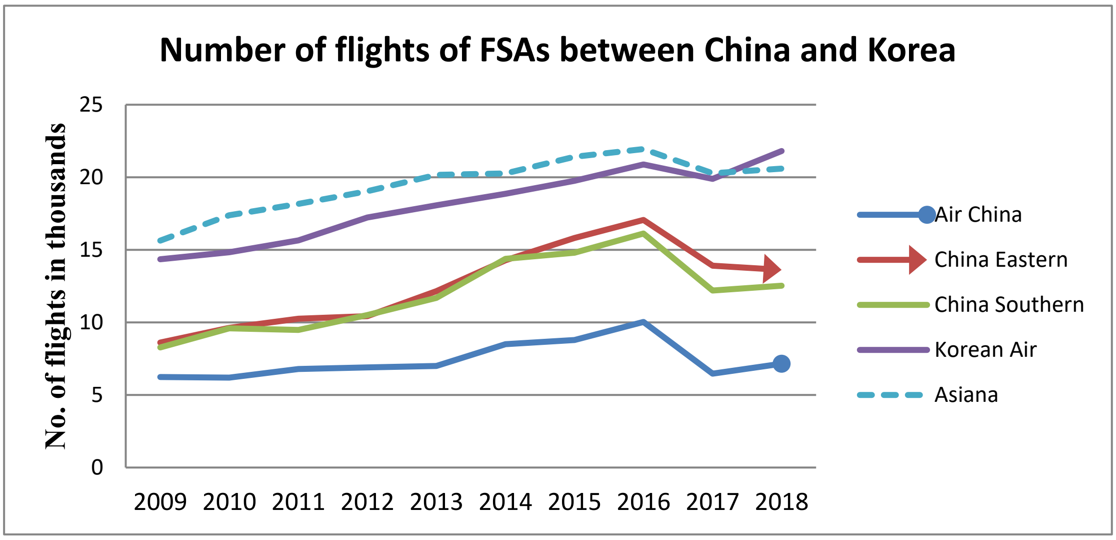

Fig.5 Number of FSC flights between China and Korea

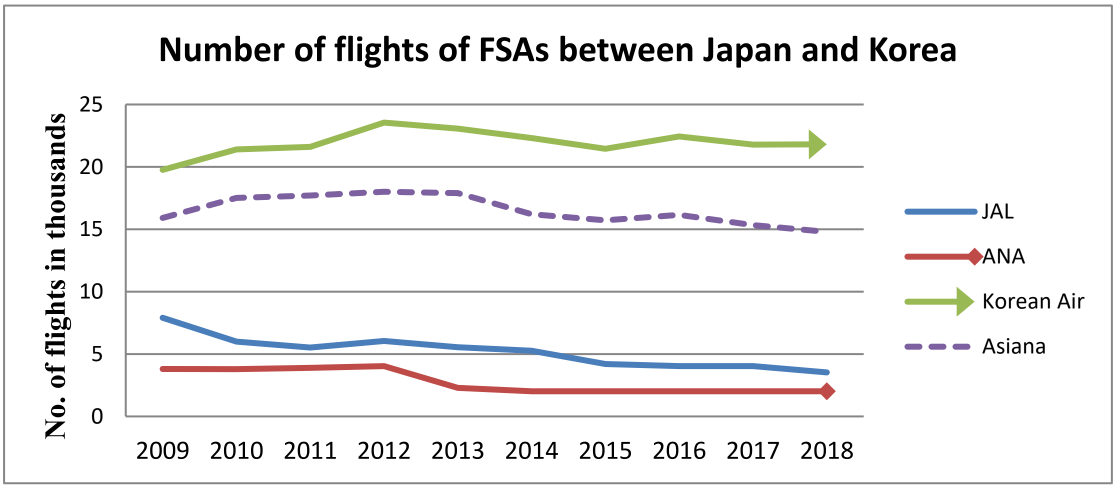

Fig.6 Number of FSC flights between Japan and Korea

4. The model

Many studies have examined the effect of LCCs on airline pricing and traffic (e.g., Windle and Dresner, 1995, 1999; Dresner et al., 1996; Morrison, 2001; Homsombat et al., 2014; Zhang, 2015; Fu et al., 2015; Zhang et al., 2017; Wang et al., 2018). In the spirit of Morrison and Winston (1995) and Fu et al. (2015), a reduced-form price and traffic equations are employed to see how the presence of LCCs in the NEA intra-market has influenced the traffic flow and airfares. We first estimate a reduced-form demand equation to examine how passenger traffic has changed as the LCCs' market share increases. Then we estimate a reduced-form price equation to investigate how the fares have changed as the LCCs' market share increases. The reduced-form traffic and price equations are in the following forms:

$$\begin{aligned} \ln Traffic_{it} = {} & \beta_0 + \beta_1 \ln AirportHHI_{it} + \beta_2 \ln AirportSize_{it} \\ & + \beta_3 lnRouteHHI_{it} + \beta_5 LCCshare_{it} + \sum\nolimits_{t=1} \omega_t \, Year_t + \boldsymbol{Z_i \nu} \\ & + \mu_i + \varepsilon_{jt} \end{aligned} \quad (1)$$

$$\begin{aligned} \ln Yield_{it} = {} & \alpha_0 + \alpha_1 \ln AirportHHI_{it} + \alpha_2 \ln AirportSize_{it} \\ & + \alpha_3 lnRouteHHI_{it} + \alpha_4 LCCshare_{it} + \sum\nolimits_{t=1} \omega_t \, Year_t + \boldsymbol{Z_i \nu} \\ & + \mu_i + \varepsilon_{it} \end{aligned} \quad (2)$$

The main variables are explained below:

- $Traffic_{it}$: the total traffic volume on route i at time t.
- $Yield_{it}$: the average yield on route i at time t. The yield is calculated by dividing the airfare by the flying distance.[6]
- $RouteHHI_{it}$: the Herfindahl-Hirschman Index (HHI) for route i at time t.
- $AirportHHI_{it}$: the geometric mean of the airport HHI at the route-end airports for route i at time t. Previous studies such as Ha et al. (2013), Yuen et al. (2017), Wang et al. (2018) and Ma et al. (2020) show that airport level HHI is an important determinant of air traffic and airfare in some Asian markets such as NEA countries and India.
- $AirportSize_{it}$: the geometric mean of the airport passenger traffic volume for route i at time t.
- $LCCshare_{it}$: the share of LCC traffic on route i at time t. The variable is further expanded to three variables: $LCCshare\_China_{it}$, $LCCshare\_Korea_{it}$ and $LCCshare\_Japan_{it}$, which represent the Chinese LCCs' share, Korean LCCs' share and Japanese LCC' share, respectively, on route i at time t.[7]
- $Year_t$: year dummies spanning from year 2009 to year 2019.
- $\boldsymbol{Z_i}$: a vector of time-invariant route-specific observable variables such as flying distance, tourism destination, hub status etc.
- μ_i: the time-invariant route specific unobservables.
- ε_{it} : the error term on route i at time t.

In the demand equation, $\mathrm{AirportHHI_{it}}$ and $\mathrm{RouteHHI_{it}}$ are used to capture the competition and concentration effects at the route and airport levels, respectively. It is expected that market traffic volume declines in less competitive markets. $\mathrm{AirportSize_{it}}$ is used to capture the market size, which also controls for the population and income effects in both demand and fare equations. Although much of the existing literature has used an LCC dummy to estimate the effect of the presence of LCC, this paper uses LCC market share. This is because LCC market shares in NEA vary substantially from one route to another (with a mean of 0.15 and standard deviation of 0.33). With air transport in this region moving to more liberalized arrangement, the LCC entry is no longer a

[6] The airfare yield data are obtained from IATA Airport Intelligence Services (AirportIS) published in US dollars.

[7] The LCC entry can be endogenous in that they may deliberately enter underdeveloped routes or low-yield markets, which implies that the impact of LCC market share on traffic can be underestimated and its impact on airfares can be overestimated in using models (1) and (2). Caution should be exercised in interpreting the results when this variable is treated as exogenous, although when we use the lagged value of the LCC market share variable to mitigate the likely endogeneity problem, the results do not differ much.

concern and our focus is thus mainly on how the degree of LCC penetration affects air traffic and yields. Therefore, $\mathrm{LCCshare}_{it}$ is used to capture the impact of LCCs' market share on the traffic and prices. Year_t is a vector capturing yearly specific unobserved factors. μ_i is the time-invariant route specific unobservables. They might be correlated to market prices and traffic flows. Therefore, they are controlled for by applying individual fixed effects. Z_i is a vector of time-invariant route-specific observable variables that would be omitted when applying the individual fixed effects.

5. Empirical results

The estimation results are shown in Tables 3 and 4. Table 3 reports the impact of LCCs' market share on the passenger traffic. The dependent variable is the total passenger traffic on the international routes between China, Japan and Korea. The second, third and fourth columns focus on the China-Japan, China-Korea and Japan-Korea, respectively. In general, a 10% rise in the LCC market share can significantly increase the total passenger traffic in the NEA intra-market by 2.5%[8] on average. In the China-Japan market, a 10% rise in the market share of Chinese LCCs leads to an increase in passenger flows by 6.92%; a 10% rise in the market share of Japanese LCCs can result in an increase in bilateral passenger traffic between China and Japan by 7.87%. If Chinese LCCs' market share increases by 10%, then China-Korea's bilateral passenger traffic is expected to increase by 4.52%; similarly, if Korean LCCs' market share increases by 10%, there will be an increase of the bilateral passenger traffic by 2.28% in the China-Korea market. Lastly, in the Japan-Korea market, a 10% increase in the market share of Japanese LCCs and Korean LCCs will boost the Japan-Korea bilateral passenger traffic by 4.84% and 3.55%, respectively.

According to these results, it appears that the development of Chinese LCCs and Japanese LCC can contribute to a higher traffic flow in NEA, particularly in the China-Japan market. The marginal benefit brought about by the increase in Korean LCCs' share is relatively smaller, probably because they have already had a heavy presence in this market. To further test this result, we replace the LCCshare variable with the LCC dummy and the results remain highly consistent[9].

Table 3 The estimation results of demand equations

	(1)	(2)	(3)	(4)

[8] It is calculated by 1-exp(-0.2833). The impacts of "LCCshare_China", "LCCshare_Japan" and "LCCshare_Korea" are calculated in a same way.

[9] To save space, results using LCC dummy are not reported but are available upon request.

VARIABLES	All lnTraffic	CNJP lnTraffic	CNKR lnTraffic	KRJP lnTraffic
LCCshare	0.2833***			
	(0.0795)			
lnRouteHHI	-0.9401***	-0.8451***	-1.0050***	-0.9709***
	(0.0504)	(0.0778)	(0.0832)	(0.0962)
lnAirportHHI	-0.4554***	-0.5813***	-0.5904***	0.2384
	(0.0971)	(0.1503)	(0.1212)	(0.1750)
lnAirportsize	0.6004***	0.4977***	0.4993***	0.8943***
	(0.0478)	(0.0604)	(0.0769)	(0.1794)
LCCshare_China		1.1781***	0.6006***	
		(0.2421)	(0.1441)	
LCCshare_Japan		1.5471***		0.6608***
		(0.2272)		(0.1931)
LCCshare_Korea			0.2594**	0.4391***
			(0.1152)	(0.1608)
Constant	13.6676***	14.8360***	16.4434***	5.1664**
	(0.9936)	(1.5900)	(1.3213)	(2.5892)
Observations	6,887	3,409	2,338	1,140
R-squared	0.3633	0.4093	0.4640	0.3566
Number of markets	1,193	586	408	199

1. Robust standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. The results of year dummies are not reported to save space.

The signs and coefficients of the other variables are as expected. The route level HHI represents the degree of concentration on a given route. The coefficients of this variable are consistent and significant in all four columns. The results show that higher market concentration is associated with lower passenger flows. The airport level HHI represents the degree of concentration of the airport. The higher the airport concentration, the more difficult for new airlines to enter the airport, and the smaller the total passenger volume. Introducing new LCCs and granting international flying rights to existing LCCs can effectively enhance competition, thereby boosting passenger traffic. Airportsize captures the effects of population and income of the airport catchment. The positive sign of Airportsize indicates that passenger traffic is positively associated with the size of the airport catchment and the level of the standard of living.

Table 4 reports the impact of LCCs' share on yields. The first column of the table shows that a 10% increase in the LCC market share can significantly reduce the yields in the NEA markets by 3.08%. Columns (2), (3) and (4) analyze the China-Japan, China-Korea market, and Japan-Korea markets, respectively. In the China-Japan market, a 10% increase in the market share of Chinese LCCs and Japanese LCCs can reduce the market yields by 5.79% and 3.96%, respectively. In the China-Korea market, a 10% rise in the market share of Chinese LCCs and Korean LCCs leads to a decline in fares by 4.31% and 4.61%, respectively. In the Japan-Korea market, an increase of 10% in the market share of Japanese LCCs and Korean LCCs will result in a decrease in the yields by 2.91% and 1.13%, respectively. These results suggest that the development of Chinese LCCs between China and Japan can bring down the prices by the largest percentage, followed by the development of Korean LCCs in the China-Korea market.

RouteHHI is significantly positive in Columns (2) and (4), indicating high route concentration is positively associated with yield in China-Japan market and Korea-Japan market. AirportHHI is not significant. Market power associated with airport dominance is confirmed in Borenstein (1989), Morrison and Winston (1989), Berry (1990), and Evans and Kessides (1993). However, other studies suggest that such effects might have been overstated in the absence of controlling for factors such as the presence of LCCs (Morrison and Winston, 1995). Borenstein (2012) shows that in the last two decades, the impact of airport dominance has declined and can become negative.

The negative sign of the LCC market share in the price equation and the positive sign in the demand equation are consistent with previous literature such as Dresner et al. (1996) and Morrison (2001). However, in China's domestic market, Wang et al. (2018) found that the LCC share variable does not have a significant effect of reducing the prices and promoting passenger traffic. Ma et al. (2020) argue that as China's aviation policy is overly protective of the state-owned airlines, Chinse LCCs cannot easily enter most of the profitable markets. At this stage, Chinese LCCs are only fringe players that are unlikely to have a profound impact on the airline industry. However, this research shows that in the international market, they are effective competitors and have a remarkable influence on the route-level fares and traffic. Akgüç et al. (2018) also note that LCC fares are found to be about 40% cheaper on international flights than the FSA fare and 20% cheaper on domestic flights. Offering lower fares is actually the key contribution of LCCs in connecting people and places.

Table 4 Estimation results of the price equation

VARIABLES	(1) All lnyield	(2) CNJP lnyield	(3) CNKR lnyield	(4) KRJP lnyield
LCCshare	-0.3683***			
	(0.0423)			
lnRouteHHI	0.0333	0.0822***	-0.0301	0.1387***
	(0.0268)	(0.0302)	(0.0419)	(0.0346)
lnAirportHHI	-0.0421	-0.0085	0.0902	0.0025
	(0.0428)	(0.0496)	(0.0592)	(0.0607)
lnAirportsize	0.0846***	-0.0318	0.0605	0.1342**
	(0.0262)	(0.0286)	(0.0441)	(0.0538)
LCCshare_China		-0.8642***	-0.5633***	
		(0.0738)	(0.1045)	
LCCshare_Japan		-0.5036***		-0.3443***
		(0.1115)		(0.0758)
LCCshare_Korea			-0.6177***	-0.1198***
			(0.0633)	(0.0357)
Constant	-2.2699***	-1.3113**	-2.7824***	-4.1946***
	(0.4687)	(0.5388)	(0.7344)	(0.8933)
Observations	6,887	3,409	2,338	1,140
R-squared	0.5499	0.7265	0.4694	0.6592
Number of markets	1,193	586	408	199

1. Robust standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. The results of year dummies are not reported to save space.

One issue worth noting is that route level HHI may cause endogeneity concern in both traffic and price equations. We use two methods to cope this issue. First, we replace routeHHI with its one-period lagged value. Second, we apply the classical instrument introduced by Borenstein (1989): routeHHI is instrumented by the square of the fitted value of route market share (from its first-stage regression) plus the "rescaled" sum of the squares of all other carriers' shares as follows:

$$\text{IRUTHERF}=\widehat{RouteShare}^2 + \frac{RouteHHI-RouteShare^2}{(1-RouteShare^2)} * (1-\widehat{RouteShare})^2 \quad (3)$$

We apply above instruments to equations (1) and (2) and the results are largely consistent with the results without using instruments, indicating endogeneity issue associated with RouteHHI is not a big concern of this paper. The results are presented in Tables 5 and 6.

Table 5 Estimation results of the traffic equation considering endogeneity associated with RouteHHI

	Using one-period lagged value of routeHHI				Using instrument proposed by Borenstein (1989)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	All	CNJP	CNKR	KRJP	All	CNJP	CNKR	KRJP
VARIABLES	lnTraffic	lnTraffic	lnTraffic	lnTraffic	lnTraffic	lnTraffic	lnTraffic	lnTraffic
L.lnRouteHHI	-0.4728***	-0.3780***	-0.4479***	-0.8015***				
	(0.0498)	(0.0856)	(0.0735)	(0.0782)				
lnRouteHHI					-0.9403***	-0.8451***	-1.0050***	-0.9708***
					(0.0312)	(0.0430)	(0.0510)	(0.0804)
lnAirportHHI	-0.8341***	-0.8179***	-0.9592***	-0.2414	-0.4553***	-0.5813***	-0.5904***	0.2383*
	(0.1011)	(0.1628)	(0.1332)	(0.1913)	(0.0552)	(0.0806)	(0.0847)	(0.1412)
LCCshare	0.4708***				0.2833***			
	(0.0889)				(0.0412)			
LCCshare_China		1.5913***	0.6883***			1.1781***	0.6006***	
		(0.2564)	(0.1613)			(0.1157)	(0.1073)	
LCCshare_Japan		1.5146***		0.5308***		1.5471***		0.6608***
		(0.2184)		(0.1811)		(0.2008)		(0.1765)
LCCshare_Korea			0.4695***	0.4944***			0.2594***	0.4391***
			(0.1536)	(0.1614)			(0.0683)	(0.0831)
lnAirportsize	0.5766***	0.5106***	0.5115***	0.5109***	0.6004***	0.4977***	0.4993***	0.8943***
	(0.0561)	(0.0713)	(0.0866)	(0.1704)	(0.0360)	(0.0470)	(0.0595)	(0.1252)
Constant	13.1127***	12.6365***	14.7202***	12.8259***	13.6683***	14.8360***	16.4434***	5.1663**
	(1.1247)	(1.7898)	(1.6664)	(2.6263)	(0.6831)	(0.9590)	(1.0712)	(2.0794)

Observations	5,464	2,719	1,837	908	6,887	3,409	2,338	1,140
R-squared	0.3148	0.3850	0.3689	0.3943				
Number of markets	955	478	325	152	1,193	586	408	199

1. Robust standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. The results of year dummies are not reported to save space.

Table 6 Estimation results of the price equation considering endogeneity associated with RouteHHI

	Using one-period lagged value of routeHHI				Using instrument proposed by Borenstein (1989)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	All	CNJP	CNKR	KRJP	All	CNJP	CNKR	KRJP
VARIABLES	lnYield	lnYield	lnYield	lnYield	lnYield	lnYield	lnYield	lnYield
L.lnRouteHHI	0.0023	0.0689**	-0.0145	0.0294				
	(0.0244)	(0.0323)	(0.0375)	(0.0346)				
lnRouteHHI					0.0334*	0.0822***	-0.0301	0.1388***
					(0.0175)	(0.0222)	(0.0282)	(0.0346)
lnAirportHHI	-0.0162	0.0003	0.1006*	0.0535	-0.0421	-0.0085	0.0902*	0.0024
	(0.0423)	(0.0544)	(0.0539)	(0.0653)	(0.0309)	(0.0416)	(0.0468)	(0.0607)
LCCshare	-0.3855***				-0.3682***			
	(0.0439)				(0.0231)			
LCCshare_China		-0.8053***	-0.6834***			-0.8642***	-0.5633***	
		(0.0775)	(0.0894)			(0.0597)	(0.0593)	
LCCshare_Japan		-0.5022***		-0.3413***		-0.5036***		-0.3443***
		(0.1093)		(0.0896)		(0.1036)		(0.0758)

LCCshare_Korea			-0.6287***	-0.0877**			-0.6177***	-0.1198***
			(0.0753)	(0.0364)			(0.0377)	(0.0357)
lnAirportsize	0.0816***	-0.0561*	0.1365***	0.1282**	0.0846***	-0.0318	0.0605*	0.1342**
	(0.0296)	(0.0315)	(0.0491)	(0.0622)	(0.0202)	(0.0242)	(0.0329)	(0.0538)
Constant	-2.1101***	-0.9047	-3.9167***	-3.5269***	-2.2703***	-1.3113***	-2.7824***	-4.1947***
	(0.5025)	(0.5927)	(0.8033)	(1.0735)	(0.3827)	(0.4951)	(0.5918)	(0.8933)
Observations	5,464	2,719	1,837	908	6,887	3,409	2,338	1,140
R-squared	0.5649	0.7161	0.5139	0.6861				
Number of markets	955	478	325	152	1,193	586	408	199

1. Robust standard errors in parentheses
2. *** p<0.01, ** p<0.05, * p<0.1
3. The results of year dummies are not reported to save space.

6. The interdependence of LCC development and the single aviation market in NEA

The purpose of this section is to establish the link between the LCC sector and the development of a single aviation market in NEA. We show that they share some common barriers, and that removing these barriers will facilitate the growth of the LCC market and the establishment of a single aviation market in NEA. We argue that a single aviation market will in turn boost the LCC sector as well as the interests of the whole aviation industry. ,

6.1 Common barriers for the development of LCC market and aviation integration in NEA

Despite the growing awareness of economic interdependence and globalization, there is a lack of significant formal institutionalization at the NEA level that allows the EU type process to take place for a single aviation market (Zhang, 2005). Nevertheless, there have been attempts to negotiate a China-Japan-Korea Free Trade Agreement (FTA) to allow the flows of goods and services across borders. However, the air transport sector has been largely ignored and the possibility of establishing a single aviation market in NEA has been rarely mentioned, although more liberal air transport arrangements have been struck bilaterally between the countries. Zhang (2005) identified various forms of barriers preventing the NEA sky from open at the regional level, including regulatory and institutional barriers, infrastructure and financial barriers, technical barriers, etc. Most of these barriers still exist today, which not only restrict the development of a single aviation market in NEA, but also limit the growth of the NEA LCC sector.

In all the NEA countries, infrastructure constraint has been pointed out as a major barrier to market liberalization. The majority of large airports in Northeast Asia are heavily congested, making it very difficult for LCCs to get ideal slot time. In particular, the slot limitation at the Narita airport has been noted for a long time as the single most important barrier against expanding air services to/from Japan. There are no concerted rules in NEA for slot allocation to ensure transparency with a consideration of the needs of new entrants, particularly the LCCs. For example, there is a lack of transparency for China's airport slot allocation process (Zhang and Zhang, 2017). Market mechanisms for airport slot allocations have been tried out at Shanghai and Guangzhou airports for a more efficient utilization of scarce airport capacities, but good slot time has become too expensive and unaffordable to LCCs.[10] IATA's Worldwide Slot Guidelines (WSG) can be adopted as a reference base for NEA. These guidelines serve as a good foundation upon which the slot allocation process works for the benefit of airlines, airports and the passengers.

NEA had the tradition of protecting the traditional flag FSCs. Oum and Lee (2002) note that Japan had a passive attitude towards international air service liberalization. However, its aviation policy was dramatically changed in 2007 from protectionism to liberalization with an aim to develop itself as the Asian gateway (Lee, 2016). In the following years, it concluded open skies or quasi-open skies with Korea, the US and China. In October 2003, CAAC declared that it would liberalize its international air transport sector with a "proactive, progressive, orderly and safeguarded" approach (Lei and O'Connell, 2011). Lei et al. (2016) note that a fundamental change since 2003 was that the interests of the state-owned carriers would no longer be the sole consideration when the government negotiated traffic rights with foreign countries. However, so far China's LCC sector has not had a fair share in the international markets. Priorities are still given to the state-owned carriers in allocating international flying rights. Among the NEA countries, Korea is the most active negotiator in seeking open-skies agreements, probably due to its small domestic market. Therefore, it seems that the main obstacle to a single aviation market lies in the attitude of China. However, this attitude could soften in the near future with the advent of the China-US trade war and protectionism threat, the dramatic development of high-speed rail, and the recent Wuhan coronavirus crisis at China would have a greater incentive to find new markets for the large number of domestic carriers (about 60 in 2019). As noted in Oum and Lee (2002, p. 326) for the Korea experience, "once a government allows new carriers to emerge, invariably they feel obligated to keep them alive and help them grow". Furthermore, as noted by Jiang and Zhang (2016) and Wan et al. (2016), with the competition from HSR in the domestic market, Chinese carriers would have a greater incentive to develop their international markets. In addition, HSR could become an effective feed for these carriers which improve their competitiveness in international markets.

[10] Nine slots at Guangzhou Baiyun Airport were actioned in 2015 for 550 million yuan and these slots went to the state-owned carriers and their subsidiaries (Zhang and Zhang, 2017). IATA opposes slot auctions because those who can afford the price may not use the slots efficiently and in the best interests of airports and passengers.

6.2 LCC development accelerates economic integration in NEA

The presence of LCCs in the international market is not simply about a trip for vacations or visiting a second home, but also facilitates working far from home (Button and Vega, 2008). Therefore, Akgüç et al. (2018) argue that LCCs affect the quantity of movement, and at the same time change the nature or type of movement of workers. They make within-country and cross-border commuting more convenient, which facilitates post-migration travel to visit family and friends, thereby contributing to the integration of Europe (Akgüç et al., 2018). Similar effects have been observed in other parts of the world. For example, ASEAN LCCs commanded 48% of the total airline seat capacity in 2018, the second highest in the world after South Asia's 51% (Dy, 2019). The rise and prosperity of LCCs throughout ASEAN have transformed the aviation landscape of this region. They provide an important opportunity for pushing for and speeding up regional airline competition and liberalization (Zhang, 2008). The ASEAN LCCs have already achieved a strong penetration on the routes to and from NEA and changed the competitive landscape. The findings of this research point to a similar direction: the NEA LCCs have had an impact on the air transport sector and can make a significant contribution to the development and integration of the NEA economies.

6.3 A single aviation market boosts the LCC sector and strengthen the interests of whole aviation industry in NEA

In the meantime, a single aviation market can accelerate the growth of the LCC sector in NEA. Most of the NEA LCCs are short-haul routes and focus on point-to-point routes. Currently there have been few successes for long-haul LCCs as the cost advantage due to faster aircraft turnarounds will disappear for long-haul routes (Akgüç et al., 2018). The European experience shows that the optimum market niche for LCCs is intra-European continental flights (Castillo-Manzano and Marchena-Gomez, 2010). A single aviation market in NEA will unleash the potential of LCCs: most of routes between the three countries are short-haul routes; there are many secondary airports in China and Japan allowing for more point-to-point services and for more rotations per day as well as higher aircraft and crew utilization.

With globalization and the continued reduction of transportation and communication costs, international rivalry now occurs not only between individual countries, but also between regional blocs. In the EU and North America – the two most important regional blocs – reliable and efficient transport services have played a key role in strengthening and improving the competitiveness of their industrial bases. The EU member states used to have their own bilateral agreements with third countries which tend to favor legacy carriers over new entrants such as LCCs (Akgüç et al., 2018). The EU Internal Aviation Market that was born back in 1992 requested the EU member states to act in close cooperation and coordination with the European Commission when negotiating bilateral agreements with non-EU countries. As a result, more than 1000 bilateral agreements have been amended to comply with EU law to allow for attributing international traffic right in a transparent and non-discriminatory way to all EU carriers (Akgüç et al., 2018). Apart from signing open-skies with the US and Canada on behalf of its member states, the EU has reached agreements with the Western Balkans, Georgia, Israel, Jordan, Moldova, and Morocco to build the European Common Aviation Area that aims to integrate EU's neighbors into the EU single aviation market. These moves will ensure that the EU remains to be a leading player in the global aviation market. It is important, therefore, to consider creating NEA a single aviation market and taking a unified, concerted approach towards the continental blocks and major aviation partners. This is because the fragmented, incremental approach by each NEA country towards the EU and its constituent member states might be suboptimal for the NEA as a unit, as opposed to a unified, strategic approach. With a unified approach, the NEA region also has a larger room to undertake "give-and-take" negotiations in terms of the size of its own internal market. In addition, a unified approach may be a more strategic and effective way to deal with the potential of a "divide and conquer" strategy (Zhang, 2008).

A unified approach can also be used to deal with ASEAN. ASEAN is one of the world's fastest growing emerging markets. In 2010, ASEAN signed the ASEAN-China Air Transport Agreement to establish an unlimited air service arrangement (passengers and cargo) between China and ASEAN members. Traditionally, air transport services between ASEAN and China were offered by the flag carriers, and they only operated flights serving gateway cities. The open-skies agreement allowed both flag and non-flag carriers, particularly LCCs, to increase flight frequency and offer flights to many second- and third- tier cities. As a result, air connectivity between ASEAN and China has increased substantially. The number of flights operating between the two parties increased from 862 a week in 2010, to 1,000 a week in 2013. In 2017, this number exceeded 5,000 (Law et al., 2018). LCCs from China and ASEAN made a major contribution to these increases.

ASEAN and NEA are very much interdependent and bilateral activities are significant. In particular, the ASEAN may serve as the NEA's "hinterland" when it tries to compete with North America and the EU. A strong presence in the ASEAN market would allow NEA carriers to rationalize the intra-East Asian operation and reduce costs, as there exist significant network economies of feeder-trunk traffic (Clougherty, 2002, 2006; Zhang et al., 2008; Clougherty and Zhang, 2009). It would also be important for regional hubs such as Incheon, Tokyo, Shanghai, Hong Kong, and Singapore to become world-class aviation hubs (Chang et al., 2020; Cheung et al., 2020). Finally, there will be mutual gains from the integration, particularly in facilitating the development of LCCs. The main disadvantage of LCCs in Asia is the smaller geographic areas of domestic economies while confronting an array of regulatory constraints and barriers in intra-Asia markets (Zhang et al., 2008). A liberal market including NEA and ASEAN will open up numerous secondary city-pair markets in the region. These are the markets where FSCs tend not to operate, but LCCs can thrive with their business model.

7. Conclusion

There has been much research arguing for a China-Japan-Korea FTA due to the large benefits to the three countries and on the important implications for global multilateral trade (Madhur, 2013). Indeed, these countries have actively engaged in many rounds of talks negotiating this deal. However, the air transport sector has been largely ignored and the possibility of establishing a single aviation market in NEA has been rarely mentioned. This paper examines the development of NEA LCCs and reveals their contributions to the increase in passenger traffic and the reduction in airfares in the markets between China, Japan and Korea. We argue that a single aviation market can facilitate the growth of the LCC sector, which in turn will make a significant contribution to the NEA's connectivity, mobility and integration. In addition, with a single aviation market, NEA countries can adopt a proactive, unified approach in negotiating air transport agreements with the major aviation partners to maximize the interests of this region as a whole. A unified approach would prove to be essential in the global competition among mega-regional blocs.

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