

Research on the Change of International Air Navigation Service Charge

Shuangjun Liu, Yu Yin, Wenlang Li, Zhaojie Meng, Yikang Peng, Mingming Jiang

China Southern Airlines Company Limited, Guangzhou Guangdong, 510470, China

Abstract: There are differences in the global air navigation service charge system, and the charging standards are not the same. With the increasing trend of charging standards in European countries and Russia, this article further analyzes the changes in the total cost of air navigation service charge for different international routes by studying the charging increases of each country. It provides a reference for airlines to dynamically adjust routes, in order to minimize operational costs.

Keywords: Air Navigation Service Charge; Cost Analysis; Route Adjustment.

1. Introduction

The air navigation service charge is one of the major operational costs for airlines, especially accounting for a significant proportion in cross-regional long-haul route operations. In recent years, air navigation service charge expenditures have shown an annually upward trend. Apart from the impact of changes in flight volume, changes of charging standards in various countries have had a remarkable effect. Charging standards in China's mainland, Hong Kong, Macao, and Taiwan have remained unchanged, while those in European countries and Russia have risen significantly. Analyzing the cost structure and changing trends of air navigation service charges for international routes helps airlines dynamically to adjust route directions in order to minimize operational costs.

2. Changes of Air Navigation Service Charges in various Countries

2.1. Management of Charging Standards

The formulation of air navigation service charges mainly follows the guidelines of ICAO, emphasizing cost recovery and fair allocation. Countries adjust their charging standards according to their own airspace management policies. En-Route charges of 42 European countries are uniformly managed by European Organisation for the Safety of Air Navigation (EUROCONTROL). In the Asia-Pacific region, each country independently formulates standards, while in the United States, the FAA leads the calculation of air navigation service charges.

2.2. Global Charging Trends

Charging standards of various countries change dynamically, categorized into monthly adjustment, annual adjustment and irregular adjustment. The table below shows changes in charging standards of selected countries/regions.

Table 1. Categories of En-Route Charge

Adjustment Period	Countries / Regions
Monthly Adjustment	Finland, Norway, Poland, Sweden, Denmark, Hungary, Czech Republic, Turkey, Bulgaria, Romania, Armenia, Serbia, Georgia (En-Route charges), United Kingdom (En-Route charges)
Annual Adjustment	Netherlands, Estonia, Latvia, Germany, Lithuania, Austria, Slovenia, Croatia, Belgium, France, Italy, Greece, Slovakia, Malta, Cyprus, Georgia (approach control fees), United Kingdom (approach control fees), Uzbekistan (En-Route charges)
Irregular Adjustment	China, Russia, Sri Lanka, India, New Zealand, Tajikistan
Unchanged	Hong Kong, Macao, Taiwan regions of China, other countries

According to Table 1, EUROCONTROL member countries adjust their charging standards regularly on a monthly or annual basis, while China, Russia, Sri Lanka, India, New Zealand, and Tajikistan make irregular adjustments. The following analysis focuses on Eurocontrol countries and Russia.

2.2.1. Changes in Charging Rates of European Countries

The charging model of the 42 European countries under the management of EUROCONTROL is $rate \times GCD / 100 \times P$, where $rate$ is the charging rate, GCD is the Great Circle Distance, and P is the maximum take-off weight of the aircraft.

EUROCONTROL member countries control charging changes by adjusting $rate$ [1], with the trend diagram shown in Figure 1.

According to Figure 1, from 2023 to 2025, there are certain increases in En-Route charges of some EUROCONTROL member countries at the beginning of each year. In 2025, there are many countries which raised their rates with large increments, with an average increase of 16.79%. Charges of Estonia, Poland, Netherlands, and Latvia saw substantial rises of 71.78%, 61.69%, 43.81%, and 42.62% respectively, while only 7 countries reduced their charges (as shown in Figure 2)

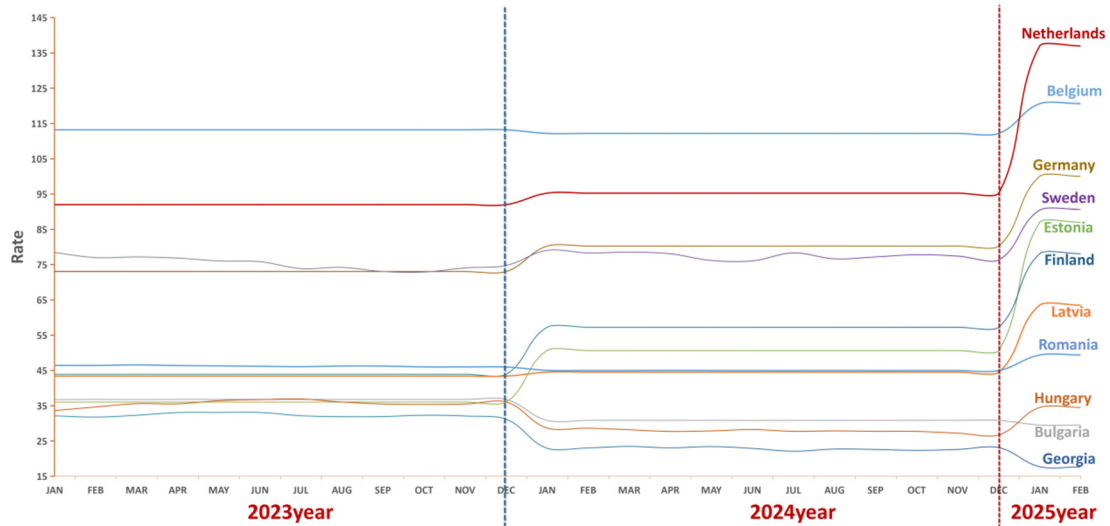


Figure 1. Trend of Changes in Charging Rates of EUROCONTROL Member Countries

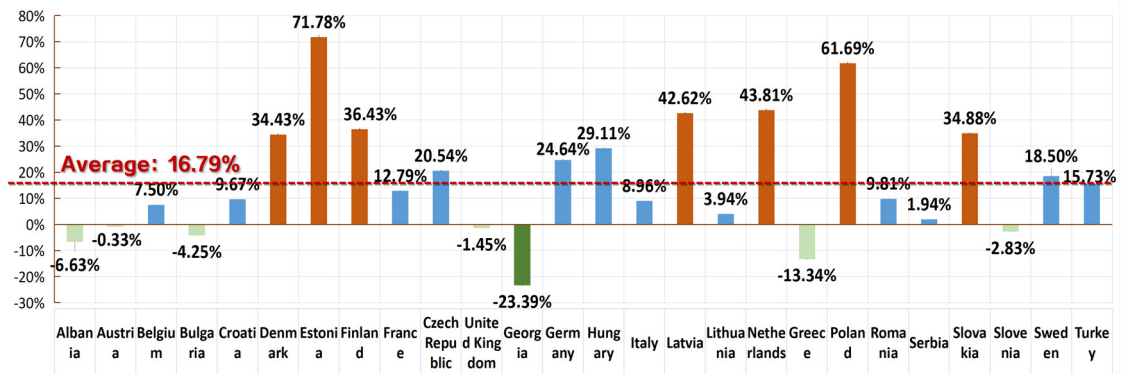


Figure 2. Charging Rate Increases of 26 EURCONTROL Member Countries in 2025

2.2.2. Changes in Charging Coefficients of Russia

The En-Route charging model of Russia is $\text{Round} \left(\frac{GCD}{100}, 0 \right) \times E$, and the approach control charging model is $E1 \times P$, where GCD is the Great Circle Distance, E is the weight charging coefficient, $E1$ is the airport charging coefficient, and P is the maximum take-off weight of the aircraft. E is valued according to the interval where P is located, as shown in Table 2. $E1$ is valued according to the airport, as shown in Table 3.

Russian Civil Aviation Authority adjusted the charging coefficients twice in late October 2022 and late March 2023, with increases of 40% and 10% respectively. In addition, flights crossing Novosibirsk region in Russia are required to pay an additional overflight compensation fee of 1,050 USD (approximately 7,500 CNY). For routes entering into and exiting from Europe and North America via Russia, charges for Russia account for 50%-60%, showing that the adjustment of charging coefficients of Russia has led to a significant increase in total cost of these routes.

Table 2. Values of Weight Charging Coefficient E in Russia

En-Route Charges					
Maximum Take-off Weight (tons)	2020/1/1-2022/10/31	2022/11/1-2023/3/31	Increase	2023/4/1-Present	Increase
300<P≤400	E=138.0	E=193.3	40%	E=212.6	10%
200<P≤300	E=134.9	E=188.9		E=207.8	
100<P≤200	E=130.1	E=182.1		E=200.3	
50<P≤100	E=104.7	E=146.7		E=161.4	

Table 3. Values of Weight Charging Coefficient E1 in Russia

Approach Control Charges					
Airport	2020/1/1- 2022/10/31	2022/11/1- 2023/3/31	Increase	2023/4/1- Present	Increase
UUEE	E1=7.5	E1=10.5	40%	E1=11.6	10%
UHWW	E1=5.9	E1=8.3		E1=9.1	
USSS	E1=7.1	E1=9.9		E1=10.9	
UNNT	E1=5.5	E1=7.7		E1=8.5	
UEEE	E1=9.1	E1=12.7		E1=14.0	

3. Changes in Air Navigation Service Charges of Various Routes

3.1. Overview of Global Routes

There are discrepancies in flight distances when overflying different countries [2]. Typical routes are selected in the

regions of Europe, North America, Africa, Australia and New Zealand, the Middle East, Japan and South Korea, and Southeast Asia. The air navigation service charges of the single flight are compared based on the current aircraft type on the route, the average temperature and wind speed in the summer-autumn and winter-spring period, the annual average exchange rate and oil price. The results are shown in Figure 3.

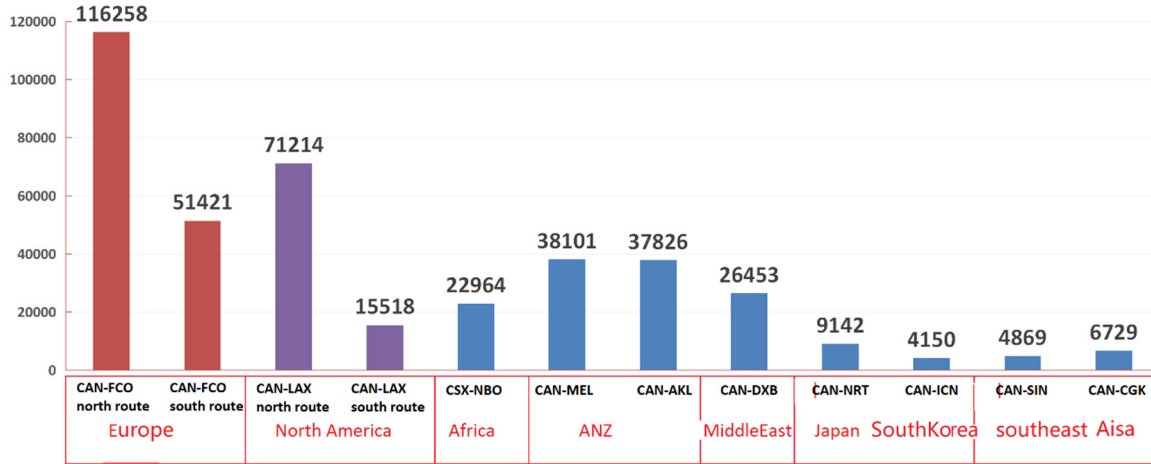


Figure 3. Comparison of the Single-Flight Charges (in CNY) in Global Regions

It can be analyzed from Figure 3 that the single-flight charges of European and North American routes are higher than those for other regions, mainly because the routes are long as well as the charging standards in Russia and EUROCONTROL member countries are high. The following selects a typical European route (Guangzhou-Rome) and a North American route (Guangzhou-Los Angeles) to analyze the charging differences in various periods (2023 to 2025) and the charging differences between north and south routes (the north route via Mongolia and the south route via Kazakhstan) from four dimensions: flight time, flight distance, fuel consumption, and En-Route charges.

3.2. European Routes

According to Table 4 and 5, firstly, European air navigation service charges have increased for two consecutive years, mainly due to the increase in charges for Russia and EUROCONTROL member countries. Secondly, the route via Kazakhstan has much lower charges than the route via Mongolia because it avoids or significantly reduces the flight distance in Russian airspace.

In the actual operation of flights, the European outbound route via Kazakhstan has a longer flight distance, longer flight time (an increase of 13 minutes) and more fuel consumption (an increase of 1.7 tons), but the air navigation service charge is lower, so the route should be selected according to the situation. The European inbound route via Kazakhstan has a shorter flight distance, shorter flight time (saving 36 minutes), less fuel consumption (saving 3 tons) and lower air navigation service charges, making it the best choice.

In addition to operating costs, flight operations also need to pay attention to safety risks. The route through Mongolia has a long flight time in Russia, and there are GPS signals and unstable communication in this airspace, which poses certain operational risks. However, due to the limited number of countries flown over, the overall operation results are still relatively smooth. Flying over West Asian countries via Kazakhstan's route carries risks such as GPS false signals and temporary route closures, especially due to conflicts between countries causing route closures, unavailability of alternative airports, and difficulties in obtaining approvals.

Table 4. Cost Comparison for Route Guangzhou-Rome

Guangzhou-Rome	Flight Time / HH:MM	Flight Distance / km	Fuel Consumption / tons	Air Navigation Service Charges / YUAN				
				2023	2024 and Increase		2025 and Increase	
CANFCO03NF (via Mongolia)	12:07	10682	69.5	99578	109155	9.62%	116258	6.51%
CANFCO02SF (via Kazakhstan)	12:20	10945	71.2	49974	50224	0.5%	51421	2.38%
Cost Variation	+13min	+263km	+1.7tons	-49604	-58931	/	-64837	/

Table 5. Cost Comparison for Route Rome-Guangzhou

Rome-Guangzhou	Flight Time / HH:MM	Flight Distance / km	Fuel Consumption / tons	Air Navigation Service Charges / YUAN				
				2023	2024 and Increase		2025 and Increase	
FCOCAN03NF (via Mongolia)	11:40	10256	67.1	110883	121816	9.86%	128352	5.37%
FCOCAN02SF (via Kazakhstan)	11:04	9747	64.1	54752	55591	1.53%	56680	1.96%
Cost Variation	-36min	-509km	-3tons	-56131	-66225	/	-71672	/

3.3. North American Routes

It can be analyzed from Table 6 and 7 that due to the increase in charging standards of Russia in 2023, the overall cost of North American routes increased. In addition, the outbound North American route that does not overfly Russia is the preferred route for operation due to shorter flight distance, shorter flight time, less fuel consumption, lower air navigation service charges and a larger aircraft payload. Although the inbound North American route that does not overfly Russia has lower air navigation service charges, it is affected by the headwind of the jet stream axis, resulting in longer flight time, more fuel consumption and limited

payload. To increase the payload, for flights not restricted from overflying Russia, the inbound North American route that overflies Russia is preferred.

In terms of operational safety risks, the route passing through Russia has a long flight time within Russian territory, and there are GPS signal and communication instability phenomena. The route without passing through Russia has fewer alternative airports due to long flights in the Pacific Ocean. In case of emergency, it is necessary to divert to Russian airports with higher safety risks, and the airport's support capacity is poor, making it difficult for flights to resume operations.

Table 6. Cost Comparison for Route Guangzhou-Los Angeles

Guangzhou-Los Angeles	Flight Time / HH:MM	Flight Distance / km	Fuel Consumption / tons	Air Navigation Service Charges / YUAN				
				2023	2024 and Increase		2025 and Increase	
CANLAX01NF (via Russia)	13:46	12047	114.6	64483	71214	10.44%	71214	10.44%
CANLAX01YF (not via Russia)	12:04	10658	103.9	15717	15518	-1.27%	15518	-1.27%
Cost Variation	-102min	-1389km	-10.7tons	-48766	-55697	/	-55697	/

Table 7. Cost Comparison for Route Los Angeles-Guangzhou

Los Angeles-Guangzhou	Flight Time / HH:MM	Flight Distance / km	Fuel Consumption / tons	Air Navigation Service Charges / YUAN				
				2023	2024 and Increase		2025 and Increase	
LAXCAN01NF (via Russia)	14:53	13070	122.4	65014	72044	10.81%	72044	10.81%
LAXCAN01YF (not via Russia)	15:21	13553	127.1	15550	15351	-1.28%	15351	-1.28%
Cost Variation	+28min	+483km	+4.7tons	-49464	-56693	/	-56693	/

4. Conclusion and Prospects

In the operation of international routes, changes in the air navigation service charge standards of various countries can only describe the changing trend of charges in a certain airspace. Airlines should macroscopically grasp the impact of charge adjustments on the overall operational costs from the perspective of routes and make full use of charging rules to dynamically adjust route directions. However, the adjustment space is used to be limited. On the one hand, due to unstable international situations, detour routes may lead to an increase in air navigation service charge costs. On the other hand, it is necessary to establish and improve the route use decision-

making mechanism, balance operational safety, service, and revenue and strive to maximize benefits.

References

- [1] EUROCONTROL website: eruocontrol.int, Library, Monthly Adjusted Unit Rate.
- [2] Ding Yanhua. A Brief Discussion on the Important Role of Route Planning in International Operations [J]. Civil Aviation Management, 2016(3):22-24.
- [3] Xue Dabin. Research on Route Flight Path Optimization [D]. Nanjing: Nanjing University of Aeronautics and Astronautics, 2019.