



Research on the sampling methods of transportation price of highway general cargo

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ABSTRACT

In recent years, the transportation capacity of highway general cargo is greater than the demand, so the increasing market competition and the price in the long-term doldrums lead to numerous conflicts that affect the healthy and stable development of the cargo market. There is not yet a systematic sampling program for the provincial and municipal transportation prices which bring lots of difficulties for the information collection and monitoring. Based on objective circumstances such as the cargo market dispersion, the regional differences and the poor cooperation, this paper proposed a sample survey method by the double stratified sampling method. It is suitable, scientific and feasible for our cargo market validated by the pilot areas. The study of the sampling methods of highway general cargo transportation prices is of the important practical significance. It can strengthen the market supervision for the highway general cargo transportation, establish the information collection and release system of cargo price, and promote the linkage between prices and costs, and finally form the reasonable cargo prices guide.

Keywords: transportation of highway general cargo; transportation price; sampling method; double sampling; stratified sampling

INTRODUCTION

The highway cargo transportation market structure in China called as the atomic types have many practitioners and more intense competition. Overall, the supply capacity of general cargo is excessive with the low prices. It is difficult for the transport costs to transfer to price^[1]. All of these result the disorderly market competition and the hidden danger for the transportation security and social stability. For the problems of highway cargo transportation market, the paper is proved to be feasible through a basic sampling point of transportation price by the city, Yiwu.

The transport price of general cargo includes the heavy cargo less than truckload rate (LTL) and full truckload (FTL) price with the unit of "yuan /t·kilometer".

2. Extraction principles of sample cities and routes

2.1 The principles of sample cities selected

An important selection criterion is the number of Class A logistics enterprises and the annual freight volume of the city selected.

2.2 The principles of sample route selected

The comprehensive route selected should cover the main activity area and the major cargo transportation direction.

2.3 The determining step of sample route

① Based on the recommendation from city transport authorities, the local large logistics companies and logistics

parks, cargo market should be investigated firstly; ② The route can be determined by the local large logistics companies, logistics parks and cargo market. Routes selected across provinces and interior provinces should satisfy poor level of objective circumstances, it has brought great difficulties for the survey of transportation price^[2].

3. The sampling method of the sample enterprises

3.1 The selecting principle of transportation companies

The dispersion of the transportation sponsors results in the great difficulty relying on enterprises to carry out the price survey. Therefore, the transport enterprises and the individual drivers included in the sample survey need to meet the following conditions. First of all, the transport enterprises and the individual drivers can be contacted and expressed willingness to coordinate data collection activities. Secondly, their starting point of transportation routes is in the local spot. Thirdly, the transport companies have the complete business information recording, and the individual drivers can clearly express the price and freight volume which they carry^[3].

3.2 Enterprise survey methodology and sampling frame

(1) Survey methodology

Double sampling method applies to the situation that the information of population is lacking, also difficulty to estimate directly the population, need to extract one part of the sample to ensure access to basic auxiliary information, and then take another small sample from the extracted to conduct investigations. This way can reduce the scope of the investigation and the difficulty of the investigation to some extent^[4].

(2) Finishing and stratified for sampling frame

The prefectural transportation authorities are responsible for the registration of all road freight operations as N according to local conditions. The companies and individual vehicles that obtain the licenses by the annual check system belong the first sample unit n'_h . Then the second sample unit n_h can be obtained from the first sample unit based on a certain proportion of the sample. Because most individual drivers only have one truck, the number between individual drivers and companies is very intervallic. So the individual drivers and transport companies should be re-sampling survey, respectively.

4. The stratified sampling of sample route

4.1 Sampling frame

Based on the sample selection principle above, the study will try to find out the real intention or situation of the major freight routes of local sample companies in the cities. The preliminary pre-survey activities of the main routes are carried out. The indexes are used as the main content to establish the survey sampling frame of transportation price and the cost, such as the starting city and ending city, transportation price, transport models, vehicle or LTL, traffic and so on.

4.2 Hierarchical design

The stratified sampling method is used for the freight routes. First, the targets of sample survey are the tariffs of freight route of sample enterprise in cities after double sampling. The tariffs of freight route should be surveyed independently. The estimator got by the sample survey can form the freight estimator of the whole province based on the weight around the city, volume weight, expert empowerment and other methods. Secondly, the sampling frame of freight route of sample enterprise around each city is established. The different sizes of sample transport enterprises have been stratified to form enterprise layer after double sampling. Finally, the base layer is divided. Within the enterprise layer, the base layer in provinces routes and several interprovincial routes are divided according to the characteristics of the transport routes. ^[5]

4.3 Sampling symbols in the base layer

For the convenience of illustration, the related sampling symbols in the base layer were defined in Table 1. The overall estimators of all parameters are marked out using the subscript "st" to show the layering.

4.4 Determination and distribution of the sample number in the base layer

Based on the early pre-survey of sample enterprise routes, the tariffs population variance in the every layer of the basic layers, S_{hj}^2 , is calculated. The right of each layer, W_h , is determined in accordance with the proportion between the number of routes in each layer, N_h , and the overall number of all the pre-survey routes, N . According to the absolute error d of 5%-10% and the confidence level of 95%, the total amount of sample in the base layer, n_j , is calculated in the case of the tariff variance.

$$n_j = \frac{\sum_{h=1}^L W_h S_{hj}^2}{\frac{d^2}{(u_{a/2})^2} + \frac{1}{N} \sum_{h=1}^L W_h S_{hj}^2}$$

The number of sample assigned to each layer from the base layer: $n_h = n_j * W_h$.

Table.1 Explanation for the related symbols of the base layer

Symbol	h	i	N_h	n_h	Y_{hij}	y_{hij}
Explanation	Subscript The h -layer	Subscript The route number in layer	The overall number of the h -layer routes	The number of sample routes in the h -layer	The overall value of the i -route in the h -layer	The value of the i -route in the h -layer
Symbol	W_h		f_h	\bar{Y}_{hj}		\bar{y}_{hj}
Formula	$\frac{N_h}{N}$		$\frac{n_h}{N_h}$	$\bar{Y}_{hj} = \frac{1}{N_h} \sum_{i=1}^{N_h} Y_{hij}$		$\bar{y}_{hj} = \frac{1}{n_h} \sum_{i=1}^{n_h} y_{hij}$
Explanation	The right level of the h -layer route		The sampling ratio of the h -layer route	The mean value of transportation price of the h -layer route		The mean value of transportation price of the h -layer sampling route
Symbol	S_{hj}^2			s_{hj}^2		
Formula	$\frac{\sum_{i=1}^{N_h} (Y_{hij} - \bar{Y}_{hj})^2}{N_h - 1}$			$\frac{\sum_{i=1}^{n_h} (y_{hij} - \bar{y}_{hj})^2}{n_h - 1}$		
Explanation	The overall variance of transportation price of the h -layer route			The variance of transportation price of the h -layer sampling route		

4.5 Estimates and precision calculations

(1) Estimates

According to the sample number distributed in each layer, routes samples in each layer is calculated independently on the basis of simple random sample with stochastic computer software. Each estimate of transportation price in each layer \hat{Y}_{hj} is sample mean of h -layer \bar{y}_{hj} , With the base layer weight W_h , the overall weighted average of subsidiary layer is estimated.

(2) Precision calculations

① The precision calculation of overall tariffs mean of a layer in enterprise layer

First, estimate of variance:

$$V(\hat{Y}_{stj}) = \sum_{h=1}^L W_h^2 V(\hat{Y}_{hj}) = \sum_{h=1}^L W_h^2 V(\bar{y}_{hj}) = \sum_{h=1}^L W_h^2 \frac{1-f_h}{n_h} S_{hj}^2$$

Second, estimate of standard deviation

$$S(\hat{Y}_{stj}) = \sqrt{V(\hat{Y}_{stj})}$$

② The precision calculation of overall tariffs mean of municipal enterprise layer

Employing double sampling stratification, the precision calculation of tariff mean of enterprises layer is:

$$V(\hat{Y}_{stj}) = (\frac{1}{n'} - \frac{1}{N}) S^2 + \sum_{h=1}^3 \frac{W_h V(\hat{Y}_{stj})}{n'} (\frac{1}{f_{hD}} - 1)$$

Note: The implications of S^2 , W_h , N , n' are different from this chapter and can be seen in double sampling stratification formula in Sampling Technique.

③ The precision calculation of overall tariffs mean of general provincial corporate

First, estimate of variance:

$$V(\bar{Y}_j) = \sum_{k=1}^m W_k^2 V(\hat{Y}_{stj})$$

Second, estimate of standard deviation:

$$S(\hat{Y}_j) = \sqrt{V(\hat{Y}_j)}$$

4.6 Freight costs investigation for individual driver

For most of individual drivers have one vehicle with same scale, in order to simplify calculation of estimate mean and precision calculation of individual drivers' transportation routes, the estimate mean and precision calculation of enterprises layer in double sampling stratified are not counted. Through the estimate mean of basic layer sample can get the route transport price of municipal individual driver, then get the estimate of the whole individual driver.

Table.2 The stratified information table of sample route

Stratified h	Route provinces	Average Tariffs (Yuan/ton·km)	Tariffs median (Yuan/ton·km)	Route numbers	Route numbers weights	Traffic Weights	Average Tariffs (km)
h=1	Hebei	0.273	0.268	6	/	0.059	1366
	Heilongjiang	0.241	0.256	4	/	0.020	2708
	Jilin	0.286	0.286	1	/	0.002	2202
	Liaoning	0.282	0.259	6	/	0.037	1872
	Neimenggu	0.281	0.258	3	/	0.012	2063
	Xinjiang	0.218	0.218	2	/	0.009	4771
	Ningxia	0.224	0.224	1	/	0.003	2234
	Qinghai	0.269	0.269	1	/	0.002	2509
	Gansu	0.258	0.268	4	/	0.012	2070
	Average	0.264	0.256	/	/		2186
Total	/	/	28	0.18	0.17	/	
h=2	Henan	0.358	0.336	13	/	0.076	994
	Shandong	0.322	0.308	14	/	0.111	1208
	Shanxi	0.368	0.390	4	/	0.025	1487
	Shaanxi	0.302	0.319	3	/	0.025	1512
	Average	0.339	0.338	/	/		1112
Total	/	/	34	0.22	0.24	/	
h=3	Jiangsu	0.529	0.554	15	/	0.083	463
	Anhui	0.397	0.407	8	/	0.053	614
	Fujian	0.493	0.478	9	/	0.029	677
	Hubei	0.430	0.485	3	/	0.050	922
	Hunan	0.439	0.432	11	/	0.033	960
	Jiangxi	0.466	0.433	8	/	0.041	572
	Average	0.470	0.465	/	/	/	664
Total	/	/	54	0.34	0.29	/	
h=4	Guangdong	0.348	0.313	7	/	0.061	1120
	Guangxi	0.323	0.309	8	/	0.024	1641
	Hainan	0.308	0.308	1	/	0.002	1786
	Sichuan	0.321	0.321	1	/	0.031	1871
	Chongqing	0.338	0.338	1	/	0.014	1625
	Guizhou	0.525	0.525	2	/	0.006	1744
	Yunnan	0.365	0.365	2	/	0.012	2452
	Average	0.353	0.354	/	/	/	1577
Total	/	/	23	0.15	0.15	/	
h=5	Cixi	0.634	/	1	/	/	213
	Haining	0.686	/	1	/	/	175
	Hangzhou	0.690	/	1	/	/	145
	Huzhou	0.795	/	1	/	/	220
	Jiaxing	0.893	/	1	/	/	196
	Jiangshan	0.532	/	1	/	/	188
	Lishui	0.581	/	1	/	/	172
	Longgan	0.658	/	1	/	/	228
	Longquan	0.562	/	1	/	/	267
	Ningbo	0.644	/	1	/	/	233
	Quzhou	0.694	/	1	/	/	144
	Runan	0.600	/	1	/	/	250
	Wenling	0.769	/	1	/	/	234
	Wenzhou	0.655	/	1	/	/	229
	Xiaoshan	0.870	/	1	/	/	115
	Yuyao	0.632	/	1	/	/	190
	Huangyan	1.020	/	1	/	/	196
Average	0.701	/	/	/	/	200	
Total	/	/	17	0.11	0.10	/	

5. Sample survey of general cargo freight rates in Yiwu

Relied on Jiangdong and Jiangbei two commodity markets in Yiwu, in 2012 the sampling survey of commodity tariff is carried in Yiwu. More than 70% commodity outward freight of Yiwu is concentrated in the two markets. The survey of transport routes can reflect the market value condition of general cargo freight in Yiwu. The transportation of commodity market in Yiwu are carried all by individual driver, which meet the specification of the survey relied on the wholesale market. This example illustrate the transportation price survey method of individual drivers' routes.

5.1 The sampling frame established

The sample survey of freight price in Yiwu extract 160 transportation routes of 30 provinces or municipalities including Zhengjiang and collect the information such as name of destination city, transportation distance, vehicles; monthly-freight volume and monthly-tariff in pre-survey; name of freight department and company principal information, etc. All the supply of goods in Yiwu are commodity, so the chance of the same commodity in one truck is few. Most are LTL transportation, so the price information collected are LTL tariff^[6].

5.2 Line stratification

According to the above requirements, routes of the sampling frame is layered designed and divided into 5 layers. Due to the large freight volume in municipality such as Beijing and Shanghai and the statistic principal of one route sampling, municipalities are not included in sampling survey, but belong to comprehensive survey. The main sampling data of each layer is show in Table 2.

5.3 Calculation and allocation of the total sample

According to the absolute error d of 5%-10% and the confidence level of 95% $u_{\alpha/2} = 1.96$, the total amount of sample in the base layer, n_j , is calculated in the case of the tariff variance. Without transport cost, n_j is the municipal total amount of sample.

$$n = n_j = \frac{\sum_{h=1}^L W_h S_{hj}^2}{\frac{d^2}{(u_{\alpha/2})^2} + \frac{1}{N} \sum_{h=1}^L W_h S_{hj}^2} = \frac{0.008142}{\frac{0.05^2}{1.96^2} + \frac{1}{157} \times 0.008142} \approx 12$$

The sample amount of each layer is allocated in proportion and defied by $n_h = n \cdot W_h$.

5.4 Value tariffs investigation related statistics

On the basis of allocated sampling route number in every layer, sampling route is defied by random sampling with SPSS software and related statistics is calculated. The result is show in table 3.

Table.3 The related statistics of tariffs stratified sampling

Stratification n h	Stratified rights W_h	Routes inner stratification N_h	Sample number n_h	Sample mean \bar{y}_{hj}	Sample inner stratification f_h	Sample variance S_{hj}^2	Overall mean \bar{Y}_{hj}	Overall variance S_{hj}^2
1	0.18	28	2	0.216	0.071	0.0019	0.266	0.0027
2	0.22	34	3	0.333	0.088	0.0095	0.339	0.0061
3	0.34	54	4	0.451	0.074	0.0109	0.470	0.0099
4	0.15	23	2	0.304	0.087	0.0024	0.353	0.0074
5	0.11	17	2	0.608	0.118	0.0043	0.701	0.0169

Seeing from the sampling survey results, tariff estimate of five layers 0.378 yuan/ton·km, actual value 0.407 and overall tariff variance of stratified sampling survey only 0.00051, it is proved that estimate meet the confidence level 95%. The sampling results is credible and this scheme is feasible.

CONCLUSION

Based on the scale of transportation operators, double sampling is resampled. It can grab the characteristic of survey respondent, reduce the task and solve the problem of cargo freight market dispersion and difficulty in sampling survey. The stratified sampling method can avoid the situation of large distance of routes and great disparity of tariff, and also better to resolve the problem of many routes and complex situation. In general, after test, double stratified sampling is applicable to highway general cargo tariff sampling survey.

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