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THE RURAL TRANSPORT IMPROVEMENT STRATEGY INTRODUCED REGIONAL AVIATION IN JAPAN

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Abstract: Today, Japanese air transportation market has the following major issue. Levels of service were set low for most routes to airports located in underpopulated regional areas. Since the potential demand has not surfaced on such routes, airlines have lowered the provided levels further, consequently getting caught in a vicious circle. To improve this situation, the government's public assistance to airlines is considered effective. The purpose of this study is to verify effects of public assistance for regional air service. Specifically, two points were examined: 1) analysis of the role of public subsidies in the formation of a regional air network, 2) quantitative analysis of the economic ripple effect on Hokkaido by the operation of HAC. In conclusion, the following two findings were obtained: 1) the subsidies contributed to early expansion of the regional air network, 2) the economic ripple effect reached approximately ¥1.15 billion for five years after starting operation.

Key Words: Regional aviation, Air transportation policy

1. INTRODUCTION

From the end of the 20th century, Japanese public transport services faced a major turning point, that is, abolition of regulations that adjust supply and demand. With introduction of the principle of market competition, competition from the aspect of profit intensified. At the same time, it became impossible to maintain policies by cross subsidization. The purpose of abolition of supply and demand adjustment regulations is liberalization of market entry. It, however, also involved freedom of exit from the market. Thus incentives by cross subsidization disappeared except for the necessity from the viewpoint of corporate strategies, and unprofitable supply of services was stopped (Yamauchi, 1998). Profitability of a service, however, does not necessarily correspond to its necessity. Maintenance of services by public burden is therefore permitted when it is necessary, especially from the viewpoint of social policies, even if it is unprofitable.

At the same time, regional necessity may be recognized, although its level is not as high as that of the necessity from the viewpoint of social policies. In this case, while services may be maintained with subsidies from local governments, there are no actual institutionalized systems. While it is important to 1) promote efficient operation by business owners, and 2) reflect the intentions of users concerning the necessary level of service when providing

subsidies based on regional necessity, there are no institutionalized mechanisms to guarantee them in many cases (Imahashi, 1998).

Looking at the location of airports in Japan now, 103 airports are already in service throughout the nation, and air service is provided even in some sparsely-settled regions having disadvantageous traffic conditions. In such regions, improvements in air service will enable improvements in traffic conditions and realizations of higher competitiveness of regional industries, as well as lead to the greater independence of those regions. Under the present circumstances, however, it is not easy to improve the level of service even if there are potential demands, because many routes that are in service in depopulated regions are not profitable. The methods to support regional air service are not only a public subsidy but also bonds or loan fund. In this paper, however, we are not concerned with bonds or loan funds because we limit the discussion to the routes which are not easy to improve the level of service. In other words, the risk is too high for a private sector to invest.

The purpose of this study is to discuss the strategies for improvement in transportation level of service with a public subsidy system. In other words, as mentioned above, it is a study of a public subsidy system that can contribute to maintenance of services demanded by residents while facilitating management efforts of business owners. This study addresses and analyzes the case of Hokkaido, where introduction of a regional aviation is recognized as being successful. Specifically, analysis was conducted concerning the following two points:

1) Analysis of the role of public subsidies in the formation of a regional aviation network from the financial aspect concerning Hokkaido Air System (HAC)
2) Quantitative analysis of the economic ripple effect on Hokkaido by the operation of HAC

2. SUPPLY AND FEASIBILITY OF REGIONAL AVIATION IN HOKKAIDO

2.1 Present Transportation Network Situation in Hokkaido

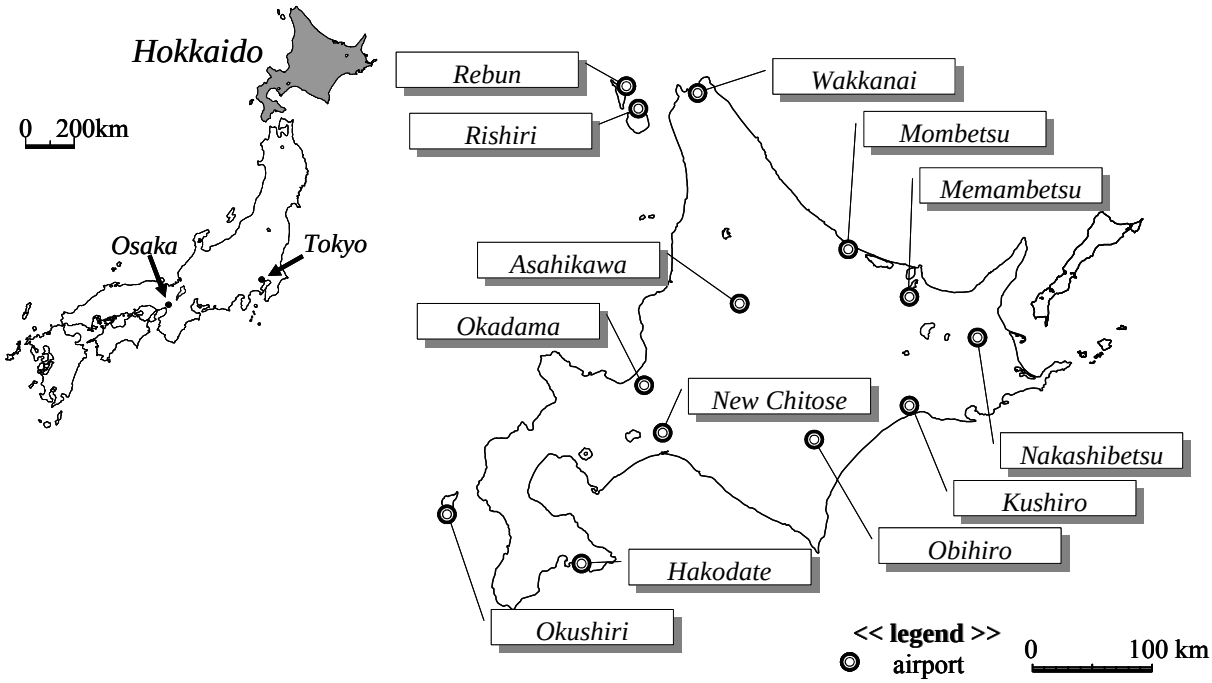

Figure 1 Location of Airports in Hokkaido

Approximately 1,000 km from the nation's capital, Tokyo, Hokkaido is located at the northern tip of the Japanese archipelago. Although Hokkaido and Honshu are separated by the sea, there are established railways (no *shinkansen* bullet trains, however), a ferry, and civil

aviation networks. Civil aviation services account for 85% of the total passenger demand between Hokkaido and Honshu, the main island of Japan.

Administrative, economic, and other central functions are concentrated in Sapporo. On the other hand, in areas besides the metropolis of Sapporo, population is sparsely distributed, resulting in low passenger demand. Therefore, the marketability of public transportation projects has little potential. In fact, automobiles account for approximately 90% of transportation in Hokkaido. Furthermore, construction of expressways is lagging behind other areas in the nation. In fact, many major cities are not yet completely linked to the expressway network. As the distances covered by intercity traffic tends to increase in Hokkaido, higher transportation costs are required, accordingly.

Hokkaido has 13 airports, including three on outlying islands as shown in Figure 1. Many airfields were constructed before World War II, most of which are still used as airports. The challenge we now face is to utilize such a transportation infrastructure to revitalize the region.

2.2 Demands of Local Passengers

The following programs are fictitious scenarios. These programs are not real at all.

Here is the program that is managed by a municipal body established in the vicinity of the Asahikawa Airport including the Asahikawa municipal government. The municipal body will promote the use of Asahikawa Airport.

There are six round trip flights from Asahikawa to Tokyo per day in November 2001. There is a program to increase three flights (see Table 1) so that it can be one day trip from Asahikawa to Tokyo. This program can be come to realization soon only if you pay contribution. If not, this program is postponed indefinitely. This contribution should be collected from every household in Asahikawa only once a year.

If this program comes true, the number of flights between Asahikawa and Tokyo increases that you can cut travel time for Tokyo. However, notice that if you pay the contributions then what's left from your income will you limited goods and services.

1. Do you agree to this program?

1) Yes 2) No 3) Cannot decide

2. If your answer is YES in question number 1, please circle your answer in the following table.

willingness to pay (yen)	answer
1) 0	1 . agree 2 . oppose
2) 5,000	1 . agree 2 . oppose
3) 10,000	1 . agree 2 . oppose
4) 15,000	1 . agree 2 . oppose
5) 20,000	1 . agree 2 . oppose
6) 25,000	1 . agree 2 . oppose
7) 30,000	1 . agree 2 . oppose
8) 35,000	1 . agree 2 . oppose
9) 40,000	1 . agree 2 . oppose
10) 45,000	1 . agree 2 . oppose
11) 50,000 Fill in maximum payable amount (,000)	1 . agree 2 . oppose

Figure 2 Questionnaire Sheet

Table 1 Flight Schedule Presented in Questionnaire

Haneda →		Asahikawa	→ Haneda		
aircraft	departure	arrival	aircraft	departure	arrival
A3	8:30	10:05	*increase*	*7:20*	*9:05*
A321	9:05	10:40	A3	10:50	12:35
A3R	11:30	13:05	A321	11:35	13:20
A321	13:40	15:15	A3R	14:00	15:45
M90	15:30	17:05	A320	15:50	17:35
A3	17:05	18:40	M90	17:40	19:25
increase	*20:55*	*22:30*	A3	19:30	21:15
increase	*21:55*	*23:30*			

A survey was conducted near a local airport to better understand the views of local citizens regarding changes in air networks.

In December 2001 a distribution and collection method questionnaire was mailed that targeted 60 residents of Asahikawa that appraised local residents' intentions to bear the costs of upgrading Asahikawa Airport. Airport administrators had implemented measures based on a Contingent Valuation Method (hereafter CVM). Figure 2 shows this questionnaire sheet.

Willingness to pay (hereafter WTP) was calculated by a disaggregate logit model. In the result, the relation between WTP and approval rate was estimated as the Figure 3 showed. It was the result of estimation of this curve that the likelihood ratio was 0.4813 and the hit ratio was 86.60%. It was high goodness of fit. Then, median WTP was calculated ¥24,568 ($196.80 ($1=¥124.84: the average dollar-yen exchange rate during the survey period)).

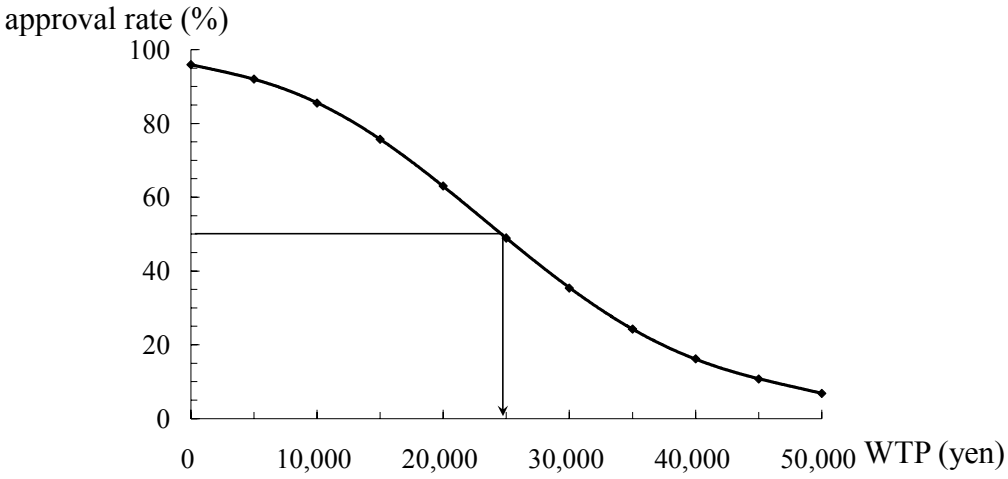

Figure 3 Willingness to Pay Approval Rate

The questionnaire revealed that local citizens were willing to pay ¥24,568 ($196.80) for the project. Compared with the airfare between Asahikawa and Tokyo at the time the questionnaire was conducted, i.e. ¥33,500 ($268.34), this amount was fairly high. The results clarified that local residents were willing to pay for necessary upgrades to civil aviation services to improve flight frequencies and schedules, according to the aforementioned analysis. Since the survey subjects were different, a conclusion cannot be made without thorough consideration, but it may be possible to introduce a regional aviation in a form that satisfies the people's expense.

2.3 Regional Challenges and Aviation Roles in Hokkaido

Currently, Japan is in the process of transforming its infrastructure development policies. Conventional policy used to ensure that, regardless of where people lived, they could enjoy a certain degree of urban services, such as administrative, medical, educational, and so on. To

that end, transportation and infrastructure facilities were designed and constructed to demonstrate urban functions. However, the Japanese people will no longer accept the cost of further construction, increasing the probability that in some areas facilities and transportation infrastructure will remain insufficient.

On the other hand, a globalization trend has been inexorably sweeping over regional cities. Regions are encouraged to become more independent by promoting competitive local industries. In Hokkaido, some regions cannot self-sustaining develop because of accessibility to the market problem although they have abundant and unique resources for tourism, agriculture, forestry or fisheries. In some of these regions, airports have already been constructed. It is difficult to say, however, functions are fully utilized under the existing air transportation system. Therefore, the introduction of a regional aviation system is thought to be a solution.

Based on the above facts, the introduction of regional aviation into Hokkaido has the potential to address the region's transportation woes. The sections below review examples of advanced regional aviation and then study the feasibility of introducing it into Hokkaido.

2.4 Examples of Advanced Regional Aviation

In the United States, "commuter air transportation" was legally defined for the first time in 1969, signaling the start of regional aviation. After deregulation of civil aviation in 1978 in the United States, airlines introduced a hub-and-spoke system network. Such networks significantly developed and expanded regional airlines as part of spoke routes. Even now, primarily in Europe and the United States, regional airlines play an important role in air transportation. Over the past decade in particular, the introduction of regional jet services has progressed in various countries, enabling regional airlines to make great strides.

In the United States, airlines have small aircrafts more than 10% of all aircraft which they have. Between 2001 and 2002, 123 additional regional jet air routes were added, approximately half of which were new routes. The development of regional airlines has improved civil aviation networks. Such airlines as Atlantic Coast Airlines and American Eagle, for example, operate routes that also serve as feeders for mega carriers. Moreover, these routes have maintained a steady demand since September 11, 2001 and are still growing. In Europe routes operated by regional jets have continued to expand at various airports. For example, at Munich Airport in Germany, there are 43 routes of all (209 routes) and 195 flights per day of all (640 flights per day) operated by regional jet. These flights by regional jet have about 700km distance on an average.

In particular, this section cites Cross Air (presently Swiss International Airlines) as an example of an European regional airline. Based in Zurich, Cross Air was launched in 1978 by an airline operating on three routes. Since 1982, the company has expanded its network by adding Basel, Switzerland to its base. Around 1990, the company also assumed the role of a feeder to Swiss Airlines, achieving further development. However, the major target of market development was the niche market. Compared with the United States, where regional airlines developed as spoke routes in a hub-and-spoke system, in Europe such regional airline network formation is based on a round-robin system. That is, the company ventured into routes that no other airline operated and developed the market. Initially, Cross Air introduced a hub-and-spoke system by regional jets. The realities were, however, that demand for transit was not generated because an "economy of scale by mass transportation between hubs," which is a salient feature of a hub-and-spoke system, did not occur. This is also the reason that such a hub-and-spoke system failed in Japan. Furthermore, the aircraft operation method is characteristic of a network expansion strategy. Since flights usually begin at a hub airport, the first flights at the other airports depart later. Cross Air, however, operated the first flights from both airports simultaneously, enabling both regions to equally enjoy transportation links. Demand was also established around business passengers. Therefore, they made profits even when regional jets were used, whose operational costs per

passenger are high (Yai, 2003).

2.5 Feasibility of Introducing Regional Aviation into Hokkaido

As stated in 2.3, the introduction of regional aviation into Hokkaido will support regional independence from a transportation aspect. Based on 2.4, however, the aforementioned introduction faces the following two major challenges:

1) Since a hub-and-spoke system network is difficult to form in Japan, would it be possible to establish a European style round-robin system network? That is, is it possible for regional airlines to create new demand by developing a niche market and playing the role of feeder to mega carriers?
2) Will business users, who are willing to pay slightly high airfares, become the mainstay?

These two issues are matters of revenue and expenditure. HAC has overcome these issues and created a successful operation in Hokkaido. The extensive analysis on HAC will be examined further in the Chapter 3 and 4.

3. SUBSIDY SYSTEMS FOR REGIONAL AVIATION AND THEIR ROLES

3.1 Summary

An important task of the aviation policy is the implementation of an industrial regulation policy for air transportation service. This would be established by regulatory and subsidy policies. Of these, the subsidy policy is for the national and local governments to provide subsidies to airline companies for commuter routes that are difficult for private companies to maintain. Such subsidies can be further divided into a) those fostering the early stages of development, and b) those offering support during periods of decline and transitions of service structures (Regional aviation promotion organization, 2003). This study addresses the first subcategory of subsidies.

3.2 Subsidy Measures for HAC

3.2.1 Overview of the Subsidy Measures

Table 2 Subsidies from Hokkaido Prefectural Government to HAC

FY	1997	1998	1999	Total	Remarks
aircraft purchase program	1,546	1,704	-	3,250	subsidy rate: 9/10
aircraft (1)	1,391	1,534	-	2,925	
spare conponent	155	170	-	325	
ground support vehicle purchase program	9	63	-	72	subsidy rate: 1/2
ground power vehicle (1)	7	-	-	7	
luggage transfer vehicle (1)	2	-	-	2	
snowplow (2)	-	46	-	46	
simplified heating vehicle (1)	-	7	-	7	
transfer / maintenance car (1)	-	10	-	10	
staff training program	146	41	55	242	subsidy rate: 1/2
total subsidies	1,701	1,808	55	3,564	
investment	240	-	-	240	
total	1,941	1,808	55	3,804	

(unit: million yen)

The Hokkaido Prefectural Government, together with Japan Air System, provided the capital to establish HAC. After that, the government also provided subsidies to cover the cost of purchasing aircraft and training personnel. However, it never provided revenue grants. Table 2 shows the amounts of contributions and subsidies provided to HAC by the Hokkaido Prefectural Government. HAC has operated independently without government support since 2000.

3.2.2 Examination of Profitability of HAC Routes

In this section, focus is placed on the "subsidy for aircraft purchases" that accounted for over 80% of subsides provided to HAC by the Hokkaido Prefectural Government in terms of monetary value, aimed at studying their influence on profitability by route. All amounts shown in this section were estimated by the author. Although basic unit data used for estimation were obtained from HAC, the calculations are based on the author's hypothesis. It is necessary to note that the company has nothing to do with the results of the analysis.

a) Analysis Method

In this study, a fare calculation method proposed in the previous study (Morichi *et al.*, 1984) is applied (Eqs. (1) to (3) below).

$$C = A \times \frac{N}{D} + k_3 \tag{1}$$

where,

$$A = \frac{\left(k_1 \times \gamma \times \frac{L}{S} + k_2 \times \gamma + k_4 \right)}{L} \tag{2}$$

$$\gamma = \frac{P}{N} \tag{3}$$

C : fare by distance, N : number of operating aircrafts, D : annual demand,
L : route distance, S : aircraft velocity, P : annual number of landings
k_1 : basic unit of the cost in proportion to annual operation time,
k_2 : basic unit of the cost in proportion to annual number of landings,
k_3 : basic unit of the cost in proportion to annual transport passenger-kilometer,
k_4 : capital recovery cost per aircraft

b) Calculation of Basic Units

Basic units shown in Eqs. (1) to (3) were calculated by following the process in Figure 4 and using data from 2000. Here, the "aircraft cost" was changed when calculating k_4 to indicate whether the subsidy for aircraft purchases was applied or not. This method was originally intended for application to air service that operates a single route. Of the data used, items related to costs were for all the routes of HAC, and details for each route cannot be clarified. The costs were therefore calculated by tracing the operation of three aircraft owned by HAC from their operation schedule and finding the number of aircraft used for each route, although this method is an approximation. While this method included some overlaps, for example the number of operating aircrafts, it was not adjusted in this study.

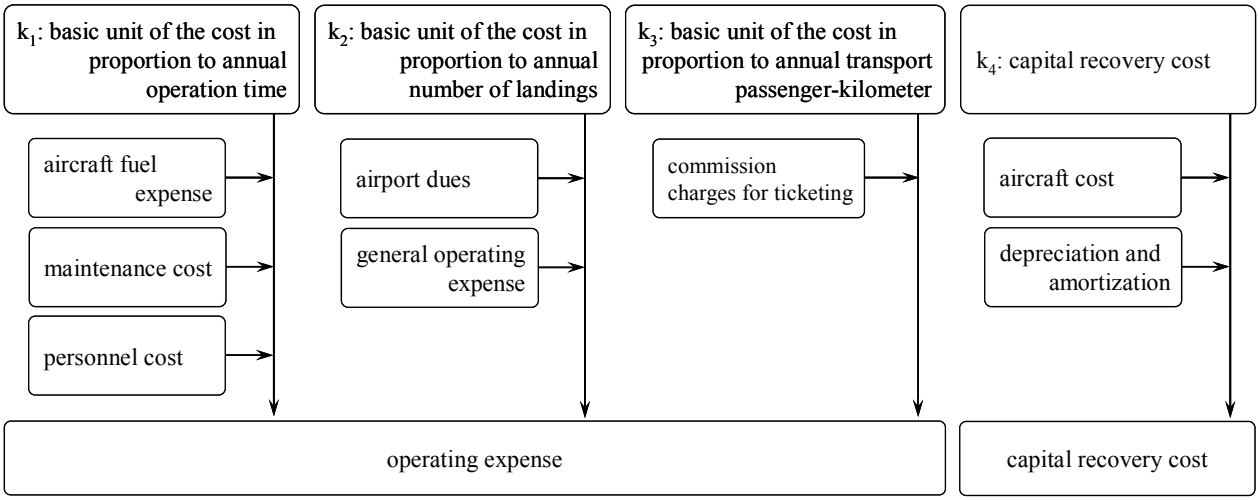

Figure 4 Flow Chart of Calculation of Basic Units

c) Results

Fares by distance of routes operated by HAC were calculated based on the estimated basic units. Table 3 shows the results of the analysis. It was found that a difference of approximately ¥400 million would be found depending on whether or not subsidy for aircraft purchases was provided. Profit decreased in general in cases lacking subsidies. In particular, the New Chitose – Hakodate and Hakodate – Asahikawa routes became money-losing routes.

Table 3 Result of Analysis

route	actual fare per unit distance (yen / km)	in case of provided subsidy: fare per unit distance (yen / km)	in case of provided subsidy: difference (yen)	in case of provided subsidy: operating profit (million yen)	in case of not provided subsidy: fare per unit distance (yen / km)	in case of not provided subsidy: difference (yen)	in case of not provided subsidy: operating profit (million yen)
New Chitose - Hakodate	78	68	10	65	89	**-11**	**-70**
New Chitose - Kushiro	57	26	31	330	30	26	28
Hakodate - Kushiro	54	34	20	136	40	14	91
Hakodate - Asahikawa	55	47	8	56	59	**-4**	**-34**
Hakodate - Memambetsu	44	37	8	51	43	1	6
Asahikawa - Kushiro	50	54	**-4**	**-13**	67	**-18**	**-58**
average / total	56	44	1	625	55	1	220

(The **bold characters** are indicated the deficit route)

3.2.3 Discussion

If the Hokkaido Prefectural Government had not provided subsidy to HAC for the purchase of aircraft, it would have taken a long period of time to increase the number. It would have also required more time to stabilize operations (HAC actually turned a single-year profit in 1999 and a cumulative profit in 2000). As a result, the service levels would have been lower than the actual one, and establishment of the network would not have progressed as quickly.

Changes in the air network of Hokkaido are shown for before (1996: Figure 5) and after (Feb. 2004: Figure 6) HAC's commencement of operations. The figures show that there were only routes connecting Sapporo (Chitose, Okadama) and local cities, except for those to isolated islands before HAC began operations, and that routes connecting local cities outside the Sapporo area were established by the operations of HAC. In this way, HAC established a round-robin network. As a result, high-speed transportation systems have been improved significantly in areas with airports.

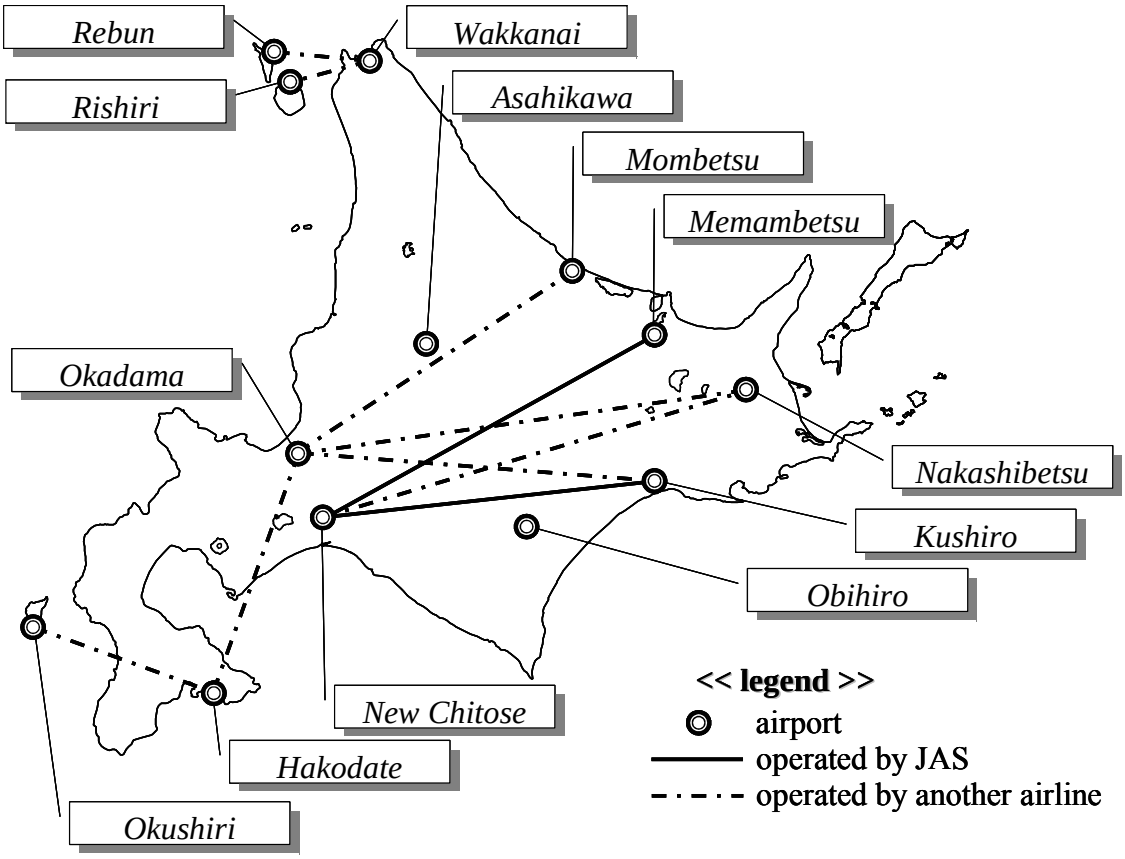

Figure 5 Regional Air Networks in Hokkaido (in 1996)

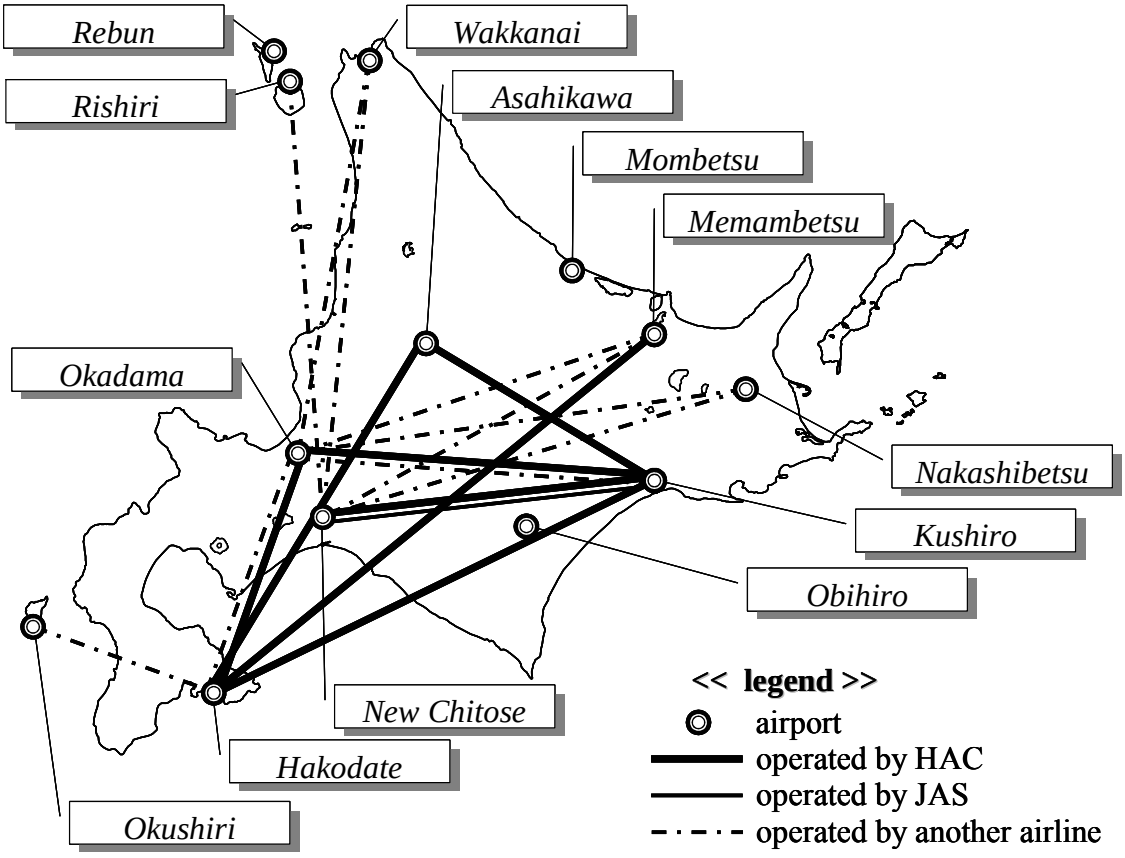

Figure 6 Regional Air Networks in Hokkaido (in February 2004)

From the above, it can be said that HAC played an important part in formation of the air network in Hokkaido, and it was supported by public subsidies provided by the prefectural government for aircraft purchases and other purposes.

4. ECONOMIC EFFECT OF THE OPERATION OF HAC

4.1 Analysis Items And Data Used

Next, the ripple effects of the operation of HAC on Hokkaido's economy were quantitatively analyzed. In this study, economic effects were estimated from the following three aspects:
1) Economic effect from demands for traveling induced by the operation of HAC (induction effect)
2) Economic effect from expenditures supporting operation of HAC (operation effect)
3) Time-saving effect by conversion of use from other means of transportation to HAC
Two surveys conducted by the Hokkaido Regional Aviation Promotion Council (Table 4) were also used as basic data for analysis.

Table 4 Survey Questionnaire Data

	questionnaire for passengers	questionnaire for companies
period	Oct. 14 to 20, 2003	Jan.28 to Feb. 13, 2004
distribution / collection	directly (in HAC flights)	by postal mail
subjects	all passengers (only one time by each passenger)	companies located in HAC operated areas (Hakodate, Asahikawa, Kushiro, and the sphere of Memambetsu Airport)
number of survey-sheet distributed	1,397	500
number of survey-sheet collected	1,370	168
response rate (%)	98.1	33.6

4.2 Induction Effect of the Operation of HAC

(1) Estimation of Tourist Consumption by Induced Passengers in FY2002

In the questionnaire for passengers, respondents who answered "I would not have traveled" or "I would have gone somewhere else" to the question, of "How would you have traveled if there was no HAC flights?" were counted as induced demands. The induction rate for each route was found from the rate of the induced demands in all samples. Table 5 shows the induction rate and number of induced passengers by route.

Table 5 Number of Actual And Induced Passengers, Induction Rate

route	Sapporo Hakodate	Sapporo Kushiro	Hakodate Asahikawa	Hakodate Kushiro	Hakodate Memambetsu	Asahikawa Kushiro	Total
actual number of passengers (persons)	23,001	87,589	24,964	14,834	11,412	10,707	172,507
induction rate (%)	5.26	8.05	6.34	6.34	6.34	6.34	-
number of induced passengers (persons)	1,211	7,047	1,582	940	723	679	12,182

Next, the consumption amount by induced passengers during their trips was determined. The Hokkaido Prefectural Government collected statistics by considering all consumption activities as those for sightseeing, regardless of the purposes of trips, and the same approach was taken in this analysis. The consumption by tourists in Hokkaido was estimated based on the reference material (Hokkaido Research Committee on Economic Effects of the Tourism Industry, 2000). Here, the average consumption unit of visitors from outside of Hokkaido was applied as the consumption unit of induced passengers because the unit of visitors inside Hokkaido is not appropriate for the air passengers' unit. The reason is that almost visitors inside Hokkaido travel by car.

From the survey questionnaire for users, it was found that the average number of days of traveling was 2.99, and the average length of stays was 1.99 days among induced passengers using HAC. The tourist consumption of induced passengers was therefore estimated as shown in Table 6. From the above, the tourist consumption of induced passengers in FY2002 was estimated to be ¥567 million.

Table 6 Tourist Consumption of Induced Passengers

	tourist consumption from outside of Hokkaido			tourist consumption of induced passengers	
	average consumption (yen / personal)	average length of stay (day)	consumption per day (yen / day)	average length of stay (day)	consumption on tourism (yen / personal)
transportation expense	10,791	3.81	2,832	2.99	8,469
accommodation fee	18,029	2.81	6,416	1.99	12,768
meal expense	8,479	3.81	2,225	2.99	6,654
shopping and souvenir expense	16,351	3.81	4,292	2.99	12,832
petty expense	7,426	3.81	1,949	2.99	5,828
Total	-	-	-	-	46,550

(2) Estimation of Economic Ripple Effects by Tourist Consumption of Induced Passengers

Next, ripple effects on industries in the prefecture by tourist consumption of induced passengers in Hokkaido were estimated. First, commercial and transportation margins of related items were estimated from the 1995 inter-industry table, and some of the output was returned to commerce and transportation. By making this adjustment, the producer price of the tourist consumption of induced passengers was estimated to be ¥545 million. The prefectural output found from the prefectural self-sufficiency rate was ¥500 million.

From this prefectural output, the production induction effect in Hokkaido (indirect primary effect) was estimated to be ¥709 million. The domestic budget diverting effect (indirect secondary effect), which is the effect that salaries paid for the production induces further production for successive consumption, was ¥278 million. The economic ripple effect by induced passengers in FY2002 was thus ¥987 million, as a sum of production induction and domestic budget diverting effects.

Table 7 Economic Ripple Effect of Induced Passenger's Consumption

FY			1998	1999	2000	2001	2002
direct effect	producer price of tourist consumption		2.28	3.52	4.31	4.15	5.45
	(producer price within Hokkaido)		2.09	3.23	3.95	3.81	5.00
indirect effect	primary	production induced effect	2.97	4.57	5.61	5.40	7.09
	secondary	roundabout budget effect	1.16	1.79	2.20	2.12	2.78
total economic ripple effect			4.13	6.37	7.81	7.52	9.87

(unit: 100 million yen)

Last, the induction effect from 1998 to 2001 was estimated on the assumption that there was negligible yearly fluctuation in the induction rate for each route and consumption per induced

passenger. The results are shown in Table 7.

4.3 Operation Effect of HAC

Table 8 Expenditure in Hokkaido Related to Operation of HAC Checked Against Inter-industry Table

	inter-industry table	orders, purchases and expenses		subtotal
	checked for 33 sections	within Hokkaido	outside of Hokkaido	
salaries	(consumption activities)	407,888	-	407,888
travel expenses (excl. accommodation)	transportation / communication / broadcasting	22,843	-	22,843
accommodation expenses	service	3,000	2,000	5,000
construction, repair and maintenance	construction / civil engineering works	167,881	1,500	169,381
heating / lighting	electricity / gas / water	1,814	-	1,814
computer-related equipment	machinery	4,480	-	4,480
purchase of aircraft parts		-	75,079	75,079
purchase of general equipment		-	322,566	322,566
equipment, business machine lease and maintenance	office supplies	5,729	-	5,729
purchase of uniforms and related items	fabrics	4,017	114,960	118,977
purchase of office supplies	office supplies	3,167	-	3,167
fuel	oil / coal products	131,507	-	131,507
advertising / publicity	service	28,784	-	28,784
printing	publication / printing	2,846	-	2,846
commissioned work	service	119,929	155,221	275,150
sales commissions		-	114,490	114,490
other expenses	service	5,112	412,522	417,634
total annual expense		908,997	1,198,338	2,107,335
expenses excluding salaries		501,109		

(unit: thousand yen)

Table 9 Economic Ripple Effect Generated from Operation Expenses of HAC

FY		1998	1999	2000	2001	2002
direct effect	producer price of expenditures supporting operation of HAC	2.28	3.10	3.60	3.91	4.83
	(producer price within Hokkaido)	2.00	2.71	3.15	3.42	4.22
indirect effect	primary : production induced effect	2.76	3.75	4.36	4.72	5.84
	secondary : roundabout budget effect	2.30	3.07	3.75	3.83	4.41
total economic ripple effect		5.06	6.82	8.11	8.55	10.25

(unit: 100 million yen)

The economic ripple effect in Hokkaido was found from expenditure related to the operation of HAC. First, the amount spent in Hokkaido in FY2002 was estimated based on data provided by the company. Each expense item was checked against the inter-industry table after taking expenditure items into account to find the economic ripple effect (See Table 8). First, the amount of orders, purchases and expenses in Hokkaido was ¥909 million. Of this amount, ¥408 million was directed to domestic budgets as salaries, and created industrial ripple effect through consumption activities. The direct effect was therefore estimated to be ¥483 million, by adjusting ¥501 million excluding salaries to producer prices taking the commercial and transportation margins into account. Of this amount, the prefectural output was estimated to be ¥422 million. It was therefore found that the production induction effect was ¥584 million and the domestic budget diverting effect was ¥441 million in Hokkaido.

Table 9 shows the economic ripple effect generated from operation expenses of HAC between FY1998 and 2001.

4.4 Time-saving Effect of the Conversion to HAC

In the survey questionnaire for users, respondents who answered "I would have traveled by other routes or means of transportation if there were no HAC flights" were treated as conversion. Means of transportation before conversion and their ratio were estimated from these results. Table 10 shows the details.

Table 10 Number of Passengers Changing Mode to Direct Flights of HAC

original mode / route	by air		by rail (JR)	by car	
	connection	other route		summer season	snow season
Sapporo - Kushiro	-	-	46,983	1,944	933
Sapporo - Hakodate	-	-	8,716	-	-
Hakodate - Asahikawa	-	3,758	16,701	2,040	883
Hakodate - Kushiro	1,701	3,119	8,223	622	229
Hakodate - Kitami	1,283	2,993	5,986	304	124
Asahikawa - Kushiro	-	1,823	6,382	1,201	622

(unit: persons)

Next, reduction of required time by conversion to direct flights of HAC from other means of transportation was found as shown in Table 11. This was estimated from the timetable from April 2002.

Table 11 Time-saving through Changing Mode to Direct Flights of HAC

original mode / route	by air		by rail (JR)	by car	
	connection	other route		summer season	snow season
Sapporo - Kushiro	-	-	50	210	220
Sapporo - Hakodate	-	-	52	140	165
Hakodate - Asahikawa	-	80	148	195	240
Hakodate - Kushiro	45	180	220	355	390
Hakodate - Kitami	105	155	354	325	385
Asahikawa - Kushiro	-	100	209	210	210

(unit: minutes)

From the above, the timesaving effect by direct flights of HAC can be calculated. The effect was estimated by assuming the time value as ¥3,827/hour. For this time value, the time estimation value of passengers in the Cost-effectiveness Analysis Manual for Airport Development Projects 1999 was used. The estimation results are shown in Table 12. The timesaving effects for FY1998 to 2001 were also estimated from the annual number of

converted users on the assumption that the reduced time was comparable to that of FY2002, although the results are not shown here due to space limitations. As a result of this analysis, the timesaving effect by conversion to direct flights of HAC between FY1998 and 2002 was found to be ¥4.02 billion (see Table 13).

Table 12 Time-saving Effect through Changing Mode to Direct Flights of HAC

original mode / route	by air		by rail	by car	
	connection	other route	(JR)	summer season	snow season
Sapporo - Kushiro	0	0	14,984	2,604	18,879
Sapporo - Hakodate	0	0	2,891	0	2,891
Hakodate - Asahikawa	0	1,918	15,766	2,537	21,572
Hakodate - Kushiro	488	3,581	11,539	1,408	17,586
Hakodate - Kitami	859	2,959	13,516	630	18,269
Asahikawa - Kushiro	0	1,163	8,508	1,609	12,112
Total	1,347	9,620	67,203	8,788	91,327

(FY 2002, unit: 10 thousand yen)

Table 13 Time-saving Effect through Changing Mode to Direct Flights of HAC

original mode / FY	by air		by rail	by car		Total
	connection	other route	(JR)	summer season	snow season	
1998	405	6,607	41,587	6,523	2,722	57,844
1999	1,136	9,396	54,635	6,889	3,501	75,557
2000	1,488	10,463	65,037	7,978	3,649	88,615
2001	1,563	10,795	64,885	7,766	3,686	88,695
2002	1,347	9,620	67,203	8,788	4,368	91,327
Total	5,940	46,881	293,347	37,945	17,926	402,038

(FY1998~2002, unit: 10 thousand yen)

4.5 Results And Discussion

Table 14 Economic Ripple Effects of Starting HAC's Operation

FY	1998	1999	2000	2001	2002	total
induced passengers effect	4.13	6.37	7.81	7.52	9.87	35.70
operation effect	5.06	6.82	8.11	8.55	10.25	38.79
time-saving effect	5.78	7.56	8.86	8.87	9.13	40.20
total economic ripple effect	14.97	20.75	24.78	24.94	29.25	114.69

(unit: 100 million)

From the above analysis, the economic ripple effect by the operation of HAC was summarized as shown in Table 14, and was estimated to be approximately ¥11.5 billion in total from the commencement of operation to FY2002. The total amount of public subsidies provided by Hokkaido was ¥3.8 billion (see Chapter 3). It is difficult to discuss the policy effect from a simple comparison of this and the economic effect estimated in this study. However, it is expected that the economic ripple effect will further increase, and the policy effect will also be improved by continuing the operation of HAC in the future.

5. CONCLUSION

In this study, introduction of regional aviation and public subsidies were analyzed by performing a case study on HAC. As a result, the following two conclusions were reached:
1) Out of public subsidies, focus was placed on subsidies for purchase of aircraft, and the profitability of routes with or without such subsidies was analyzed. As a result, there was a

difference of approximately ¥400 million between these two cases. This means that the subsidies contributed to early expansion of the regional air network and improvement in service levels. It also led to establishment of demand and early stabilization of the management base of the airline company. This also suggests that air service that can survive market competition can be realized without providing revenue grants.

2) The economic ripple effect of the operation of HAC on the Hokkaido region was analyzed. The induction effect, ripple effect by expenditure and timesaving effect were quantitatively clarified. The analysis revealed that the economic ripple effect of the operation of HAC on the Hokkaido region reached approximately ¥1.15 billion (FY1998 ~ 2002). Further increase in economic ripple effect is expected by the continuation of operation of HAC, indicating also the increase in policy effect of public subsidies provided by the Hokkaido Prefectural Government.

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