"D. A. TSENOV" ACADEMY OF ECONOMICS

Faculty of Finance

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ABSTRACT

on the dissertation for the award of the degree of Doctor of Education and Science (in Economics) in the doctoral program "Finance, Money Circulation, Credit and Insurance" (Finance) on the topic:

"Financial management of investments in the national and cross-border transport network"

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CONTENTS OF THE ABSTRACT

I. General characteristics of the dissertation

1. Relevance of the topic

The classical understanding of transport infrastructure in the 21st century has had an evolution that combines an outpacing increase in the number and tonnage of motor vehicles (VMT) and a lagging state of transport infrastructure. In urban areas, motorists often lose hours in traffic jams. On the inter-urban network side, problems arise with its maintenance and timely repairs. With globalisation, economies are becoming more open, leading to an increase in international trade. Construction and building of roads, bridges and service facilities not only retain but also build on their value and importance to society and modern civilization.

Building roads is mainly the prerogative of the state in the person of the government and municipalities. The national road network itself is hierarchically codified and corresponds most closely to the volume and intensity of traffic to be served. In recent years, as the climate has warmed, the challenges of winter snow clearance and road maintenance have been replaced by summer heatwaves in which the asphalt road surface loses its qualities and cannot provide normal load carrying capacity. This necessitates a search for new and more expensive solutions for asphalt laying and jointing of transport facilities. Without budgetary resources and without imposing standards where the road user pays for its use, maintaining the road network would be impossible.

With its strategic location in the Balkans, in South-Eastern Europe, Bulgaria's national road network is logically the "gateway to the EU", the beginning and the end of the EU's cross-border transport network (TEN-T). Large-scale trade flows with Asia as a whole and with the export-oriented neighbouring economy of Turkey pass through Bulgaria. At the same time, our southern neighbour Greece is among the top summer holiday destinations for citizens from Romania and Serbia, which generates significant flows of tourists

transiting the country by private car mainly between June and August. In addition to these transit flows, the internal transport network has clearly defined priorities and routes for construction, both at the level of the motorway network and at the level of the high and low class road network.

The delayed during the pandemic period and the subsequent political uncertainty projects for the Hemus Motorway lots, together with the environmental disputes on the Struma Motorway route through the Kresna Gorge, as well as the delayed high-speed roads to Vidin and Ruse are a clear sign that Bulgaria should invest faster and on a large scale in transport infrastructure. Unfortunately, these investments already have different cost-per-line-kilometre or per-lot calculations, and all this is the result of numerous socioeconomic factors, including high inflation rates in 2022.

2. Object and subject of the study

The **object of the** study is the national and cross-border transport network. The **subject of the** scientific work is the financial management of investments in the transport network - republican and transnational - to ensure the increasing intensity of traffic of motor vehicles, passengers and cargo.

3. Research thesis

The thesis relates to the claim that investment in the national and cross-border transport network creates sustainability for the economy as a whole and for transport as a sector, in the interest of economic operators and consumers, by ensuring economic growth and securing logistical needs at appropriate transport costs. As a sector, transport reflects the level of economic standard and reflects on the efficiency of other societal and economic spheres. The national and cross-border transport network is a mixed public-private commodity. This puts public benefits and costs at the heart of the evaluation of investment in such facilities, as well as the relationship between the density of the road network of a given class

and GDP per capita by region and for the country as a whole. Ensuring a positive benefit-cost ratio and maximising net public benefits is a function of developing and following a long-term strategy for the renewal and maintenance of the national and cross-border transport network.

4. Objective of the dissertation

The aim of the dissertation is to identify the problems and propose solutions for the development of sustainable road infrastructure, successfully integrating the Republican into the Trans-European Transport Network (TEN-T), through the analysis and evaluation of investment needs, projects and programmes in Bulgaria and Europe.

5. Research objectives and methodology

In the dissertation the following **tasks** are set for solution:

First. To analyse the state of the national and cross-border transport network and identify the problem areas for sustainable development and investment planning of the road network of the Republic of Bulgaria.

Second. To derive models, through statistical processing of monthly traffic data, for the congestion of the main routes for international traffic within the integrated national road network of the Republic of Bulgaria in the Trans-European Transport Network (TEN-T) with a view to a new concept for a transport network providing a safe road infrastructure for the movement of goods and people between countries within and outside the EU.

Third. To justify and approbate a benchmark approach for efficient and prospective financial management of investments in the road sector while satisfying a set of technological and organizational constraints and according to societal conditions and needs, with a focus on facilities and routes with a direct positive effect on GDP and the expansion of transit traffic capacity, subject to payment of appropriate tolls and vignettes.

The scientific toolkit in the study is based on the use and application of comparative analysis, regression-correlation analysis, methods of deduction and induction, statistical methods of analysis, graphical and tabular systematization of results of traffic data processing, etc.

6. Scope of the study

The scope of the study follows the definition of the financial management of investments in the republican and cross-border transport network as a targeted action based on long-term planning, secured financially through public, European and borrowed funds, where operational commitments for maintenance are combined with strategic decisions for development and expansion in order to ensure the domestic and transit transport of people and freight with guaranteed road safety standards. The dissertation follows the view that for a country with an open economy like Bulgaria it is of particular importance to expand capacity for cross-border traffic, especially across the Danube. The larger neighbouring economies of Turkey, Romania and Greece logically play the role of absorbing markets for Bulgarian exports, with a direct positive effect on economic growth and GDP. In parallel, through the TOLL system of charging for transit traffic, resources are accumulated for the maintenance and development of the main European transit corridors, with pricing by vehicle type to be based on both cost-coverage estimates and estimates of the impact of traffic on the condition of the road surface in a variety of weather conditions, especially in summer and winter.

Outside the scope of the study remain the issues of the relationship of investment in low-class road infrastructure, where the problems accumulated over decades require large-scale investment with low road traffic forecasts in view of the depopulation processes of villages, towns and regions, as well as economic migration within the EU and the country.

7. Structure of the study

The dissertation has a total length of 193 standard pages, structured in three chapters as follows:

8. Applicability of the study results

The views and analyses developed in the thesis can form the basis of a programme for accelerated upgrading of the national transport network within the TEN-T. All management decisions should be based on the relationship between traffic data, road surface depreciation and safety requirements for passenger and freight transport. In parallel, active investment should be made in the national rail network, where speed improvements and rolling stock replacement are a priority.

II. Main content of the dissertation

Chapter One. Regulatory Framework and Current Issues for Transport Network Investment Planning in Bulgaria and the European Union

The research hypothesis, which is tested in Chapter 1, is formulated as follows: the sustainable development of the road network of the Republic of Bulgaria and the EU requires a permanent analysis of the state of the republican and cross-border transport network and identification of the problem areas requiring investment in maintenance and development.

In view of the hypothesis thus formulated, Chapter One is structured in the following distinct parts. In paragraph 1, the challenges for investment planning in the field of the national and cross-border transport network are discussed. Paragraph 2 examines the operation of regulatory mechanisms for the targeted development of the republican and trans-European transport network (TEN-T). Paragraph 3 analyses the current trends in road traffic volumes and flows in northern Bulgaria as a factor for the economic justification of TEN-T development.

The following more important results, conclusions and findings can be summarised within the presentation in chapter one:

First. Road infrastructure investment planning is a complex and challenging area of economic and engineering knowledge, where interdisciplinary knowledge and standards ensure optimal performance, efficiency and economy. The country's road infrastructure is managed by a specialised agency, the Road Infrastructure Agency (RIA), which has competence and responsibility for planning, repair, maintenance and investment in the scope of national roads. For the use of the road network by cars in Bulgaria, a system of charging with vignettes has been introduced. It is linked to the time factor and not to the kilometres travelled factor. An electronic toll has been introduced for vehicles with a higher tonnage. According to the RIA, the total length of the roads of the

republican road network in Bulgaria as of the first quarter of 2024 is 19 932.1 kilometres. This network includes 9 motorways with a total length of 879.1 km of constructed sections; 9 Class I roads with a total length of 2,975 km; 44 Class II roads with a total length of 4,035 km; 150 Class III roads with three-digit codification and a total length of 6,400 km; and 256 Class III roads with four-digit codification of the respective road with a total length of 5,651 km. The total length of highways designed for construction and investment in the country is 1,661 km. with 52.93% in operation. The electronic toll system started its construction in Bulgaria with the signing of a contract between the Road Infrastructure Agency and the Austrian company Kapsch Telematics Technologies Bulgaria on 15 January 2018. This system introduces an electronic vignette everywhere. The actual operational integration of the system is from 1 January 2019.

Second. The railway network in the Republic of Bulgaria consists of three independent railway networks, each of which has a separate traffic management and control system. The first of these networks is for the movement of intercity rail vehicles - passenger and freight. The second is the tram network in the capital Sofia, and the third is the Sofia underground network. In operation in Bulgaria by 2024 is a network of railway lines with a total length of 4423 km, including 4072 km of train lines, 308 km of tram lines and 52 km of metro lines. The Sofia metro is the only one of its kind in Bulgaria. It was put into operation on 28 January 1998. By 2024, its total length is 52 km. 47 metro stations (of which 13 are joint lines M1 and M4). The Sofia Metro has the status of a national object, which allows its construction to be financed from European funds, the national budget and the budget of Sofia Municipality. A loan from the Japan Bank for International Cooperation is being secured for the construction of the second radius of the First Metro. Its amount was USD 104.034 million when the contract was signed on 6 February 2002. In 2009, the term of the loan was extended to 2011 due to construction delays. Its repayment term is 20 years, from 2012 to 2032, at an annual interest rate of 1.8%. Unlike the Sofia Metro, where there has

been rapid development and large-scale investment, the national rail network, as part of the European rail network, is characterised by some of the lowest passenger speeds. The state and development of the Eastern Mediterranean rail corridor by 2021 clearly shows the serious reserves in achieving rolling stock speed on the railway network in Bulgaria. The secured European funds and the launched projects and repairs on sections lead to the expectation of a positive change in the outlook for the condition of the railway lines in the country by 2030.

Third. Through the operational programmes for the development of transport and transport infrastructure, a common objective is set to be achieved, formulated as follows. In terms of strategic planning, the operational programme for transport development up to 2020 has five priority axes, among which are the development of rail infrastructure as part of the TEN-T rail network, the reciprocal development of road infrastructure, both on the so-called core but also on the extended TEN-T network of roads, the improvement of passenger and freight transport capacity through intermodality points with parallel investments in the development of low-carbon urban transport, investments in a modernised traffic information system

Fourth. The development of the trans-European transport network (TEN-T) is a key objective in Community strategic planning. This development is a budget-backed task, both at the level of funding from the European Commission and the Structural Funds and from national governments themselves. With the debate on the adoption of a revised regulation (Zaharieva, 2015)supported by the European Parliament and the EU Council (Damyanov & Zaharieva, 2006) metrified all components of the transport network, setting specific deadlines. For the new, revised regulation to work, the European Commission (Damyanov, Spiridonov, Zakharieva, Sarkisyan, & Stefanov, 2011) solutions are being sought and proposed to provide opportunities to combine transport modes to save time, energy and resources. The discussion of the sustainability of the transport network in different weather conditions is also brought to the fore. Last but not least, the

revised regulation also aims to improve the capacity of the TEN-T network to provide military mobility and defence capabilities by integrating solutions and budgetary resources (Manov, 2012) EU and NATO. The key objectives and priorities for development in the revised regulation, according to the Directorate for Mobility and Transport, include the rail network covered by two specific objectives ensuring a minimum speed standard and a technological standard for digital management, the road transport network with two specific objectives ensuring urban mobility and parking capacity, intermodal solutions to ensure connectivity and mobility for passengers and freight along the air-land-water transport chain, the development of the European maritime and river Drought is creating certain problems for the main river routes, including climate change leading to seasonal waterlessness and virtually stopping shipping in certain sections of the main EU inland river transport channel Rhine-Main-Danube.

Fifth. The classical understanding of transport infrastructure in the 21st century is evolving due to the outpacing increase in the amount of vehicles and the lagging behind in terms of the pace of development and maintenance of transport infrastructure. This backlog is most evident on the roads of northern Bulgaria, where delayed public investment in expressways and highways, together with increasing transit traffic through northern BCPs along the river. Danube are the basis for justifying the relevance of the study. The problematic nature of the development is also supported by the direct correlation of damage to the vehicle fleet in traffic accidents, including the loss of human lives where the transport network lags behind in its development, as evidenced by research in the field of automobile insurance. By investing in new bridges over rivers and roads, the European Commission has been able to improve the quality of transport infrastructure. *Overcoming the transport capacity deficit on the Bulgarian-Romanian section of the* Danube, *by investing in bridges across the* Danube between Bulgaria and Romania. *Danube by investing (public, private and/or public-private) in new infrastructure, including new bridge facilities (Oryahovo,*

*Nikopol, Svishtov, Tutrakan and Silistra) and doubling the capacity of the Ruse-Giurgiu bridge, complementing the European TEN-T network for continental (North-South) and intercontinental (Europe-Asia) transport of people and goods***.**

Sixth. In studies of the insurance market in Bulgaria in the second decade of the 21st century, there is a clear trend towards both an increase in the income of general liability insurers and an increase in claims against insurers for the payment of damages arising from traffic accidents. Globally, road accidents are a planetary challenge, claiming 1.2-1.4 million lives worldwide each year and resulting in at least 50-60 million injuries with varying degrees of loss of health and disability. There is an established correlation between catastrophic mortality and the level of development of a society - high mortality is an attribute of underdeveloped economies and developing countries. Road accidents are the main cause of death among the population aged between 15 and 30 years. And a number of analyses indicate that there is a huge negative impact on GDP as a result of road crashes. According to the World Health Organization (WHO), crashes reduce approximately 3 percent of GDP potential. Improving road safety is a complex process involving different elements of the economy and society. It is imperative that the various actors involved are given clear responsibility and authority to ensure that all important aspects are adequately covered. It is equally important to have a designated body with clear responsibility for coordination to ensure coherent programmes and efficient use of resources to implement road safety measures. Today, there is a gap between government efforts, those of insurers and those of end users. By achieving greater synergy between stakeholders, it is possible to further reduce costly road crashes. Investment should therefore be made not only in roads as a linear dimension, but also in the quality of the pavement itself, markings, lighting, gradients and curves. Only a quality road network will be able to absorb the increasing transit traffic from Asia, via Bulgaria, to Central and Eastern Europe.

Seven. The empirical study of the intensity of road traffic in Northern Bulgaria is based on data from the Road Administration and the toll system. The locations of the measurement points for the Oryahovo and Nikopol ferries are with measurement points Altimir (OPU Vratsa on road II-15), Muselievo (OPU Pleven, Nikopol municipality, on road II-34) and Lyubenovo (OPU Pleven, Nikopol municipality, on road II-52). The regression equations show an increase in the average daily traffic by 293 cars at Ruse ($y = 293.02x + 9200.6$; $R^2 = 0.8328$), by 177 cars at Vidin ($y = 177.4x + 2127.1$. For the TIR category, there was an increase of 308 trucks with trailer ($y = 307.67x + 61.511$; $R^2 = 0.7177$) at Vidin and 15 trucks with trailer at Ruse ($y = 15.337x + 1486.1$; $R^2 = 0.1365$).

Table 1. Capacity of ferry lines and tariffs for crossing at Oryahovo, Nikopol and Svishtov

Ferry line	**Tariffs in €**				**Capacity**	
	TIR	Bus	Car	Passenger	Number of courses per day	Capacity of one TIR run
Oryahovo - Beckett	49.00	45.00	12.00	1.00	13	20
Nikopol - Turnu Magurele	60.00	35.00	10.00	1.00	4	10
Svishtov - Zimnich	63.00	44.00	4.00	2.00	5	6

Eight. The alpha analysis shows that Ruse, being one of the largest Bulgarian cities, has the highest car traffic with alpha = 9200 cars (the measurement period is 2010; 2015-2019). In the case of Vidin, the estimation has a low starting alpha due to covering a period before the commissioning of the bridge (2010 and 2015), and is achieved for the period 2016-2020 to an annual average of 1,745 trucks with trailer, while for Ruse the alpha = 1,486 TIRs. As a

result of the study, conclusions can be drawn to support the financial and economic justification for new investments in the TEN-T network in northern Bulgaria. The two bridges and the three ferries between them accommodate significant daily traffic of vehicles in general and trucks with trailer (TIR) in particular, which show a steady increasing trend with a temporary decrease in the year of the first lockdowns at COVID-19. Expansion of the network with new highway and expressway alignments in the north, potentially a new bridge or bridges at the ferry complex locations will definitely ease the intensity of congestion on our road network and reduce insured accident type events.

Chapter Two. Transport network and modelling of transit traffic through Bulgaria within TEN-T

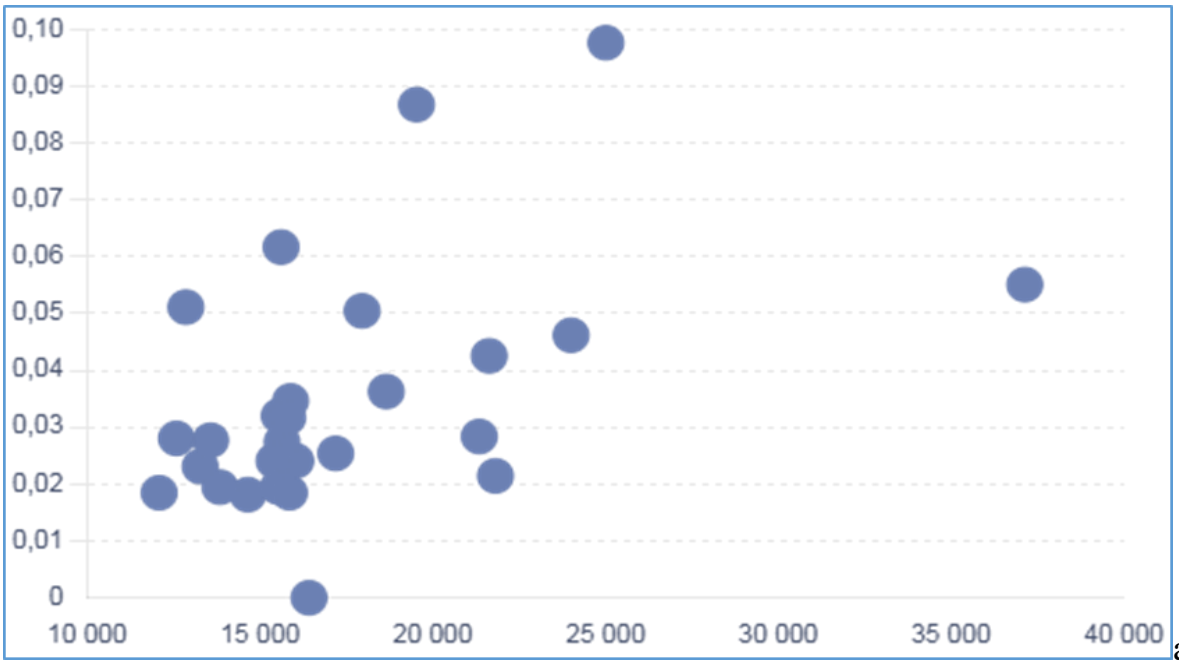
The research hypothesis to be tested in Chapter 2 is formulated as follows: the development of a new concept for a national transport network providing a safe road infrastructure for the movement of goods and people between EU and non-EU countries should be based on statistical models with studied monthly traffic load data for the main transit routes within the integrated national road network in the Trans-European Transport Network (TEN-T).

With this hypothesis in mind, Chapter Two is structured in two distinct parts. Paragraph 1 examines the relationship between regional GDP and the density of the high-end road network. Paragraph 2 systematizes traffic data for selected major BCPs on a monthly basis for the year 2023 and derives estimates of arithmetic means and variances. In paragraph 4, the monthly traffic data from major BCPs are examined using correlation analysis and descriptive statistics by identifying significant correlations for major transport corridors through the country.

The following more important results, conclusions and findings are drawn and summarised within the presentation in Chapter Two:

First. The relationship between GDP per capita and road density is complex and depends on many factors, including historical, urban and socio-economic aspects. Research on the subject consistently supports the view that road network development is a key driver of economic growth, with benefits that extend beyond simple transport improvements to include market expansion, regional development and industrial efficiency. However, the effectiveness of such investments may vary depending on the historical context, regional specificities and project implementation. The strongest correlations at the regional level exist between GDP *per capita* and the density of highways and Class 1 roads. The correlation decreases significantly for lower road classes, such as Class 2 and Class 3.

Second. Motorways are major transport arteries that connect major cities and economic centres. Good motorway coverage stimulates economic activity by reducing transport costs, increasing access to markets and attracting investment. Regions with a well-developed motorway network often have higher GDP as they are more attractive to businesses and investors. Class 1 roads play a very important role in regional connectivity between smaller cities and industrial areas. This class contributes to economic growth by facilitating trade and mobility by providing access to natural and industrial resources, which can increase the economic productivity of regions. For Class 2 roads, the estimate of the impact on the economy is more limited compared to highways and Class 1 roads. These roads are important for agricultural regions where economic activity is lower, but they still provide essential infrastructure for access to markets and services. In regions with lower economic activity, investment in infrastructure is more limited, resulting in lower densities of this class of road. Class 3 roads are generally local and connect the smallest settlements and rural areas. Local roads are less important to the big economic picture as they mainly serve local needs and do not contribute significantly to commerce and industry.



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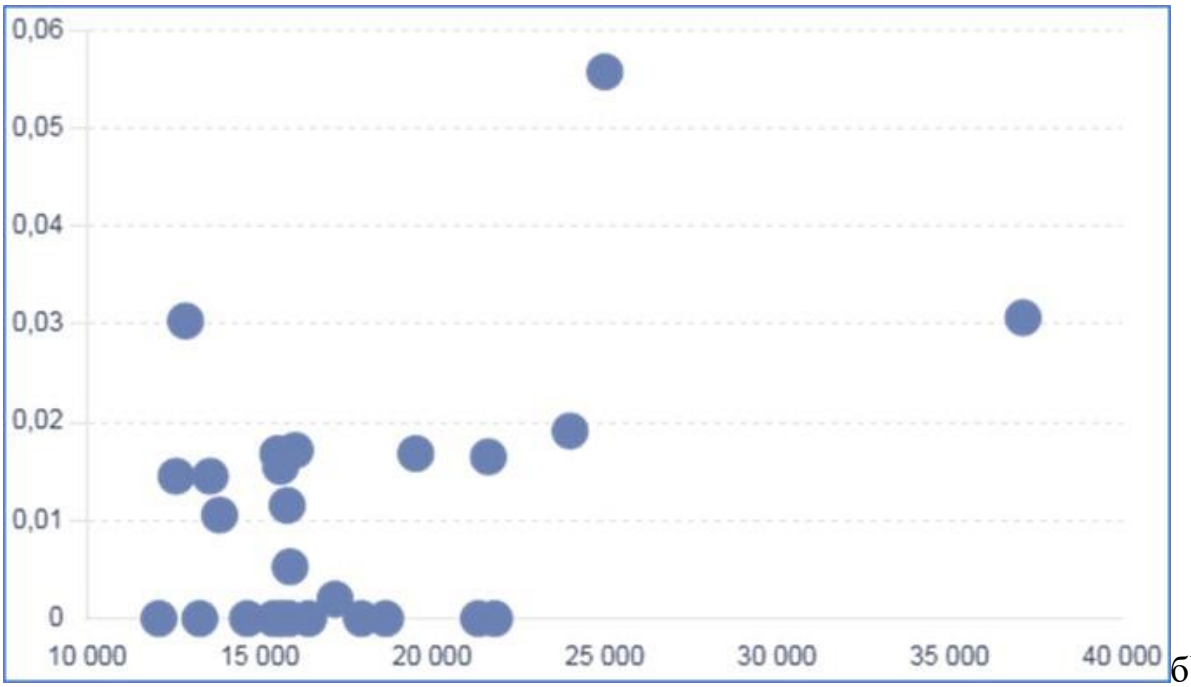

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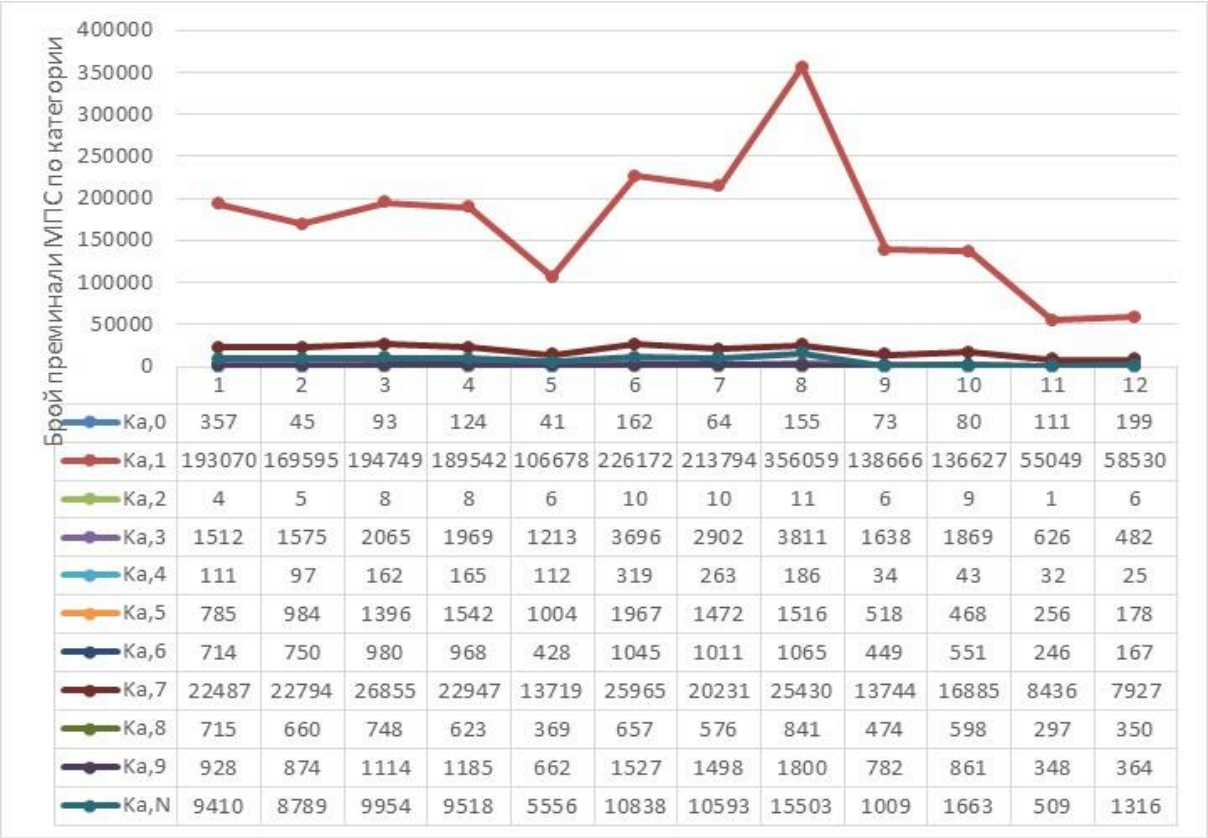
Figure 1. Correlation between regional GDP per capita, £ and density of Class 1 roads (a) and Motorways (b) in the districts in km

Source: NSI data as of 2023, own calculations

Third. The evaluation and analysis of traffic count data recorded by the National Toll System cameras is performed for nine regulatory defined vehicle categories. To these is added a final category that is designated as unclassified but

passed vehicles. Based on data from 26 fixed control units, the main measuring points were selected and 5978 cumulative monthly records of the number of vehicles of the respective category passed were processed. Of the 26 fixed control units, the main BCPs Vidin, Ruse, Kapitan Andreevo, Makaza, Kulata, Kalotina and Oryahovo were identified as essential for the transit traffic system and processed. The data for Vidin and Kalotina are aggregated for entry and exit, while the other BCPs are codified with "2" for exit and "1" for entry. The data for the other BCPs remain analytical and indicative of the potential to accommodate additional traffic.

Fourth. Leading traffic indicators compared to other vehicle categories is the Makaza Pass with 172281 monthly average number of vehicles of category "1" (private vehicles without trailer), followed by the Kalotina BCP with 169878 monthly average number of vehicles of category "1". The reported vehicles at Makaza BCP consistently exceed those reported at the northern border entrance of the main BCPs at Ruse, Vidin and Oryahovo, indicating that the southern border BCP under study is not only busy with transit traffic, but also with traffic originating from Bulgarian tourists visiting Greece for summer holidays. For category "7" Large trucks with or without trailer, total number of axles 5, the highest average monthly traffic data of 39618 vehicles is reported at the BCP Capitan Andreevo by the entry cameras in Bulgaria. The peak nature of the visits of speedway travellers from Germany, via Serbia and Bulgaria, to Turkey and vice versa, which transit traffic at BCP-Calotina reached in August a record for all major BCPs 356 thousand. The number of vehicles of category "1" at this BCP has increased by over 100 million, while the other categories of vehicles are still busy.



	1	2	3	4	5	6	7	8	9	10	11	12
Ka,0	357	45	93	124	41	162	64	155	73	80	111	199
Ka,1	193070	169595	194749	189542	106678	226172	213794	356059	138666	136627	55049	58530
Ka,2	4	5	8	8	6	10	10	11	6	9	1	6
Ka,3	1512	1575	2065	1969	1213	3696	2902	3811	1638	1869	626	482
Ka,4	111	97	162	165	112	319	263	186	34	43	32	25
Ka,5	785	984	1396	1542	1004	1967	1472	1516	518	468	256	178
Ka,6	714	750	980	968	428	1045	1011	1065	449	551	246	167
Ka,7	22487	22794	26855	22947	13719	25965	20231	25430	13744	16885	8436	7927
Ka,8	715	660	748	623	369	657	576	841	474	598	297	350
Ka,9	928	874	1114	1185	662	1527	1498	1800	782	861	348	364
Ka,N	9410	8789	9954	9518	5556	10838	10593	15503	1009	1663	509	1316

Figure 2. Average monthly traffic data for Kalotina BCP for the number of vehicles passed by category for 2023.

Fifth. Based on descriptive statistics and correlograms, 108 combinatorial pairs were tested to establish statistical significance between monthly traffic data by vehicle category and major BCPs. The most mainstream group of vehicles, passenger cars without trailer, show extremely high traffic through their respective reporting points. The lowest values are reported for Vidin and the highest for Kalotina. The highest number of vehicles on average for the period under consideration was reported for M2 and M1, followed by Kalotina and Ruse. The largest standard deviation was for Ka_1, followed by Rs1_1 and Rs2_1. Again, the coefficient values for asymmetry are different from 0 and are positive for all variables, indicating positive asymmetry. A larger excess is found for KA1_1 and KA2_1. The Pearson correlation coefficients from the matrix show for most pairs of variables a very large positive correlation with r values ranging between 0.70 and 1.00 at a significance level of 0.01. It is strongest between M2_0

and M1_0 (0.995), between Rs1_1 and Rs2_1 (0.987), between Ku1_1 and M1_1 (0.976), between Ku1_1 and M2_1 (0.966) . The following are the relationships between: Vd1 and M1_1 (0.958) ; Vd1 and M2_1 (0.939) ; Vd1 and Ku1_1 (0.939) ; Ku2_1 and M1_1 (0.929) ; Ku2_1 and M2_1 (0.941) ; Ku2_1 and Ku1_1(0.930). In the range 0.70 - 0.90 are the Pearson coefficients for the pairs of variables: Vd1 and Rs1_1; Vd1 and Rs2_1; Vd1 and KA1_1; Vd1 and KA2_1; Vd1 and Ku2_1; Rs1_1 and KA1_1; Rs1_1 and M1_1; Rs1_1 and M2_1; Rs1_1 and Ku1_1; Rs1_1 and Ku2_1; Rs2_1 and KA1_1; Rs2_1 and KA2_1; Rs2_1 and M1_1; Rs2_1 and M2_1; Rs2_1 and Ku1_1; Rs2_1 and Ku2_1; Rs2_1 and Ka_1; KA1_1 and M1_1; KA1_1 and M2_1; KA1_1 and Ku1_1; KA1_1 and Ku2_1; KA2_1 and M1_1; KA2_1 and M2_1; KA2_1 and Ku1_1; KA2_1 and Ku2_1. A high and positive correlation, with r values between 0.50 and 0.70 and at 0.05 significance level, exists between Rs1_1 and KA2_1 (0.618); Vd1 and KA_1 (0.608); Rs1_1 and KA_1 (0.655); Ku1_1 and Ku2_1(0.658).

Sixth. Also forming a significant transit traffic "Large trucks, with or without trailer, with 5 axles over 12 t" clearly show the linkage of the traffic data with the main European corridors of the TEN-T network passing through the country. The statistical analysis shows that the highest traffic is generated by vehicles in the category "Large trucks, with or without trailer, with 5 axles over 12 tonnes". The lowest recorded traffic is at point KA2 and amounts to 103 vehicles. This category is particularly notable for the high minimum at checkpoint KA1, as well as at checkpoints Vidin and Kulata. The recorded maxima are also large for the above mentioned registration points for passing trucks. The data show that the largest standard deviation is for traffic through checkpoint KA2. On average for the period, most vehicles passed through Capitan Andreevo, Vidin and Kulata (1 and 2). Positive asymmetry is found mostly for Rs1_7 and Rs2_7, and negative for KA2_7. For KA2_7, Rs1_7 and Rs2_7, there is also a pronounced excess because the coefficient values exceed +6. More significant negative values of this coefficient are reported for M1_7, Ku1_7 and KA_7. The

correlogram data for the category "Large trucks, with or without trailer, with 5 axles over 12 t", similarly to the previous category, show a relatively small number of relationships that have statistical significance. A very high positive correlation at 0.01 level of significance is found between: Rs1_7 and Rs2_7 (0.981); Ku2_7 and KA1_7 (0.748); Ku1_7 and KA1_7 (0.732) and Ku2_7 and Ku1_7 (0.711). A very high positive correlation, with an r-value above 0.70, at a significance level of 0.05, exists between KA_7 and Vd_7 (0.725), between M2_7 and Rs2_7 (0.702) and between Ku1_7 and M2_7 (0.703). Significant and positive correlation at the same level of significance was found between: M2_7 and M1_7 (0.699); M2_7 and KA1_7 (631) and between Rs1_§ and M2_7 (0.582). No statistically significant correlation was found between the remaining pairs of variables.

Chapter Three. Benchmark projects and cross-border programmes to support investment in the transport network

The research hypothesis that is tested in Chapter 3 is formulated as follows: to achieve a direct positive effect on GDP and expand transit traffic capacity in return for appropriate tolls and vignettes, a benchmark approach for efficient and forward-looking financial management of investments in existing and new transport facilities and routes should be justified and tested, taking into account technological and organisational constraints as well as societal conditions and needs.

In view of the hypothesis thus formulated, Chapter Three is structured in the following distinct parts. Paragraph 1 focuses on the investment planning, design and construction of the Ruse - Veliko Tarnovo Motorway. Paragraph 2 assesses the financial provision of strategic road projects using Hemus Motorway as an example. Paragraph 3 discusses the solutions, advantages and effects of applying the Ex Post Financial Model for the project route of the Vidin - Botevgrad Motorway. Paragraph 4 focuses on the author's analysis of the

programme perspectives for cross-border cooperation between Bulgaria and Romania in the period 2021-2027 in support of TEN-T. The final paragraph 5 is devoted to the preliminary feasibility study of the project for a third bridge over the Danube at Svishtov-Zimnich as a possible target outcome in the CBC programme between Bulgaria and Romania in the period 2021-2027.

The following more important results, conclusions and findings are drawn and summarised within the presentation in Chapter Three:

First. The Ruse - Veliko Tarnovo Motorway project is a key infrastructure investment project in Northern Bulgaria. With its meridional North-South location, it provides a fast connection between the location along the southern border of the BCP with the TEN-T network located along the European transport corridor No IX. The corridor is also a link between the northern Baltic Sea and the Mediterranean Sea with intermodal opportunities along the Danube.

Figure 3. Design solution for connection at the road junction "Tsenovo" at km 63 of the motorway "Ruse - V. Tarnovo" to Svishtov

Source : https://youtu.be/7i4I_7BmVMs

The design and construction of the Ruse - Veliki Tarnovo Motorway is expected to comprehensively improve the transport service for transit and

domestic traffic. Another important objective to be achieved is a multi-fold improvement in road safety in view of the high accident and casualty rates on the current road section with the bridge at Byala. The preparation for the construction works (conceptual design, EIA, etc.) of the construction of the AM "Ruse - Veliko Tarnovo" is partially financed under OP "Transport and Transport Infrastructure" 2014-2020. In the new programming period 2021-2027 the project has been approved for funding under the Operational Programme Transport Connectivity.

Second. Hemus Motorway is considered one of the most important infrastructure projects for the country. For Northern Bulgaria it is of key importance for changing the direction of demographic and economic development. With its length of 420 km, the motorway is the longest single motorway project in the whole country. The motorway will create a direct high-speed link between the capitals of Bulgaria and Romania, crossing the Danube via the new broadband bridge at Ruse. The expected effects extend from the sphere of real production to the sphere of services and especially on the development of tourism and regional tourist routes between the Danube and the national parks in the Balkan Mountains. In terms of demographic effects, the construction of the motorway is expected to halt the depopulation processes that directly affect the nearly 2.8 million people living in Northern Bulgaria. The combination of a number of adverse factors from 2020 onwards has led to a severe delay of this strategic infrastructure investment project. Other things being equal, by 2024 the majority of the sections studied above would already be in operation and accelerating regional and municipal development in the economies of Northern Bulgaria.

Third. The construction of the Vidin - Botevgrad Motorway is part of the investments in providing capacity for transport of people and freight along the pan-European transport corridor Orient/East Mediterranean. The route follows the first class road I-1 (E-79) Vidin - Sofia and provides a fast connection for the transit flow of heavy trucks from Asia via Danube Bridge 2 to Europe. The

connection at Botevgrad with Hemus Motorway finally "closes" the transit motorway ring in southern and western Bulgaria by connecting at Sofia with Hemus, Trakiya/Maritsa and Struma motorways. Thanks to the project, the heavy transit traffic in the semi-mountainous and hilly terrain of north-western Bulgaria will be moved out of the settlements. This will reduce accident rates and traffic accidents. In terms of the financial model for securing the construction, for the first time under the PPA, the so-called Ex Post Scheme has been applied, where the entire contract value is paid by the Employer to the Contractor after completion of the site and signing of the acceptance documents for the works. Such a model optimises work processes and motivates the contractor to provide equipment, materials and labour for the execution of the contract as quickly as possible.

Fourth. The INTERREG V - A Romania-Bulgaria programme is a programme funded by the European Union through the ERDF, which aims to "develop the border area between the two countries by financing joint projects". Its total budget for the period 2014-2020 is 258.504.126 euro. The programme stimulates cooperation between EU countries is the basis of the founding treaties and agreements establishing and functioning the Union. The territorial scope for programmatic impact covers seven counties in Romania (Mehedinets, Dolg, Olt, Teleorman, Giurgiu, Culras, Constanta) from three regions - RO22, RO31 and RO41. On the Bulgarian side, it includes eight counties in Bulgaria (Vidin, Vratsa, Montana, Pleven, Veliko Tarnovo, Ruse, Silistra, Dobrich), also from three planning regions (BG31, BG32 and BG33). The twin cities along the Danube border, Vidin - Calafat, Oryahovo - Becket, Nikopol - Turnu Magurele, Svishtov - Zimnich, Ruse - Giurgiu, Tutrakan - Oltenica and Silistra - Kalarasi, were logically identified as the drivers for the implementation of the programme in its original 2013 justification. Through the methodology of SWOT analysis and "problem tree" in 2013 a number of impact areas were identified to find priority funding in the programme. These include depopulation and out-migration of

population in border regions, poor health status, migration of medical personnel, low business growth, low attractiveness for foreign direct investment, low income, high mortality rate and low fertility rate, lack of connectivity across the Danube, which is more of a natural barrier than a connectivity opportunity, lack of sufficient locations for cross-border crossing of the river, risks to the organisation of navigation on the river in the summer months due to low water thresholds, lack of multimodal transport facilities.

Fifth. The integrated Danube policy for the spatial development of coastal areas within the programming period 2021-2027 and the opportunities of the INTERREG programme in the cross-border (INTERREG A), transnational (INTERREG B) and interregional (INTERREG C) cooperation strands should contribute to: Enhanced use of the Danube as a transport corridor its ports; Achievement of high environmental standards in transport and logistics, meeting the indicators in the Green Deal; Better protection and management of forestry and forest areas.

Conclusion

The presented paper confirms in methodological and deductive terms the validity of the research thesis that by investing in the republican and cross-border transport network, sustainability of the road network and transport system is created. This in turn ensures economic growth, satisfies logistical needs and lowers transport costs. However, the scale of these investments is key. Delayed investment in the face of increasing traffic volumes leads to accelerated wear and tear on the road surface, but also to a more expensive quantification of the cost of new expressway and motorway routes. Timely rehabilitation, repair and maintenance is also an important consideration, where delaying by just one or two years the replacement of the wearing course of asphalt often results in a multiplication of the subsequent cost per metric unit of the road in question.

Poorly maintained roads create the risk of road accidents, increasing accident rates and the number of insurance claims.

The analyses, conclusions and generalizations drawn allow to claim that validation of the leading working hypotheses has been achieved. The examined traffic data clearly confirms that transit flows through the country in the part of passenger cars have a pronounced seasonal dynamics, related to the movement of tourists from north to south and vice versa (in the summer season), as well as of speeders from west to southeast and vice versa. Heavy truck traffic is characterised by persistence and all-season intensity.

Through the system of vignettes for vehicles up to 3.5 tonnes and electronic tolls, budgetary resources are accumulated for the ongoing maintenance of the national road network, both for domestic traffic and transit traffic. However, the construction and expansion of the road network requires a variety of financial instruments, including funding from the national budget, under Operational Programmes and through loans. Contracting techniques with contractors range from advance payment to Ex Post payment upon acceptance of the site as completed. The delay in the construction of the Hemus Motorway due to a complex of reasons - political, economic and health - is making the completion of the strategic transport object more expensive and delaying the support for the revitalisation of Northern Bulgaria.

III. Guidelines for future research on the dissertation topic

As guidelines for future research work on the topic can be mentioned:

1. Steps and solutions to overcome the delay in the coordination of the design of new bridges over the Danube in line with the texts in the strategic document "Memorandum of Understanding between the Government of the Republic of Bulgaria and the Government of Romania on the implementation of joint initiatives to improve the conditions for navigation in the common Bulgarian-Romanian section

of the Danube and for transport connectivity between the two countries" (Approved by Decision No. 174 of 1 April 2019 of the Council of Ministers. In force since 29 March 2019, Issued by the Ministry of Transport, Information Technology and Communications, Official Gazette of the Republic of Moldova, No. No. 34 of 23 April 2019).

2. The feasibility of applying the Benefit-Cost Analysis methodology to the selection, design and construction of road infrastructure in order to align the public interest with the data and forecasts of future road congestion of the relevant class.

IV. Reference to the scientific and applied contributions in the dissertation work

First. Justification of the link between the sustainable development of the road network of the Republic of Bulgaria and the EU with the need for a permanent analysis of the state of the republican and cross-border transport network in order to identify the problem areas that require investment in maintenance and capacity expansion.

Second. Derivation of statistical models with correlation matrices based on monthly traffic data for the year 2023 for the load of the main routes for transit traffic within the integrated national road network of the Republic of Bulgaria in the Trans-European Transport Network.

Third. Applying a benchmark approach for efficient and prospective financial management of investments in existing and new transport facilities and routes, taking into account technological and organizational constraints, with a focus on overcoming the lag of Northern Bulgaria in terms of the density of the high-class road network as a factor for regional GDP growth.

Fourth. Arguing for the need for timely rehabilitation and maintenance of the road network, where delays in repairs and replacement of the wearing asphalt layer make the subsequent cost per metric unit of the road section concerned many

times more expensive. Poorly maintained roads definitely increase the number of road accidents, depreciate the machinery fleet, lead to an increase in the accident rate and the number of insurance claims.

V. List of publications of the PhD student

1) Zahariev, A., Prodanov, St., Radulova, A., Zarkova, S., Lazarov, B. (2021). Transport connectivity and investments in the focus of integrated development plans of municipalities in the Republic of Bulgaria (on the example of Belene and Pordim). Round table with international participation "Statistical dimensions of regional disparities and inequalities between northern and southern Bulgaria, Svishtov, 16 October 2020. Proceedings, AI "Tsenov", pp. 32-41, ISBN 978-954-23-1892-7
2) Zahariev, A., Lazarov, B. (2021) Danube South: Svishtov - Zimnich Bridge on the way from feasibility assessment to practical implementation. Proceedings of the scientific conference "Logistics and public systems", 25-27 February 2021, Naval Aviation University "Vasil Levski", pp. 1005 - 1014, ISSN 2738-8042.
3) Lazarov, B., (2021) Programme perspectives for cross-border cooperation between Bulgaria and Romania in the period 2021-2027. Twenty-fifth student scientific-practical conference "Global and regional dimensions of international economic relations", Proceedings, Svishtov, pp. 80-85, ISSN 2738-8573.
4) Zahariev, A., Prodanov, St., Marinov, I., Lazarov, B. (2021). The bridge Danube South: Svishtov-Zimnicea as an economic growth factor for Bulgaria and Romania. (2021) International Symposium: Experience. Knowledge. Contemporary Challenges. 8th Edition. Back to the Future. Socio-economic Challenges and Perspectives - Bucharest, Romania, May 27th-28th, pp. 88-98. ISBN: 978-606-8716-59-6.

5) Lazarov, B. (2022). Trends in road traffic intensity in northern Bulgaria as a factor for economic justification of TEN-T development. Annual Almanac Research of Doctoral Students, Svishtov, Issue 17 (Studies and articles), pp. 289-302.
6) Lazarov, B. (2024). Transit Traffic Study through Bulgaria for 2023 within TEN-T. Electronic scientific journal "Scientific Atlas", Year 2024, Issue 10, pp. 26-61, ISSN 2738-7518

VI. Reference for compliance with the national requirements under the Regulations for the Implementation of the Law for the Development of Academic Staff in the Republic of Bulgaria

Studies: 1 stand-alone

Articles: 1 stand-alone

Scientific reports: 3 co-authored and 1 stand-alone

Minimum number of points: 30

Number of points achieved for Indicator 7 (Articles and papers published in non-refereed peer-reviewed journals or published in edited collective volumes), cf. Annex to Art. 1a, par. 1 of the Regulations for the Implementation of the Law for the Development of the Scientific Staff in the Republic of Bulgaria with the Minimum National Requirements for the Scientific, Teaching and/or Artistic or Sporting Activities of Candidates for the Acquisition of a Scientific Degree and for Holding the Academic Positions of "Senior Assistant Professor", "Associate Professor" and "Professor" in Scientific Fields and/or Professional Fields in Area 3. Social, Economic and Legal Sciences, Professional Field 3.1. Sociology, Anthropology and Cultural Studies, 3.2. Psychology, 3.3. Political Science, 3.4. Social Activities, 3.5. Public Communications and Information Sciences, 3.6. Law, 3.7. Administration and Management, 3.8. Economics, 3.9. Tourism

15 pts. + (1+1+0.95) pts. of articles and scientific reports x 10 pts. = 44.5 pts.

VII. Declaration of originality of the thesis

The dissertation in the volume of 193 pages under the title: '**Financial management of investments in the national and cross-border transport network**' is authentic and represents the author's own scientific production and research. It makes use of the author's ideas, texts and visualization through graphs, charts, tables and formulas, and complies with all the requirements of the Copyright and Related Rights Act (State Gazette No 56 / 29 of June 1993 et seq.) by properly citing and referencing other authors' thought and data, including:

1. The results achieved and contributions made in this dissertation are original and have not been borrowed from studies and publications in which the author has not participated.
2. The information provided by the author in the form of copies of documents and publications, personally compiled reports, etc. corresponds to the objective truth.
3. Scientific results that have been obtained, described and/or published by other authors are duly and extensively cited in the bibliography.

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PhD student Borislav Lazarov