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## **ABSTRACT**

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

### **Business Behaviour of Transport Enterprises in the Context of Market Anomalies**

**Supervisor:**

**Assoc. Prof. Dr. Aneliya Radulova**

**Svishtov  
2025**

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The dissertation has been discussed and proposed for defence under the Law on the Development of the Academic Staff in the Republic of Bulgaria by the Department of “Finance and Credit” at the D. A. Tsenov Academy of Economics, Svishtov. The dissertation consists of 153 standard pages. Structurally, it consists of an introduction, an exposition in 3 chapters, a conclusion, and a list of literature – a total of 135 sources. In support of the presented main text, 24 tables, 27 figures, and 1 appendix are included. Three articles have been published on the topic of the dissertation. A declaration of authenticity and originality is attached.

The defence of the dissertation will be held on October 6, 2025 in the “Rectorate” Conference Hall of D. A. Tsenov Academy of Economics, Svishtov, and the web-based conference system of D. A. Tsenov Academy of Economics at a meeting of the academic jury, appointed by order of the Rector of D. A. Tsenov Academy of Economics, Svishtov.

The materials for the defense are available at the “Doctoral and Academic Development” Department.

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# **I. GENERAL CHARACTERISTICS OF THE DISSERTATION**

## **1.1. Relevance of the research**

In the conditions of a globalizing economy, transport is a vital factor on which the social, cultural, political, and economic development of a nation depends. Transport helps to break down man-made boundaries and reduce the geographical distance that once separated people and places. It is the means by which communities are connected on the one hand with different countries around the world, as well as companies with suppliers and customers, creating conditions for the expansion of knowledge and the deepening of international relations.

The emergence of the various types of transport corresponds to the established economic structures and the mobility of the labour force at a specific stage in the development of human society, to which a particular type of transport adapts. By becoming a catalyst for migration, transport has caused economic and social transformation in a number of nations, and the diversification and development of transport systems has led to expansion and intensification of the production of goods and their exchange.

The interdependence between transport and economic growth is indisputable: the ability to easily transport resources supports the development of the economy, providing opportunities for prosperity and growth and, at the same time, it is also a stimulus for growth and development. The lack of a direct link between transport and economic growth does not contradict the fact of its significant influence on the structures and processes of production, the location and size of enterprises, the structures and processes of distribution, and other characteristics of production units.

The complexity of the relationship between transport and economic development lies in the variety of possible effects: increasing development of economic

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exchange between economic agents, establishment of trade relations with distant commercial zones, and a positive indirect impact on the development of other economic sectors.

Despite the ambiguous and measurable impact of transport on economic growth, the transport sector of a country is an indicator of its economic prosperity and success. A decisive factor for the development of the sector is the presence of adequate transport infrastructure and connected transport networks. The presence of efficient transport systems is a guarantee for increasing economic and social benefits for society, for improving access to local and global markets and employment. Logically, poorly developed and unreliable transport systems represent potential for increased costs, missed market opportunities, and lower quality of life — in other words, an inadequate transport system has a negative impact on the efficiency of the economy as a whole.

Transport is a strategic sector of the EU economy that directly affects the daily lives of all EU citizens. The goal of sustainable transport policy in the EU is the implementation of transport systems that meet the economic, social, and environmental needs of society.

The fact that transport is what enables the connection between international markets shows its vulnerability to arbitrary shocks in certain regions or on a global scale, causing market anomalies. Market anomalies are patterns or events that deviate from the standard market hypothesis. The presence of anomalies or the detection of deviations can be defined as the identification of events, elements, and observations that differ from usual norms. From a financial, economic, social, and political perspective, these are situations in which business units do not function effectively or, at the very least, do not operate at their full potential. Such a market anomaly was caused by the global COVID-19 pandemic,

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undoubtedly the most defining economic and social event in decades. The restrictions imposed due to the pandemic led to major disruptions on a global scale and had a negative impact on global economies. The pandemic proved to be a serious challenge for supply chains and logistics in many countries, causing delays, interruptions, reduction in the volume of logistics flows, and an enormous adverse financial effect.

The considerations outlined regarding the role of transport in socio-economic development highlight the relevance of the issues addressed in this scientific study. The understanding of the importance of the transport sector for the development of the economy and the well-being of the population in Bulgaria predetermines the author's interest in an in-depth analysis of the mechanisms, scope, and areas of influence of transport and transport infrastructure on economic growth.

## **1.2. Object and subject of the research**

**The object** of the research is the development of the transport sector in Bulgaria. **The subject** of the present study is the assessment of the scope of influence of the transport sector and transport infrastructure on economic growth in general and, in particular, under conditions of market anomalies caused by unforeseen economic crises.

## **1.3. Research thesis**

**The thesis defended** in the scientific study is that the undeniable interdependence between transport and sustainable economic growth necessitates the need to overcome emerging challenges facing transport business units in conditions of market anomaly, anticipate changes, rethink the established model of market behaviour and discover opportunities for innovative approaches in the transport services market.

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#### **1.4. Aim of the dissertation**

The main aim of the present study is to identify the main forms of manifestation and mechanisms of influence of transport and transport infrastructure on the development of the economic system, to assess the development of the transport sector in Bulgaria, and to evaluate the behaviour of companies in the transport sector under conditions of market anomaly.

#### **1.5. Research tasks**

The realization of the main aim is achieved through the fulfilment of the following tasks:

1. To outline the prerequisites for the development of transport in historical perspective and the mechanisms of influence of transport on economic development in the context of the specifics of transport services.

2. Based on the relationship between transport and economic growth, to assess the impact of transport infrastructure on economic growth and to identify the areas of influence.

3. To structure the components and indicators for assessing the sustainability of a transport system.

4. To characterize the environment and trends in the development of the transport sector in Bulgaria.

5. To establish the socio-economic parameters of the development of the transport sector in Bulgaria for the period 2012–2023.

6. Based on a survey, to assess the business behaviour of transport companies under market anomaly conditions.

#### **1.6. Methodology and scope of the research**

The methodological and theoretical basis of the dissertation research consists of the main concepts regarding the development of transport as an economic sector

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and its impact on economic development, as well as normative documents outlining the state and strategic goals for the development of the sector in Bulgaria and in the European Union.

In accordance with the system approach and dialectical principles, the following methods have been used: descriptive, analysis and synthesis, deduction and induction, generalization, and comparative statistical analysis.

The information base for carrying out the empirical research of the structural transformation occurring in the national economy is the available statistical information from the website of the National Statistical Institute of Bulgaria and Eurostat.

## **1.7. Structure of the research**

### **Introduction**

## **CHAPTER ONE: SOCIO-ECONOMIC DIMENSIONS OF TRANSPORT**

### **1.1. Transport and economic development**

*1.1.1. Influence of transport on economic development in historical perspective*

*1.1.2. Mechanisms of influence of transport on economic development*

*1.1.3. Specifics of transport services*

### **1.2. Impact of transport infrastructure on economic growth**

*1.2.1. Assessment of the impact of transport infrastructure on economic growth – literature review*

*1.2.2. Transport infrastructure – areas of influence*

### **1.3. Sustainable transport system – components and indicators for assessment**



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*1.3.1. Dimensions of sustainable development of the transport sector*

*1.3.2. Indicators for sustainable transport*

## **CHAPTER TWO: SOCIO-ECONOMIC PARAMETERS OF THE TRANSPORT SECTOR IN BULGARIA. COMPARATIVE ANALYSIS**

2.1. Characteristics of the environment and trends in the development of the transport sector in Bulgaria

2.2. Dynamics of transport services in Bulgaria

*2.2.1. Sectoral structure of transport services in Bulgaria (2012–2022)*

*2.2.2. Comparative analysis of the development of freight road transport within the EU (2012–2022)*

2.3. Dynamics of transported goods by type of transport (2012–2023)

## **CHAPTER THREE: DISPROPORTIONS IN THE DEVELOPMENT OF TRANSPORT BUSINESS UNITS UNDER CONDITIONS OF MARKET ANOMAL**

3.1. Limitations in the development of transport under market anomaly conditions

*3.1.1. The COVID-19 pandemic and challenges for the transport sector worldwide*

*3.1.2. Impact of the COVID-19 pandemic on transport companies in Bulgaria*

3.2. Degree of impact of the COVID-19 pandemic on the sustainable development of transport business units

3.3. Barriers and opportunities for the development of transport companies in Bulgaria in the short term

*3.3.1. Assessment of the limitations to the sustainable development of transport companies in the post-pandemic period*

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*3.3.2. Respondents' expectations regarding the possibilities for sustainable development of transport companies in the short term*

***Conclusion***

***References***

***Appendix***

## **1.8. Applicability of the research results**

The theoretical understanding of the mechanisms through which transport influences economic development and the proven interdependence between transport infrastructure and the productivity of production units have the potential to support the undertaking of adequate measures for establishing sustainable development of the transport sector in Bulgaria.

The conclusions outlined from the conducted survey regarding the most significant factors that affected the activity and financial condition of transport companies in the post-pandemic period, as well as the most essential circumstances limiting the sustainable development of the companies, allow for the formulation of practical policies aimed at increasing the resilience of the transport sector.

## **II. Main content of the dissertation**

### **Introduction**

The introduction substantiates the relevance of the research topic and outlines the theoretical and practical framework of the research area. The main elements of the scientific research are defined: object, subject, and the research thesis of the

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dissertation. The main aim of the research is formulated, as well as the research tasks, the methodology, and the information provision.

## **CHAPTER ONE: SOCIO-ECONOMIC DIMENSIONS OF TRANSPORT**

Chapter One discusses issues related to the specific influence of transport on economic development in historical perspective, the mechanisms by which transport affects economic development, and the specifics of transport services. Based on a literature review, an assessment is made of the impact and areas of influence of transport infrastructure on economic growth. Views on the indicators for measuring the dimensions of sustainable development of the transport sector and the indicators for sustainable transport are analysed.

Based on the considerations presented in the scientific work regarding the specifics and importance of the transport sector and transport infrastructure in the organization of social production, and the synthesis of various economists' approaches to the analysis and understanding the processes requiring sustainability in the development of transport, we can express the following considerations:

**First**, from the point of view of business development, the impact of transport, viewed historically, is manifested in the following directions:

(1) in creating conditions for the development of new forms of trade between industries and their location;

(2) the need for the construction of transport infrastructure to reduce costs and increase the reliability of existing trade channels;

(3) expansion of market size and increase in productivity as a result of access to more diverse and specialized resource markets, and the creation of opportunities for choice for producers and consumers.

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**Second,** the market of transport services, as a sphere of manifestation of economic relations between transport organizations (producers of transport services) and consumers of transport services (freight owners), forms general economic, financial, technical, and technological connections between the transport system and its external environment, and defines the forms of connections between the transport sector and other types of markets, including markets for goods, labour, and money.

**Third, the mechanisms of influence of transport** on economic development, derived from the results of conducted empirical studies, prove the interdependence between transport infrastructure and the productivity of production units. The assessment of the directions, forms of manifestation, and the existence of complex characteristics and significant roles makes it possible to conclude *that transport infrastructure leads to the generation of multiple impacts on the economy, society, and the environment*. The direct economic effects, proven by numerous empirical studies, are manifested in several directions: (1) improvement of overall factor productivity; (2) increase in production capacity; (3) production units expand the scope of their activity and gain access to larger labour markets.

**Fourth,** transport has complex interactions with the environment and society, which justifies the increased interest in assessing the effectiveness of transport systems in accordance with the concept of sustainability. According to the Global Sustainable Mobility Ranking for 2020, Bulgaria ranks 25th out of 183 countries. In 2022, the indicators for sustainable mobility in Bulgaria have lower values. The Global Sustainable Mobility Ranking places us at 34th out of 183 countries, and the Sustainable Mobility Index decreases by 0.2 points and amounts to 63.5 (SuM4All, 2022) while the Sustainable Mobility Index (SMI) was 66.5 points (SuM4All, 2020).

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## **CHAPTER TWO: SOCIO-ECONOMIC PARAMETERS OF THE TRANSPORT SECTOR IN BULGARIA. COMPARATIVE ANALYSIS**

The focus in Chapter Two is on identifying the socio-economic parameters of the transport sector in Bulgaria. The environment and trends in the development of the transport sector in Bulgaria are characterized based on the established dynamics of the main economic indicators and of the transported goods by type of transport for the period 2012–2023. A comparative analysis of the development of freight road transport within the EU (2012–2022) has been carried out.

The crisis caused by the COVID-19 pandemic demonstrated the essential role of transport and the social, health, and economic costs incurred when the free movement of people, goods, and services is severely or even entirely restricted. The emerging economic and social crises, caused also by a number of external factors to the community, prove that mitigating their consequences is possible through the existence of an adaptive and innovative transport sector. The challenges to the development of the transport sector in Bulgaria are formulated in the Integrated Transport Strategy for the period up to 2030, developed in compliance with the principles of consistency, continuity, and synergy with national and European strategic documents.

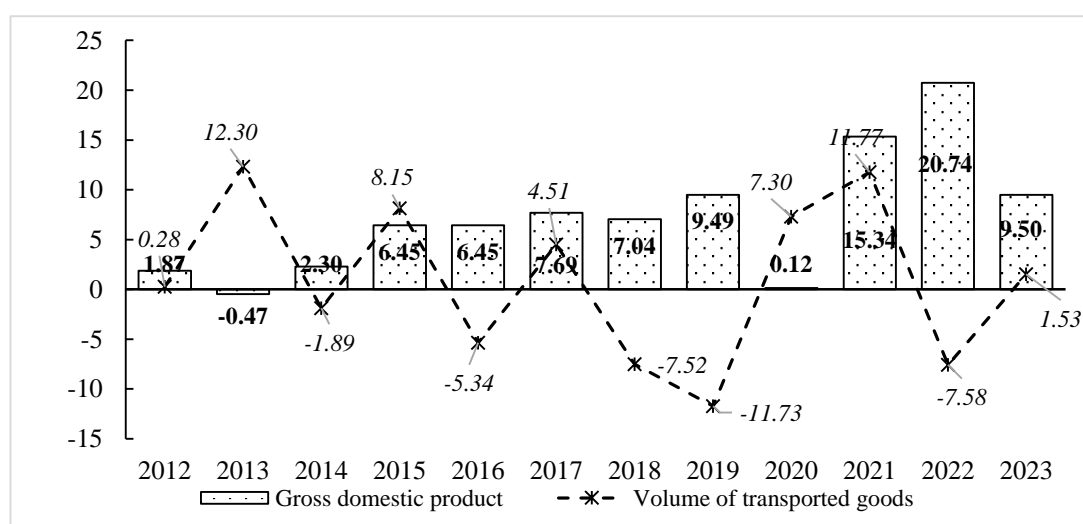
**The main objectives** of the Strategy are aimed at: (1) increasing the efficiency and competitiveness of the transport sector, (2) improving transport connectivity and accessibility (both internal and external), and (3) limiting the negative effects of the development of the transport sector (Стратегия, 2017).

The defined strategic goals are in line with the Common Transport Policy, the strategic and regulatory documents of the EU, as well as with the National

Transport Policy and national strategic and regulatory documents. The formulated goals and the planned actions to achieve them represent Bulgaria's contribution to the Single European Transport Area in accordance with the European regulatory frameworks concerning the development of transport in the EU. One of the main priorities of the national policy for the development of intermodal transport is the creation of the necessary prerequisites to support sustainable modes of transport.

The assessment of the state of the transport market in Bulgaria for the period 2012–2023 has been carried out on the basis of data on the demand for freight transport for each type of transport, measured by the volume of transport (realized demand) and the performed work measured in ton-kilometers.

For the analyzed period, the change in the volume of transported goods by all types of transport registered an average annual growth rate of 0.98 percentage points, with an average annual GDP growth rate (at current prices) of 7.21%. The reported fluctuations in the rate of change in the volume of transported goods reflect the irregularity in the demand for transport services (see Fig. 1).



Author's calculations. (HCI, 2024)

**Fig. 1 Rate of change of GDP and volume of transported goods for the period 2012–2023 (chain indices, %)**

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Significant declines in the volume of transported goods are observed in 2018 (-7.52%), 2019 (-11.73%), and 2022 (-7.58%), despite a recorded increase in GDP during these years — most notably in 2022, with a growth of 20.74%.

Based on the identified characteristics of the environment in which the transport sector in Bulgaria develops and the revealed dynamics of the main economic indicators, the following conclusions can be drawn:

**First**, the regulatory documents, valid for all EU member states, are aimed at promoting convergence, reducing regional disparities, as well as improving connectivity and access to the internal market for all regions.

**Second**, taking into account the fact that the development of the transport sector is of strategic importance for the EU, Bulgaria pursues an adequate policy aligned with the main objectives of the Union, in the direction of developing a sustainable transport network on the territory of the country.

**Third**, for the analysed period, the sector "Transport, storage, and post" generated 8.05% of the value added at factor cost in the Bulgarian economy, showing a relatively noticeable decline during the years in which the restrictions imposed by the COVID-19 pandemic affected the functioning of the national economy.

**Fourth**, the values of the analysed economic indicators in 2022, compared to the levels from the previous year, mark an increase, most significant in the value added generated in the sector and the reported wage expenditures.

**Fifth**, foreign direct investment (FDI) in the sector "Transport, storage, and post" for the analysed period holds a relatively low share and, on average, accounts for 1.86% of the total FDI in the national economy.

The analysis of the results from the study on the rate of change in the volume of goods transported by different types of transport in Bulgaria allows us to summarize the following:

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*First*, during the analysed period, road transport reports an increase of 17.86% in the total volume of transported goods and 44.18% in the transport work performed, compared to the first year of the period. A comparison between the volume of transported goods in 2019 and 2012 shows a decrease of 18.10%, and the total transport work performed decreased by 15.47%. After overcoming the economic slowdown caused by the COVID-19 pandemic, the volume of transported goods in 2023 is 43.92% higher compared to 2019, and the transport work performed by road transport increased by 70.57%.

*Second*, railway transport in Bulgaria carries goods mainly within the country. The average values of transported goods for the period are in a ratio of 68.5:31.5 in favour of domestic transport. The transport work performed for domestic shipments holds an average share of 66.8%. The transported goods increased by 37.17% in 2023, and the transport work rose by 56.67% compared to the first year of the period.

*Third*, in the case of maritime freight transport, the average annual rate of change in the volume of unloaded imported goods is negative (-5.98%) and positive for exports, amounting to 8.60 percentage points. The same trend is observed in inland waterway transport – a negative growth rate of -2.56% for imports and a positive rate of 14.15% for exports.

### **CHAPTER THREE: DISPROPORTIONS IN THE DEVELOPMENT OF TRANSPORT BUSINESS UNITS UNDER CONDITIONS OF MARKET ANOMALY**

Chapter Three examines the disproportions in development and the challenges facing the transport sector on a global scale, as a result of the restrictions imposed on the sector by the COVID-19 pandemic. The degree of impact of the COVID-



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19 pandemic on the sustainable development of transport business units in Bulgaria is "measured" on the basis of a conducted survey. The barriers and opportunities for the development of transport companies in Bulgaria in the post-pandemic period are identified.

The impact of the COVID-19 epidemic posed various challenges to the sector globally and created preconditions for deviation from the standard market hypothesis and the establishment of a significant market anomaly. The crisis affected all types of transport — from road and public transport in cities to buses, trains, and airplanes at both national and international levels. The COVID-19 pandemic also changed people's transport behaviour in drastic ways, with a significant decline in the use of air and public transportation (IEA, 2020).

A study on the impact and effects of the pandemic on the transport sector within the EU emphasizes the uneven dynamics in the development of certain types of transport, which experienced more significant slowdowns than others. For example, prior to the outbreak of the virus, it was estimated that passenger transport would grow by 42% between 2010 and 2050, and that freight transport services would grow by 60% over the same period (European Commission, 2019). However, both passenger and freight transport were heavily affected by the impact of COVID-19.

To determine the extent of the influence of restrictions caused by COVID-19 and the change in market behaviour of transport companies during and after the pandemic, a survey was conducted using a specially developed unique questionnaire. The survey was carried out during the period October 2024 – January 2025 via Google Forms. The results of the study were processed using the specialized data analysis software SPSS.

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The questionnaire is structured into four sections and includes 35 questions. Nearly half of the questions are subjective assessments based on the Likert scale method, where the validity range is from 1 (completely untrue/strongly disagree) to 5 (completely true/strongly agree), and where the respondent should mark the statement that corresponds to the correct answer.

The first section includes information characterizing the specifics of the surveyed legal entity: legal status, territorial scope, number of employees, and key financial indicators of the respondents. The second section contains questions for assessing the impact of the restrictions imposed by the COVID-19 pandemic on the activities of transport companies and the degree of adaptability under conditions of market anomaly. The third section provides information regarding the respondents' perceptions of the business environment in which they operate following the post-pandemic collapse of 2020, and the fourth section — their expectations for the development of the transport company in the short term.

The profile of the respondents allows the formulation of key insights from those working in the transport sector in Bulgaria concerning the impact of the COVID-19 pandemic, the degree of adaptability under conditions of market anomaly, and expectations for short-term development.

Based on the conducted analysis assessing the degree of influence of the COVID-19 pandemic on the activity of transport companies in Bulgaria and its impact on the necessity of making financial decisions in an allocative business environment, the following conclusions can be drawn:

***First***, respondents unequivocally emphasize the occurrence of significant changes in the organization of the transport activity of their companies and in their financial condition as a result of the movement restrictions imposed during the pandemic declared in 2019.

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**Second**, the most significant impact on the changes in the organization of activity and the financial condition was caused by: (1) reduced demand for transport services, (2) decreased frequency of demand for transport services on routes/lines that were established before the pandemic, and (3) changes in the behaviour of consumers of transport services.

**Third**, as a result of the reduced workload and in an effort to stabilize their financial condition, transport companies have undertaken actions to: (1) reduce the number of employees, and (2) increase transport tariffs.

**Fourth**, a real, quantitative measure of the impact of the COVID-19 pandemic is reflected in the reported decrease in company revenues — valid for 70.3% of respondents.

**Fifth**, the main reason for the necessity to increase transport tariffs during and after the pandemic, according to 83.8% of respondents, is the rise in fuel and energy prices during the pandemic and immediately in the post-pandemic period.

The views of the respondents regarding the most significant factors that have influenced the activity and financial condition of transport companies in the post-pandemic period, as well as the expectations for the development of transport companies in the short term, are reflected through the degree of agreement or disagreement with the statements included in the questionnaire.

The opinions of the respondents can be summarized as follows:

**First**, respondents highlight three essential circumstances that limit the sustainable development of companies: (1) the unfavourable business environment in Bulgaria, (2) the lack of an adequate transport policy in the country, and (3) the unsatisfactory transport infrastructure in Bulgaria, which requires modernization.

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**Second**, the leading factors, according to respondents, limiting the sustainable development of transport companies are: (1) the unpredictability of economic policy in Bulgaria, (2) the rising cost of labour, and (3) the lack of qualified personnel.

**Third**, despite not particularly optimistic expectations for improvement in the economic environment in Bulgaria over the next 3 to 5 years, respondents do expect an improvement in the financial and economic situation and an increase in the overall business turnover.

**Fourth**, expectations for increased demand for transport services in Bulgaria and the European Union are reflected in the respondents' intentions to increase the number of employees and production capacity.

**Fifth**, the leading risks to the opportunities for business expansion and sustainable development of transport companies, according to respondents, are: (1) rising fuel and energy prices, (2) shortage of qualified personnel, and (3) potential unexpected geopolitical events.

**References:**

1. European Commission. (2019). Directorate-General for Mobility and Transport. *Transport in the European Union. Current Trends and Issues*. Retrieved from <https://ec.europa.eu/transport/sites/transport/files/2019-transport-in-the-eu-current-trends-and-issues.pdf>
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### **III. Guidelines for future research on the topic of the dissertation**

The relevance of the present scientific study predetermines the need to deepen research in the following areas:

1. Enriching theoretical frameworks and “discovering” empirical evidence for the degree of impact of transport on the economic growth of economic systems.

2. Deepening research to enhance the understanding regarding the establishment of the dimensions of sustainable development of the transport sector and the leading indicators for assessing the sustainability of transport systems.

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#### **IV. Reference on the scientific and applied contributions in the dissertation**

*First*, based on an in-depth study of scientific literature and empirical research, the prerequisites for the development of transport in historical perspective have been identified, along with the mechanisms through which transport influences economic development in the context of the specifics of transport services.

*Second*, economic concepts and theories regarding the interdependence between transport, economic growth, and the impact of transport infrastructure on economic growth have been synthesized. On this basis, the spheres of influence of transport have been identified, and the components and indicators for assessing the sustainability of transport systems have been outlined.

*Third*, based on normative and empirical analysis of the environment and trends in the development of the transport sector in Bulgaria, the socio-economic parameters of the development of the transport sector in Bulgaria for the period 2012–2023 have been established.

*Fourth*, based on the results of the conducted survey among transport companies in Bulgaria, the business behaviour of transport units under conditions of market anomaly has been evaluated, and the main barriers and constraints to sustainable development have been identified.

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## V. List of publications by the doctoral student

### *Studies*

Vasilev, Vasil P. *Transport and Economic Growth: Forms of Manifestation and Mechanisms of Influence*, Annual Almanac “Doctoral Students’ Scientific Research” Issue XVI – 2023, Book 19 – Studies and Articles

<https://almanahnid.uni-svishtov.bg/title.asp?title=3038>

### *Articles*

1. Vasilev, Vasil P. *Specific Features, Current State, and Trends in the Development of the Transport Services Market in Bulgaria*, Annual Almanac “Doctoral Students’ Scientific Research” Issue XV – 2022, Book 18 – Studies and Articles

<https://almanahnid.uni-svishtov.bg/title.asp?title=2933>

2. Vasilev, Vasil P. *Socio-Economic Parameters of the Transport Sector – Comparative Analysis*. International Scientific Conference on “Problems and Challenges Facing Economic Science and Education in the 21st Century”, Union of Scientists in Bulgaria, 27.11.2024, pp. 123–131.



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

**National requirement in number of points: 35**

**Number of studies indexed in NACID – 1**

**Number of articles indexed in NACID – 2**

**Number of points from studies and articles indexed in NACID: 35**

**Total number of points: 35**

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## VII. Declaration of originality of the dissertation

The version of the dissertation comprising 153 pages under the title: “*Business Behaviour of Transport Companies under Conditions of Market Anomaly*” is authentic and represents the author’s own scientific work. It includes original ideas, texts, and visualizations through graphs, diagrams, tables, and formulas, while observing all the requirements of the Copyright and Related Rights Act by duly citing and referencing the intellectual work of others as well as data, including:

1. The results achieved and the contributions identified in the dissertation are original and have not been borrowed from studies and publications in which the author did not participate.
2. The information provided by the author in the form of document copies, publications, personally prepared references, and others corresponds to the objective truth.
3. Scientific results that have been obtained, described, and/or published by other authors are duly and thoroughly cited in the bibliography.

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(PhD student Vasil Vasilev)