Chapter

Providing Sustainable Transport Infrastructure through Internalization of External Costs: A Case Study from South-Eastern European Countries

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Abstract

The most important goals for transport systems development in the European countries are related to increasing transport system efficiency and sustainability and pushing national economies' competitiveness. After a thorough analysis of transport costs, a system of measures should be undertaken to achieve these goals. All these issues are on the top of the political agenda so far, considering the impacts of the COVID pandemic in recent years and the current developments of Just Transition and the European Green Deal ambitions. However, they could not be reached without accounting for transport's social costs, especially external ones. The chapter's main objective is to demonstrate the opportunities of the internalization approach and its updates for evaluating marginal external transport costs on a national level for South-Eastern European countries. As a result, a background will be provided to help policymakers in these counties to prioritize measures and projects envisaged in inland modes of transport based on potential savings for the society, which is not done so far. The chapter also discusses the effects of improving transport infrastructure functioning and performance by using internalization of external costs.

Keywords: sustainable transport, external costs for transport, internalization of external costs, infrastructure charging, transport policy

1. Introduction

The main ambition of the Transport policy in the EU is to provide efficient and sustainable transport systems and services to societies and to push national economies' competitiveness. These goals could be reached through a system of measures undertaken after a thorough analysis of transport costs [1]. However, this analysis needs the application of contemporary cost accounting approaches in transport and up-to-date infrastructure charging principles.

The infrastructure charging system in transport in the EU is based on the "user is to pay" principle. However, besides the internal costs (private costs) calculated in infrastructure charges, other costs are generally not reflected in charges but influence external parties. Hence, it is necessary to differentiate charges to account for external costs for different modes of transport. The differentiation could be achieved by internalizing external costs for transport in infrastructure charges by applying a common approach for infrastructure charging in all modes of transport.

All these issues appear to be of utmost importance when analyzing transport activities and the opportunities for funding infrastructure projects in South-Eastern European Countries and to achieve respective transport policy goals.

The evaluation of marginal external transport costs on a national level for South-Eastern European countries is suggested in this chapter to clarify the application of the approach and its opportunities to balance transport modes sustainably. Furthermore, the results could help countries' policymakers prioritize measures and projects envisaged in inland modes of transport based on potential savings for society, which has not been done so far. Finally, the chapter suggests measures for improving transport infrastructure funding and performance.

2. Methodology for evaluation of external infrastructure costs

On the European level, many projects and studies were carried out to estimate the proper impact of externalities and to translate it into societal costs (GRACE, UNITE, RECORDIT, SPECTRUM, HEATCO, NEWEXT, etc.). Although the transferability of results remains limited, a considerable number of different researchers pave the way toward proper valuation. The Handbook on the external costs of transport and its updates give a detailed overview of what is being done in the field of cost estimation so far [2].

The cost data used by infrastructure companies are insufficient, heterogeneous, and inappropriate for thorough analysis and evaluation. On the other hand, using complex cost categories and new information sources is a resource- and time-intensive, which is unacceptable in the short term [3]. Therefore, existing practices and methods for determining infrastructure charges are the initial basis for specifying cost categories and the data used for estimating marginal social costs for transport [4].

The necessity to develop a common framework for charging for transport infrastructure use is defined at the European Union level [5]. It is because infrastructure charges affect the conditions of competition in the internal market. Furthermore, they are related to ensuring access to the transport market and significantly affect the development of international transport [6]. Therefore, in order to achieve the objectives set, the following basic principles are justified:

- The same basic principles are applied to all modes of transport;
- Levying infrastructure charges lead to greater efficiency of the use of transport infrastructure.
- All users must pay for the costs they cause, or at least ensure that operating costs are covered;
- The charges must be directly linked to the costs induced by infrastructure users and other costs, including the environmental and other external costs.

- They must differ only where there are fundamental differences in the cost and quality of services and should not be discriminatory regarding users' nationality and origin.

The only approach that fully meets these criteria is charging based on marginal social costs, i.e., users pay the costs (internal and external) that they trigger when using the infrastructure. This approach incentivizes consumers to reduce infrastructure costs while maximizing individual benefits and economic and social well-being.

Besides the costs reflected in the applied infrastructure charges (internal costs), some costs are not paid by the users causing them but affect parties external to the transport process and are not included in the charges [2]. Some of these external costs are marginal. The procedures for allocating costs depend on the valuation method applied. Cost allocation is usually done indirectly through theoretical and empirical cost analysis, using different indicators and coefficients of the other influencing factors [7]; these allocation indices can be combined to establish marginal costs for different vehicle types [6]. The allocation indices can be combined to evaluate marginal costs for different vehicle types.

The introduction of proper charging for the use of transport infrastructure provides for charges to be set entirely based on full social costs, i.e., variable and fixed infrastructure costs and external costs [8]. To this end, it is necessary to specify how to assess the different types of external costs. In doing so, their calculation is again linked to the setting of marginal costs.

Three major groups of external costs could be specified as follows:

1. *Congestion costs* – incl. Costs for the scarcity of infrastructure, including time and additional operating costs; for scheduled transport: delay costs as well as additional costs in urban areas – including time losses of non-motorized traffic in urban areas;

2. *Environmental costs* – incl. *Costs for air pollution* [9], – health/medical costs, crop losses, building damages etc.; *costs for climate change* – avoidance costs to reduce risk of climate change and damage costs of increasing average temperature; noise costs –annoyance and health costs; *well-to-tank costs* – including climate change and air pollution costs of energy consumption and GHG emissions of up- and downstream processes, cost elements such as repair cost and restoration measures (e.g. unsealing, renaturation, green bridges); *costs for habitat damage* – including damage or restoration costs of air pollutant related biodiversity losses [10]; and *costs for soil and water pollution* – including restoration and repair costs for soil and water pollutant with focus on transport-related heavy metal and hydrocarbon emissions; *noise costs* – including the environmental price of noise that reflects the welfare loss occurring with one extra decibel of noise as well as induced annoyance and health costs.

3. *Accident costs* – including medical costs, production losses, and losses of human lives.

In assessing the *congestion costs*, three leading indicators are used that affect the level of these costs – the assessment of the travel time, the ratio of " travel time – demand for transport services," and the function of demand. The value of travel time can be evaluated in several different ways: first, by assessing the value of time for society as a whole. In this case, a distinction should be made between the time to work and the rest spent on travel. The salary per hour may reflect the production result that can be achieved for the time used for transport [11].

Concerning rest time, the willingness to pay for actual or hypothetical consumer preferences should be assessed. These preferences are studied using surveys. The assessment of private travel is carried out using the neoclassical model of individuals maximizing the utility of the consumption of services under certain budgetary constraints [12]. The costs for business trips take into account individual aspects of a person's productivity. Further research is needed in this area to justify better the indicators that determine the assessment of the travel time.

The optimal level of congestion charges is determined by the intersection of the cost curve of transport infrastructure users and the demand curve for transport services. This level reflects the demand for access to transport infrastructure and responds to the necessity of internalizing these costs in the charges, thus providing for cost reduction. Thus, the demand function determines the relationship between actual external costs and equilibrium charges to address the consequences of congestion.

The flow of vehicles providing transport services can be explained as a physical relationship between the number of vehicles using the transport infrastructure over a specified period and the corresponding speed at which those vehicles move. The ratio of "travel time – demand for transport services" can be described with different functions (hyperbolic, logit, linear) [8]. In this case, it is crucial to consider the relative share of demand diverted due to congestion, which will be directed to another time or alternative route.

A significant factor influencing the occurrence of congestion is the costs of individual infrastructure users. These costs increase as the number of users increases. Thus, if the charges paid by users are set to reflect the actual external congestion costs, the demand for access will be reduced and, together with it, the external costs themselves.

Several studies have been carried out in the EU on external congestion costs. However, these congestion impacts have not been sufficiently investigated [13]. Moreover, it is unclear whether these costs should be defined as external when scheduled services are offered. For example, the costs associated with delays due to congestion caused by one rail operator to another are external. However, it is debatable whether delays in the presence of only one operator should be considered essential for price fixing or included in them. With this in mind and based on the conclusions on the state and use of infrastructure in different modes of transport, it can be summarized that these costs must be considered when determining infrastructure charges for road and air transport and are less critical in rail. In this respect, it is necessary to study them further and include them in the charges when reaching the appropriate level of use of the infrastructure.

The *environmental costs* are related to eliminating heterogeneous transport influences such as noise, air, water, and soil pollution. However, the valuation of these influences is hampered by the fact that it is not goods and services that can be sold and bought. Therefore, different methods are used [14], such as:

- the market for substitute goods and services, respectively, transport costs where consumers benefit from public recreational facilities, are used to estimate these costs. Alternatively, they could be evaluated by using the consumer assessment of individual goods and services depending on their exposure to pollution or noise. Thus, assessing such goods and services concerning their environmental characteristics can be used. The environmental costs can also be assessed by examining the members of society willing to pay to reduce or eliminate adverse environmental effects. There are some difficulties associated with the sensitivity of individuals to the ecological factor in applying this method;

- conditional estimates – this method is related to a study of consumers' willingness to pay in order to eliminate adverse effects or their willingness to pay in order to continue to tolerate these effects. The difficulties relate to questionnaires development and the provision of credible answers, as well as to psychological biases associated with a lower willingness to pay for the elimination of harmful influences than to accept benefits in order to continue to bear them;

- indirect methods are applicable for the costs of preventing environmental pollution. They are applied in two stages: the first is technical. It aims to quantify the consequences of adverse environmental effects. The second is to assess the damage caused, both through the market prices of the damaged goods and through the repair costs of such damage or other subjective assessments. However, the application of this method involves difficulties due to the lack of information, and the value of environmental damage is inaccurate.

Measuring the different adverse effects is complex, but there are still some studies [15] attempting to quantify them accurately. For example, noise is measured depending on the duration and sensitivity of the human ear. Its impacts are usually assessed by lowering the prices of buildings in noisier areas. Noise also impacts people's health due to its influence on the cardiovascular system and sleep, which are general health components. Air pollution is measured by the amounts of harmful vehicle emissions – nitrogen and sulfur oxides, particulate matter, and volatile organic compounds. Assessing their impact on people, animals, plants, and buildings is complicated. There are still significant inconsistencies in determining the long-term effect of these on human health. The values estimates include the direct costs of disability, the cost of protection from emissions, and the assessment of consumers' willingness to pay to avoid damage caused by air pollution.

The *accident costs* are inherent in the transport industry [16]. They have a high value depending on the number of people killed and injured in accidents, the cost of human life, or the damage caused. The value of human life is most often assessed by assessing human capital and calculating losses or reduced production due to damage caused. It is also possible to assess the willingness to pay extra for transport at greater risk.

For the calculation of the accident costs, it is necessary to consider not only the assessment of the value of human life but also the value of the damage caused to persons and property, as well as the production losses resulting from the absence of employees from work. The cost of the damage includes direct (medical expenses, transport of victims, etc.), indirect costs (loss of production), and subjective assessments (of pain and suffering). Therefore, it is impossible to determine to what extent these costs are covered by transport insurance [12]. Furthermore, there are also fluctuations in the extent to which these external costs are related to the transport volume, respectively, with the flow of vehicles and at driving speeds. These issues also require studying the interaction between congestion and the number of transport accidents.

The possibilities for internalizing external costs are not yet fully used in the infrastructure charging systems in transport sectors of the South-Eastern European countries [6]. Except for charges on liquid fuels and excise duties relating to covering the costs of protecting and preventing environmental pollution, there are only a few to consider these costs (for example, environmental and noise-related markups in airport charges). Therefore, there is a need for in-depth and concrete research into these opportunities and the definition of approaches and methods for evaluating external costs and their internalization in infrastructure charges. Furthermore, the revenues from such charges may be used to finance future investments. There is no need to set a uniform approach to measuring external costs, but it must be determined how different cost estimates or approaches can be applied correctly. However, the possibilities for internalizing external costs can be determined by whether the marginal cost function is increasing or decreasing [17]. Therefore, determining the marginal costs of transport infrastructure should be based on the average of the elasticity factors of maintenance and repair costs to changes in transport volume.

Thus, if the cost function is decreasing, as in rail and waterborne transport, the marginal costs have not reached their minimum, and there are opportunities for economies of scale. That is, with a 1% increase in transport volume, costs increased by less than 1%. Therefore, in this case, it is possible to apply supplements and include external costs in infrastructure charges without drastically reducing revenue. Conversely, when the cost function is increasing, i.e., a 1% increase in transport volume corresponds to a more significant cost increase, there is a decreasing return on a scale. In this case, the inclusion of external costs will cause a substantial increase in charges and affect the usage of transport infrastructure.

The discussed charging approach is critical to ensure the efficient use of infrastructure and creates the conditions for its financing from users' payments, which require new and different funding models. Transport operators and users paying the actual costs have clear incentives to make their choice, for example:

- To use vehicles that cause less damage to the infrastructure, less environmental pollution, and are more secure;

- To rearrange their routes and logistics chains to those with lower infrastructure damage levels, less congestion, lower risk of accidents, and a lower environmental impact;

- To reconsider their modal choice and use modes of transport with fewer external effects.

Consequently, the infrastructure charging system developed in implementing such a common approach provides incentives to improve transport performance through more comprehensive benefits by reducing the costs associated with external effects. Even transport operators who have not changed their services will benefit from changes undertaken by others, such as reducing congestion and improving infrastructure conditions, reducing the risk of accidents, etc.

3. Methodology for internalization of external costs

Based on the analysis carried out of the current principles of infrastructure charges in transport, it is found that the charges in the different modes of transport are based on the average or marginal cost of maintaining, repairing, and operating the infrastructure concerned [1]. Therefore, to take into account marginal social costs for transport, general principles for evaluating costs, including external ones, should apply to all modes of transport.

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Cost grouping is essential as it reflects the content of the costs already determined and is a step toward their allocation. At this stage, the existing cost categorization may be used, or accounting information sources adapted to the theory of marginal costs [18]. However, to justify the inclusion of the relevant group of costs in determining infrastructure charges, it is necessary to define more detailed and precise cost categories. In doing so, an account should be taken of the information limitations according to which specific categories of expenditure are aggregated, and it is not possible to accurately reflect the different variable costs [19].

In some cases, determining the reasons for different costs is relatively easy, and in others – not so much. Therefore, the different cost categories may be further grouped according to their reasons. The individual elements of the variable costs shall then be defined using the relevant qualitative technical and economic indicators.

After grouping the costs according to their intended purpose, it is crucial to create the necessary prerequisites for their transfer to those who cause them through the system of infrastructure charges [8]. Ideally, charges should change as each cost changes. However, the practical application of such an approach is not easy, so it is necessary to use more generalized categories. First, an analytical approach may be applied when examining infrastructure costs based on the total costs allocated to one vehicle. The second option is to apply the synthesis approach, which collects information on the costs associated with individual vehicles and summarizes these costs. The availability of data on the costs concerned their categorization and the possibilities for allocating them predetermine the use of one of the two approaches. Synthesis is appropriate when the objective is to determine the function of the total costs from which to infer the first derivative (the function of marginal costs). Where the total costs are known and the individual elements are not, it is more appropriate to use the analysis.

For cost allocation purposes, it is necessary to link the different cost categories to the relevant indicators, using data on physical and technical interaction between vehicles and roads or railways. In applying this approach, the allocation procedure must be transparent. These requirements may be tailored as follows:

When allocating marginal costs depending on the weight and number of vehicles, axle load indicators are used mainly. The mileage indicator is used to allocate costs that do not depend on the gross weight of the vehicles. In order to improve the information base, it is necessary to extend the above analysis method (in terms of mixed traffic, the share of different heavy goods vehicles).

Estimates of individual costs differ; some have a direct financial dimension, others depend on the likelihood of an event, and others have a physical or physiological expression (see **Table 1**).

The focus at this stage should be on the cost drivers and not on the incurrence of the costs themselves. Infrastructure costs, as well as environmental and congestion costs, can be directly attributed to the transport volume [20]. In this regard, the infrastructure charges imposed on consumers are the most appropriate toolbox for ensuring adequate price signals in the transport infrastructure market. However, concerning the costs caused by transport accidents, this toolbox can be assessed as inappropriate. On the other hand, approaches based on general taxation and specific transport taxes and charges (e.g., vehicle tax and charges on liquid fuels) are not particularly precise as they are not based on the specific costs incurred due to transport accidents. Furthermore, these taxes and charges do not alert consumers to correct their behavior because of accidents.

Fixed costs		**Variable costs**	
Internal costs	**External costs/ benefits**	**Internal costs**	**External costs/benefits**
Capital expenditures:	*Costs:*		*Other external costs*
• return on capital; • interest payments; • -asset regrowth.	• restrictive effects; • pollution of nature; • visual disturbances.		• *Air and water pollution:* (local/local pollutants – e.g., dusting; regional pollutants – e.g., nitrates; global pollutants – e.g., carbon dioxide).
Fixed running costs:	*Benefits:*	*Variable running costs:*	*Costs/Benefits:*
• maintenance costs (weather and climate-related); • operating costs (lighting, traffic management, information); • administration costs.	• improved access; • systemic benefits; • increased productivity.	• operating costs (traffic management, use, ancillary services); • maintenance costs related to operation (reconstruction, replacement of rails, repair).	*Transport accidents* *Congestion* *Noise and vibration*

Table 1.
Costs elements related to the use and maintenance of infrastructure.

Introducing the charges related to externalities will lead to the provision of additional revenue from infrastructure charges. From a fairness point of view, it is desirable to use the accumulated money to compensate victims of accidents, for example, or to finance measures to limit future negative influences. Furthermore, even higher cost recovery levels can be achieved if the funds are allocated to achieve common infrastructure objectives [21]. Analyses carried out on the European level provide a reason to summarize that the total revenues for the transport system will exceed infrastructure costs.

Differentiation of charges taking into account external costs is also possible as different modes of transport have different external costs. Such a measure would more effectively impact the charges for using the infrastructure. In this respect, it is necessary to introduce simultaneously environmental charges related to noise, harmful emissions, transport accidents, and congestion in different modes of transport. Demand for infrastructure capacity changes depending on the hours of the day, the type of traffic, and the direction of alternative routes. In principle, transport operators should pay different fees for different destinations and times of day in order to adequately reflect the insufficient (depleted) capacity and ensure its more efficient allocation [8]. This guideline should be used to increase the efficiency and sustainability of the use of transport infrastructure.

Improving the infrastructure charging system by internalizing external transport costs will lead to more efficient use of infrastructure and higher coverage of the costs of maintaining and operating it. In addition, this process will create prerequisites for financing the construction of new infrastructure. In combination with subsidies provided directly by the state to offset the overall public benefit to non-direct users of infrastructure, a high, or perhaps full, level of covering maintenance and operation costs is likely to be achieved. Suppose full coverage is not ensured, and the state wishes to ensure a higher level. In that case, this can be achieved by imposing additional, fixed, non-discriminatory user charges that do not change the proportions between modes of transport. In addition, investment projects will, at least in the medium term, require a high level of cost coverage. In such cases, higher charges may be applied for a particular time, following the rules on non-discrimination and providing guarantees that monopoly profits will not be allowed to be realized.

In the presence of sufficiently reliable and detailed methodologies based on the described approach, it is possible to recalculate the marginal costs for each year [22]. Thus, in the event of a change in cost ratios or a significant change in the use of infrastructure (e.g., when capacity is exhausted), changes will be able to be reflected promptly and infrastructure charges updated. In this way, they will consider the actual conditions for using the infrastructure and provide adequate revenue for undertakings offering access to it.

However, it should be taken into account that the marginal costs do not change proportionately as the volume of transport changes. Therefore, it cannot be assumed that the mathematical function of the costs is linear. Furthermore, it is necessary to determine what other factors affect the costs of maintaining and operating transport infrastructure. All these limitations require an examination of the type of cost function.

3.1 Evaluation of marginal costs function

Research carried out at the European level has shown that the main costs, which vary according to the volume of transport for railways and road infrastructure, are the cost of maintenance and repair. The leading indicators used to allocate costs are defined in this respect. For terminal infrastructures, such as airports and ports, these are the labor costs of staff engaged in servicing aircraft/vessels and passengers or handling goods [22]. In road and rail transport, the leading indicators are the volume of traffic in gross tonne-kilometers, the number of bridges and tunnels, the level of electrification, and the infrastructure's operation duration. Regarding terminal infrastructure, the airports and ports shall consider the number of air movements, passengers served, and ships served. Seasonal and weekly fluctuations in transport volume should also not be overlooked.

The function describing the change in the cost of maintaining and repairing the transport infrastructure presents the relationship between these costs and the transport volume. For the definition of this heading, the relationship between the total marginal costs of transport infrastructure (TC_{infra}), the volume of traffic (Q), and the factors influencing them should be clarified. Influencing factors may be, for example, infrastructure parameters (I), the cost of construction of the infrastructure (p), vehicle weight (W), speed of movement (S), weather conditions (Z), etc. Therefore, the overall type of cost function suggested by the author is:

$$TC_{infra} = f\,(Q, p, W, S, I, Z, \dots) \tag{1}$$

Research carried out in EU countries gives rise to the transcendental logarithmic function being considered the most accurate for studying infrastructure costs in road and rail transport [23]. It provides possibilities for initial analysis of the total costs and phasing out the function according to the type of infrastructure. Another advantage is that it is a flexible mathematical model that gives good results in studying unknown products or cost functions. This model also meets the requirements of neoclassical economic theory related to the substitution of production factors, economies of scale of production, and technological changes [24]. The limitations of using the transcendental logarithmic function are not significant. They relate only to possible changes in the vehicle technologies in use.

The type of aggregated function adapted to railway infrastructure conditions and the necessary cost data is as follows (adapted and suggested by the author):

$$\ln(C_m) = \alpha 0 + \alpha_l . \ln l + \alpha_k . \ln k_t + \alpha_{Qg} . \ln Q_g + \alpha_{Sw} . \ln S_w + \alpha_{Nt} . \ln N_t + \ln l\left(½\beta_{ll} . \ln l + \beta_{lk} . \ln k_t + \beta_{Qg} . \ln Q_g + \beta_{Sw.l} . \ln S_w + \beta_{Ntl} . \ln N_t \right) + \text{lnkt}\left(½\beta_{ktkt.}\ \text{lnkt} + \beta_{ktQg} . \ln Q_g + \beta_{Swkt.}\ \ln S_w + \beta_{Ntkt.}\ \ln N_t \right) + \text{lnQg}\left(½\beta_{QgQg.}\ \ln Q_g + \beta_{NtQg} . \ln N_t \right) + \ln N_t(½\beta_{NtNt} . \ln N_t), \tag{2}$$

Where the dependent variable C_m reflects the costs of maintaining railway infrastructure, and the independent variables are:

l – the length of the railway sections;

k_t – the variable determining the electrification of railway lines;

S_w – the number of arrows in each plot;

Q_g – the gross traffic volume on the relevant section;

N_t – the number of trains passing on the sections for a certain period (e.g., for 1 year);

α_0 – constant;

α – the elasticity coefficient;

β – the correlation factor between the indicators.

Data availability and quality influence costs and are crucial for econometric analysis. In this respect, it is necessary to provide detailed data and adapt them to the regression analysis needs. A similar model is suitable for describing the cost function in road transport. The model includes the cost of repairing and maintaining individual road sections, variables for road category, and annual average daily transport volumes.

Concerning airport infrastructure, an appropriate form for the cost function is cubic, as it best describes the cost dependency on the volume of transport at airports with predominant international traffic. The main indicators to be included in the model are as follows: number of staff (n), respectively, duration of work in person-hours by type of activity, annual cost of carrying out the different types of services (C), number of air movements (m), respectively number of passengers served. The study of the type of cost function for different indicators follows the model (adapted and suggested by the author):

$$C = \beta_0 + \beta_{n1}.n + \beta_{n2}.n^2 + \beta_{n3}.n^3 + \beta_{n4}\ n^4 + \varepsilon_t \tag{3}$$

This model must also consider seasonal and weekly fluctuations in transport volume and differences in service standards. In this way, higher reliability of the analysis can be ensured.

In the short term, facilities' wear and tear costs are not so high for port infrastructure. Therefore, the main costs to be considered in the analysis are the costs of loading and unloading operations and the labor costs of port workers. The model describing the type of cost function may include the following indicators: annual costs of using the port (TC), the quantities of freight passing through the port per year (Q), and the total quantity of goods passing through the port over the entire period (Q_{cum}). It is also possible to include the annual investment costs, the number of persons employed in ships' servicing, and the labor costs for those persons. Studies carried out in EU countries show that the most appropriate form of the function is the logarithmic Cobb-Douglas specification of the type (adapted and suggested by the author):

$$\log TC = \log a + b\log Q + c\log Q_{cum} + d_y \tag{4}$$

In the absence of sufficiently detailed and reliable data for econometric analysis (large statistical rows of at least 50 meanings are required), it should be clarified that the summaries made are theoretically valid but require further practical and applied analyses. In addition, they should present the specific results of the correlation between the change in costs and the factors influencing them.

Implementing the first stages of the described approach provides for basic infrastructure charges for roads, railways, ports, and airports to be defined. However, it should be taken into account that the marginal costs do not account for all variable costs, i.e., they need to be included in infrastructure charges in other ways to ensure higher or even full cost recovery.

The marginal costs of transport infrastructure shall be determined by the use of the econometric models or only by the simple determination of the cost elasticity factors relative to the transport volume. In the absence of a sufficiently detailed database of the cost categories, quantifying the marginal costs of transport infrastructure may be done using the principles for the transfer of research results as recommended by the Handbook on external transport costs [2]. The relevant reference values by cost category shall be selected, and the results obtained using the econometric approach shall be applied.

Following the suggested methodological approach, the next stage for infrastructure charging involves markups' calculation to reflect the external costs for transport and harmonize the infrastructure charging systems in different modes of transport. Then, depending on the indicators included in the study of the cost function and calculated elasticity factors, it is necessary to determine the amount of marginal external costs related to each indicator. Thus, the remaining costs (external) can be allocated based on the marginal costs already allocated.

3.2 Calculation of external marginal costs for SEEC for evaluating markups to infrastructure charges

The calculation of markups to marginal infrastructure costs can be carried out by using the transferring tool for the results of econometric studies as suggested in the Handbook on the external costs of transport [2]. However, detailed data on different indicators for certain road sections or individual infrastructure sites should be considered in this case. The coefficients obtained should not be applied directly. Instead, they should be adapted to the using conditions, the characteristics of the country's infrastructure, and the year of calculation. The calculated cost dependency factors for the transport volume will determine the marginal external costs. The remaining additional costs may be allocated proportionally to predetermined cost dependency factors from the average daily traffic volume per category of vehicles. Overall workflow of the model in terms of input data, model variables and output, is presented in **Figure 1**.

Considering recent updates of the Handbook on external transport costs on the European level [2], there are no projects or studies conducted in most South-Eastern

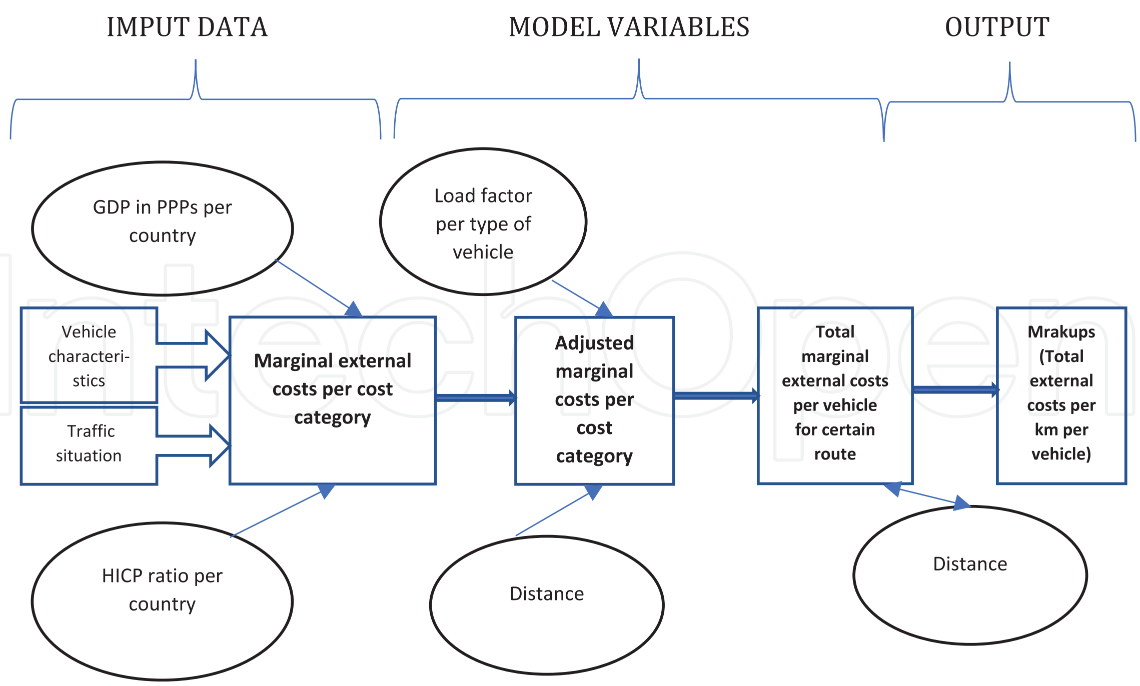

Figure 1.
Model workflow from data input to expected results.

European countries. However, external cost evaluation for some of the countries in this region has been included in the OECD report on external transport costs in Central and Eastern Europe [1]. Still, other relevant studies do not cover most of the SEE region countries.

The Handbook on the external costs of transport represents one of the possible reference bases for further external costs studies in the South-Eastern European countries [25]. The methodology for the external cost calculation can be widely used since the unit values for input figures are presented in monetary terms related to the specific value, such as Euro per hour, per accident, per unit of emission, per life year lost, etc. The output values are presented in a form that can be translated for internalization. The central unit for the infrastructure pricing is the cost per vehicle- or tonne-kilometers. Similar to other studies of external costs, a transfer of cost per passenger or tonne-kilometer has been carried out to compare different modes. Where relevant or valuable, other output unit values are shown. When applying the results to the SEE region, it should be considered that the figures are directly applicable to some SEE countries (EU members). However, for others (non-members), the value transfer approach is used to transfer the data to these countries. It can still provide reliable data for policy purposes at lower accuracy based on the guidelines for estimating external transport costs. The Handbook provides ready estimations with limited case-specific data; total/average and marginal external cost figures are provided for all countries and transport modes. Where relevant, differentiations to relevant vehicle characteristics (e.g., fuel type, size class, etc.) and traffic situation (type of road, day/night, thin/dense traffic, etc.) are provided [2].

The example provided in this section presents the calculations of total marginal external costs for pilot routes in SEE countries (for road and rail infrastructure) by using marginal values in order to present the potential of the described approach to defining markups to marginal infrastructure costs for charging for the use of infrastructure in these countries.

Calculating marginal external costs for specific routes in SEE countries is based on the reference values of the marginal external costs (€ct/vehicle for accident costs and €ct/tkm for all other costs) and transport modes provided by the Handbook referring to 2016.

These values are adjusted by using GDP per capita in PPPs coefficients for 2016 by country and by respective coefficients related to harmonized indices of consumer prices (HICP) for 2021 relative to 2016 (counted to index 2020 = 100). Through this adjustment, the reference values have been updated in line with current economic conditions and reflect the specificities of each SEE country (see **Tables 2** and **3**).

For the approach validation, the calculations of marginal external costs have been made for the pilot routes presented in **Table 4**, which presents the characteristics of each pilot route in detail.

The external costs for pilot routes are calculated according to the recommendations in the Handbook [2] and Annex 2: General instructions for the calculation of external costs [24]. In addition, the following methodology has been applied:

- First, type of vehicle (LDV and HDV), network type (motorways and outside urban), and vkm or tkm for each type of vehicle and section of the network are defined;

- Second, the correct marginal values for external costs by countries (€ct/vkm or tkm) for 2016 from the Handbook on external transport costs are selected and adjusted to 2021, accounting for each SEE country's current economic conditions. It is made by using the coefficient of GDP per capita in PPPs per every SEE country and the HICP ratio for 2021–2016 coefficients (see **Table 2**) as the referent values for marginal accident costs are recommended for the EU as a whole;

- Third, the adjusted marginal values are multiplied by the total volumes (vkm or tkm) to calculate each route's total external costs.

- Thus, the respective external costs for moving vehicles of a particular type on the separate sections and pilot routes are calculated.

- For rail transport, calculations of marginal external costs are made according to the following considerations:

Country	GDP per capita in PPPs coefficient (2016)	Correction factor based on the ratio of HICP (2021–2016)
Bulgaria (BG)	0.49	1.10
Croatia (HR)	0.62	1.07
North Macedonia (NM)	0.37	1.10
Greece (GR)	0.68	1.02
Republic Serbia (RS)	0.39	1.14
Slovenia (SL)	0.84	1.07

Table 2.
Adjustment factors for calculating marginal and total external costs.

External marginal costs	Ref. values €ct/tkm	Adjusted values (€ct/tkm)					
		BG	HR	NM	GR	RS	SL
Road transport							
Accidents (motorways)*	0.25	0.1348	0.1659	0.1018	0.1734	0.1112	0.2247
Congestion							
-LCV							
afternoon peak	10.8	5.821	7.165	4.396	7.491	4.802	9.707
morning peak	37.8	20.374	25.077	15.385	26.218	16.806	33.975
-HDV	66.3	35.74	43.98	26.98	45.99	29.48	59.59
Air pollution							
-LCV							
Gasoline	0.009	0.0049	0.0060	0.0037	0.0062	0.0040	0.0081
Diesel	0.0151	0.0081	0.0100	0.0062	0.0105	0.0067	0.0136
-HGV	0.0061	0.0033	0.0041	0.0025	0.0042	0.0027	0.0041
Noise							
-day	0.01	0.0054	0.0066	0.0041	0.0069	0.0044	0.0090
-night	0.02	0.0108	0.0133	0.0081	0.0139	0.0089	0.0190
Climate change:							
- LCV							
gasoline	1.11	0.5983	0.7364	0.4618	0.7699	0.4935	0.9977
Diesel	1.18	0.6360	0.7828	0.4803	0.8185	0.5246	1.0606
-HDV	0.69	0.3719	0.4578	0.2808	0.4786	0.3068	0.6202
Costs of habitat damage (motorway)							
LCV	1.35	0.7277	0.8956	0.5495	0.9364	0.6002	1.2134
HDV	0.19	0.1024	0.1260	0.0773	0.1318	0.0845	0.1708
Well-to-tank emissions	0.10	0.0539	0.0663	0.0407	0.0694	0.0445	0.0899
Rail transport							
Accidents	0.01	0.0054	0.0066	0.0041	0.0069	0.0044	0.0090
Congestion	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air pollution							
-electrified	0.004	0.0022	0.0027	0.0016	0.0028	0.0018	0.0036
-non-electrified	0.356	0.1919	0.2362	0.1449	0.2469	0.1583	0.3200
Noise							
-day	0.01	0.0054	0.0066	0.0041	0.0069	0.0044	0.0090
-night	0.02	0.0108	0.0133	0.0081	0.0139	0.0089	0.0190
Climate change:							
-electrified	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-non-electrified	0.087	0.0469	0.0577	0.0354	0.0603	0.0387	0.0782

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External marginal costs	Ref. values €ct/tkm	Adjusted values (€ct/tkm)					
		BG	HR	NM	GR	RS	SL
Costs of habitat damage	0.24	0.1294	0.1592	0.0977	0.1734	0.1067	0.2157
Well-to-tank emissions	0.11	0.0593	0.0730	0.0448	0.0763	0.0489	0.0989

*Note: * The external costs for accidents are calculated based on reference values in €ct per vkm.*

Table 3.
Reference and adjusted values of marginal external costs for transport in SEE countries, €ct/tkm.

- Network types are defined by routes and sections as stated in **Table 3** (single or double lane, electrified, or non-electrified), as well as the type of trains, vkm, and tkm for each type and section of the network;

- As the Handbook (2020) recommends the marginal values in €ct/train km or tkm, they are adjusted to 2021, accounting for the current economic conditions by using respective coefficients, which have been already mentioned above;

- The adjusted marginal values are multiplied by the total volumes (vkm or tkm) to calculate the total external costs for the whole routes and different types of trains.

Finally, the calculation of potential markups included in the infrastructure charges as part of internalizing external transport costs could be calculated per km for every pilot route, as suggested in **Table 5**.

Calculating the marginal external costs by type of vehicles, modes of transport, and different pilot routes are used to present the total external marginal costs for each route by cost category. This creates an opportunity for comparing the costs for different routes. However, it should be considered that the value transfer to different EU countries is sensitive to national and local specifications and is only undertaken because no national studies are available. Therefore, the respective results represent rough estimates only.

As the final calculations show, the total marginal external costs for the movement of different types of vehicles are the lowest for the rail routes. Furthermore, the load capacity of the trains is many times higher than road vehicles, thus providing a better performance of rail transport and lower costs for internalization. Considering the calculated total marginal external costs per km and type of vehicle/train, they could be used for the final calculation of markups to be included in railway infrastructure charges and tolls. The results show that the respective markups increase with the load capacity of vehicles and are the highest for heavy goods vehicles. Something more, the higher the vehicle capacity in road transport, the higher the markups.

In conclusion, it should be noted that it is impossible to compare directly respective costs for different pilot routes because the vehicles used for calculations are different for each mode of transport and have different load capacities. However, if traffic data (for example, number of vehicles running on each route) are available, it would be possible to evaluate the total external costs for the usage of each route for a certain period.

The discussed approach provides an opportunity for higher cost recovery, especially in reflecting external transport costs. Where charges reflect infrastructure, congestion, and other external costs, transport services will ensure full cost recovery

Alternative route	Origin–destination	Segment of the route	Country	Distance (km)	Type of infrastructure
Pilot route I	Thessaloniki - Ljublana along Corridor X (rail)	Thessaloniki - Gevgelija	GR, NM	79	Single, non-electrified track
		Gevgelija-Skopje	NM	165.9	Single, electrified track
		Skopje- Tabanovce/ Pcevo	NM/RS	49	Single, electrified track
		Tabanovce/Pecevo-Nis	NM/RS	160	Single electrified track
		Nis-Stalać	RS	62	Double electrified track/ Single electrified track-Dunis-Stalac
		Stalać - Velika Plana	RS	89	Double electrified track
		Velika Plana - Beograd	RS	104	Single, electrified track
		Beograd- Šid granica/Tovarnik	RS	145	Double electrified track
		Šid granica/ Tovarnik – Novska	RS/HR	185	Double electrified track
		Novska- Dugo Selo	HR	84	Single, electrified track
		Dugo Selo - Dobova/	HR	58	Double electrified track
		Dobova/Ljubljana	HR/SL	150	Double electrified track
		TOTAL		**1330.9**	
Pilot route II (alternative to PR I)	Thessaloniki - Ljublana along Corridor X (road)	Thessaloniki - Veles	GR, NM	182	E75
		Veles - Nis	NM/RS	227	E75
		Nis - Belgrade	RS	241	E70
		Belgrade - Zagreb	RS/HR	394	E70
		Zagreb - Ljubljana	HL/SL	145	E70
			TOTAL	**1189**	E70
Pilot route III	Burgas - Pirot along Corridor X (rail)	Burgas - Voliyak, Sofia	BG	422	1. Burgas- Zimnitza -
					Double electrified track;
					2. Zimnitza-Yambol - Single, electrified track
					3. Yambol-Kermen- Double electrified track;
					4. Kermen -Kalitinova - Single, electrified track Kalitinovo-Mihailovo- Double electrified track;
					5. Mihailovo-Skutare - Single, electrified track;
					6. Skutare-Voluyak - Double electrified track

Alternative route	Origin–destination	Segment of the route	Country	Distance (km)	Type of infrastructure
		Voliyak, Sofia – Dragoman fr./ Dimitrovgrad (border BG/RS)	BG/RS	49	Single, electrified track
		Dragoman fr./ Dimitrovgrad (border BG/RS)- Pirot	RS	33	Single, electrified track
		TOTAL		**504**	
Pilot route IV (alternative to PR III)	Burgas - Pirot along Corridor X (road)	Burgas -Sofia	BG	382	Highway
		Sofia – Dimitrovgrad (border BG/SE)	BG/RS	61.1	E80
		Dimitrovgrad- Pirot	RS	27.1	E80
		TOTAL		**470.2**	

Table 4.
Pilot routes characteristics.

and thus help to balance the country's transport system further. Nevertheless, of course, it is a matter of transport policy decision to define the exact level of external costs covered by the infrastructure charges and to provide a reasonable explanation for the rest of these costs to be covered by the society as a whole, not only by the transport users.

4. Socioeconomic effects of the internalization of external costs for transport

4.1 Distribution effects

The aim of the internalization of external costs of transport in infrastructure charges is to increase the efficiency of transport activity and to provide proper pricing signals to the users for the actual social costs they impose by their modal choices. A compensatory mechanism should be proposed to ensure fair pricing and competition in the transport market if the internalization leads to increased infrastructure charges and undesirable allocation effects. The volume of transport, in general, is increasing, meaning wealthier households spend most of their income on transport. Therefore, determining transport charges based on the proposed approach to internalizing the external costs may have a positive rather than a negative effect on allocation. However, the final effect will depend to a large extent on the increase in costs in the respective mode of transport and on the type of compensation mechanism applied by the state. Thus, the real disposable income will increase for each socioeconomic group.

The implementation of the approach to setting infrastructure charges based on marginal social costs will provide a significant benefit to the whole society, as well. It will lead directly to improved technological, operational, and organizational

			Pilot route I – Rail				
Cost category	**Marginal external costs per 2021 per gross weight of train (€)**						
	< = 400 t	**400–600 t**	**600–800 t**	**800–1000 t**	**1000–1200 t**	**1200–1400 t**	**1400–1600 t**
Accidents*	7,06	7,06	7,06	7,06	7,06	7,06	7,06
Congestion	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Air pollution	8,92	13,37	17,83	22,29	26,75	31,20	35,66
Noise***	22,29	33,43	44,58	55,72	66,86	78,01	89,15
Climate change	15,25	22,88	30,51	38,14	45,76	53,39	61,02
Cost of habitat damage	670,82	1006,24	1341,65	1677,06	2012,47	1798,23	2683,30
Well-to-tank emissions	306,5	459,7	612,9	766,1	919,4	820,7	1225,8
Total external costs for the pilot route	**1030,80**	**1542,67**	**2054,54**	**2566,41**	**3078,28**	**2788,57**	**4102,02**
Total external costs per km per train	**0,78**	**1,16**	**1,54**	**1,93**	**2,31**	**2,10**	**3,08**
Pilot route II – Road (alternative to PR I)							
Cost category	**Marginal external costs per 2021 per type of vehicle (€)**						
	<=3.5 t	**3.5–7.5 t**	**7.5–12 t**	**12–20 t**	**20–26 t**	**26–40 t**	**44–60 t**
Accidents	1,92	2,43	2,43	2,43	0,46	0,46	0,46
Congestion**	70,39	532,55	2982,29	4970,48	9066,79	13,948,91	20,923,36
Air pollution***	55,46	30,08	48,13	64,17	83,42	128,34	192,51
Noise****	0,23	0,49	0,79	1,31	1,71	2,63	3,94
Climate change***	52,70	40,18	182,25	243,00	94,36	145,17	217,75
Cost of habitat damage	34,12	13,39	21,43	28,58	37,15	57,15	85,73
Well-to-tank emissions	2,5	4,9	7,9	10,5	13,7	21,0	31,6
Total external costs for the pilot route	**217,34**	**624,06**	**3245,21**	**5320,49**	**9297,56**	**14,303,70**	**21,455,31**
Total external costs per km per vehicle	**0,18**	**0,53**	**2,73**	**4,48**	**7,83**	**12,04**	**18,06**
Pilot route III – Rail							
Cost category	**Marginal external costs per 2021 per gross weight of train (€)**						
	< = 400 t	**400–600 t**	**600–800 t**	**800–1000 t**	**1000–1200 t**	**1200–1400 t**	**1400–1600 t**
Accidents	2,90	2,90	2,90	2,90	2,90	2,90	2,90
Congestion	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Air pollution	3,44	5,16	6,87	8,59	10,31	12,03	13,75
Noise****	10,74	16,11	21,48	26,85	32,22	37,60	42,97
Climate change	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Cost of habitat damage	154,83	187,41	199,90	249,88	299,86	349,83	399,81
Well-to-tank emissions	70,96	106,44	113,54	141,93	170,31	198,70	315,87

Pilot route I – Rail							
Cost category	**Marginal external costs per 2021 per gross weight of train (€)**						
	< = 400 t	**400–600 t**	**600–800 t**	**800–1000 t**	**1000–1200 t**	**1200–1400 t**	**1400–1600 t**
Total external costs for the pilot route	**242,87**	**318,02**	**344,70**	**430,15**	**515,60**	**601,06**	**775,30**
Total external costs per km per train	**0,48**	**0,63**	**0,68**	**0,85**	**1,02**	**1,19**	**1,54**
Pilot route IV – Road (alternative to pilot route III)							
Cost category	**Marginal external costs per 2021 per type of vehicle (€)**						
	<=3.5 t	**3.5–7.5 t**	**7.5–12 t**	**12–20 t**	**20–26 t**	**26–40 t**	**44–60 t**
Accidents	1,11	0,71	0,71	0,71	0,14	0,14	0,14
Congestion**	27,09	203,21	325,14	541,90	4324,66	6653,33	9979,99
Air pollution***	7,90	11,48	18,36	24,49	31,83	48,97	73,46
Noise****	0,09	0,19	0,30	0,51	0,66	1,01	1,52
Climate change***	9,75	43,46	69,54	92,73	36,01	55,39	83,09
Cost of habitat damage	11,85	25,40	40,64	54,19	70,45	108,38	162,57
Well-to-tank emissions	0,88	1,88	3,01	4,01	5,22	8,03	12,04
Total external costs for the pilot route	**58,67**	**286,34**	**457,72**	**718,53**	**4468,96**	**6875,25**	**10,312,81**
Total external costs per km per vehicle	**0,12**	**0,61**	**0,97**	**1,53**	**9,50**	**14,62**	**21,93**

*Notes: * The marginal accident costs are calculated based on the reference values in €ct/vehicle km.*
Values for 3,5 t vehicle are for morning peak (max).Values for 3.5 t vehicles are for gasoline.****Values for 3,5 t vehicle and 400 t train are for the day and dense traffic.*

Table 5.
Total marginal external costs by cost category and pilot routes.

efficiency, the necessary minimum changes in the modal shift, and a minimal reduction in demand for transport.

4.2 Effects in the field of integration of underdeveloped areas

Implementing the infrastructure charging system, in line with the proposed approach, will also change transport prices in peripheral or underdeveloped areas. The charges will be differentiated to have a lower impact on areas with less congestion and pollution. Therefore, charges reflecting the related costs in rural and peripheral areas where infrastructure is low and there is no congestion will be lower. Furthermore, as highlighted above, the system is likely to generate significant benefits that can be targeted at less developed areas. In case higher infrastructure charges hamper the economic development of peripheral and underdeveloped areas, the reform of the infrastructure charging system must be implemented flexibly and smoothly, providing that it does not distort competition. Difficulties will arise when the infrastructure facilities concerned are the only links with the rest of the country or are important business centers for the local economy. On the other hand, where transport infrastructure capacity is relatively low, significant investments are needed to increase accessibility to accommodate increased traffic. Therefore, there may be a need to apply charges leading to higher cost recovery.

Differentiated infrastructure charges will cause changes in the structure and distribution of transport costs. They will reduce transport costs for the whole society and reduce direct costs for some producers. Moreover, transport costs will increase for producers who cannot change their behavior per these charges. As already stated, transport costs have a relatively low share in the total production costs of industrial enterprises. In the short term, some producers will be partially affected if they are located in peripheral areas, dependent on the only mode of transport, and selling their products in small markets in competition with other domestic producers. Local authorities in these peripheral areas may take measures to support the competitiveness of the producers concerned in the central markets. They may assist them in adapting the product structure to support products of higher value and with a higher relative share and by improving the quality of the main transport links.

4.3 Economic effects

From a general economic point of view, the long-term effect of external costs' internalization will have little and no indirect impact on GDP growth but will allow for secondary benefits through revenue growth. Improving the infrastructure charging system will provide a more accurate basis for comparing returns on investment in transport and improving conditions for private investment and infrastructure operation. When introducing direct infrastructure charges, each shipment can be assessed according to the costs and benefits incurred, as all costs will be considered. This will create opportunities for transport services to deliver economic profit. On the other hand, internalizing the environmental costs will increase environmental efficiency and sustainability, i.e., where the charges reflect the costs of removing harmful emissions, the level of such emissions will fall to the point where the costs of reducing them will equalize the benefits of this measure. In this way, in terms of social efficiency, the well-being of society will be maximized, not the number of trips.

From a financial point of view, more efficient use of the transport system will reduce the need for government spending on infrastructure, health, and environmental protection. The net effect in the commercial sector will be positive. The direct effect of higher transport charges will be offset by reducing congestion and accident costs and any possible tax reductions provided by the government. There may be some decrease in transport-intensive industries where transport costs are high at the final cost of production. However, this decrease will be slight as the overall increase in transport prices will be slow, and companies will regulate (adjust) their material and technical supply and production.

For each transport mode, the relative price changes will vary depending on the cost structure as well as the initial structure of the infrastructure charging system. Nevertheless, the primary data from the various studies in the EU concerning the impact of changes in transport charges show that the net well-being of consumers is improving. Furthermore, these results show that the benefits achieved by reducing congestion and pollution and reducing tax payments outweigh the losses arising from the price increases of the transport services concerned.

Urban transport surveys show that price changes are causing positive technological changes, with peak hour traffic in cities reduced by 19–33% and external costs reduced by 13–35%. In public transport, the use of private vehicles has decreased, while the volume of public passenger transport has increased. The number of road accidents was reduced by 20%, and the average waiting time during peak periods was reduced by 16%. Therefore, introducing the approach based on internalizing external costs can lead to an overall positive outcome in society's well-being [21]. By returning fee revenues to the economy through reductions in income taxes, production, employment, and economic growth will be stimulated. All these effects will outweigh the impact of increased transport prices.

Establishing an infrastructure accounting system in transport must focus on allocating responsibilities between different levels of state governance (local, regional, infrastructure managers, country). In order to assess the actual infrastructure costs properly, it is necessary to focus the efforts on coordination between the different transport and infrastructure operators and the institutions concerned to improve information security and statistics. In this context, it is imperative to implement appropriate and applicable policy rules and actions to provide cost data and other economic and social information for the transport sector. The measures of such a policy must be aimed at drawing up guidelines and proposals for legislation on the setting of transport infrastructure charges.

Appropriate actions in this direction are as follows:

- Development of methodologies for assessing the external cost of transport infrastructure by mode of transport;

- Support of transport accounting at the national level;

- Development of accounting practices to ensure the cost calculation;

- Specifying the needs for statistics and surveys, defining priorities, and reviewing the practice of setting charges.

- Conduct studies on assessing infrastructure costs, measurement, and principles applied in transport accounting to define the necessary level of recovery for infrastructure costs.

5. Conclusions

The discussed approach to improving the infrastructure charging system in transport by internalizing external costs guarantees the effectiveness and linking of charges for the use of transport infrastructure with the relevant costs in all transport modes. Its implementation will increase the efficiency of the transport industry as a whole. Changing the charges by applying this approach will impact the level of infrastructure usage and lead to a higher level of cost recovery directly from users. Furthermore, the aim is not to increase or decrease charges for certain modes of transport but to justify the size of the different elements in setting them and the need for state subsidies [26]. Thus, better communication between transport infrastructure market participants will be achieved, and the actions and interests of each of them will be synchronized. This measure will create an opportunity to achieve the objectives related to improving transport infrastructure usage and sustainable development of the transport systems. In addition, significant economic and social effects will be achieved at the national level.

It is also necessary to improve existing infrastructure, ensure a shift to environmentally friendly modes of transport and use economic instruments to reduce fuel consumption, greenhouse gas emissions, and noise. The main objective of this is to increase the efficiency and sustainability of the countries' transport systems and to stimulate the competitiveness of the national economies.

The discussed approach is based on the following basic principles:

- developing standard basic requirements for the setting of infrastructure charges based on markups for external costs in different modes of transport;

- infrastructure charges must be based on the "user pays" principle, according to which all users of transport infrastructure pay the costs they cause;

- the level and nature of the use of the infrastructure must have a direct link to the costs and other effects (social or environmental) caused by the users;

- in order to reduce distortions of competition, different charges may be applied for the use of the same type of transport infrastructure only where there are significant differences in infrastructure costs and no discrimination is allowed for specific users;

- the infrastructure charging system in transport must ensure high efficiency in the development and use of infrastructure and ensure a public and environmentally acceptable level of usage.

The internalization of external infrastructure costs applies to all modes of transport. However, the costs' content and values vary depending on the transport mode and the conditions for access to the infrastructure (e.g., time of day and place). Cost analysis by type of transport infrastructure shows insufficient information assurance concerning part of the marginal, respectively, variable costs. This fact means that it is impossible to accurately assess all marginal costs (internal and external), and acceptable approximations are required to establish a relatively objective basis for allocating costs and charges. The non-reflectance of external costs in infrastructure charges currently leads to a significant distortion and rebalancing of intermodal competition. On the other hand, this is also the reason for the application of charges, which reduce the efficiency of transport infrastructure and send wrong price signals to transport users.

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