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POSSIBILITIES OF USING THE ECONOMETRIC METHODS IN FORMING THE TARIFFS FOR ROAD TRANSPORTATION

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The article investigated the possibilities of using the econometric of methods of pricing for the cargo transportation by means of the vehicular transport. Generalizing the main transporting conformities of the theory and existing practice of the motor vehicle transportation production cost calculation, the author studied and presented the influence of different techno-economic indicators on the transportation production cost and on the tariff solutions taken by the auto carriers. The homogeneous nature of the production processes and their results in the activities of the cargo auto transporting companies with the great variety of quantitative and qualitative techno-economic indices and conditions of the transportation are considered to be the main prerequisites of their application in the normative-parametric methods of forming tariffs. The article analysed the possibilities and limitations of using such methods as the specific indices method, regression analysis, points and aggregate methods. In case of realizing the suggested approaches, the auto carriers would be able to have more flexible tariff rates and to become more competitive at the transportation market.

Keywords: *freight transportation, tariffs, transportation costs, regulatory parametric methods*

Introduction

When transporting goods by road, the tariff schemes and the level of tariffs are determined directly by the carrier. In practice, the following three tariff schemes are used [1]:

a) Scheme with the payment of the consignment transportation. This scheme is usually used by the carrier, if the operating conditions provide the necessary factors for profitable operation of the motor vehicles loading.

b) Scheme with the payment of motor vehicles. According to this scheme the client pays for the car-hours of work and it is used in cases where operating conditions do not provide sufficient commercial load of motor vehicles.

c) Scheme with the individual-contractual payment. This scheme envisages the application of the simplified and consolidated measures of the transport services by mutual consent (haul, race, delivered containers, etc.), according to which the calculation of the tariff fees is performed.

The tariff rate is the price of the transport work unit and it should be the initial value of determining the tariff, though in the auto carriers' activities practice it is either considered as the derivative or is not taken into account at all. From the point of transportation efficiency the tariff rate as well as the production cost deserves serious attention and deep analysis.

The aim of the work is to consider the possibilities of using the econometric methods of pricing for the motor vehicle transport – to strengthen the tariff system flexibility and to increase the auto carriers' competitiveness. To achieve the above-mentioned aims, the following tasks should be solved:

- the fundamentals of theory and existing practice of the motor vehicle transportation production cost calculation were generalized;
- the influence of different techno-economic indices on the transportation production cost and tariff solutions was considered;
- possibilities and limitation of using the normative-parametric methods for forming tariffs in motor vehicles transportation were presented.

1. Transportation Production Cost as the Foundation of Forming Transportation Tariffs

1.1. Transportation Work Measurements and Costs Grouping for Calculating the Production Cost

The fundamentals of the transport tariffs formation are the level and structure of the cost of transportation. The production cost of transportation is the main economic indicator of the efficiency of vehicles. The actual cost of transportation is determined by the ratio of the total costs associated with the implementation of transportation to the volume of the accomplished transporting work.

The measures of the transport work for trucks are the turnover (W) or range (L), depending on the form of payment for the transportation services.

The costs associated with the implementation of transportation should be grouped in the following manner:

a) Variable costs (AVC_l), depending mainly on the run (l) of the motor vehicles performing the transportation and, therefore, determined per kilometre. The variable costs include the costs of fuel, of lubricants, of restoration and repair of tires, of maintenance and repair of motor vehicles;

b) Fixed costs (AFC_t), not directly connected with the concrete transportation performance and not depending on the motor vehicles functioning indicators on line. The fixed costs are calculated, taking into consideration 1 hour of motor vehicles driving (t). The fixed costs also include overhead and depreciation expenses;

c) Wages of drivers (TC_p), which are determined according to the scheme adopted for this type of transport system remuneration. The wages may depend on the implementation of transport work, worked out hours and other factors.

The value of the production cost of the transporting work with the definite type of transportation, taking into consideration the above-mentioned indicators groups, can be determined by the following formula:

$$C_{tkm} = \frac{TC_p + AFC_t \cdot t + AVC_l \cdot l}{W} \qquad (1)$$

1.2. Transportation Distance Influence on the Tariff Rates Production Cost and Value

The pointed grouping of losses corresponds to the generally accepted transport costs distribution according to the initial-final and motional operations. In accordance with this approach the value of the production cost and, consequently, of the tariff rates for transportation, will be decreased as far as the share of costs in the total sum of expenses of the initial-final operations is decreased. This share is known to be reduced in case of increasing transportation distance.

The influence of the mentioned conformity on the tariffs level – the value of transportation cost was analysed basing on the data of the transportation-expedition company “Trans-Auto”. Table 1 presents this company tariffs for the auto train transporting the cargo with the mass up to 20 tones along the 40 routes of different distance [2]. The range of the change of transportation distances is: from 180 km (Moscow – Vladimir route) to 4000 km (Moscow – Krasnoyarsk route).Taking into consideration the pointed data, the values of the tariff rates are calculated for every route – for 1 km and for 100 tonnes/km (in roubles and euro).

Comparing the presented data, it is necessary to mention that besides the distance, the other, sometimes; very essential factors influence the values of the transportation cost and of the tariff rates. So, the minimal cost of the transportation corresponds to the shortest of the considered routes (Moscow – Vladimir: 1300 roubles for the distance of 180 km), but, at the same time, the highest cost (130000 roubles) corresponds not to the longest route (Moscow – Tomsk: 3850 km, but does not correspond to Moscow – Krasnoyarsk: 4000 km). The highest value of the tariff rate (9,53 euro/100 tonnes/km) corresponds not to the route with the minimal distance, but to Moscow – Ryazan route (200 km). But the lowest value of the tariff rate (3,04 euro/100 tonnes/km) corresponds not to the longest route Moscow – St.Petersburg (710 km).

Calculated values of the tariff rates for 1 km distance along all the routes are presented in Fig.1, where the pointed conformity is clearly seen – the lower values of the tariff rate correspond to the longest distance transportation.

Table 1. Calculation of the Tariff Rates on the Base of the Transportation Cost of the "Trans-Auto" Transportation Expedition Company

Route		Distance, km	Cost of transportation, Roubles	Calculated tariff rates		
Departure	**Arrival**			**Rouble/km**	**Euro/km**	**Euro/100tkm**
Moscow	Astrakhan	1400	50000	35,71	0,91	4,54
Moscow	Belgorod	670	25000	37,31	0,95	4,74
Moscow	Bryansk	390	17000	43,59	1,11	5,54
Moscow	Vladimir	180	13000	72,22	1,83	9,17
Moscow	Volgograd	960	31000	32,29	0,82	4,10
Moscow	Voronezh	530	21000	39,62	1,01	5,03
Moscow	Ekaterinburg	1830	67000	36,61	0,93	4,65
Moscow	Ivanovo	300	17000	56,67	1,44	7,20
Moscow	Izhevsk	1210	42000	34,71	0,88	4,41
Moscow	Kazan	830	30000	36,14	0,92	4,59
Moscow	Kirov	930	40000	43,01	1,09	5,46
Moscow	Kostroma	360	20000	55,56	1,41	7,06
Moscow	Krasnodar	1360	42000	30,88	0,78	3,92
Moscow	Krasnoyarsk	4000	125000	31,25	0,79	3,97
Moscow	Kursk	530	25000	47,17	1,20	5,99
Moscow	Lipetsk	450	19000	42,22	1,07	5,36
Moscow	Niznevartovsk	3600	97000	26,94	0,68	3,42
Moscow	Nizhny Novgorod	440	16000	36,36	0,92	4,62
Moscow	Novorossiysk	1500	45000	30,00	0,76	3,81
Moscow	Novosibirsk	3225	110000	34,11	0,87	4,33
Moscow	Omsk	2900	105000	36,21	0,92	4,60
Moscow	Orel	370	17000	45,95	1,17	5,84
Moscow	Orenburg	1450	52000	35,86	0,91	4,55
Moscow	Penza	650	25000	38,46	0,98	4,88
Moscow	Perm	1400	50000	35,71	0,91	4,54
Moscow	Rostov on Don	1100	35000	31,82	0,81	4,04
Moscow	Ryazan	200	15000	75,00	1,91	9,53
Moscow	Samara	1100	35000	31,82	0,81	4,04
Moscow	St.Petersburg	710	17000	23,94	0,61	3,04
Moscow	Saratov	850	30000	35,29	0,90	4,48
Moscow	Smolensk	405	21000	51,85	1,32	6,59
Moscow	Sochi	1700	45000	26,47	0,67	3,36
Moscow	Stavropol	1450	45000	31,03	0,79	3,94
Moscow	Surgut	3000	95000	31,67	0,80	4,02
Moscow	Siktivkar	1450	52500	36,21	0,92	4,60
Moscow	Tomsk	3850	130000	33,77	0,86	4,29
Moscow	Tyumen	2150	80000	37,21	0,95	4,73
Moscow	Ufa	1400	53000	37,86	0,96	4,81
Moscow	Chelyabinsk	1800	63000	35,00	0,89	4,45

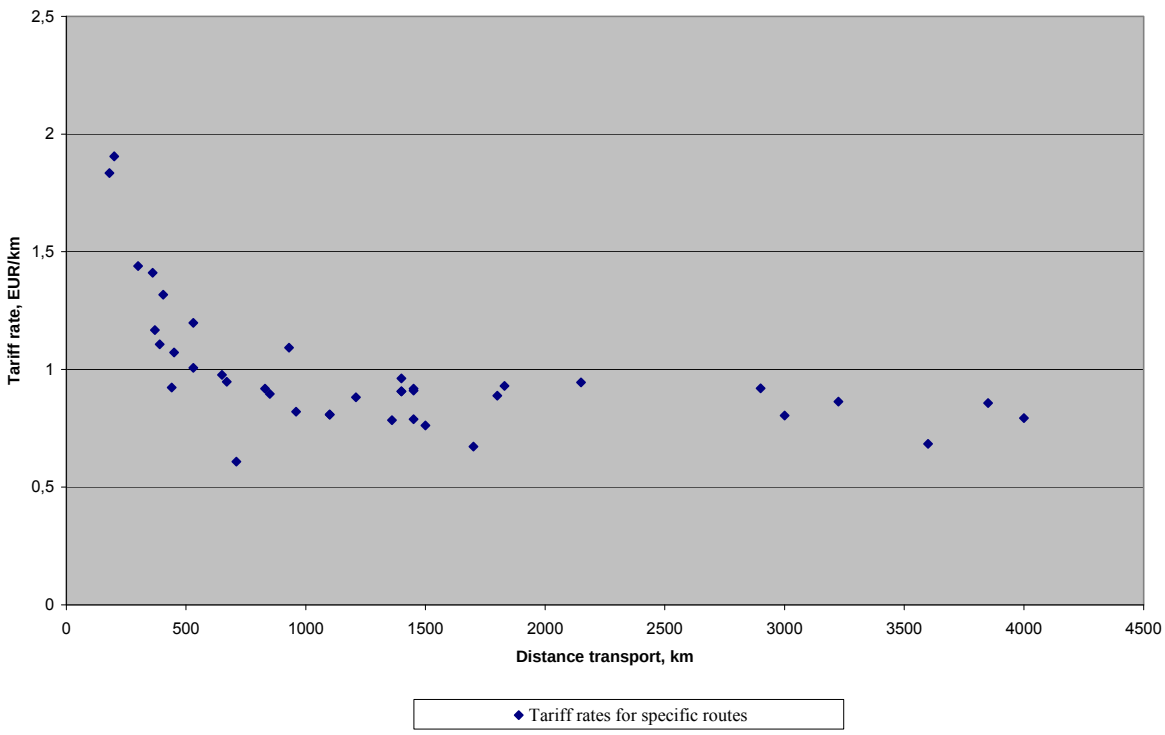

Figure 1. Calculated values of tariff rates on 40 routes

1.3. Automobiles Application Influence on the Transportation Production Cost

To make the calculations of planning transportation production costs convenient, all the costs for each type of motor vehicles can be normalized and conditionally reduced to one kilometre of running (*S*). Then the calculated value of the transportation costs can be determined by the formula:

$$C_{tkm} = \frac{S}{q \cdot \gamma_d \cdot \beta}, \qquad (2)$$

where q – load capacity of the vehicle, t;
γ_d – the dynamic coefficient of lift;
β – coefficient of mileage.

The formula 2 presents the influence of the level of using the motor vehicles on the transportation production cost. Figure 2 demonstrates the results of the performed analysis of the pointed dependences based on the data of one of the Latvian carriers. Each curve on the graph shows the decrease of the transportation production cost in case of increasing the coefficient of using the run (β), and at the same time, at the constant value of the dynamic coefficient of using the lift (γ). In its turn, the increase of the level of using the lift will lead to the decrease of the transportation production cost, this fact being reflected on the graph by the transfer to the curve, located below. The lowest level of the transportation production cost is provided by the automobile nominal loading and the empty run absence (γ = 1 and β = 1), in the graph it corresponds to the extremely right point on the lower curve.

It is clear that reduction of the cost of transportation means for the carrier the expansion of the opportunities for the economic choice. Keeping the same rate, the carrier can increase profits and improve the profitability of transport. However, there exists the other possible solution – to reduce the tariff in order to improve competitiveness and to increase its market share haulage. But in any case, the condition of the positive result is connected with the growth of using the motor vehicles. This, in its turn, requires a rational choice of the car load capacity of each carriage and routing of traffic as well as the minimization of empty runs.

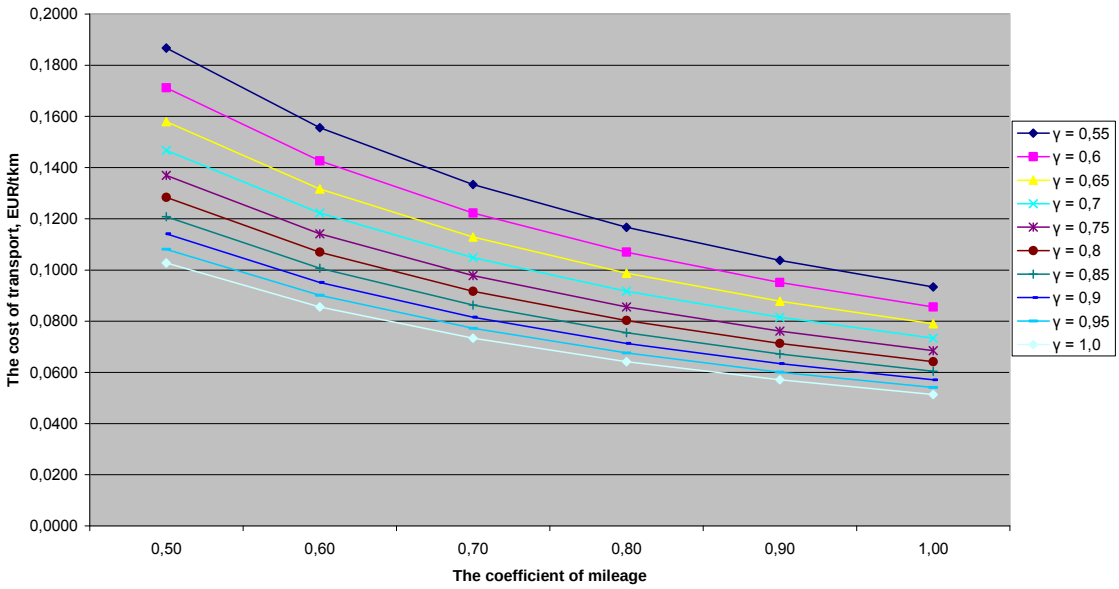

Figure 2. Dependence of the transport cost (S_{tkm}) on the coefficients of downloading (γ) and the use of race (β)

2. Using the Normative-Parametric Methods for Tariffs Formation

2.1. Prerequisites of Using the Normative-Parametric Methods for Motor Vehicle Transportation

The homogeneous nature of the production processes and their results in the motor vehicles transportation with the variety of the quantitative and qualitative techno-economic parameters and conditions of the transportation are considered to be the main prerequisites of their using for the normative-parametric methods of forming tariffs in pricing. The dependence of the production cost, tariffs and tariff rates on the transportation distance were demonstrated above. The quality and state of roads, time of transportation and the conditions of passing through customs control also influence the transportation production cost and, therefore, the tariffs level

The tariff schemes and tariffs, in general, can be differentiated by the carriers and clients, according to the types of goods and to the type of traffic, depending on the used vehicles.

Thus, the wage boards for the transportation of cargo are determined by presence and taking into account the large number of parameters reflecting each specific shipment. With an overall uniformity of the transport services in the conditional delivery of cargo from point A to point B – all traffic can be regarded as a parametric number of homogeneous processes differing drastically by the techno-economic parameters.

The analysis of the cost of transportation shows that its value varies with the techno-economic parameters and this relationship can be the extended to the value relation. The set tariffs allow using the dependences found in the individual contract system of using standard-parametric methods of pricing [3]. The possibilities and limitations of the application and formation of road freight tariffs are reflected in the following methods: specific indices, regression analysis, aggregating and point's estimation, etc.

2.2. Possibilities and Limitations of Using the Specific Indices Methods

The specific indices method involves the selection of specific indicators of the fundamental parameter, whose value largely determines the overall size of the tariff transportation charges. The measurement and enforcement of the costs to one kilometre distance can use this value as the basis of the unit price of one kilometre and then apply it for determining the size of tariff transportation charges. The applications of this approach are very limited because they do not take into account all the other techno-

economic parameters, not mentioning the relationship between supply and demand, assuming that they are stable and unchangeable.

Figure 3 presents the dependences of the transportation costs on the distance and allows drawing the following conclusions:

- the growth of the transportation cost with the increase of range has the non-linear nature, this fact being explained by 2 reasons. As it was mentioned above, if the distance is increased, the share of cost of the initial-final operations in the total sum of costs is decreased. The second reason is connected with the growth of the share of the efficient run (increase of the coefficient of using the run) in the auto carriers' activities on long routes.
- in using piece-work tariff payment for transportation (payment calculations for tonne/kilometres), the decrease of the coefficient of using the load capacity can be the reason of insufficient profits for covering costs.

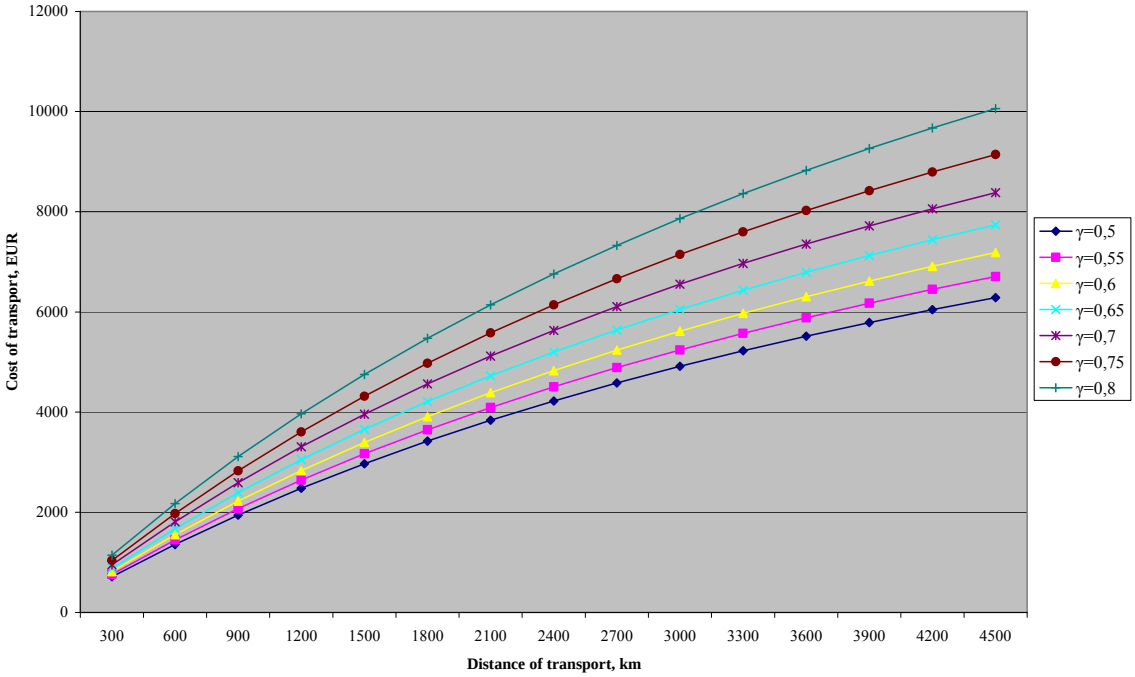

Figure 3. Growth of transport costs depending on the distance at the different utilization rates of lift and mileage

Consequently, the use of the specific indices method for pricing is possible only under the condition of measuring the same parameters, making them stable and thus, satisfying the carriers.

2.3. Application of the Regression Analysis of the Motor Vehicle Cargo Transportation Cost

The method of the regression analysis is used for determining the variation rate tariff dependence on the change of some, above mentioned transportation techno-economic parameters as well as for constructing and aligning the value relations.

$$P = f(X_1, X_2, \ldots, X_n, \varepsilon), \quad (3)$$

where $X_1, X_2, \ldots, X_n$ – techno-economic parameters.

ε – random component, conditioned by the stochastic nature of dependence.

The quantitative dependence between the changes of the effective (P) and (X_i) factoral properties is based on regression analysis.

The use of the regression analysis for pricing requires the independent observations. In particular, it is unacceptable to include the prices obtained by means of the regression method into the parametric range of prices.

The results of the application of the regression analysis with the use of the special data selection, consisting of the real indices connected with the cargo transportation by one of the Riga auto transporting companies, are presented as the illustration.

The selection included 70 observations according to following 10 positions:

- actual cost of transportation, euro (P);
- actual distance of transportation, km (L);
- actual weight of the transported cargo, t (G);
- volume of the body of the actually presented vehicle, m^3 (V);
- presence of the dangerous cargo, (i_{dang});
- type of the client (cargo dispatcher), (i_{cl});
- date of transportation;
- type of transportation – export, import, transit, (i_{rout});
- actual value of the added cost tax, euro (T_{VAT}).

The analysis is performed with the use of SPSS programmes. As a result of revealing the interconnections between the variables and introducing the fictitious variables, the equation of regression of the following type was formed:

$$P = -31{,}567 + 0{,}532 * L + 433{,}226 * i_{dang} + 1{,}122 * T_{VAT} + 387{,}865 * V + 259{,}052 * i_{rout2} + \\ +1160{,}174 * i_{rout3} + 600{,}771 * i_{cl}$$

Checking up for autocorrelation gives the satisfactory value of the Durbin-Watson coefficient – equal to 1,889.

2.4. Points and Aggregate Methods

The point's method essence is connected with the fact that on the base of the experts' estimations of the significance of the transportation parameters for the cargo owner, each parameter obtains the definite quantity of points, the total sum of which estimates the significant qualitative parameters of transportation. The application of these parameters is implemented in 2 stages:

- the price of one point is determined by

$$P' = \frac{P_B}{\sum (B_{Bi} V_i)} \quad , \tag{4}$$

- the price of transportation with the account of new values of the qualitative parameters is

$$P_n = \sum (B_{ni} V_i) P' \quad , \tag{5}$$

where P_B – price of transportation in basic conditions;
B_{Bi} – point estimation of the i-th quality parameter of carriage in basic conditions;
B_{ni} – point estimation of the new value of the i-th quality parameter;
V_i – weight of the parameter.

The aggregating method is connected with summarizing the tariff fees for certain elements of the transport process included into the parametric range.

3. Conclusions

Different approaches to forming tariffs for motor vehicles cargo transportation are based on the through account of the conformities in creating the transportation costs. The article analysed the influence of a great amount of various techno-economic factors and conditions on the production cost of transportation as the initial value in forming transportation tariffs. The author investigated and showed the

possibilities and limitations of using the normative-parametric methods in forming transportation cases at the transporting market.

The article suggested more flexible tariff system and the ways of strengthening and intensifying the competitiveness in this sphere as well as described the methods of introducing the above-mentioned approaches into the activities of auto carriers. The work contains the possibilities of increasing the arguments in favour of the emphasized approaches.

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