https://doi.org/10.1016/j.tranpol.2021.12.006

Japanese Aviation Market Performance during the COVID-19 Pandemic

- Analyzing airline yield and competition in the domestic market

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Abstract

The Japanese aviation market experienced significant changes in the past decade, with a few entrant low-cost carriers (LCCs) changing the duopoly by the two dominant full-service airlines (FSAs) of Japan Airlines and All Nippon Airways. However, the major disruptions caused by the COVID-19 pandemic might change industry development trajectory. This study provides an updated review of the development and performance assessment of the Japanese domestic market, with a focus on the effect of the COVID-19 pandemic on airlines' capacity, frequency, yield and competition using data from 2019 to 2020. Special efforts are dedicated to investigating whether there is significant asymmetry between FSAs and LCCs across different types of routes. Our empirical results suggest that the pandemic did impose significant negative effects on airline yield, scheduled seats and frequency. Such effects were different across mainline vs. regional routes, with FSAs still maintaining much of their dominance. The two leading FSAs' duopoly appears to be strengthened, whereas the market share of the third-largest carrier, Skymark Airlines, shrank significantly towards the end of 2020. Regional routes' sustainability has been further challenged to the extent that more resources may have to be allocated to maintain regional connectivity until sustainable recovery of travel demand. Entrant LCCs continue to put downward pressure on yield, but their contribution to overall market competition may be moderated by their affiliations with the two dominant FSAs under the so called airlines-within-airlines strategy. Affiliated LCCs could strengthen, instead of reducing, the dominance of the duopoly JAL and ANA over independent airlines in the Japanese domestic market. The government should ensure that there are no entry barriers blocking independent entrants to the market.

Keywords: COVID-19; low-cost carrier; Japanese aviation market; airlines-within airlines strategy; airline competition

1. Introduction

The Japanese aviation market has been dominated by the duopoly of Japan Airlines (JAL) and All Nippon Airways (ANA) for extended periods, but experienced significant changes in the past decade with the entrance of a few competitive low-cost carriers (LCCs). As of 2010, the largest LCC in Japan was Skymark Airlines which only secured a market share of 5% in terms of RPK. The two dominant full-service airlines (FSAs), ANA and JAL, controlled a total of more than 80% of the market. Such a situation started to change with a few competitive LCCs commencing operation between 2012 and 2014, which gained a sizable market share within 5 years (CAPA, 2018b). The combined market share of JAL and ANA declined from 94% in 2006 to 83% in 2012, then further to 78% in 2016 (CAPA, 2018a). The introduction of LCCs has not only increased competition and lowered fares in the aviation market, but also contributed to the growth of passenger volume in Japan since 2012 (PRILIT, 2014; Hanaoka, 2018). Domestic passenger volume had grown substantially from 84 million in 2010 to 106.8 million in 2019, with average load factor improved from 64.6% to 73.8%.

Such a growth pattern however has been significantly disrupted by the major shocks caused by the COVID-19 pandemic. LCCs provide simple, differentiated services compared to FSAs with lower costs. As a result, LCCs can often compete with significantly lower fares and lead to strong traffic growth. Such a pattern has been consistently observed in the aviation markets in North America, Europe and recently in Asia (Windle and Dresner, 1995; Dresner et al., 1996; Morrison, 2001; Alderighi et al., 2004; Franke, 2004; Gillen and Lall, 2004; Doganis, 2005; Zhang et al., 2008; Fu et al., 2011; Fu et al., 2015a; Wang et al., 2017). On the other hand, it has been pointed out that because of LCCs' reliance and sensitivity to lower costs, an identical cost increase will be more likely to harm them more than FSAs (Fu et al., 2006; Oum and Fu, 2007). In addition, FSAs can achieve economies of density by combining traffic via hub-and-spoke networks. In comparison, LCCs typically operate point-to-point networks without offering extensive connection services (Zhang and Wei, 1993; Brueckner and Spiller, 1994; Hendricks et al., 1995, 1999; Brueckner and Zhang, 2001; Fu et al., 2019). It is not clear whether the pandemic would bring asymmetric impacts to FSAs and LCCs. On the one hand, FSAs might be the major losers because of the aggregate effects of the reduction in long-haul travel, erosion of hub-and-spoke operations and extra control over connection services. On the other hand, LCCs may be suffered even more due to the reduction of leisure travel and price sensitive customers, which are their main target segments. Moreover, Japan has extensive rail services in the inter-city market which offers a competitive alternative to air transport (Fu et al. 2014). Because rail investments are largely sunk (i.e., cannot be easily switched to other routes), a rail operator will have to continue its operation on a route even if it is not profitable in the short term. In summary, the COVID-19 pandemic brought unprecedented challenges to the aviation sector, which could potentially change the industry development trajectory. It is far from clear what kind of "new normal" will emerge post-pandemic.

To control the spread of the COVID-19 pandemic, various containment measures have been imposed by governments. Restrictions of passenger movement, especially cross country travel bans, caused significant disruptions in the international markets. Some studies proposed methods to gauge the risks of imported COVID-19 cases associated with international flights (Zhang et al., 2020; Yang et al., 2021). In theory, border measures can be adjusted dynamically to mitigate the negative impacts of various travel restrictions. Studies also found that the COVID-19 pandemic had changed air travelers' behaviors, such as conservative ticket booking, avoidance of physical activities etc. (Zhang et al., 2021a; Zhang et al., 2021b). Since air transport not only contributes to the national economy directly in terms of employment and tax revenue but also plays important roles in regional development by providing essential inputs to other sectors such as trade, logistics, and tourism (Fu et al., 2021; Salesi et al., 2021; Tsui et al., 2021), a healthy recovery of the aviation sector is of critical importance. Although the pandemic's negative impacts on air travel demand are expected, the specific effects on airline network and connectivity, airline dominance and competition, airport performance are not yet fully analyzed. There are some promising signs of market recovery in selected countries, but there is significant heterogeneity across markets, with much uncertainty remains in terms of the strength of recovery and patterns of the "new normal" to emerge post-pandemic (Czerny et al., 2021). Compared to other aviation markets in Asia, the Japanese domestic market exhibited some special features such as the dominance of rail services in major city-pairs including the most important transport corridor along the Tokyo-Nagoya-Osaka region, low penetration but accelerated LCC growth, and duopoly FSAs that have effective control of competitive LCCs. Detailed analysis of this market not only helps the aviation industry and policy-makers to better prepare for the post-pandemic era in Japan, but also contributes to a better understanding of aviation recovery toward a more resilient industry structure in general (Sun et al., 2021). This study therefore aims to provide an updated view of the Japanese domestic aviation market, with a focus on the effect of the COVID-19 pandemic on airlines' capacity, frequency, yield and competition. Special efforts are dedicated to investigating whether there is significant asymmetry between FSAs vs. LCCs, in the presence of strong competition from high-speed rail services in selected routes. The competitive effect of the airline-within-airline strategy employed by JAL and ANA on the third-largest domestic carrier in Japan, Skymark Airlines (ICAO code: SKY, hereafter referred to as Skymark) is also examined. Such an analysis reveals how airlines adjusted their operations amid the evolving pandemic and market dynamics, and whether specific market segments are better positioned in the forthcoming new normal.

The rest of the paper is organized as follows: Section 2 presents an updated overview of the Japanese domestic market including a descriptive summary of the impacts imposed by the COVID-19 pandemic on Japanese airlines. Section 3 reports the details of the data and methodology used for the empirical study on yield with detailed results. The effect of the airline-within-airline strategy used by JAL and ANA on Skymark was also investigated. The last session summarizes and concludes.

2. The Japanese domestic market development and pandemic disruptions

Japan has the third-largest domestic aviation market in Asia, accounting for 1.1% of the world share in 2019[1]. For the analysis of this important market, this section first reviews the market development in the past decade, notably the growth of LCCs. This is followed by an updated review of market competition and airline networks, and a qualitative impact analysis of the COVID-19 pandemic.

2.1. Duopoly market with LCC growth in the past decade

The Japanese domestic aviation market has been dominated by Japan Airlines and All Nippon Airways which collectively controlled more than 70% of the domestic market in terms of available seat kilometers (ASK) in 2019.[2] This market structure has been sustained for an extended period. There were only three FSAs, namely JAL, ANA, and Japan Air System[3] before the Ministry of Transport relaxed its regulation on the domestic market in 1997, which allows new entrant airlines to compete with the incumbent carriers.[4] Air Do was established in 1996 and commenced operations in 1998, entering the busiest domestic route between Sapporo and Tokyo. Skymark Airlines also started operations in 1998, using the Tokyo Haneda airport as its operational base for services between Tokyo and Fukuoka. Skymark and Air Do initiated services with significantly lower fares vs. competitors and achieved high load factors. This has triggered significant volume growth on the two routes (Yamaguchi et al., 2001). Following entrants StarFlyer and Solaseed Air (formerly Skynet Asia), were formed after 2000 and entered the Tokyo-Kitakyushu and Tokyo-Miyazaki routes, respectively. Despite the low fares offered upon route entries, prices rebounded to levels higher than their pre-entry price in multiple routes. This led to questions on their competitiveness and contribution to social welfare (Murakami, 2009).

Although these early entrant airlines claimed to be LCCs, their average costs were almost comparable to FSAs (Murakami et al., 2015). The Japanese government nevertheless continued the supportive policy, building low-cost terminals in Tokyo Narita and Osaka Kansai airports. A few more LCCs commenced operation between 2012 and 2014 as summarized in table 1, notably Jetstar Japan, Peach Aviation, Vanilla Air, Spring Airlines Japan and AirAsia (as reported in the table, Vanilla merged with Peach in 2019, and AirAsia Japan ceased operations in 2020). These airlines seem to be more competitive with lower costs compared to previous entrant carriers and have been referred by some researchers as “genuine” LCCs. In comparison, Skymark Airlines is classified as an FSA by CAPA while categorized as an LCC by ICAO. A similar issue appears for Air Do, Solaseed Air and StarFlyer. For better discussion and reference, we name these four early entrants as “emerging” airlines while the five recently established airlines (i.e. Jetstar Japan,

[1] IATA Air Passenger Market Analysis 2019
[2] Compiled by author with OAG data
[3] The carrier ceased operation in 2006 and merged into JAL.
[4] The Ministry of Transport merged into the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2001.

Peach Aviation, Vanilla Air, AirAsia Japan and Spring Airlines Japan) as LCCs as categorized by CAPA. Other than these airlines, there are a few "regional airlines".[5] They provided only 2.4% available seat kilometers (ASKs) in 2019, mainly connectivity between hubs and remote regions. With these entries the market share of the JAL and ANA duopoly declined from 94% in 2006 to 83% in 2012, then further to 78% in 2016 (CAPA, 2018a).

[5] This category includes Amakusa Airlines (IATA code AHX) (53% owned by prefecture government), Fuji Dream Airlines (FDA) (100% owned by Suzuyo & Co. Ltd.), IBEX Airlines (IBX) (47.9% owned by Japan Digital Laboratory Co. Ltd.), Japan Air Commuter (JAC) (60% owned by JAL) and Oriental Air Bridge (ORC) (39.8% owned by Nagasaki Airport Building Co. Ltd. and prefecture government).

Table 1. List of LCCs and emerging airlines as of 1 July 2021

Carrier	Shareholders	Fleet	Year of commencing operations	Main base	Number of domestic routes in 2019	Categorization		Company status
						CAPA	ICAO	
Jetstar Japan (JJP)	Japan Airlines (50%) Qantas (33.3%) Tokyo Century Corporation (16.7%)	A320	2012	Narita Airport, Tokyo	25	LCC	LCC	Active
Peach Aviation (APJ)	ANA Holdings Inc. (77.9%) First Eastern Aviation Holdings Limited (7.0%) INCJ, Ltd. (15.1%)	A320	2012	Kansai Airport, Osaka	21	LCC	LCC	Active
Vanilla Air (VNL)	ANA Holdings Inc. (100%)	A320	2013	Narita Airport, Tokyo	7	LCC	LCC	Merged with Peach on 26 Oct 2019
Spring Airlines Japan (SJO)	Japan Airlines (66%) Spring Airlines (33%)	B737	2014	Narita Airport, Tokyo	3	LCC	LCC	Active
AirAsia Japan (WAJ)	AirAsia (48.9%) Octave Japan Infrastructure Fund (19%) Rakuten Inc. (18%)	A320	2012 (1st entry) * 2017 (2nd entry)	Chubu Centrair International Airport, Nagoya	2	LCC	LCC	Ceased operations on 4 Oct 2020
Air Do (ADO)	Development Bank of Japan (32.49%) ANA Holdings Inc. (13.61%)	737-700 767-300	1998	Haneda Airport, Tokyo New Chitose Airport, Sapporo	10	FSA+	LCC	Active
Solaseed Air (SNJ)	Development Bank of Japan (19.24%) Miyazaki Kotsu Co., Ltd. (17.03%) ANA Holdings Inc. (17.03%)	737-800	2002#	Haneda Airport, Tokyo Miyazaki Airport, Miyazaki	12	FSA+	LCC	Active
StarFlyer (SFJ)	ANA Holdings Inc. (17.96%)	A320-200	2006	Haneda Airport, Tokyo Kitakyushu Airport, Fukuoka	6	FSA+	LCC	Active
Skymark Airlines (SKY)	Integral Corporation (50.1%) Development Bank of Japan & Sumitomo Mitsui Banking Corporation (33.4%) ANA Holdings Inc. (16.5%)	737-800	1998	Haneda Airport, Tokyo Kobe Airport	19	FSA+	LCC	Active

Source: Prepared by the author from airline websites, MLIT and OAG data

* AirAsia Japan was a joint venture between ANA and AirAsia. AirAsia left the venture in 2013. Part of the assets was transferred to Indonesia AirAsia and ANA continued to operate with the remaining aircraft till the end of 2013 and subsequently rebranded it as Vanilla Air in November 2013.
# Solaseed Air commenced operations as Skynet Asia Airways in 2002 and rebranded as Solaseed Air in 2011.
+ Discrepancy in carrier categorization between CAPA and ICAO. The four “FSAs” are classified as “emerging airlines” in our study as explained in the main text.

PRILIT (2014) revealed that the total passenger number on the 9 routes with LCC entry increased 1.71 times in 2012 and 2.42 times in 2013 respectively compared to 2011, while the decreases in FSA passenger number on those routes were insignificant, being 0% and 4% respectively. Hanaoka (2018) also concluded that the introduction of genuine LCCs had contributed to the growth of passenger volume in Japan since 2012 by inducing new demand. Similar conclusions were obtained by Fu et al. (2014) using empirical estimation and simulations over the Japanese inter-city travel markets. Figure 1 shows the domestic passenger volume from 2010 to 2020. Before the pandemic, domestic passenger volume in Japan grew substantially from 84 million in 2010 to 106.8 million in 2019, with load factor also improved from 64.6% to 73.8%. The Japan Aircraft Development Corporation (JADC) anticipated the RPKs in Japan to grow at 3% annual rate till 2038 (JADC, 2019), about 1.8 times higher than that of 2018. Despite more significant growth since the early 2010s, LCCs remained as fringe competitors, capturing only 17% and 26% of seat capacity in the Japanese domestic and international markets respectively (CAPA, 2019). The COVID-19 pandemic caused passenger volume to decrease 56.2% in 2020 and put many airlines under significant financial pressure. It is unclear whether the industry development trajectory will be radically changed post-pandemic.

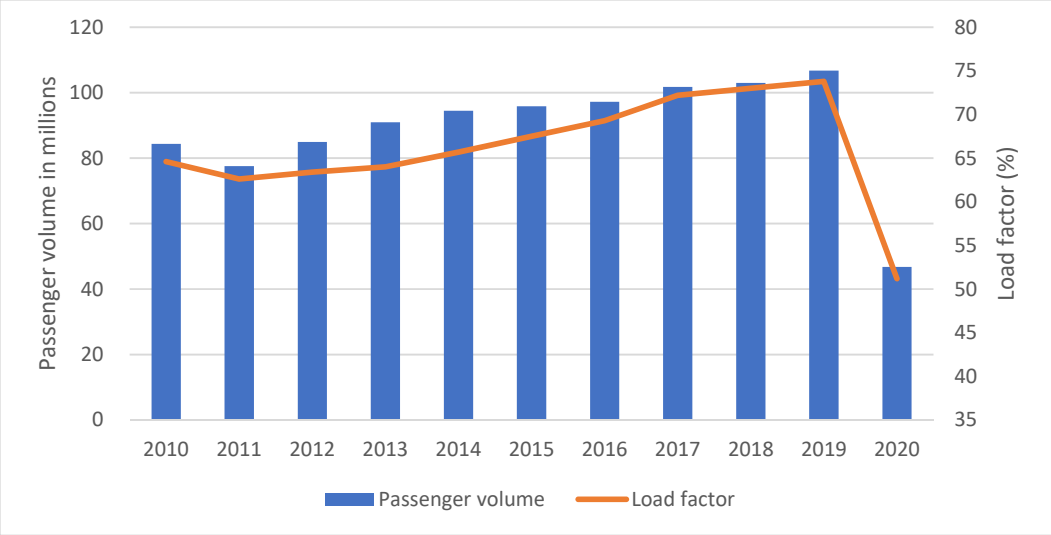


Fig. 1. Japan domestic passenger volume and load factor from 2010 to 2020
Source: Compiled from MLIT

It should be highlighted that JAL and ANA each have control of some of the LCCs. For example, as shown in Table 1 ANA controls the merged Peach/Vanilla, whereas Jetstar Japan is affiliated with JAL. To defend the market share loss to LCCs, many FSAs resort to establishing their own low-cost subsidiary (LCS) airlines, a practice referred to as the airlines-within-airlines strategy in the aviation industry. Most LCSs established in the US and Europe were unable to reduce unit costs to the level comparable to established LCCs and failed to deliver a profitable business (Morrell,

2005). Such an airlines-within-airlines strategy however has been adopted by quite a few airlines in the Asia Pacific region. Following the success of Qantas and Jetstar in Australia, other Asian carriers in Singapore, Thailand, Korea and Japan have also adopted such a strategy. Lin (2012) analytically considered such a strategy's effects on network competition between FSAs and LCSs. Studies in Australian markets suggested that Qantas established its LCS Jetstar as a fighting brand against Virgin Australia and carriers in international markets (Gillen and Gados, 2008; Homsombat et al., 2014; Whyte and Lohmann, 2015; Zhang et al., 2017; Zhang et al., 2018). However, the implications of such a strategy have not been formally investigated for Japan's aviation market.

2.2 Airline competition and route networks

Japan is an archipelago with four main islands running from Northeast to Southwest and numerous small islands surrounding the main islands. About 70% of the population live in cities with a population of more than half a million, whereas metropolitan areas contributed 74% of the national GDP in 2016 (OCED, 2018). Therefore, most flights are linking the four main islands and the southern island of Okinawa. There are 8 major hub airports in Japan, in the cities of Sapporo, Nagoya, Tokyo (Haneda and Narita airports), Osaka (Itami and Kansai airports), Fukuoka and Naha (Hanaoka, 2018). Except for the Centrair airport in Nagoya, domestic flights between these hub airports are defined as trunk routes by the MLIT, with all other routes defined as local routes (MLIT, 2021). Around 43% of total domestic passenger flown in 2019 was on scheduled flights on trunk routes (MLIT, 2020). Despite the high demand, seat supply on trunk routes has been limited because of slot constraints especially in the Haneda Airport (Adler et al. 2014). Slot constraints at major airports could seriously limit airline competition since there will be limited room for increases in capacity and frequency. Incumbent airlines having control of many slots may enjoy some strategic advantages at their hubs (Sheng et al. 2015, 2019).

ANA and JAL remained as dominant airlines in the domestic market, controlling 72% of the market share in terms of ASKs in 2019. Jetstar was the largest LCC with a 4.8% share, followed by Peach and Vanilla which merged in October 2019. As shown in figure 2, JAL, ANA, Skymark, Jetstar, Peach, Vanilla, and consolidated data of regional carriers represent about 90% seat supply of the whole domestic market. We focus on these carriers/carrier groups in this study.

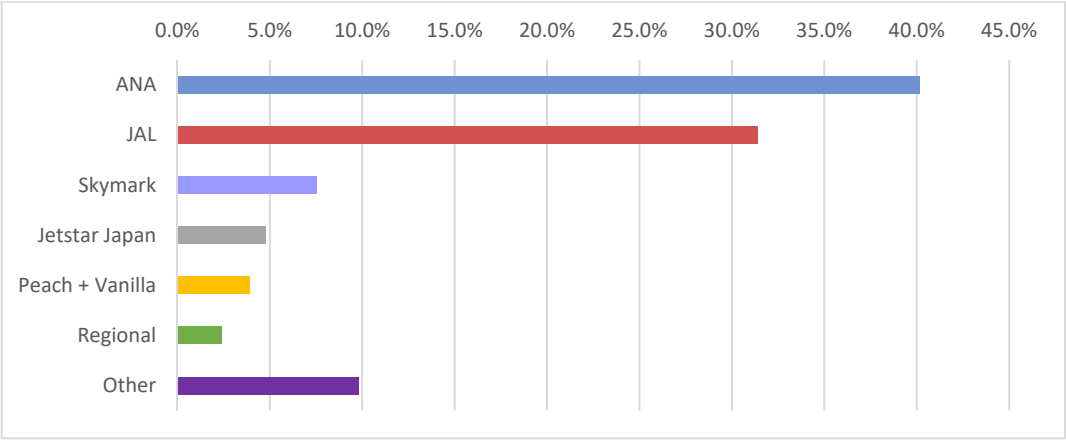


Fig. 2. Domestic market share in terms of ASKs in 2019
Source: Compiled with OAG data by author

Table 2. Top 20 busiest domestic routes in Japan in 2019 in terms of ASK

Rank	Market	Great circle distance (km)	Passenger volume in thousand[+]	ASK in million	JAL market share	ANA market share	Duopoly share
1	HND-OKA	1554	6105	11969	42%	47%	89%
2	CTS-HND	817	9417	10208	33%	41%	74%
3	FUK-HND	878	8812	10007	36%	45%	80%
4	HND-KOJ	933	2466	3311	37%	31%	68%
5	HND-ITM	402	5541	2913	45%	55%	100%
6	HND-KMJ	872	1954	2550	45%	34%	78%
7	HND-NGS	952	1742	2487	34%	47%	81%
8	FUK-OKA	867	1923	2222	28%*	41%	70%
9	NGO-OKA	1300	1257	2165	29%*	20%	49%
10	CTS-NGO	976	1633	2158	26%	27%	54%
11	HND-KMI	870	1429	1997	30%	33%	62%
12	ITM-OKA	1211	1169	1907	46%	54%	100%
13	HIJ-HND	635	1957	1855	37%	63%	100%
14	CTS-NRT	787	1915	1818	5%	11%	15%
15	KIX-OKA	1169	1190	1756	24%*	33%	57%
16	HND-KKJ	819	1239	1616	31%	5%	35%
17	CTS-KIX	1083	1194	1598	25%	28%	53%
18	CTS-ITM	1037	1177	1560	36%	64%	100%
19	HND-MYJ	674	1554	1480	33%	67%	100%
20	HND-OIT	770	1257	1465	44%	30%	73%

Note: CTS: New Chitose Airport, FUK: Fukuoka Airport, HIJ: Hiroshima Airport, HND: Tokyo International Airport, ITM: Osaka International Airport, KIX: Kansai International Airport, KKJ: Kitakyushu Airport, KMI: Miyazaki Airport, KMJ: Kumamoto Airport, KOJ: Kagoshima Airport, MYJ: Matsuyama Airport, NGO: Chubu Centrair International Airport, NGS: Nagasaki Airport, NRT: Narita International Airport, OIT: Oita Airport, OKA: Naha Airport
Source: Compiled with OAG data and MLIT data by author
[+] MLIT data
*The three routes to Naha (OKA) were operated by Japan Transocean Air for JAL

As reported in Table 2, the Japanese domestic markets are quite concentrated, with the top 20 busiest domestic routes accounted for about 58% of the domestic market in 2019 in terms of ASK. Most routes are dominated by the two major FSAs, with ANA

generally had a higher share especially on routes out of Haneda Airport. LCCs and emerging carriers were able to capture significant market shares on a few routes such as CTS-NRT and NGO-OKA. It is worth noting that multi-airport systems have been established in the Greater Tokyo Area and Greater Osaka Area. There are two major airports in Tokyo namely Narita International Airport (NRT) and Tokyo International Airport (HND). For the case of Osaka, Kansai International Airport (KIX), Osaka International Airport (ITM) and Kobe Airport (UKB) share significantly overlapped catchment areas (Yamaguchi, 2013). As passengers in both cities can fly from available airports within the same region, each airport within the same area serves as a potential imperfect substitution to each other. And thus, airlines flying out different airports in a multi-airport system to the same destination are competing with each other.

To reveal the focus markets of individual carriers, we report each carrier's top 10 busiest routes in 2019 in terms of ASK, in Figure 3 and Table 3 respectively. JAL and ANA shared a lot of similarities in route choices. Jetstar competes with the Peach + Vanilla Group on certain routes, and they competed with FSAs and Skymark at the same time. Skymark is separately reported, as it has been argued that it is neither an FSC nor an LCC: it could not charge a premium fare like an FSA, yet its costs were not as low as a genuine LCC. It is also the third largest carrier in terms of ASKs and is considered as an airline independent of the JAL group or ANA group. Regional carriers served a different market segment, providing connections mainly among second-tier cities. Overall, FSAs are not facing material competition from LCCs in their most core markets. Other than a few relatively thin routes, LCCs need to compete with all types of airlines. Skymark has multimarket contact with various FSAs and LCCs in its networks.

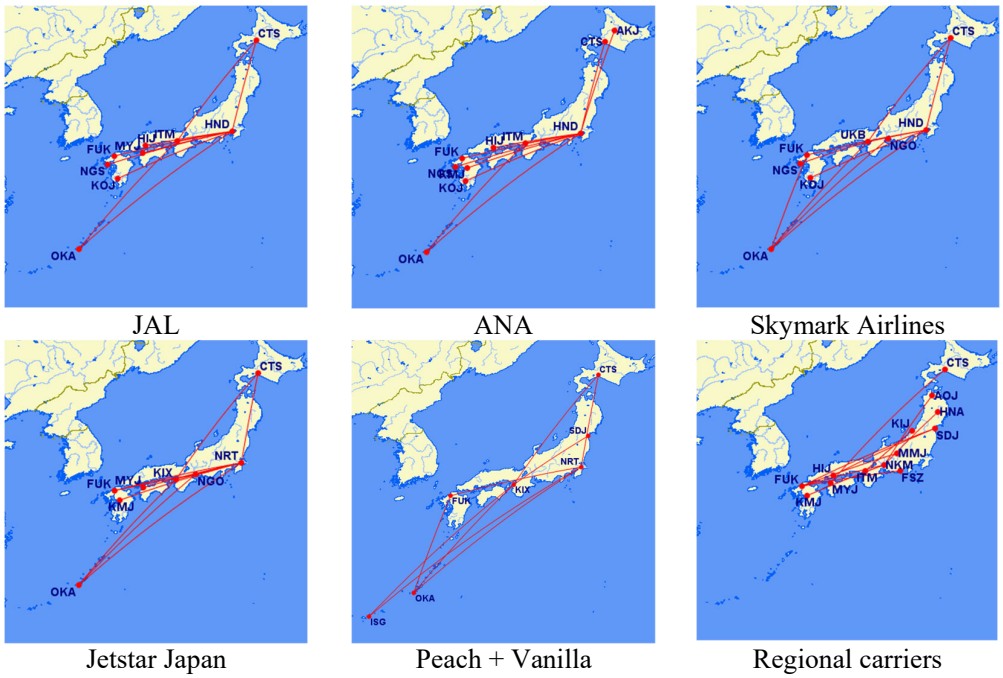


Fig. 3. Top 10 busiest route by each airline in terms of ASK in 2019
Source: Compiled by the author with OAG data, figures created by gcmap.com

Table 3. List of top 10 busiest domestic routes by each airline in terms of ASK in 2019

JAL	ANA	Skymark Airlines	Jetstar Japan	Peach + Vanilla	Regional carriers
HND-OKA	HND-OKA	FUK-HND	FUK-NRT[+]	CTS-NRT[+]	FUK-SDJ
FUK-HND	FUK-HND	HND-OKA	CTS-NRT[+]	CTS-KIX	FUK-NKM
CTS-HND	CTS-HND	CTS-HND	NRT-OKA	KIX-OKA	FSZ-FUK
HND-ITM	HND-ITM	HND-UKB[+]	KIX-OKA	KIX-SDJ	AOJ-NKM
HND-KOJ	HIJ-HND	NGO-OKA	CTS-KIX	NRT-OKA[+]	HNA-NKM
HND-KMJ	HND-NGS	HND-KOJ	KMJ-NRT[+]	FUK-NRT[+]	KMJ-NKM
ITM-OKA	ITM-OKA	OKA-UKB[+]	KIX-NRT[+]	FUK-OKA	FUK-KIJ
HND-NGS	HND-KOJ	FUK-OKA	FUK-NGO	ISG-KIX	FUK-MMJ
HIJ-HND	CTS-ITM	NGS-UKB[+]	NGO-OKA	ISG-NRT[+]	HIJ-SDJ
AKJ-HND	HND-MYJ	CTS-UKB[+]	MYJ-NRT[+]	CTS-FUK	ITM-KIJ

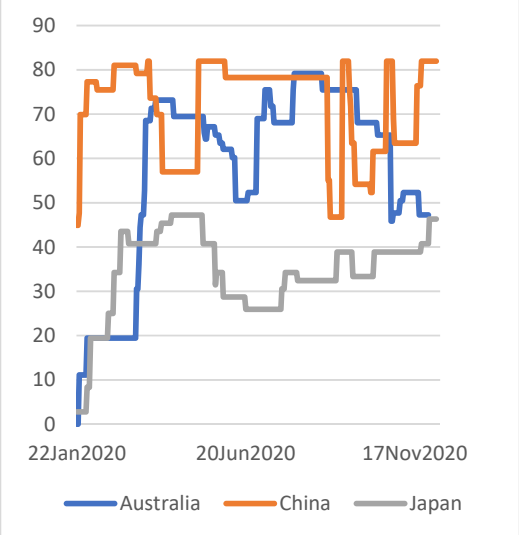
	Competition among FSAs
	Competition among LCCs and FSAs
	Competition among FSAs, LCCs and Skymark
	Competition among FSAs and regional carriers
	Monopoly routes

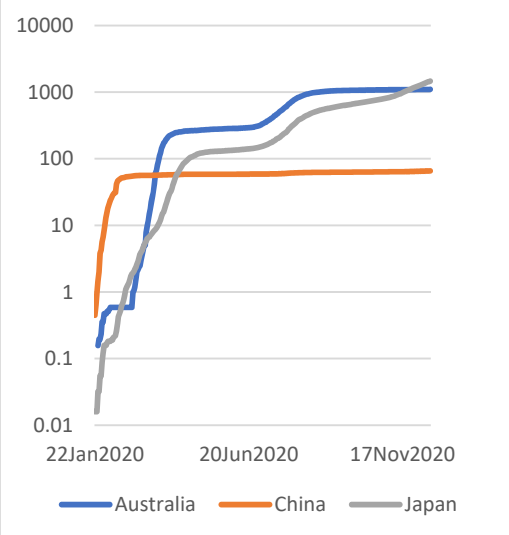
Note: AKJ: Asahikawa Airport, AOJ: Aomori Airport, HNA: Morioka Hanamaki Airport, ISG: Ishigaki Airport, KIJ: Niigata Airport, MMJ: Matsumoto Airport, NKM: Nagoya Airfield, SDJ: Sendai Airport, UKB: Kobe Airport
[+] UKB is a potential competing airport against ITM and KIX while NRT is a potential competing airport against HND
Source: Compiled by the author with OAG data

2.3. The COVID-19 pandemic in Japan and effects on airlines

The outbreak of COVID-19 has brought a major public health emergency to the world, causing over 1.7 million deaths by the end of 2020 (WHO, 2020). Various non-pharmaceutical interventions have been enforced to limit human mobility and reduce the transmission rate. The side effects of those measures have led to unprecedented economic loss with tourism and aviation industries among the most badly-hit victims (IMF, 2021; Pearce, 2021). Many airlines are under significant financial pressure with their credit ratings downgraded (IATA, 2020). Airlines' traffic volume loss also brought challenges to airports, especially if these airlines served as the airports' dominant carriers (Homsombat et al., 2011; Fu et al., 2015b). If the financial losses are significant it could also impose major problems to on-going and planned capacity expansions, since airport investments tend to be lumpy and significant, and subject to various regulatory requirements (Yang and Fu 2015; Xiao et al. 2016, 2017).

The first COVID-19 patient in Japan was confirmed on 15th January 2020 (MHLW, 2020), with infections came in several waves in the following months. Various measures to curb COVID-19 spread have been adopted, albeit with different restrictiveness compared to other countries. Hale et al. (2021) introduced a government response tracker known as the Oxford COVID-19 Government Response Tracker (OxCGRT) to capture the change of government policies among different nations. The stringency index is compiled with containment and closure indicators such as stay-at-home requirements and school/workplace closure, measuring the restrictiveness of containment policies. The panel data of the stringency index can be obtained from the Our World in Data (OWID) data repository. As shown in figure 4 and 5, despite the number of COVID-19 cases in Japan was comparable to that in Australia and more than the number in China, the Japanese government imposed fewer restrictions generally, probably due to the uniqueness of Japanese emergency law where forced lockdown by the order of government is not permitted (Tashiro and Shaw, 2020). Although fewer restrictions should have less impact on travel, the Japanese domestic passenger market was among the weakest among those tracked by IATA in February 2021.[6]





[6] IATA Air Passenger Market Analysis Feburary 2021

Fig. 4. OWID stringency index
Source: Compiled by the author with OWID data

Fig. 5. Cumulative COVID-19 cases per million people
Source: Compiled by the author with OWID data

Figure 6 shows the effect of COVID-19 on the supply in the Japanese domestic market. Generally, market ASK declined sharply in April 2020, bottoming out in June 2020. The responses of each airline were different as illustrated. JAL, ANA, Jetstar Japan and Peach cut their services drastically at the beginning of the pandemic to cope with reduced demand. Skymark was the third largest carrier before the pandemic, but ranked lower than LCCs toward the end of 2020. Although the domestic market share distribution was fairly stable before the COVID-19 pandemic, with the general decline in traffic volume and subsequent differences of recovery pattern, the competition dynamics have changed towards the end of 2020. The most worrying airline was Skymark, whose market presence almost disappeared. To better reveal the reasons behind such market dynamics, in the following sections we will quantify the changes in airlines' operations with a focus on the implications of yield and the airlines-within-airlines strategy.

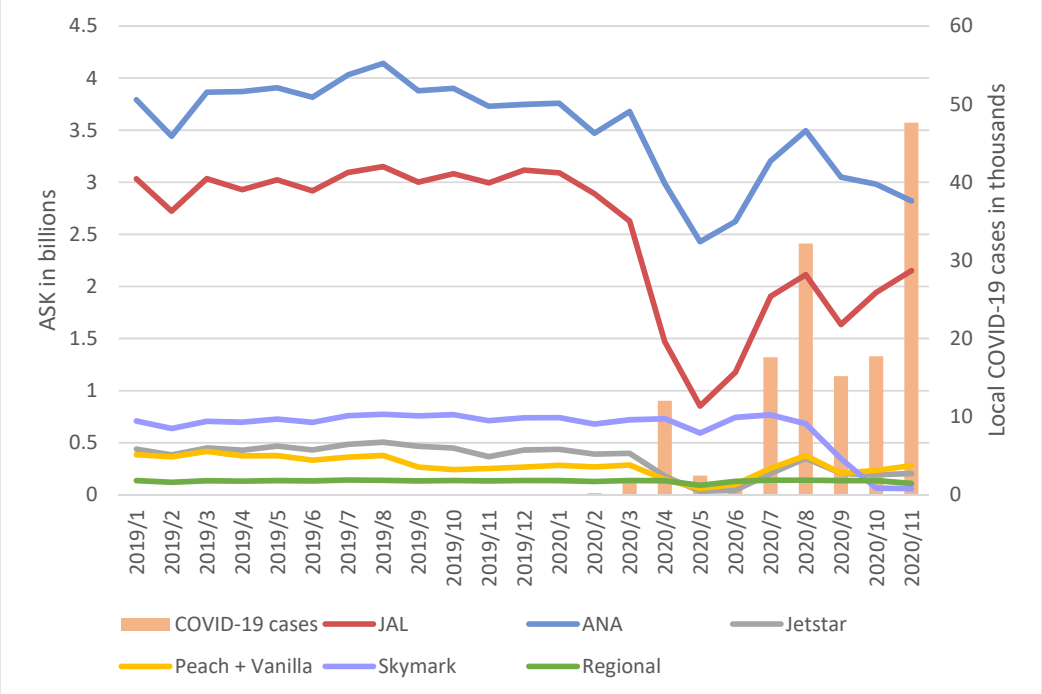


Fig. 6. Airline's domestic ASK from 2019 to 2020
Source: Compiled by the author with OAG data

3. Quantifying changes in airlines yield

Whereas the decline in traffic volume and airline supply are well known, it is not clear how airlines' yields would change. On the one hand, the decline in traffic demand usually reduces airline yields. On the other hand, airlines' supply also reduced significantly, and passengers traveling amid the pandemic are likely due to essential travel needs and thus tend to be less sensitive to airfare. Therefore, there may not be a definite prior assumption on the direction and magnitudes of airline yield change. This is an important question as airline yield is a critical determinant of airline revenue and profitability in the short term, and the aviation industry's sustainability in the long term. To quantify such changes, our model examines the effect of COVID-19 on airlines' average yield at route level in the Japanese domestic market using monthly route level panel data, obtained from the PaxIS database maintained by IATA. Other variables used include weekly frequency data obtained from the OAG database, daily COVID-19 cases data from the OWID project (Hannah Ritchie et al., 2020), and the 2015 population data from the Statistic Bureau of Japan. Because yield data are obtained monthly, for consistency relevant weekly frequency data were converted to average daily value to compute the monthly value. A non-directional domestic route is considered if direct flights services were provided by a Japanese airline between two domestic airports. Our reduced-form econometric model is an extension from those used in the literature (see, for example, Morrison and Winston 1995), with the following specification for the Japanese market.

$$\begin{aligned} \ln(Yield_{int}) = {} & \beta_0 + \beta_1 \ln(HHI_{nt}) + \beta_2 \ln(Dist_n) + \beta_3 \ln(Freq_{int}) + \beta_4 HSR_n + \\ & \beta_5 \text{ sqrt}(Pop_n) + \beta_6 LCC_n + \beta_7 Regional_n + \beta_8 \ln(COVID_t) + \\ & \beta_9 LCC_n * \ln(COVID_t) + \beta_{10} Regional_n * \ln(COVID_t) \\ & + \sum \beta_m MR_m + \varepsilon_t \end{aligned} \quad (1)$$

The dependent variable is the average yield obtained by dividing revenue of all classes in US dollar by RPK. Airport Herfindahl-Hirschman Index (HHI) was included because its possible effects on fares have been well documented. Airport level HHI was used instead of route HHI to avoid possible endogeneity between route HHI and route yield. Frequency represents the number of flights of an airline flown on a particular route. *Ceteris paribus*, a higher frequency leads to better service quality by reducing schedule delay and thus increasing yield. As Douglas and Miller (1972) defined, the time difference between a passenger's desired departure time and the closest available scheduled departure time is referred to as the "schedule delay". Such a difference is inversely proportional to airlines' flight frequency. High-speed rail (HSR) is the major mode of domestic travel in Japan which can serve as a competitive substitute for air transport, and therefore is expected to impose downward pressure on yield. City population serves as a proxy for potential travel demand /market size, which should have positive effects on airfare. On the other hand, higher passenger density allows airlines to reduce operation costs by exploiting the benefits of economies of traffic density, and thus may lead to lower airfare. There is therefore no clear prior for the net effect of population on yield. Most studies suggest that the presence of LCCs reduces the average fare level of a route (Dresner et al., 1996). However, a study on the Chinese aviation market suggested that the leading LCC, Spring Air, did not compete

aggressively with FSAs despite its lower cost, and entered routes with high fares. Fu et al., (2015a) argued that Spring Air was likely following a "cream-skimming" strategy to achieve a high-profit margin by serving the most profitable routes without capturing very large market shares nor triggering price wars with incumbents. Therefore, the LCCs' effects on yield in the Japanese market, especially during a pandemic, have yet to receive systematic analysis. A regional dummy is used to control the potential difference in the business model between regional carriers and FSAs. COVID is the number of monthly COVID-19 cases divided by the population in million, using the latest available data for 2015. and it is expected that COVID-19 would impact yield negatively. Finally, monthly dummy variables were included to account for the seasonal effects. Variable definitions are summarized in Table 4.

Summary statistics of the key variables are provided in Table 5. The average yield of the sample is 20 cents while the yield before the COVID-19 outbreak was 21.9 cents, which decreased by 13.7% to 18.9 cents after the outbreak (unless specified otherwise, all values are reported in US$). The average airport HHI in the domestic market is close to 4000, suggesting the domestic market is not very competitive in the presence of JAL-ANA duopoly. In the domestic markets, LCCs served 15% of the sample routes while regional carriers served 13% of the routes.

Table 4. Definition of variables for the regression model

Variable	Definition
$Yield_{int}$	The yield of airline *i* on route *n* at time *t*
HHI_{nt}	The geometric average of the Herfindahl-Hirschman Index (HHI) values at the departure and arrival airports on route *n* at time *t*. HHI at an airport is calculated with the number of aircraft movements for domestic services.
$Dist_n$	The great circle distance of route *n* in KM
$Freq_{int}$	The frequency of airline i on route n at time t
HSR_n	Dummy variable coded as 1 if there is HSR service available between OD cities. HSR is defined as the fast and semi-fast rail services (i.e. Nozomi and Hikari).
Pop_n	The geometric average of origin and destination city population in million in 2015 of route n
LCC_n	Dummy variable coded as 1 if flight service was provided by an LCC on route *n*.
$Regional_n$	Dummy variable coded as 1 if flight service is provided by a regional carrier on route *n.*
$COVID_t$	Number of COVID-19 cases per million population in Japan at time t
MR_m	Monthly dummy variables (m = 2, …, 12) for February to December, respectively.

Table 5. Summary statistics of variables used the yield model

	Mean	Max	Min	SD
Yield (USD)	0.20	9.06	0.02	0.19
Orig airport HHI	3837	10000	1530	2193
Dest airport HHI	3844	10000	1531	2198
Distance (km)	718	2241	22	412
Frequency	90.3	775.0	0.1	84.2
Population in million (Orig)	2.57	9.27	0.02	3.19
Population in million (Dest)	2.58	9.27	0.02	3.19
Dummy HSR	0.28	1	0	0.45
Dummy LCC	0.15	1	0	0.35
Dummy regional	0.13	1	0	0.34
COVID-19 case per million people	49.51	376.63	0	94.09

Table 6 summarizes estimation results. The coefficients of distance, population, dummy variable of HSR services, and dummy variable for LCC are significant and of the expected signs. The coefficient of frequency is positive, suggesting higher yield can be obtained for services with more frequent flights. Previous studies have shown that flight frequency has a positive effect on passengers' choices of airport and airline (Ashford and Benchemam, 1987; Pels et al., 2001, 2003; Wang et al. 2014), and the willingness to pay for flight frequency is significantly positive (Richard 2003; Carlos Martín et al., 2008). The coefficient of airport HHI is negative which is different from expectation. The Pearson correlation coefficient between airport mean HHI and mean population between two endpoints is -0.218. This reveals that the average airport HHI is usually lower in route with higher demand. For example, the busiest route in 2019 was HND-OKA (Tokyo Haneda airport and Naha airport) and its average airport HHI was 2605. While the average HHI of the least busy scheduled service, OKE-TKN (OKE: Okinoerabu Airport, TKN: Tokunoshima Airport), was 7130. That is, lower average airport HHI is often observed in busier routes with high demand in terms of ASK, such as trunk routes between major hubs, where airlines could charge relatively high ticket price. On the other hand, the demand on routes with small cities as origin/destination tends to be limited. Those routes usually cannot support multiple airlines running a profitable business without government subsidy (OECD/ITF, 2018). Thus, higher average airport HHI is observed in the less profitable thinner routes. The regional dummy was statistically insignificant, indicating that regional carriers had a similar average yield as FSAs. These niche market players typically serve thin routes which can only accommodate a small number of airlines.

We are most interested in the estimate for variable COVID-19, which is significant and negative. The interactive terms with LCC dummy and regional dummy are also significantly negative. Since the reference is yields of FSA services, these estimation results suggest that the pandemic reduced airline yield and such effect is asymmetric among FSAs, LCCs, and regional carriers. Specifically, the impact is the least on FSAs

while it is most significant on regional carriers. As of the end of 2020, monthly new COVID-19 cases per million people in Japan was more than 600 and our model suggests that the average yield of FSAs, LCCs and regional carriers decreased by 12.9%, 27.9% and 49.7% respectively[7]. Such a decrease in yield combined with the reduction in passenger volume would be devastating to airlines' revenue. Doubling in COVID-19 cases would further reduce the yield of FSAs, LCCs and regional carriers by 1.4%, 3.0% and 5.0% respectively.

Table 6. Yield regression (1) estimation results

	Estimate	Std. Error	Pr(>|t|)
Airport HHI	-0.0885***	0.0088	0.0000
Distance	-0.6601***	0.0039	0.0000
Frequency	0.0335***	0.0030	0.0000
Population	0.1325***	0.0066	0.0000
Dummy HSR	-0.0381***	0.0061	0.0000
Dummy LCC	-0.3768***	0.0091	0.0000
Dummy regional	0.0078	0.0100	0.4355
COVID-19 case	-0.0216***	0.0014	0.0000
Dummy LCC × COVID-19 case	-0.0255***	0.0031	0.0000
Dummy regional × COVID-19 case	-0.0718***	0.0033	0.0000
Observations	14578		
F statistics	0.0000		
Adjusted R-squared	0.7404		

Significance codes: ***, ** and * indicate significance at 0.001, 0.01 and 0.05 level, respectively.
Results for month dummies are not included to save space

As aforementioned, ANA and JAL both have control of major LCCs. The effects of such airlines-in-airlines strategy (AWA) have not been studied for Japan. Skymark is the third largest airline in terms of ASK largely independent of the duopoly FSAs and their affiliated LCCs. It started as an LCC-like carrier in 1998 and eventually shifted to more FSA-like operations, even considering the introduction of premium economy class services on A330 for domestic routes (CAPA, 2013). Because of mounting debts and intensified competition with LCCs, Skymark filed for bankruptcy protection in 2015. Although its rehabilitation plan was also backed by ANA and subsequently ANA acquired 16.5% shares of Skymark (Fujikawa, 2015), Skymark is still considered as independent from the two major FSAs (Hanaoka, 2018). JAL and ANA increased their stakes in LCCs amid the pandemic. JAL increased its stake in Spring Airlines Japan to a majority stake in May 2021. Although international market analysis is not covered in this paper, it is worth noting that a new wholly owned LCC by JAL, Zipair, became operation in June 2020 to serve international routes. ANA also plans to start a new LCC brand to cover international markets in 2022. It appears that both major FSAs are committed to the AWA strategy to secure continued market dominance, in both domestic and international market. To investigate such effects, we examine the impacts to the third largest domestic airline, Skymark, with the following model:

[7] Percentage change of yield was obtained by using the estimated coefficients, and with equation 1 we have EXP(β_8 ln(*COVID*) + β_9 *LCC**ln(*COVID*) + β_{10} *Regional**ln(*COVID*))-1.

$$\ln(Yield_{nt}) = \beta_0 + \beta_1 \ln(HHI_{nt}) + \beta_2 \ln(Dist_n) + \beta_3 \ln(Freq_{nt}) + \beta_4 HSR_n + \beta_5 \text{sqrt}(Pop_n) + \beta_6 \ln(COVID_t) + \beta_7 pFSA_n + \beta_8 pLCC_n + \beta_9 AWA_n + \beta_{10} AWAin_n + \sum \beta_m MR_m + \varepsilon_t \quad (2)$$

This model is similar to equation 1 except that a new dummy variable AWA was introduced, which takes the value of 1 if services offered by the JAL group (JAL & Jetstar) or ANA group (ANA & Peach & Vanilla) or both was available on route *n.* Dummy variable AWAin was included to measure the potential indirect competition which is coded as 1 if AWA is 0 but either JAL group or ANA group or both operating to/from airports within the Greater Tokyo Area or Greater Osaka area on route *n* (for example, in the case of Skymark serving FUK-HND vs. JAL/Jetstar serving FUK-NRT; in another case Skymark serving CTS-UKB vs. ANA/ Peach serving CTS-KIX). Two new dummy variables, pFSA and pLCC corresponding to the presence of FSAs and LCCs respectively, are added to measure the competition effects. Dummy variables LCC and regional are removed since estimation is carried out for the subset of routes with Skymark services.

Summary statistics of variables used in equation 2 are reported in table 7. The markets served by Skymark had a similar structure to the domestic market in terms of HHI, distance, population and the presence of HSR competition. The average yield of Skymark was 0.16 US$, 20% lower than the market average yet still higher than competing LCCs. Specifically, the average yields of Jetstar, Peach and Vanilla within our sample period were 0.118, 0.105, and 0.107 US$, respectively. There were 21 routes served by Skymark between 2019 and 2020 in our dataset, among which the carrier encountered the AWA strategy on 13 routes. The routes of CTS-FUK, CTS-NGO, FUK-OKA and NGO-OKA are markets where Skymark competed directly with JAL or ANA group employing AWA strategy, while Skymark faced indirect AWA strategy in Tokyo region on CTS-HND, FUK-HND, HND-KOJ, HND-OKA; and Osaka region on CTS-UKB, KOJ-UKB, NGS-UKB and OKA-UKB: and both Tokyo and Osaka region on HND-UKB.

Table 7. Summary statistics of variables used yield model (2)

	Mean	Max	Min	SD
Yield (USD)	0.16	0.33	0.05	0.05
Orig airport HHI	3741	10000	1530	2445
Dest airport HHI	3758	10000	1531	2447
Distance (km)	911	1641	339	356
Frequency	110.2	359.4	0.7	90.3
Population in million (Orig)	2.44	9.27	0.04	2.82
Population in million (Dest)	2.45	9.27	0.04	2.83
Dummy HSR	0.31	1	0	0.46
COVID case per million people	53.08	376.63	0	97.23
Dummy pFSA	0.75	1	0	0.43
Dummy pLCC	0.73	1	0	0.45
Dummy AWA	0.20	1	0	0.40

Dummy AWAin	0.47	1	0	0.50

Estimation results for Eq.(2) are shown in table 8. The presence of FSAs reduces Skymark's yield by 17.4% whereas the presence of LCC does not have a statistically significant effect. Fu et al. (2011) found a similar pattern when analyzing the markets out of Chicago, and ascribed to product differentiation (i.e. significant competition among FSAs who provide more substitutable services to each other). The AWA strategy has a significant negative effect on Skymark's yield. The average yield on the 4 affected routes with direct competition was 16.6% lower than other routes, and this effect is additional to the effect of competition against FSAs or LCCs which are captured by the variables of pFSA and pLCC. But the indirect effect of AWA strategy is statistically insignificant. Such finding reveals that JAL and ANA are both using the airlines-within-airlines strategy to secure their dominance, which forced down the yield of the independent Skymark. However, such strategy is effective on head-on competition with Skymark only, whereas indirect competition in a multi-airport system does not have much significant effects.

Table 8. Regression results of equation 2

	Estimate	Std. Error	Pr(>|t|)
Airport HHI	-0.1790***	0.0265	0.0000
Distance	-0.7194***	0.0160	0.0000
Frequency	0.0251***	0.0065	0.0001
Population	-0.1464***	0.0127	0.0000
Dummy HSR	0.0068	0.0144	0.6352
COVID-19 case	-0.0175***	0.0025	0.0000
Dummy pFSA	-0.1915***	0.0380	0.0000
Dummy pLCC	-0.0175	0.0379	0.6448
Dummy AWA	-0.1815***	0.0251	0.0000
Dummy AWAin	0.0181	0.0242	0.4552
Observations	877		
F statistics	0.0000		
Adjusted R-squared	0.8577		

Significance codes: ***, ** and * indicate significance at 0.001, 0.01 and 0.05 level, respectively.
Results for month dummies are not included to save space

4. Summary and conclusion

The Japanese aviation market has experienced some major changes in the past decades, and was expected to maintain stable growth thanks to the continued expansion of genuine LCCs. The COVID-19 pandemic brought major shocks, with its long-term effect yet to be determined. It is not clear how the Japanese market can emerge post-pandemic, and whether there will be major or permanent changes to the industry development trajectory. This paper aims to address these research questions by providing an updated review of the development and performance of the Japanese domestic aviation market, with a focus on the effect of the COVID-19 pandemic on airlines' capacity, frequency, yield and competition. Our empirical results suggest that the pandemic has brought major shocks to airlines' yields, and such negative effect was differentiated among FSAs, LCCs and regional carriers. Specifically, small independent regional carriers seemed to be the worst losers. These airlines are

independent of the duopoly FSAs and their affiliated LCCs. If they continue to suffer financially, the sustainability of their routes will be further challenged. More resources may have to be allocated to maintain regional connectivity until travel demand recovery. Although duopoly FSAs and LCCs performed better than regional airlines, they still suffered significantly. AirAsia Japan was unable to deal with the prolonged pandemic and ceased operation. The third-largest carrier Skymark was also sidelined with its capacity shrunk about 90% towards the end of 2020. The pandemic has actually strengthened the duopoly in the domestic market. In addition, JAL and ANA have taken significant steps in controlling more LCC stakes (Tomoda and Kondo, 2020), despite possible market cannibalization between their low-cost subsidiaries and their own full services. Our analysis of Skymark's yield suggests that such an AWA strategy has reduced the independent Skymark's yield significantly. That is, Jetstar and Peach have been used as an effective fighting brand by JAL and ANA respectively against Skymark. Such effects are most obvious when AWA strategy is applied on the same routes where Skymark operates, while not significant if an LCS is introduced on an "adjacent" route linking another airport in the same multi-airport system.

Although Japanese LCCs have not penetrated the market as successfully as LCCs in other markets such as those in Southeast Asia and Australia, the growth of the Japanese LCC sector has been significant since 2012, which remained as one of the key drivers for market development. The entry of LCCs in many markets has been identified as welfare increasing (see for example study on the US market by Murakami, 2011). Travelers in Japan are expected to also benefit from more competitive LCCs in the market. With airlines all suffering significantly amid the pandemic and dominant duopoly FSAs adopting the airlines-within-airlines strategy, there is a good chance that JAL and ANA will have more market dominance in the forthcoming market recovery. Therefore, the Japanese government may have to play a dual role for the aviation market in the coming days: on the one hand, they have to help promoting the recovery of the aviation market in general. Meanwhile, they need to monitor, and where necessary, promote domestic competition. Specifically, our investigation results suggest that although low cost carriers often promote market competition, their affiliations with dominant FSAs could actually strengthen, rather than reduce, the dominance of the ANA – JAL duopoly. This would also be a very challenging task considering the financial losses by the aviation sector as a whole, making it difficult to introduce additional competition regulations to the airlines fighting for survival. In such a case, the Japanese regulator may make more efforts to ensure that there are no significant entry barriers blocking the services or establishment of independent LCCs. Lastly, policy addressing the survivability of regional carriers may be contemplated as these carriers suffered significantly during the crisis. This could also help small cities maintain the essential connectivity. Since the negative impacts of the pandemic could last longer than the pandemic itself, updated empirical investigations are needed in the coming years to closely examine the performance of the Japanese aviation market.

Acknowledgement:

We are very grateful to the two anonymous reviewers and the guest editors, whose comments have led to a significant improvement of the paper. Financial supports from

the Hong Kong GRF P0037794 (Q85W) and the Natural Science and Engineering Council of Canada are gratefully acknowledged.

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