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Author(s)	Sawa, Sempey
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FREIGHT CLASSIFICATION INDEX OF JAPAN NATIONAL RAILWAY

By Sempey SAWA*

The method of making the freight classification index being adopted in the Japan National Railway Corporation, the subject of study in the present treatise is pregnant with many interesting factors as an instance of the application of the theory of transport rates making. As far as the present writer knows, practically no study has so far been made of the classification index. "The Economics of Transport, Revised Edition", published by the present writer two years ago, may well be said to have been the first attempt at research in the particular field. The classification index is not only important as virtually constituting a basis upon which the freight rates system of the Japan National Railway stands, but also offers a significant object of study from the view-point of the theory of freight-rate-making, and, in a broader sense, of the management of the railway accounting. In spite of this, however, the subject has up till now been seldom taken up for serious study, which the present writer cannot help but considering as utterly incomprehensible. Now, attempt will be made here to probe the classification index, which is adopted in the revision of freight rates in Japan National Railway, February, 1953. Prior to the revision, it is noted, the Council of Freight Classification, especially set up in the National Railway, had practically no serious discussion about the freight classification index among its members,¹⁾ resulting in the approval without any amendment of the freight classification index as introduced by the National Railway authorities. In view of its importance as a determining factor of the National Railway revenues and expenditures fundamentally affecting the railway freight rates system as well as in the light of its influence on the entire range of Japan's national economy, such should be considered to be highly inexplicable.

* The author is professor of Economics at the Kyoto University.

1) "Proceedings of the Council of Freight Classification Index", in the issues of Oct. 1952, Apr., May & June, 1953, of the "Journal of Freight Traffic Monthly", Traffic Department, Japan National Railway Corporation.

It should, of course, be conceded that the contents of the index itself is rather hard to comprehend for a layman. It, however, is so systematically constructed that its comprehension, as a whole, should not so difficult. We, indeed, must have the complete conception of this rates-making system, in order to know the character of the freight rates system of the National Railway.

These points have already been treated in the Appendix to the "Economics of Transport, Revised Edition",²⁾ published by the present writer. It, however, is considered appropriate to take them up again in the present treatise, for the reason that their treatment in the afore-mentioned book is considered inappropriately terse and that several new factors to be supplemented have been found by the present writer in the course of his subsequent study of the problem.

Table 1 shows the freight classification index adopted in the revision of the National Railway freight rates in February, 1953 which are in practice at present. In the Table, Class 1 to Class 12 are comprised in the normal class, while Class 21 to Class 23 in the special class. Of these two classes, the special class is literally "special" in the sense that it is provided mainly for purposes of "social policy", and, at the same time, it is supplementary to the normal class. This circumstance naturally excludes this special class from the range of study in the present treatise the main purpose of which is to make a theoretical research of the classification of freight rates. As a matter of fact, in the normal class the classification index is determined on the basis of clas-

Table 1. Freight Classification Index of Japan National Railway

Class	Classification index	Divisions of Commodity Price
1	200	over ¥ 1,344,001
2	160	up to ¥ 1,344,000
3	130	336,000
4	110	96,000
5	102	32,000
6	98	12,800
7	95	6,400
8	91	3,200
9	87	1,600
10	83	800
11	79	400
12	75	200
21	85	
22	80	
23	75	

(Commodity Price is market price per metric weight ton, inclusive of packing cost at the station of dispatch.)

sified price levels of commodities, whereas, in the special class, its index is nominally fixed independently of price classification. In short, the special class is not an economic class in the true sense of the term.

2) Sawa's "Economics of Transport", Nov., 1954. pp. 346-349, Further refer to pp. 134, 139, 145 and 167.

Now, the division of commodity price is highly significant as a standard of the classification index, which, again, should serve as a basis on which freight rates are determined. That the classes of freight rates are based on a price division of commodity transported starts from the proposition, as explained later, "what the traffic will bear" (the value of transport service) is assessed by its price, or, in other words, from the interpretation that higher freight rates should be imposed on higher-valued goods and lower rates on lower-valued goods.

The price of commodity (merchandise) as shown in the "division of commodity price" refers to the price per metric weight ton, which is assessed according to the following formula :

$$\begin{aligned} \text{price per ton} &= (\text{price per piece of commodity}) \times (\text{pieces per ton}) \\ &= \frac{\text{price per piece of commodity}}{\text{weight per piece of commodity}} \times 1,000 \end{aligned}$$

The "price" as referred indicates the price on rail per ton, inclusive of packing cost.

The price on rail is the producer price plus all cost until the commodity is put on rail, which stands as follows in case it is consigned to the forwarding business :

$$\text{price on rail} = (\text{price at factory}) + (\text{cost of package}) + (\text{freight collection fee}) + (\text{truckage}) + (\text{cost of loading})$$

What deserves attention in Table 1 is the fact that, from Class 12 to Class 5, the classification indices form the arithmetic series with common difference 4, while the indices from Class 5 to Class 1 form irregular series with broader leaps. The division of commodity price, on the other hand, from Class 12 to Class 6, forms the geometric series with common ratio 2, whereas the series Class 6 to Class 1 increases with the irregular and broader leaps. Thus, the ratio of Class 12 against Class 1 is assessed as follows :

$$\text{In classification index, } \frac{200}{75} = 2.66$$

$$\text{In division of commodity price, } \frac{\text{over } \yen 1,344,001}{\yen 200} = \text{over } 6720$$

This fact, highly important from the point of view of a theory of transport rates, indicates the existence of a limit to the scope of the application of the generally approved theory that the higher the price of a commodity becomes, the more its rates-bearing capacity increases. This is to say that while the commodity price progresses either at a geometrical or larger ratio, the freight rates are forced to progress at mere arithmetic difference or so.

It should be noted, in this connection, that, while Table 1 shows the classification index adopted in its original program by the National Railway authorities, both the Ministry of Agriculture & Forestry and the Ministry of International Trade & Industry had their own respective draft programs.

In view of the extensive effect of the railway freight which is bound to exert on the price of farm products, industrial materials, industrial manufactures, trade commodities, etc., the Ministry of Agriculture & Forestry as well as the Ministry of International Trade & Industry were asked for opinion, in response to which the Ministers submitted their own views, as indicated in Table 2.

Table 2. National Railway Freight Classification Index (Draft program prepared by the Agriculture-Forestry Ministry and the International Trade-Industry Ministry)

Classes	Class Index	Standard Price
1	200	over ¥ 1,100,000
2		up to 1,100,000
3		500,000
4		260,000
5		130,000
6		50,000
7		15,000
8	95	7,000
9		4,500
10		3,000
11		2,000
12	75	1,000
21	100	
22	90	
23	80	
(24)	70	

¥7,000, is slightly higher than ¥ 6,400 as provided in the National Railway program; (3) This program has Class 24 as the lowest class of the special classes. This stems from the intention of these both Ministries that rice and the staple foodstuff should be placed under the special class. The index for Class 21 stands at 100, which is considerably higher than in the National Railway plan; (4) In this plan, no index is given to the other classes than classes 1, 8 and 12. Conceivably this is because the lacking indices were trusted to be decided on by the National Railway.

Then, how was the index 75 for Class 12, the lowest provided in Table 1, assessed? Table 3 should supply an answer to this question. This Table gives a detailed cost accountings of National Railway, where the

This draft program, compared with the National Railway program, is rather so crude and contains so many weak points that it could not be adopted. Only to be noted in this program is the fact that: (1) while the class index for Class 12, the lowest in the rank, is 75, the same as in the National Railway plan, the corresponding price division stands at ¥ 1,000, much higher than the ¥ 200 level as provided in the National Railway plan; (2) Class 8 in this program, corresponding to Class 7 in the National Railway plan, has 95 for its class index as in the case of the National Railway plan, while its price division,

“cost of freight carriages” refers to direct costs, while all the other costs, including management and security cost, administration cost, interest and depreciation cost correspond to indirect costs. Thus, it is seen that both the direct and the indirect costs form the total cost involved.

Table 3. Detailed Classified Costs in the Department of Freight Traffic, Japan National Railway

Costs		Categories	Costs during 3rd quarter of 1951	Ratio	Costs for 1952	Ratio
Cost of Freight Carriages		Maintenance of way	¥4,488,627,000	184	¥17,796,202,000	155
		Maintenance of signal & communication	887,546,000	37	3,653,440,000	32
		Maintenance of cars	3,788,178,000	156	19,117,203,000	167
		Cost of transport	10,431,622,000	430	48,680,901,000	424
		Sum	19,555,973,000	807	89,247,746,000	778
Managements & Securities			190,735,000	6	622,389,000	5
Administrations			1,654,137,000	70	7,305,531,000	64
Interest & Depreciations			2,827,005,000	117	17,487,761,000	153
Total			24,227,850,000	1000	114,664,427,000	1000

Notes. (1) Percentage of direct costs against the average costs

(i) 3rd quarter period, 1951.....80.7%

(ii) 195277.8%

(2) Freight rates index for covering direct costs.

(i) 3rd quarter period, 1951 ;

$$\left(\frac{\text{Gross rates revenues}}{\text{Gross expenses}} \times 100 = 96\% \right) \times 80.7\% = 77\%$$

(ii) 1952 ;

$$\left(\frac{\text{Gross rates revenues}}{\text{Gross expenses}} \times 100 = 94\% \right) \times 77.8\% = 73\%$$

Thus, it is seen that the percentage of direct costs in the total expenses (ratio of direct costs) stands at 80.7 % for the 3rd quarter period, 1951, while that for 1952 was 77.8 %.

Now, the percentage of the gross rates revenues in the total expenses for both years is assessed, respectively, as follows :

3rd quarter period, 1951 :

$$\frac{\text{¥ 23,332,944,000 (gross rates revenues)}}{\text{¥ 24,227,850,000 (total expenses)}} \times 100 = 96\%$$

1952 :

$$\frac{\text{¥ } 107,869,722,000 \text{ (gross rates revenues)}}{\text{¥ } 114,664,427,000 \text{ (total expenses)}} \times 100 = 94\%$$

Therefore, if these ratios, respectively, are multiplied by the foregoing percentage for the direct costs, the freight rates, which is to cover the direct costs, will be obtained, as follows:

$$\begin{aligned} \text{3rd quarter period, 1951: } & 96\% \times 80.7\% = 77\% \\ \text{1952: } & 94\% \times 77.8\% = 73\% \end{aligned}$$

Thus, an average of these two values:

$$(77\% + 73\%) \div 2 = 75\%$$

This figure, 75, corresponds to the class index for Class 12, the lowest normal class in Table 1.

The fact that the National Railway employs 75 as the class index for the lowest Class 12 implies its being content with the freight rates revenues covering 94–96% of the average expenses incurred, with a 4–6% deficit. If, however, the Railway authorities take the position that the freight rates revenues, even under Class 12, should cover the entire direct costs involved, the index for Class 12 should clearly be raised up to 77.8%–80.8%. It is noted, in this connection, that the National Railway, in revising the freight rates system in February, 1953, actually took no attempt of raising the average level of the freight rates revenues. This explains why the index for Class 12 was kept at 75.

If the National Railway had intention of having not only the direct cost but also the average cost properly covered, the index should have stood at 105 as resulting from the equation:

$$95 : 100 = 100 : x \quad x = 105$$

This figure, 105, is to be found between Class 5 and Class 4 in Table 1.

From this, it is known that the freight normal class of the National Railway can be classified into three major categories. First, the lowest Class 12 is supposed, so far as the fundamental principle concerns, to be barely sufficient to cover the direct costs. (Actually, however, it is not even sufficient to cover the direct cost, as has already been explained above.) The situation improves, however, as the class proceeds; Class 5 is shown to be sufficient to cover the average cost involved. (The fact is, however, that until the class progresses up to Class 4, the average cost could not be properly covered.) As the class proceeds further up to Class 1, not only the average cost as well as the direct costs are fully covered but also there accrues a certain amount of surplus. Interesting about these three categories is the fact that, between Class 5 and the classes below it, where the direct costs, sometimes, even the average costs, may be covered,

the index for each class proceeds at an arithmetic series; but, between Class 4 and the classes above it, we see the index progress at a greater difference than an arithmetic series. This, again, roughly corresponds to the geometric and non-geometric numerical progression seen in the divisions of price corresponding to the classification index.

The fact that the ratio 94-96 % of the gross rates revenues against the gross expenses for the years 1951-1952 was used here as the basis of assessment of the classification index indicates that the National Railway takes it for granted that a deficit of 4-6 % in freight transport is unavoidable. This deficit, of course, ought be made up for by other business fields operated by the National Railway. This is seen from the fact that the ratio of the gross rates revenues against the gross expenses involved stands at 102 % as far as railway passenger transport is concerned, at 114 % as far as ferry-boat transport is concerned and at 58 % as far as automobile transport is concerned. Then, in the whole business, including the other miscellaneous revenues, there is found a complete balance between whole expenses and whole revenues. (Refer Table 4)

Table 4: Expenses and Revenues of National Railway as Classified into Various Business Lines.

Items		Revenues (A)	Expenses (B)	$\frac{A}{B} \times 100$
Railway Transport	Passenger	¥114,243,888,000	¥111,799,379,000	102%
	Freight	107,869,772,000	114,664,427,000	94
	Total	222,113,660,000	226,463,806,000	98
Ferry-boat Transport	Passenger	1,271,229,000	1,939,306,000	66
	Freight	4,025,733,000	2,723,469,000	148
	Total	5,296,962,000	4,662,775,000	114
Automobile Transport	Passenger	2,725,600,000	4,678,562,000	58
	Freight	857,118,000	1,512,518,000	57
	Total	3,582,718,000	6,191,080,000	58
Miscellaneous		6,111,178,000	—	—
Grand Total		237,104,518,000	237,317,661,000	100 (99.91)

Table 3 shows the process by which the classification index 75 for Class 12 is obtained. Then, how are the index numbers of the other classes to be obtained? The process, in short, is to assess the quantities of various traffic goods according to each different item and category, and, with the freight-rates-bearing capacity of each of them duly taken into

consideration, to determine the index number of each class so as to make the gross rates revenues amount to 94~96 % of the gross expenses. In doing this, special attention has been paid to the decision of the index number for Class 7 to which coal, the most important item of traffic goods transported by the National Railway, belongs.

Theoretically, the weight of the traffic goods transported in terms of ton should not serve as a basis, but, the basis should be in terms of ton-kilometer as a correct barometer of the quantity of work done according to each class. This is not feasible, however, because (1) it involves too complicated procedure of numerical assessment, and because (2) there is no remarkable difference in the average railway transport kilometers among items or categories of traffic goods in Japan, due to the industrial location and the residential diffusion. From these reasons, it becomes evident that the weight quantity of the traffic goods transported in terms of ton alone may, not inappropriately, be employed for indicating the quantity of work done concerning each class of traffic goods.

Table 5, shown below, is a table of converted classification index, in which the index number 75 for Class 7 as seen in Table 1 is converted into basic number 100.

Table 5. Table of Converted Classification Index.

Class	Class Index	Converted Class Index
1	200	210.53
2	160	168.42
3	130	136.84
4	110	115.79
5	102	107.37
6	98	103.16
7	95	100.00
8	91	95.79
9	87	91.58
10	83	87.37
11	79	83.16
12	75	78.95
21	85	89.47
22	80	84.21
23	75	78.95

The conversion depends on the fact that coal, the most important item, occupying 29 % of the total of the goods transported and 16 % of total freight rates revenues, belongs Class 7, and, also, the freight rates chargeable for all the other classes will, according to each actual traffic distance, easily be accounted by means of the converted class index shown in Table 5 and of the freight distance rates prepared in Table 6. The cost for the terminal handling and loading or discharging is fixed uniformly at ¥ 70.

To show a few examples :

In case of traffic distance of 5 km,

Class 7 rates ¥ 3.20 × 5 = ¥ 16

terminal costs = ¥ 70

total = ¥ 86

Class 6 rates ¥ 86 × 103.16 % = ¥ 88.72 = ¥ 89

Class 8 rates ¥ 86 × 95.79 % = ¥ 82.37 = ¥ 82
 In case of traffic distance of 500 km,
 Class 7 rates
 (¥ 3.20 × 100) + (¥ 1.89 × 100) + (¥ 1.88 × 200) + (¥ 1.77 × 100) +
 ¥ 70 = ¥ 1,132

Class 3 rates ¥ 1,132 × 136.84
 = ¥ 1,549

Class 11 rates ¥ 1,132 × 83.16
 = ¥ 941

Shown in Table 7 is a part of such assesment of rates.

Table 6. Distance Freight Rates of Class 7.

Division of Traffic Distance	Distance Rates per 1 km
up to 100 km.	¥ 3.20
" 200 "	1.89
" 400 "	1.88
" 600 "	1.77
" 800 "	1.67
above 801 "	1.61

Table 7. Freight Rates, Tariff for Car-Loads

Traffic Distance Km. up to	Normal Classes												Special Classes		
	1	2	3	4	5	6	7	8	9	10	11	12	21	22	23
5	181	145	118	100	92	89	86	82	79	75	72	68	77	72	68
10	215	172	140	113	110	105	102	93	93	89	85	81	91	86	81
15	248	199	161	127	127	122	118	113	108	103	98	93	106	99	93
20	282	226	183	155	144	138	134	128	123	117	111	106	120	113	106
25	316	253	205	174	161	155	150	144	137	131	125	118	134	126	118
30	349	280	227	192	178	171	166	159	152	145	138	131	149	140	131
35	383	307	249	211	195	188	182	174	167	159	151	144	163	153	144
40	417	333	271	229	213	204	198	190	181	173	165	156	177	167	156
45	451	360	293	243	230	221	214	205	196	187	178	169	191	180	169
50	484	387	315	266	247	237	230	220	211	201	191	182	206	194	182
55	518	414	337	285	264	254	246	236	225	215	205	194	220	207	194
...
...

Note: The distance freight rates as shown in Table 7 do not in themselves indicate the costs of distance carriage. The distance freight rates, actually, show the basic freight rates assessed on the consideration of "what the traffic will bear" while the carriage costs are being taken into account. In view of the very nature of the railway as an enterprise, it is highly difficult to assess acculately individual actual carriage costs for every distance covered. The fact is, as far as the Japan National Railway is concerned, that no exact assessment is made of actual traffic costs involved in every distance carriage of every item or category of goods transported. In practice, the Japan National Railway has the traffic expenses divided into the terminal costs and running transport costs, on the basis of which costs involved are assessed. The percentage of the terminal costs agrinst average cost is rather high, and, therefore, if terminal fee is to be levied on the principle of covering accurately the costs which are actually involved, the freight rates for shorter distances will come up to a disproportionately high level. In view of this, this principle is discarded and the freight rates are determined on the basis of "what the traffic will bear" (the value of transport), as shown in Table 6.

While the preceding lines complete a description of the freight classification index and the method of its determination adopted by the Japan National Railway, a few words will be added in the way of explaining the short history of freight classification index system so far followed.

Now, if the method of assessing freight rates on the basis of a certain class rate is called a class-index method, it is to be said that a class index method, with regard to passenger and freight rates, had been already in the working at the time the Japan National Railway first started its operation as early as 1872. (Refer Table 8)

It should be admitted, however, that the index, shown in Table 8, served only to indicate the class difference of rates adopted, because it never was a result of a systematic assessment in purpose of adjusting the entire range of the revenues and expenses of the Railway as a whole.

It was probably only after the revision of railway freight rates effected in March, 1946, that an ambitious attempt was made to assess the class rates, comprehensively and systematically, on the basis of the entire system

Table 8. Railway Freight Rates Tariff Between Shimbasi and Yokohama, at the Days of the Inauguration of National Railway.

	Class	Rates	Ratio
Passenger Traffic	Upper	112.50 sen	300 %
	Middle	75.00	200
	Lower	37.50	100
Freight Traffic	(1)	31.25 sen	500
	(2)	25.00	400
	(3)	18.75	300
	(4)	12.50	200
	(5)	6.25	100

Note :

Unit. for passenger 1 person.

for freight 100 kin

(kin: Japanese weight unit)

of revenues and expenses as concerns the National Railway. Up to that time, the tapering freight rates were adopted specially for each category of traffic goods, while the class rates were not uniform according to the locality involved. The revision of 1946 effectively adjusted all these discords or disuniforms by determining, for the first time, the classification index as a criterion for the entire system.

For subsequent developments, reference should be made to a List appearing on Page 19, Book II of the "History and Practices of Railway Freight Rates Classification".