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Requirement Analysis and Prediction of Aviation Finance in China

Yong Ding, Xiang Ge and Fei Lv
Civil Aviation University of China, China

Abstract: With the development of air transportation, China's aviation finance market is showing a strong momentum. In this study, according to the purchase ratio, airfreight, the economic situation at home and abroad, we analyze and forecast the market demand of aviation finance in China for the next 20 years. The results show that till 2030 there will be more than 7000 aircrafts added in aviation transportation market of China, of which more than 4200 planes need to rely on financing through external finance market and the demand of aviation finance will reach $4.2 billion. In order to improve the development of Chinese aviation finance market, it is of great importance to speed up the building of aviation finance market, to improve relevant laws and regulations and to provide proper tax preferences for aviation finance enterprises.

Key words: Aviation finance, passenger turnover volume, cargo turnover volume

INTRODUCTION

In China, air transportation has developed much more rapidly than other modes of transportation since the reform and opening-up. From 2006 to 2010, China's air transportation increased at a rate of 14%, which was twice faster than rail transportation at the same period .Air travel not only meets the demand of business travelers and freight transport, but promotes as well tourist industry and commercial interactions between various regions. It is certain that air transportation, as a modernized transport mode, partial reflects a country's economic development. As it is closely related with the aviation finance market, it is meaningful to predict the capital demand in China's aviation finance market, based on the trend and capacity of air transport market in the future.

Several studies have made progress on this issue. Mason (2005) addressed the decline in yield in the airline industry by the use of published sources and a survey of 264 travellers. Alperovich and Machnes (1994) estimated international air travel demand using an aggregated model which includes variables representing consumers' wealth. Another study, conducted by Ghobrial (1992), presents an econometric model that estimates the aggregate demand for an airline. Bhadra and Kee (2008) analyses the structure and dynamics of the origin and destination of core air travel market demand using 1995-2006 US quarterly time-series data.

This study focuses on forecasting the demand for civil aircraft in China during the period from 2011 to 2030. In the first place, the concept of aviation finance is explained. In the next part, an overview is presented about the current situation of China's aviation finance market. Then, an econometric model is introduced to estimate the demand for civil aircraft in China in the next 20 years. In the last part, three strategies are given that will help accelerate the development of China's aviation finance market.

MATERIALS AND METHODS

Concept of aviation finance: Generally speaking, aviation finance is a set of financial activities relevant to aviation industry, including currency exchange directly or indirectly related with aviation products, economic activities about settlement and financing and so on and so forth. Since the core concept of finance is value exchange beyond the limit of time and area, a great many financial activities have a common ground in the general sense of aviation finance, which has been already described in numerous works (Goldsmith, 1969; La Porta *et al*., 1998; Qinxian and Qinghua, 2006; Zheng, 2007). Therefore, this research centers on the narrow sense of aviation finance.

Aviation finance, in a narrow sense, is aircraft finance, which is of obvious industrial characteristic. Accordingly, aviation finance demand is mainly reflected through the demand for aviation finance assets and the efficiency of aviation finance market. The demand for aviation finance assets can be measured quantitatively. Specifically, it is measured by the volume of trade in the aviation finance market, the amount of aviation finance medium and the number of aviation finance instruments. By contrast, the efficiency is more comprehensive and can only be measured qualitatively. It is improved with the

Corresponding Author: Yong Ding, Civil Aviation University of China, China

increase of allocation efficiency of financial resources and the ability to prevent financial risks. This study focuses on the quantitative part, because, on the one hand, the low amount of financial entities is a major obstacle to the development of the market, on the other hand, the efficiency can be improved only if the former is enlarged. In addition, demand for aviation transportation comes before demand for aviation finance assets, which can be measured by quantitative methods. Hence, this article centers on analysis and prediction of the demand for aviation finance assets based on Chain's aviation finance market.

CURRENT SITUATION OF CHINA'S AVIATION FINANCE MARKET

In recent years, owing to China's economy soaring, the demand for civil aviation service is increasingly expanding. For the time being, a great many international flights has been launched across more than 50 countries, with up to 1880 regular routes opened and 3,980,0873 km (repeat distance) reached. It is beyond question that China has stepped into the league of civil aviation powers in the world.

Meanwhile, however, it is not optimistic for the development of aviation finance market in China. In 1980, a domestic airline leased a Boeing 747 plane from Manufacture Hanover Leasing Corporation, which marked the beginning of China's aviation finance market. Till 2010, there are 2491 civil aircrafts in China, nearly 70% of which are leased through finance market. Yet, domestic financial firms have occupied a market share of less than 10%, for multinational aircraft rental companies monopolize the market. As the largest domestic airline, for instance, Air China Limited made a long-term contract with Air Lease Corporation in terms of financing 9737-800 sec and 4 A321-200 sec in the first half of 2012.

Along with the development of the market, China's airlines can benefit from it to alleviate financial pressure and improve operation efficiency. There are enormous business opportunities in this market considering China's economic growth, population and urbanization.

China's passenger turnover volume, cargo turnover volume and GDP growth at home and abroad are depicted in Fig. 1. The share of cargo turnover volume is comparatively low; the total turnover volume and the passenger turnover volume increase faster than the GDP. There is a non-linear relationship between the total turnover volume and the GDP.

Data sources: GDP from China Statistical Yearbook, turnover data from Statistical data on Civil Aviation of China.

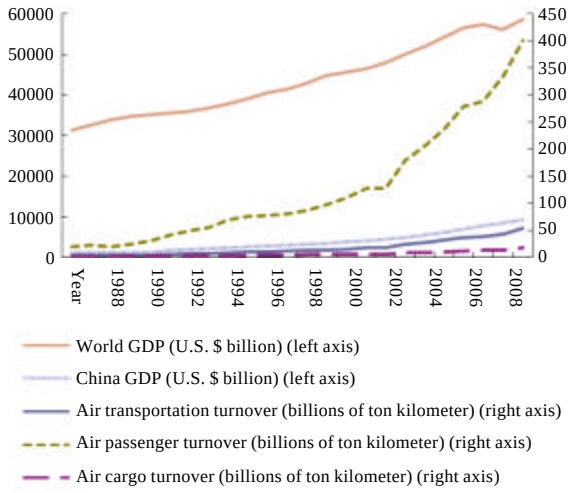

Fig. 1: China's GDP and aviation traffic volume

FORECAST OF CHINA'S AVIATION FINANCE MARKET

According to the actual situation in China, the capacity of the aviation finance market in the future is determined, based on which a nonlinear method is applied to analyze China's air transportation. The prediction will be a scientific basis for the financial management and policy-making departments.

Model parameters

Air traffic volume: The scale of aviation finance market is mainly determined by the demand for aviation transport service. In this study, total turnover volume (expressed in TZL) is selected to indicate the change of aviation volume, because it combines transportation distance with the number of passengers and the weight of goods. For further analysis, TZL is split into passenger turnover volume (expressed in LKL) and cargo turnover volume (expressed in HYL). LKL is the product of the number of passengers and transportation distance, expressed in passenger-kilometer. HYL is the product of the quantity of cargo and mail and transportation distance, expressed in ton-kilometer. TZL converts LKL and HYL into the same units of measurement, expressed in ton-kilometer. According to the International Civil Aviation Organization (ICAO), each passenger with baggage is weighed 90 kg, which converts 1 passenger-km to 0.09 ton-km. The equation for TZL is as follows:

$$TZL_t = HYL_t + 0.09LKL_t \quad (1)$$

Economic growth: According to the principles of economics, economic growth will promote the needs of air

transportation, thus the development of aviation finance. Specifically, it takes effect through two aspects. Firstly, with the process of integration of world economy and the international flow of goods and personnel speeding up, economic growth will enlarge the exchange of goods and services between different countries and regions, which will expend the demand for air transportation. Therefore, there is a probability that the economy size of China and other countries pulls the demand for air transportation. Secondly, time cost of transportation is a critical factor which influences the choice of transport modes. Compared with other modes of transportation, air transportation is much more time-saving. Economic growth drives productivity, as a result, value per unit of labor is increased. Thus, the value of time in passenger transportation rises. As economy gradually develops, the needs of air transportation escalate as well. As for freight, according to the principle of shadow price, time input, as a factor of production, becomes a part of cost of goods. In commodity circulation, delay puts off deals and inflates costs. Based on this logic, costs of transportation will be cut down as long as transportation time is saved (Zhou, 2003). It is worth noting that GDP is a good indicator which reflects the direct needs of aviation finance as well as the derived demand of transportation with time value enhanced.

Airfreight: Based on economic principles, price is a main factor that affects demand. This principle also applies to the air transport industry. When airfreight is relatively high, some travelers will choose to drive or take train and some goods will be delivered by other modes of transportation. Therefore, airfreight directly influences air traffic volume and then the demand in aviation finance market. In consideration of the unique advantages of air transportation, such as high speed and long distance transport, the fluctuation of air traffic volume which can be explained by price need further discussing.

Other parameters: Q is defined as the demand in aviation finance market, E as the purchase ratio, B as the average price of each aircraft, A as average carrying capacity per aircraft.

According to statistics over years, the purchase ratio in China is approximately 40%, thus E is set as 0.4, which is assumed fixed within the next 20 years. Based on the data from China's Civil Aviation Authority, the average value of transport category aircraft is about $100 million, thus B is equal to $100 million. The transport volume per aircraft is set equal to 33.34 million ton-km (statistics in 2010) and the parameter A is reckoned as increasing at a rate of 1.45% which is the average of the last five years.

Mathematical model: According to Statistical data on Civil Aviation of China, the percentage of passenger turnover volume in the total air traffic volume is more than 95%, with the part of cargo turnover volume between 3 to 5%. It is clear in Fig. 1 that the passenger turnover volume and the cargo turnover volume are in different modes of growth. Thus, in order to further quantize air traffic volume, some parameters are chosen such as charges per ton-kilometer (expressed in P), China's real GDP (expressed in CGDP) and other countries' real GDP (expressed in WGDP).

Correlations between variables: Through the scatter diagrams beyond, the passenger turnover volume and the cargo turnover volume are affected by CGDP and WGDP in different degrees. HYL is more sensitive to the changing of CGDP in (b) than that of WGDP in (a), so is LKL in (c) and (d). Apparently, there is apparently a non-linear relationship between variables in each sub-part of Fig. 2.

Model: Combining with the cross correlogram, two formulas have been constructed respectively. They are represented as:

$$LKL_t = c_1 + \alpha_1 CGDP_t + \alpha_2 CGDP_t^2 + \beta_1 WGDP_t + \beta_2 WGDP^2_t + \gamma_1 P_t + \mu_t \quad (2)$$

$$HYL_t = c_2 + \alpha_3 CGDP_t + \alpha_4 CGDP_t^2 + \beta_3 WGDP_t + \beta_4 WGDP_t^2 + \gamma_2 P_t + u_t \quad (3)$$

CGDP represents China's real GDP and WGDP the world's GDP (not including China's). P represents revenues per ton-kilometer which is the Airlines' costs. Then the prediction model of China's aviation finance demand is:

$$Q_t = (1-E)\times B \times \left| \frac{TZL_t}{A_t} - M_0 \right| \quad (4)$$

RESULTS AND DISCUSSION

Analysis and prediction: From the results as shown in Table 1, some variables in Eq. 1 and 3 are not significant, thus discarding those variables to get a better regression result. Then, the two equations are rewritten as:

$$LKL_t = 223574.7 + 5.081 CGDP_t - 1.133 WGDP_t + 1.06\times 10^{-6} WGDP^2_t + \mu_t$$

$$HYL_t = -5810.9 + 1.26\times 10^{-6} CGDP_t^2 + 0.019 WGDP_t + u_t$$

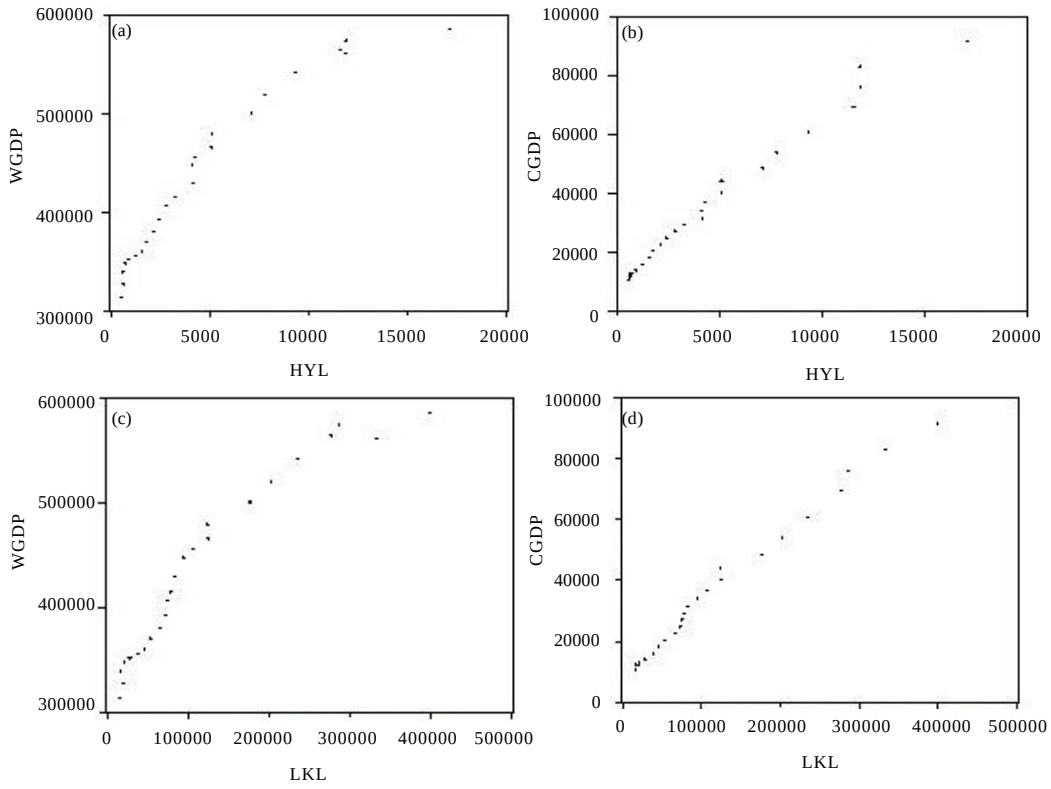

Fig. 2(a-d): Correlations between GDP and two parts of air traffic volume, (a) HYL vs WGDP, (b) HYL vs CGDP, (c) LKL vs WGDP and (d) LKL vs CGDP

Table 1: Results of regression analysis

	LKL		HYL	
Variables	Eq. 1	Eq. 2	Eq. 3	Eq. 4
Constant	321328.3*** (3.110)	223574.7*** (3.227)	-11972.9*** (-2.798)	-5810.9*** (-5.193)
CGDP	4.871*** (8.288)	5.081*** (8.887)	-0.184 (-1.564)	
CGDP squared			2.31×10^{-6}*** (2.390)	1.26×10^{-6}*** (11.229)
WGDP	-1.655*** (-3.082)	-1.133*** (-3.268)	0.043** (2.560)	0.019*** (6.467)
WGDP squared	1.67×10^{-6}** (2.417)	1.06×10^{-6}** (2.118)		
P	3658.3 (1.261)		170.02 (1.205)	
DW	1.694	1.581	1.845	2.201
R-squared corrected	0.993	0.993	0.986	0.986

Results beyond are calculated through EVIEWS6.1, ***Means being significant at 5% significance level, with ** not significant at the level; LKL is passenger turnover volume, CGDP is cargo turnover volume, CGDP is China's real GDP and WGDP is other countries' real GDP not including China's. The data of GDP at home and abroad comes from the World Bank Database in which the data is revised by the law of one price; Total air traffic volume, passenger turnover volume and cargo turnover volume come from each period of Statistical data on Civil Aviation of China; the data of revenues per ton-kilometer is from a Consulting company's database as in Table 1

It is obvious that passenger turnover volume and cargo turnover volume develop in different modes. The former is strongly affected by the world's economy, while the latter is deeply influenced by the domestic economy. It conforms to the current situation of China's air transport industry: Passengers in international flight have accounted for a large amount of passenger turnover volume, while the main part of cargo turnover volume has just happened in different regions at home. Furthermore, the residuals of Eq. 2 and 4 have passed the tests for autocorrelation and heteroscedasticity.

Forecast: Firstly, according to the latest data from IMF, the world's real GDP in 2011 increased at a rate of 3.3%. That rate is expected to be 3.6% in 2012. Based on those figures, it is conservatively estimated that the growth rate of the world's GDP in 2013-2030 is 4%. With the data from National Bureau of Statistics and World

Table 2: 2011-2030 forecast for China's aviation finance demand

Years	LKL	HYL	TZL	A	Aircrafts needed	Incremental aircrafts	Accumulative aircrafts		Incremental demand Q
							Lease	Purchase	
2011	422551	17752	55781	34	1649	52	31	21	3.1
2012	461707	19953	61507	34	1792	143	117	78	8.6
2013	504750	22426	67853	35	1949	157	211	141	9.4
2014	552159	25635	75330	35	2133	184	321	214	11.0
2015	604143	28337	82710	36	2308	175	427	284	10.5
2016	661238	32330	91841	36	2526	218	558	372	13.1
2017	723818	35849	100993	37	2738	212	685	457	12.7
2018	792235	40353	111654	37	2984	246	832	555	14.7
2019	867159	45446	123490	38	3253	269	994	663	16.1
2020	948992	51214	136623	39	3548	295	1171	780	17.7
2021	1038401	57752	151208	39	3871	323	1364	909	19.4
2022	1136076	65167	167413	40	4224	353	1576	1051	21.2
2023	1242513	73586	185412	40	4612	388	1809	1206	23.2
2024	1358603	92199	214473	41	5258	646	2197	1464	38.8
2025	1485083	94020	227678	41	5502	244	2343	1562	14.6
2026	1622912	106386	252448	42	6013	511	2650	1767	30.7
2027	1772829	120459	280013	43	6575	562	2987	1991	33.7
2028	1935964	136484	310721	43	7191	616	3357	2238	37.0
2029	2113404	154741	344948	44	7869	678	3763	2509	40.7
2030	2306319	175548	383117	44	8615	746	4211	2807	44.8

LKL is the passenger turnover volume in million ton-kilometers, HYL is the cargo turnover volume in million ton-kilometers, TZL is the total air traffic volume in million ton-kilometers, A is the average carrying capacity per aircraft in million ton-kilometers, Q is the demand in aviation finance market in $billion

Bank, the growth of China's real GDP is around 10%. Combined with domestic and international economic situation, the rate of the growth in next 10 years is conservatively estimated as 8%. Then, Eq. 2 and 4 can be used to forecast passenger turnover volume (LKL) and cargo turnover volume (HYL). According to Eq. 1, it is viable to estimate total air traffic volume (TZL).

Secondly, the transport volume per aircraft is calculated with a growth rate of 1.45% which is the average of the past 5 years and the benchmark is set to 33.34 million ton km (statistics in 2010).

Lastly, put the time series data of TZL_t and A_t into Eq. 4 to make a forecast of the next 20 years. In the equation, purchase ratio (E) is 0.4 and M_t is the number of the registered aircrafts at period t, with M_0 equal to 1597 in 2010. China's Civil Aviation Authority predicts that the average value of transport category aircraft is approximately $100 million, which is averaged based on types and market prices. Thus, B is set to $100 million. The data concerned has been rounded off, so are figures in Table 2. It is worth noting that incremental aircrafts are of no economic value when the demand is so small that it is far below aircrafts' carrying capacity.

As is shown beyond, the total air traffic volume will increase 5.9 times from 2011 to 2030, the passenger turnover volume 4.5 times and the cargo turnover volume 8.9 times. The demand for aircrafts surges to 8615, 7018 of which are to be purchased, with 2087 by crash and 4211 by lease. The total size of aviation finance market will be up to 421.1 billion dollars.

Compared to 2011, the passenger turnover volume in 2020 will be doubled and the cargo turnover volume nearly tripled. Considering aircrafts' carrying capacity, the number of incremental aircrafts in 2020 will be about 300 compared to 50 in 2011. The cumulative newly-added planes during the 10 years will be up to 1951, 60% of which nearly 1171 aircrafts need to be financed through finance market. The size of aviation finance market in 2020 is predicted to increase to $17.7 billion compared to $3.1 billion in 2011, with $116.9 billion cumulative for the duration.

During the period from 2021 to 2030, the passenger turnover volume and the cargo turnover volume are expected to maintain a rapid growth, increasing by 140 and 240%, respectively. Taking aircrafts' carrying capacity into account, the number of incremental aircrafts in 2030 will reach 746 compared to nearly 300 in 2021, with 5064 newly-added aircrafts cumulative during the period, 60% of which about 3040 aircrafts need to be financed through finance market. The cumulative demand in aviation finance market from 2021 to 2030 is predicted to reach over $300 billion.

DEVELOPMENT STRATEGY

In the international aviation finance market, companies from developed countries such as America, the U.K., Germany and Japan, cannot be so much competitive without the support of their national industrial policies. Take America for instance. The investment tax credit (ITC) was first enacted in 1962. It is prescribed in ITC that

lessors of aircrafts have rights to claim tax credits of 10% of assets' cost as long as the assets are in accordance with the section 38 of the Internal Revenue Code. This made it legal that those lessors in aviation finance market could get tax-cut, which led to the market's booming in America. Facing the large supply-demand gap and profit margin, China's government should take full advantage of the aviation finance market by learning foreign experiences. Several strategies are recommended as follows.

Perfection of china's aviation finance market: The aviation finance industry is capital-intensive, for aircrafts are high-value assets. Therefore, the source of capital always tops the list of factors of the market development. For China's domestic companies, their capital structure at present is extremely unreasonable (Liu, 2007). Since their own capital is very limited, 90% of capital demand depends on loans; consequently, their financial expense is increasingly high. Meanwhile, without a good credit rating system, most companies have to take high financing costs to get loans from commercial banks. Thus, more financing channels should be opened up. When certain conditions are satisfied, the government is expected to offer loan guarantee to help cut down financing costs of those companies, thus improving their management benefit.

Improvement of laws and regulations: The separation of ownership and management is prevalent in aviation finance industry, which makes the system bottleneck of Chain's financial legislation. It is stipulated that capital contributors are not entitled to tax preferences in terms of added value taxes and customs duties (Ouyang and Shang, 2008). This is unfair and hinders the horizontal and vertical development of aviation finance. This problem is rooted in the insufficient knowledge of what the market's nature is and how it is organized. Because of this, lessors in the market share no legislative benefit. To tackle the issue, the government should take the lessors' interest into consideration and amend relevant laws and regulations, under which the aviation finance market will develop orderly and thrive.

Tax policy supports: China's domestic companies pay much more tax than their foreign counterparts. Companies in Singapore, for instance, only bear 5% corporate income tax, while this figure is up to 25% in China. Besides, China's financial companies have to pay 5% business tax, 17% import value added tax, 5% customs duties and 0.1% stamp tax (Sun *et al*., 2008). The tax burden has yet crippled the internal businesses, despite their inferiority in international competition. Thus, to change the status quo, the government is expected to offer tax supports for those companies in terms of corporate income tax, withholding tax, stamp tax and value added tax. Furthermore, the government should allow companies in the field to employ accelerated depreciation methods, which are very effective and generally adopted by most countries.

CONCLUSION

This study introduced a model to estimate the demand for civil aircraft in China. The model forecasted that there would be approximately 7000 civil aircrafts added during the period from 2011 to 2030. Of these aircrafts, more than 4200 civil aircrafts is expected to be financed through finance market. This will pose a great challenge for China's aviation finance market since the economic environment in China is not favored for financial leasing companies. Therefore, three strategies are suggested exclusively for the development of China's aviation finance market. Those strategies are to perfect China's aviation finance market, to improve relevant laws and regulations and to offer tax policy supports.

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