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Pricing in Road Freight Transport

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ABSTRACT

Creation of price in road freight transport in Central Europe has undergone significant changes in the last 30 years. Transporters in regulated economy used mandatory tariffs, after the liberalisation of the market they were subsequently not prepared for their own price creation. Price calculation has gone through several stages of development. At present, there are existing cost calculations that are based on the division of costs into variable and fixed ones. After the accession of Central European countries to the European Union, competition in this sector has increased significantly. When calculating the price for transport, transporters use a coefficient of exploitation of journeys, which adjust the costs associated with the transport so that the costs also take into account the journey with the vehicle, which the transporter must carry out without the shipment.

The aim of this paper is to prove that from the point of view of the competitiveness of price creation it is not economically correct to use the coefficient of exploitation of journeys as a constant coefficient. The authors prove in the article that the value of the coefficient depends not only on the route of consignment transport but also on the time of transport realisation.

Keywords: *transport, coefficient, calculation, costs, competitiveness.*

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INTRODUCTION

Road transport has recently become a very actual topic in society, because all groups of the population depend on transport, whether they are natural or legal persons. The development of the economy is particularly influenced by road freight transport, which is specifically addressed in [1].

For road freight transport to work effectively in the common market of the European Union, in which the conditions for an access of transporters have been progressively harmonised [2], the same conditions for operating in the market must also be applied. However, in the field of transport, there are currently several problems with the functioning of transporters in the European Union's transport market. The author of the paper [3] has addressed the reduction of subcontracting in the common market. It should be noted that market restriction in road freight transport also works in the form of mailbox companies. This is an abuse of different wage, social and tax rules in different EU countries, which is addressed, in particular, by the authors of the paper [4]. Market operations are also influenced by specific price creating conditions. In the long run, the price of road freight transport in the European Union is growing significantly slowly comparing to growth of costs. Due to maintenance, transporters perform on the market even without profit, respectively, below the level of total costs. Such transports are redounded mainly by return transports, which are often performed by transporters at a price below the average level with an aim to avoid the risk of vehicle downtime. The distortion of the market and the competitive environment also occurs due to the fact that, according to the authors' knowledge, there is no methodology for applying changes in supply and demand in individual regions of the European Union to pricing and thus the transporter's competitiveness.

The *aim* of this paper is to identify the factors of pricing in road transport that affect the competitiveness of the transporter and to propose a methodology for incorporating the identified factors into price creation.

LITERATURE REVIEW

When doing business in road transport with economically correct calculations, it is necessary to take a special approach to fixed and variable costs [5]. Despite the fact that such an approach to pricing is necessary, what the authors [6–8] state in their works, it is not quite commonly used in road freight transport pricing in Central Europe [9]. This is related to the fact that after the price liberalisation in the early 1990s, which allowed free price creation in road freight transport, transporters were not prepared to calculate costs and continued using the pre-liberalisation tariffs [10]. An increase in the price of inputs (e.g., the price of diesel) caused tariffs to stop covering costs [11]. Furthermore, price formation was influenced by corporate taxation, which is discussed in detail in [4; 12; 13]. With the right approach of the transporter to the price creation, it is necessary that he monitors his own performance costs and that it is able to calculate the price correctly through these costs. The author of paper [14] defines the own costs in transport «as the consumption of materialised and live work and financial resources for produced transport and other services for a certain period of time under typical conditions of the reproduction process in individual transport branches, respectively, transport companies. The authors of the work [15] emphasise that own costs are purposefully tied to a given performance, activity or company department.

There are a number of general methods and techniques that create a price, but not all of them are suitable for calculating your own costs in road transport. The determination of suitable calculations in road transport is dealt with by the authors of [16; 17]. According to the authors of the studies [16] or [18], in the 1990s methods based on direct and indirect costs were mainly used for pricing in road transport. Pic. 1 shows a tool commonly used in the 1990s to calculate the price of road transport.

However, methods with the division of costs into direct and indirect ones were used mainly by larger companies. Transporters, which were created in the frame of the privatisation of state-owned enterprises and operated less than 5 vehicles, did not calculate the price but used the price of competition [16]. In some companies, especially small ones, which calculate the price for transport, this method is still used today.

After the year 2000, several authors preferred calculations for the area of transport services based on the division of costs into variable and fixed ones. These are calculations that take into account the performed output [16]. There are several procedures for calculating of the price

1. Fuels. 2. Direct material. 2.1. Tires. 2.2. Other direct material. 3. Direct wages. 4. Depreciation of vehicles. 5. Repair and maintenance of vehicles. 6. Other direct costs. 6.1. Travel expenses. 6.2. Contributions to the social and health insurance company. 6.3. Another direct costs.
Sum of 1 to 6.3 represents «Direct costs».
7. Operating overhead.
8. Administrative overhead.
Sum of 7 and 8 represents «Indirect costs».
9. Profit.
Sum of 1 and 9 represents «Price».

Pic. 1. The structure of calculations with the division of costs into direct and indirect [developed by the authors].

for transport using fixed and variable costs, discussed, e.g., in [19–21]. The principle of calculation is that variable costs depend on performance (most often the distance travelled during transport) and fixed costs depend on the duration of transport (most often on the number of days of transport). Transport is specific in that because it also realises performance that is not directly calculated through the price. The problem is that the vehicle not only performs the performance with the load but also performs the transfer from the place of consignment´s unloading to the place of loading the consignment of the next transport. Such a journey incurs costs for the transporter, but this journey is not directly paid by the customer. For the transport to be efficient for the transporter, it is also necessary to include these costs in the price for customers for the realised transport of consignments. According to the calculation methods described by [20; 21] the variable costs for a specific transport are adjusted by a constant as follows:

$$VN_P = \frac{f\left(nv_P; d_P\right)}{K},$$

where VN_P are variable costs related to transport, which are a function of unit variable costs per travelled kilometre (nv_P) and distance travelled during transport (d_P) and adjusted by the coefficient of use of journeys (K), which expresses what share the transporter will use for transport. The authors of [16; 18] state that the value of the coefficient is in the range of 0,8 to 0,9 depending on the conditions of the transporter. They recommend using a constant value of the coefficient when calculating. We will take a closer look at the dependence of the coefficient of use of rides utilisation in the next part of this paper. The coefficient does not adjust fixed transport costs (NF_P), which depend on the relationship:

$$FN_P = f\left(nf_D; d\right),$$

where (nf_D) are the fixed costs per day of operation of the vehicle and (d) is the number of days of shipment duration. As the vehicle is not in service every day of the year, it can be claimed that the fixed costs per day of operation (nf_D) are function of the fixed cost per year per vehicle (NF_Y) and the number of days of operation per year (P_V). This means that the fixed costs per transport depend on the currently used calculation methods as follows:

$$FN_P = f\left(nf_D; d\right).$$

The author of the paper [22] notes that most transport companies only record their internal costs incurred in doing business, but do not take into account external costs that they cannot quantify from accounting. These costs arise due to the operation of transport, e.g., costs of infrastructure, environmental protection, etc., and are in most cases covered by the state [23]. However, we will not deal with these costs further in this article, because these costs without their internalisation do not affect the costs of the transporter in a particular transport.

According to the authors of [24], the price is influenced on the one hand by the costs incurred to the transporter in transporting the goods, but on the other hand also by the value arising from the transport of the consignment on the transporter's side. Two basic principles are used in price creation namely utility and cost. The cost principle is based on the transport price paying the transporter the costs incurred and a reasonable profit. Therefore, if the transporter does not perform any transport performance, the transporter is burdened with fixed costs, and thus it is necessary to know the amount of its fixed and variable costs, which can be determined by a suitable way of cost calculation. The cost principle is also defined by [16] which adds to the fact that it is important for the transporter to realise that the business result for a certain period plays an important role and is not just the question of profitability of each transport performed. The utility principle, which is also called the value principle, expresses the effect of demand on the price. This is the value that arises for the transporter from the implementation or non-implementation of discussed shipment. However, the mentioned value is not an unambiguously determined quantity, but it is often the result of the opposite effect of various influences. These effects can be determined by the difference between the price of a tangible product at the place of production and at the place of consumption, where the difference defines the price limits for transport, as well as the price of transported goods. Another influence that affects value is competition, and thus as the competition is stronger, the lower is the value of the transport service and the price for transport [25]. The work [16] also defines the utility principle, noting that a quality product also requires quality transport, and that these quality requirements will continue to increase on the part of transporters, and transporters must respond flexibly to these requirements in order to be able to find a job in the future in conditions of ever-increasing and numerous competitions. From the above principles, we can also determine the price limits, namely the minimum and maximum. The minimum price is determined by the border, respectively, marginal costs of the transporter related to the realisation of the transport. The maximum price is determined by the difference between the price of the tangible product at the place of production and at the place of consumption, respectively, sales. If the price for transport were higher than this difference, the marketability of the product would decrease [26].

The transport company should monitor and manage its costs and compare these monitored costs with the competition. In Western Europe, reference tariffs or cost indices are used for this purpose.

It should be noted that the demand for transport can be defined like secondary, as it arises from customer demand for goods and services [26]. Demand for transport is influenced by factors that affect it and change customer preferences. The most important factors are the price for transport, the prices of competition, which are discussed more in [27], the value of goods, physical characteristics of goods, the income of the population, seasonality, and, especially, the quality of transport services. The quality of transport services is dealt with in detail, e.g., in [28; 29]. This quality factor consists of a set of quality features, which are speed of transport, reliability, technical and technological equipment, staffing and safety [29].

It is clear from the findings of [27] that within the European Union there are routes with higher transport demand and routes with lower transport demand. In case of lower demand for transport on a given route, there is a higher risk of non-return transport or a higher risk of driving a vehicle without a consignment. That is, the transporter should also incorporate into the price created by the above calculations the influence of the direction of the transport, because this influence creates the risk of impossibility of recovering the return transport, resulting in costs that the efficient transporter includes into the transport price [30]. This issue is being addressed in Central European conditions in [31], where the authors claim that it is economically incorrect to use a single unit price for all transfers performed by a transporter. No available costs calculation method takes into account the level of demand for return transport at the place of unloading of the first transport. For this reason, in this paper we deal with the identification of the factor of the influence of the place of unloading on the price for transport.

IDENTIFICATION OF TRANSPORT UTILISATION COEFFICIENT

The authors of [16; 18] recommend the use of the transport utilisation coefficient in the road transport cost calculations as a constant, which is calculated as the ratio of the distance travelled per year with the vehicle loaded to the total distance travelled per year. In the case of a year-round application, mathematically this is the right approach, provided that in each direction of the transport route there is an equal probability of obtaining carriage for the return journey. Based on the results of the studies [32; 33], there are significantly stronger traffic flows in direction of east-west in Europe comparing to north-south traffic routes. This means that if a shipment realised from Central Europe is finished in Southern Europe (e.g., in Serbia), the transporter would be less likely to recover the shipment comparing to shipments made in Western Europe (e.g., in Germany). From the above assumption, it is possible to assume that the utilisation coefficient of routes in the calculations should not be represented by a constant, but by a variable index, depending on the place of termination of transport. In the next part of this paper, the aim is to prove that the utilisation coefficient of routes varies depending on the direction of transport.

Given that the demand for transport is a secondary demand, which is deduced from the primary demand for other products, it can be stated that the demand for transport is also characterized by its intervals of maximum and minimum demand over time. In case of transport demand change, the coefficient of utilisation of routes, which influences the price for transport, should also react to this fact in the calculations. The aim of the next part of the paper is also to identify how the utilisation coefficient of routes changes over time (during the year or a shorter period).

If we will be successful in identification of the dependence of the utilisation coefficient of routes on the direction of transport or on time, the constant (K) should be replaced by a variable index in determining of the total transport costs and thus in determining the price in economically correct calculation.

RESULTS AND DISCUSSION

To be able to identify a change in demand across entire Europe and to avoid, as far as possible, the specific influence of transporters, we did not use a method of questionnaire to identify a change in demand. Due to the fact that transporters in most cases use transport databases to search for return transports, we used data published by transport databases for research. The transport database is a platform where the demand and supply of transport in road transport meet, i.e., it is a database of transport demand for unoccupied consignments for transport and offers of free vehicles to which transport is not assigned. We used a transport database for research, in which 43,000 companies from Europe are registered and the database processes an average of 750,000 shipments per day across Europe. Every day from 1st September 2018 to 31st August 2019, we identified the share of offered free transports and the share of offered free vehicles for transport with a focus on 19 countries: Belgium, Bulgaria, Czech Republic, France, the Netherlands, Luxembourg, Hungary, Germany, Poland, Austria, Romania, Slovakia, Slovenia, Serbia, Spain, Switzerland, Italy, Turkey, United Kingdom. To verify our assumption, we identified return transfers only to the territory of Slovakia. Every day from each country, we identified the share of transport offers offered from the total number of entries in the transport database, which are listed in Table 1. We divided the observed period into four periods marked as winter (months December, January, February), spring (months March, April, May), summer (June, July, August) and autumn (September, October, November). The value of 11,75 % in the first line means that in the transport databank, 11,75 % of the total entries from Belgium to Slovakia were offered for transport and on average 88,25 % were offered on one day on the observed period. This means that only part of the vehicles could transport the consignment back to Slovakia. Other vehicles had to transport to another state, respectively to realise a transfer without a consignment to a state where a greater offer of consignments for transport than available vehicles is, e.g., for Poland, 59 % of entries related to the offer of transporting a consignment to Slovakia are in transport databases, which corresponds to 41 % of entries of available vehicles. Some consignments have to wait a longer time for transport on this transport route, or the transport is carried out by vehicles that have to be moved empty from a state where is not a sufficient transport offer.

When analysing the outputs for the year, it can be stated that there are significant differences between countries. The highest share of registrations of offered transports to registrations of free vehicles is between the Czech Republic and Slovakia. As much as 73,84 % of registrations are related to the offered transports, only 26,16 % are related to the offer of transport

Table 1

Share of return routes offered from individual countries to Slovakia in (%) [developed by the authors]

State	Winter	Spring	Summer	Autumn	Whole year
Belgium	9,45	12,00	9,33	16,20	11,75
Bulgaria	11,80	7,80	8,20	14,30	10,53
Czech Republic	72,41	78,70	71,71	72,54	73,84
France	8,87	11,00	6,40	9,70	8,99
Netherland	12,89	21,00	14,17	15,30	15,84
Luxemburg	4,68	8,80	6,57	5,83	6,47
Hungary	25,49	26,30	34,00	37,70	30,87
Germany	17,51	19,30	11,50	21,11	17,36
Poland	51,28	50,30	70,20	64,20	59,00
Austria	26,70	45,00	28,00	35,75	33,86
Romania	8,92	4,80	7,60	9,45	7,69
Slovenia	33,78	49,00	41,00	40,56	41,09
Serbia	11,10	2,30	17,80	11,00	10,55
Spain	14,10	9,00	4,17	11,45	9,68
Switzerland	2,17	3,00	4,20	4,89	3,57
Italy	18,78	37,30	21,20	23,47	25,19
Turkey	12,33	6,70	25,83	40,60	21,37
Great Britain	16,30	17,00	7,83	18,42	14,89

capacity of free vehicles. It is significantly more problematic for the transporter to obtain transport to Slovakia from Switzerland (3,57 %), Luxembourg (6,47 %) or Romania (7,69 %). Based on the above analysis, it can be stated that the transporter does not proceed correctly when calculating the price for transport if it uses the same constant utilisation coefficient of routes for all its transports. Based on a calculation published by [5] and considering a variable cost of €0,7 per km of driving, adjusted by a constant utilisation coefficient of routes 0,85, the adjusted variable cost will be € 0,824 per kilometre. If we consider a daily fixed cost of € 160 [5], then the total cost of transporting for transport distance of 1000 km, which would last two days, would be € 1,144 per transport. According to the original calculation procedures, the costs would depend only on the costs on the individual routes (different costs are, for example, for tolls). If we process from the simplification that the level of costs is the same for all transport routes, the value of the total costs to each state of transport with a transport distance of 1000 km will be € 1,144. Such a process is not correct. E.g., in transport to the Czech Republic, the transporter will most likely be able to find a return transport to Slovakia, so the utilisation coefficient will only take into account the transfer of the vehicle from the place of unloading to the place of loading. This means that the utilisation factor will be close to 1. If the transport is realised in Switzerland, the transporter will most likely not be able to get the return transport back to Slovakia, it will have to make a larger journey with a vehicle without a loaded vehicle. It can be assumed that the transporter will be forced to leave Switzerland with an empty vehicle. However, such a situation must be taken into account in calculation of the price for transport from Slovakia to Switzerland in the form of an adjustment of the utilisation coefficient of route. In this case, the value of the coefficient can be close to 0,5, because a value of 0,5 means that the vehicle will return empty.

Used calculation methods are based on a constant value of the utilisation coefficient of routes, which is based on the year-round performance of the transporter, i.e., it does not change throughout the year. However, in the research we focused on the change in the shares of registrations in individual seasons (Table 1).

Based on the research, it can be stated that the shares of the number of registrations of free transport during the year are not constant in any of the analysed countries. In this case, however, it is not possible to determine that the largest share of free transport is the highest for all countries in a given period. Table 2 divides the countries according to the period in which it is easiest for the transporter to obtain transport from that

Table 2

Distribution of states according to the period of the greatest share of free transport registrations [developed by the authors]

Winter	Spring	Summer	Autumn
Spain	Czech Republic France Netherland Luxembourg Austria Slovenia Italy	Poland Serbia	Belgium Bulgaria Hungary Germany Romania Switzerland Turkey Great Britain

country. However, it is possible to see that most shipments are transported in the spring from the countries of Western Europe and the Czech Republic. The exceptions from the countries of the European Union are Belgium and Germany, where the highest value is in the autumn. However, it should be noted that goods transported from Asia are transported to Slovakia mainly through ports in Belgium and Germany [34], which may affect the supply of transport from these countries. In the north-south direction, the states achieve the highest offer of free transport in the summer and autumn. We were also interested in whether there is a change in the share of free transport registrations in transport databases even in shorter periods of time. Therefore, we monitored how the registrations developed over the course of one week. Table 3 contains an analysis of the development of the number of entries of the offer of shipments from the given state to Slovakia for the monitored period of one year.

In all cases, the level of the share of consignments offered for transport during the week changes. The share increases in the second half of the working week with a subsequent decline during Saturday and Sunday. The average development for all monitored countries together is shown in Pic. 2. In the overall monitoring of the development of the share of free consignments for transport, the highest share is reached on Friday, with a subsequent decrease during Saturday and Sunday. The decrease during the weekend can be expected, because not all consignors work continuously during the weekend.

Based on this research, it can be stated that the utilisation coefficient of routes is not constant neither in terms of transport direction nor in terms of transport time. The level of the utilisation coefficient of routes changes both during the year but also during a specific week. We can state that the coefficient of utilisation of routes depends as follows:

$$K = f\left(S_P;T_p\right),$$

where *SP* is transport direction and *TP* is time of beginning of transport realisation.

The total costs of the transporter for the realised transport also correspond to this development. If the transporter has to make a larger transfer of the vehicle without loading, he has to consider higher costs during transport. To correct the costs related to transport, the utilisation coefficient of routes is used, which is not constant but depends on the relation above. The relation between the total transport costs can then be adjusted as follows:

$$CN_P = VN_P + FN_P = \frac{f\left(nv_P;d_P\right)}{K} + f\left(nf_D;d\right);$$

$$CN_P = \frac{f\left(nv_P;d_P\right)}{f\left(S_P;T_p\right)} + f\left(nf_D;d\right).$$

Based on the research, we were able to identify the share of registrations of free shipments for transport and the share of free vehicles, which, however, does not represent the utilisation coefficient of routes. From the data available in the transport databases, it is possible to identify the share of free consignment entries for transport from each state to each other state on a specific day out of the total number of entries containing free consignments and free vehicles. Entries can be converted to a utilisation coefficient of routes according to the following proposed methodology:

• Transport from the place of loading of the first consignment to the place of unloading of the first consignment is always occupied, because it is carried out on the basis of the customer's order. The transporter is only exposed to the risk in return transport. This means that during the first transport, the transporter can consider making full utilisation of the route. If we express the value of the utilisation coefficient of the routes cumulatively for the whole transport there and back, the coefficient reaches the value of 0,5, to

Table 3

Share of return transports offered from individual countries to Slovakia during the week in (%) [developed by the authors]

State	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Belgium	11,18	11,04	11,36	12,89	14,59	9,19	8,70
Bulgaria	9,37	10,78	12,05	11,64	11,40	9,81	8,24
Czech Republic	73,91	73,84	76,11	75,74	75,51	69,78	69,10
France	8,49	8,25	8,88	10,62	11,93	8,91	8,11
Netherland	15,68	15,26	15,64	17,63	19,61	15,50	14,41
Luxemburg	6,91	6,71	8,18	7,02	7,53	5,03	5,01
Hungary	30,36	30,35	31,98	34,44	32,72	30,28	29,05
Germany	17,13	16,55	15,56	16,99	18,56	16,15	15,38
Poland	57,94	57,93	59,87	60,65	60,49	57,03	55,68
Austria	32,91	35,77	33,06	33,38	35,15	30,07	30,81
Romania	7,35	6,89	9,24	9,90	10,08	7,50	7,12
Slovenia	39,35	39,22	42,55	43,36	44,36	39,84	38,60
Serbia	10,51	13,29	12,39	9,89	10,00	10,48	10,89
Spain	8,89	9,06	10,43	10,59	11,90	9,38	8,51
Switzerland	2,88	3,45	4,06	3,93	5,15	3,80	3,21
Italy	24,01	23,27	24,28	26,29	28,66	24,29	24,11
Turkey	20,48	21,89	23,07	23,82	21,08	16,53	18,27
Great Britain	13,72	14,44	14,74	15,62	17,15	13,69	12,65

which the value related to the return journey of the vehicle is added. If the vehicle returns empty, no utilisation will be added to the value of the coefficient and the level of the coefficient would remain 0,5.

• If the vehicle will also carry out a return transport, it is necessary to consider transfer of the vehicle. The transfer of a vehicle represents approximately 5 % even if there is a sufficient number of free transports offered.

• If the share of offered services in the country of unloading of the first consignment is more than 50 %, which means that there are more free consignments on the return journey than the vehicles offered for transport, the transporter is likely to find a suitable transport. It is also necessary to consider a vehicle transfer, which represents approximately 5 %, i.e., the value of the utilisation coefficient of routes will increase cumulatively by 45 %. The resulting value of the utilisation coefficient of routes is 0,95 %.

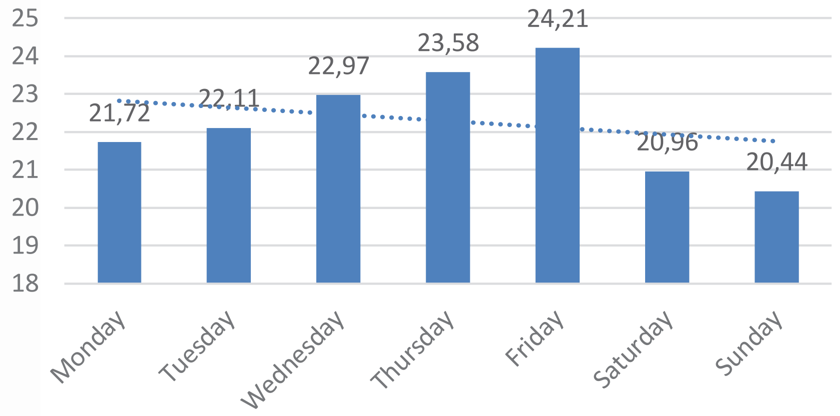
• If the share of transports offered in the country of unloading of the first consignment is less than 50 %, which means that there are fewer free consignments on the return route than the transport vehicles offered, the transporter must travel longer with the vehicle to obtain a suitable consignment. If the identified share of free transports from state «*i*» and to state «*j*» for transport «*P*» is also marked as «d_{Pij}», then the value of the coefficient can be determined as:

$K = 50 + (d_{Pij} - 5)$ (%).

It is necessary for the transporter to know whether the transport he carries out will be performed with profit or loss. This methodology creates a tool for the transporter, which can gain a competitive advantage in identifying more accurate costs arising from transport to individual countries and in individual periods of the year, respectively day of the week.

CONCLUSION

Transporters of international road freight transport currently operate in the common market of the European Union, where they can operate in international transport under the same conditions. On the one hand, the entire EU market was opened up for transporters from Central Europe, but competition has also increased significantly. A higher competitive environment also calls for more accurate cost calculations. Transporters, as they carry out part of the performance without loading, mainly during transfer of the vehicle from the place of unloading to the place of next unloading, recalculate the costs with the utilisation coefficient of routes. In common practice, a coefficient based on the annual performance of vehicles is used and is further used as a constant in recalculating costs. Based on the research, we have identified that the value of the utilisation coefficient of the routes is not constant, but variable value depending on the direction of transport. There are countries in which the transporter is able to



Pic. 2. Development of records of the offer of shipments during the week in the analysed countries together in percentages [developed by the authors].

ensure the transport of a consignment without any problems during a return transport of the vehicle, and there are countries where the return utilisation of the vehicle is problematic. We have also identified that the value of the coefficient also depends on the loading time of the consignment for transport. The coefficient changes not only during the seasons, but also during one and the same week. In the paper, the authors have proposed a methodology by which it is possible to change the constant value of the utilisation coefficient of use of routes to a variable value depending on the direction of transport and on the time of transport.

The authors are aware that there are special transports for which the application of the utilisation coefficient is problematic because it is not possible to carry out return transport in such vehicles. These are, in particular, tank vehicles intended for the transport of dangerous goods or foodstuffs.

REFERENCES

1. Avetisyan, M., Heatwole, N., Rose, A., Roberts, B. Competitiveness and macroeconomic impacts of reduced wait times at U.S. land freight border crossings. *Transportation Research Part A: Policy and Practice, Elsevier*, 2015, Vol. 78 (C), pp. 84–101. DOI: https://doi.org/10.1016/j.tra.2015.04.027.

2. Castillo-Manzano, J., Castro-Nuño, M. Driving licenses based on points systems: Efficient road safety strategy or latest fashion in global transport policy? A worldwide meta-analysis. *Transport Policy*, 2012, Vol. 21, pp. 191–201. DOI: https://doi.org/10.1016/j.tranpol.2012.02.003 [access restricted for subscribers only].

3. Rotondo, E. The legal effect of EU Regulations. *Computer Law & Security Review*, 2013, Vol. 29, No. 4, pp. 437–445. DOI: 10.1016/j.clsr.2013.05.003.

4. Osterloh S., Heinemann, F. The political economy of corporate tax harmonization – Why do European politicians (dis) like minimum tax rates? *European Journal of Political Economy*, 2013, Vol. 29 (C), pp. 18–37. [Electronic resource]: https://www.econstor.eu/handle/10419/27591. Last accessed 30.09.2022.

5. Jourquin, B., Beuthe, M. Cost, transit time and speed elasticity calculations for the European continental freight transport. *Transport Policy*, 2019, Vol. 83, pp. 1–12. DOI: https://doi.org/10.1016/j.tranpol.2019.08.009.

6. McLennan, A. Price dispersion and incomplete learning in the long run. *Journal of Economic Dynamics and Control*, 1984, Vol. 7, Iss. 3, pp. 331–347. DOI: 10.1016/0165-1889(84)90023-X [access restricted for subscribers only].

7. Forootani, A., Tipaldi, M., Zarch, M. G., Liuzza, D., Glielmo, L. Modelling and solving resource allocation problems via a dynamic programming approach. *International Journal of Control*, 2019. DOI: 10.1080/00207179.2019.1661521 [access restricted for subscribers only].

8. Vaishya, S. R, Sarkar, V. Accurate loss modelling in the DCOPF calculation for power markets via static piecewise linear loss approximation based upon line loading classification *Electric Power Systems Research*, 2019, Vol. 170, pp. 150–157. DOI: 10.1016/j.epsr.2019.01.015 [access restricted for subscribers only].

9. Gnap, J., Konecny, V., Varjan, P. Research on Relationship between Freight Transport Performance and GDP in Slovakia and EU Countries. *Nase More*, 2018, Vol. 65, Iss. 1, pp. 32–39. DOI: 10.17818/NM/2018/1.5.

10. Garaj, V. Competition and product quality. *Ekonomicky Casopis*, 1993, Vol. 41, Iss. 2, pp. 99–113.

11. Bujnova, D., Dubcová, G. Possibilities of applying costing in management decision-making. *Ekonomicky Casopis,* 1995, Vol. 43, Iss. 6, pp. 497–515.

12. Konečný, V., Semanova, S., Gnap, J., Stopka, O. Taxes and Charges in Road Freight Transport – a Comparative Study of the Level of Taxes and Charges in the Slovak Republic and the Selected EU Countries. *Nase More,* 2018, Vol. 65, Iss. 4, pp. 208–212. DOI: 10.17818/NM/2018/4SI.8.

13. Osterloh, S., Debus, M. Partisan politics in corporate taxation. *European Journal of Political Economy,* 2012, Vol. 28, Iss. 2, pp. 192–207. DOI: https://doi.org/10.1016/j.ejpoleco.2011.11.002.

14. Valaskova, K., Kliestik, T., Kovacova, M. Management of financial risks in Slovak enterprises using regression analysis. *Oeconomia Copernicana,* 2018, Vol. 9 (1), pp. 105–121. DOI: https://doi.org/10.24136/oc.2018.006.

15. Kliestik, T., Misankova, M., Valaskova, K. [*et al*]. Bankruptcy Prevention: New Effort to Reflect on Legal and

Social Changes. *Sci. Eng. Ethics.,* 2018, Vol. 24, pp. 791–803. DOI: https://doi.org/10.1007/s11948-017-9912-4 [access restricted for subscribers only].

16. Gnap, J. Kalkulácia vlastných nákladov a tvorba ceny v cestnej doprave. Žilinská univerzita, 2002, 243 p. [Electronic resource]: https://edis.uniza.sk/produkt/6389/Kalkulacia-vlastnych-nakladov-a-tvorba-ceny-v-cestnej-doprave/ [paid access].

17. Turner, S., Park, E. S. Incomplete Archived Data of Intelligent Transportation Systems for Calculation of Annual Average Traffic Statistics: What Level of Missing Data Causes Problems? *Transportation Research Record*, 2008, Iss. 2049, pp. 1–13. DOI: 10.3141/2049-01 [access restricted for subscribers only].

18. Droździel, P., Piasecki, S. Study of the medthod of assessing the economic efficiency of exploitation cars in a transport company. Folia Societatis Scientarium Lublinensis. Lublin, 1995, pp. 60–66.

19. Baller, A. C. [*et al*]. The dynamic-demand joint replenishment problem with approximated transportation costs. *European journal of operational research,* 2019, pp. 1013–1033. DOI: 10.1016/j.ejor.2019.01.070.

20. Poliak, M. The Relationship with Reasonable Profit and Risk in Public Passenger Transport in the Slovakia. *Ekonomický* časopis, 2013, Vol. 61, Iss. 2, pp. 206–220. [Electronic resource]: https://www.researchgate.net/publication/289230545_The_Relationship_with_Reasonable_Profit_and_Risk_in_Public_Passenger_Transport_in_the_Slovakia/link/6034d341299bf1cc26e4b47a/download. Last accessed 30.09.2022.

21. Lai, Y. B. The political economy of capital market integration and tax competition. *European Journal of Political Economy,* 2010, Vol. 26 (4), pp. 475–487. DOI: https://doi.org/10.1016/j.ejpoleco.2010.02.001.

22. Říha, Z., Tichy, J. The Costs Calculation and Modelling in Transport. Transport Means 2015 – Proceedings of the International Conference. Kaunas Univ. Technol., 2015, pp. 388–391. [Electronic resource]: http://www.ioda.cz/_publikace/pub/2015_The_Cost_Calculation.pdf. Last accessed 30.09.2022.

23. Trigaux, D. Wijnants, L., De Troyer, F., Allacker, K. Life cycle assessment and life cycle costing of road infrastructure in residential neighbourhoods. *International Journal of Life Cycle Assessment,* 2017, Vol. 22, Iss. 6, pp. 938–951. DOI: 10.1007/s11367-016-1190-x [access restricted for subscribers only].

24. Yiwei, Chen; Hai, Wang. Pricing for a Last-Mile Transportation System. *Transportation Research Part B-Methodological,* 2017, Vol. 107, pp. 57–69. DOI: 10.1016/j.trb.2017.11.008.

25. Krasnyanskiy, M., Penshin, N. Quality criteria when assessing competitiveness in road transport services. *Transport Problems,* 2016, Vol. 11, Iss. 4, pp. 15–20. DOI: 10.20858/tp.2016.11.4.2.

26. Kedzior-Laskowska, M. Economic attributes of quality and competitiveness on the market of road freight transport services. *Ekonomia i Prawo-Economics and Law,* 2019, Vol. 18, Iss. 4, pp. 441–457. DOI: 10.12775/EiP.2019.029. [Electronic resource]: https://www.researchgate.net/publication/338446584_Economic_attributes_of_quality_and_competitiveness_on_the_market_of_road_freight_transport_services/link/5e153beba6fdcc283761af40/download. Last accessed 30.09.2022.

27. Gnap, J., Konecny, V., Poliak, M. Demand elasticity of public transport. *Ekonomicky Casopis,* 2006, Vol. 54, Iss. 7, pp. 668–684. [Electronic resource]: https://www.researchgate.net/publication/292548426_Demand_elasticity_of_public_transport/link/603762a0a6fdcc37a84e2e46/download. Last accessed 30.09.2022.

28. Gasparik, J., Stopka, O., Peceny, L. Quality Evaluation in Regional Passenger Rail Transport. *Nase More,* 2015, Vol. 62, Iss. 3, pp. 114–118. DOI: 10.17818/NM/2015/SI5.

29. Askari, S., Peiravian, F. Public transportation quality of service: factors, models and applications. *Transport Reviews,* 2019, Vol. 39, Iss. 4, pp. 558–560. DOI: 10.1080/01441647.2018.1531083 [access restricted for subscribers only].

30. Xiao-Feng, Xie; Zunjing, Jenipher Wang. Combined traffic control and route choice optimization for traffic networks with disruptive changes. *Transportmetrica B-Transport dynamics,* 2019, pp. 814–833. DOI: https://doi.org/10.1080/21680566.2018.1517059 [access restricted for subscribers only].

31. Poliak, M., Poliakova, A., Mrnikova, M., Simurkova, P., Jaskiewicz, M., Jurecki, R. The Competitiveness of Public Transport. *Journal of Competitiveness*, 2017, Vol. 9, Iss. 3, pp. 81–97. DOI: 10.7441/joc.2017.03.06. [Electronic resource]: https://www.researchgate.net/publication/320140877_The_Competitiveness_of_Public_Transport/link/59d03c8aa6fdcc181ace0ccd/download. Last accessed 30.09.2022.

32. Mitsakis, E., Lordanopoulos, P., Aifadopoulou, G., Tyrinopoulos, Y., Chatziathanasiou, M. Deployment of Intelligent Transportation Systems in South East Europe. Status and Future Prospects. *Transportation Research Record*, 2015, Iss. 2489, pp. 39–48. DOI: 10.3141/2489-05. [Electronic resource]: https://www.researchgate.net/publication/295255006_Deployment_of_Intelligent_Transportation_Systems_in_South_East_Europe/link/56eb159308aeb65d7593a0a1/download. Last accessed 30.09.2022.

33. Albalate, D., Bel, G., Fageda, X. Competition and cooperation between high-speed rail and air transportation services in Europe. *Journal of Transport Geography*, 2015, Vol. 42, pp. 166–174. DOI: 10.1016/j.jtrangeo.2014.07.003 [access restricted for subscribers only].

34. Madudova, E., David, A. Identifying the derived utility function of transport services: Case study of rail and sea container transport. *Transportation Research Procedia,* 2019, pp. 1096–1102. DOI: https://doi.org/10.1016/j.trpro.2019.07.153. ●

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