THE IMPACT OF RAILROAD TRANSPORT ON BULGARIA'S REGIONAL DEVELOPMENT

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Abstract: The article presents a study on the impact of freight railroad transport on the development of Bulgaria's regions assessed through sectoral and econometric analyses. The analyses are based on indices such as revenues from transport activity of the licensed railway operators by regions, number of staff in the companies, development of the transport infrastructure, and migration growth rate. Most of the publications in this field address the relationship between air and/or water transport and regional development while this study focuses on improving energy-efficient and environmentally friendly modes of transport, such as freight railway transport. Its importance is corroborated through a regression analysis, which shows that the internal migration in the country depends on the development and modernization of its railway infrastructure.

Key words: regional development, freight railroad transport, sectoral analysis, econometric analysis.

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The European Union allocated to Bulgaria financial resources of approximately EUR 10 blln., which represents an average of EUR 1,400 per person over the period 2014–2020 (ESIF, 2020). Most of these funds were received from the European Regional Development Fund (36.3%). The obvious reason for this the need to overcome the existing economic, social, demographic, environmental and transport connectivity imbalances in the development of the regions in Bulgaria.

In its National Concept for Spatial Development for the period 2013–2025 (NCSD) the government prioritize the achievement of balanced development based on sustainable management, territorial cohesion, conservation of resources, energy consumption based on renewable energy sources, and improvement of transportation and communication infrastructure (NCPD 2013-2025). Moreover, the main strategic document for regional development of Bulgaria until 2022 (NRDS 2012-2022) specifically addresses the reduction of intra-regional and inter-regional disparities in economic, social and demographic aspect and emphasizes the need for high levels of employment, competitiveness and territorial cohesion.

In this respect, regional cohesion depends to a large extent on the infrastructural development of the regions, the possibilities for achieving sustainable multimodal mobility and the development of the national transport system. This is because: _First_, Bulgaria's regions have different densities of their road and railway networks. _Second_, the construction, modernization and rehabilitation of individual sections or lots of the transport infrastructure creates new jobs in the area and enhances people's mobility. _Third_, the use of energy-efficient and environmentally friendly means of transportation (such as railways) to meet people's needs for freight and passenger services is closely related to mitigation of climate changes. _Fourth_, the provision of conditions for multimodal transportation involving railways, inland waterways and roads shortens the time for delivery of goods, reduces travel time, and makes the region more attractive for investments.

Therefore, the aim of the present study to assess the contribution of rail freight transport to the development of Bulgaria's regions through sectoral and econometric analyses.

1. Literature review

The relationship between regional development and the transport sector as a scientific problem has been the subject of research in a number of publications. For example, as early as in the 1990s, Roger Vickermann (1996) studied the contribution of the transport infrastructure created along the Trans-European Transport Network (TETN) to the accessibility, mobility and macroeconomic development of the regions. He improved the methodological framework for studying the effects of infrastructural development on the regions in the context of spatial planning.

Another author who relates the improvement of the trans-European transport network with regional development is Brian Graham (1998). He examines the causal links between the provision of air transport infrastructure

services along the TETN network and regional economic development in the context of cohesion, solidarity and convergence policies. The author focuses on indicators such as social welfare, unemployment rate and net migration rate. Graham concludes that the regional economic development of the Union, and in particular of border crossing areas, depends to a large extent on the improvement of air routes and the overall liberalization of the air transport market.

Vijver, Derudder and Witlox (2016) conducted a similar study to determine the causal relationships between passenger traffic in NUTS 2[1] statistical planning regions in the EU and their employment rate. They used the Granger's causality test and concluded that the relationships between the two variables varied in strength and direction depending on the geographical location of the region. The volume of air transport services has a greater impact on the level of employment than vice versa.

Another study to assess the impact of transport infrastructure on population and employment was conducted by Eivind Tveter (2017). He used a difference-in-difference econometric model to study the effect on regional development in Norway when airport infrastructure is built in municipalities where such infrastructure did not exist. The results of the survey show a positive trend in the employment rate and population density in the respective regions.

Moreover, the influence of the transport sector on regional development was studied by Jason Monios (2015), who studied the problem in terms of establishment and development of multimodal freight villages in Italy. Through the methods of institutional and sectoral analysis, the author focuses on the establishment of intermodal transport connections as a foundation for conducting sustainable regional development policies. Another study by a group of Italian scientists - Bottasso, Conti, Ferrari, and Tei (2014) - focused on the impact of port activity on changes in the level of GDP for both the region where the seaport is located and the neighbouring regions. The authors identify the direct and indirect economic effects of this interaction and statistically prove that when the cargo turnover of a particular seaport increases by 10%, the GDPs of all regions in the vicinity of the port increase on average with 0.06% to 0.2%.

The publication of Tang, Sh., Savy, M., and Doulet, J. (2011) has a very similar objective with this study, as it examines the potential impact of high-speed railways in China on urban and regional development. However, it focuses mainly on passenger rail transport and the social and spatial

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[1] Nomenclature of Territorial Units for Statistics, for more details see: https://ec.europa.eu/eurostat/web/nuts/nuts-maps

polarization of individual regions. The three authors conclude that the construction of railroads at regional level will contribute to improving the productivity and attractiveness of rail transport, as well as to significant changes in the market shares of passenger road and air transport.

Regarding the scientific literature in Bulgaria, the publication of Nikolov et al. (2020) attempts to explore the role of innovation as a prerequisite for the use of integrated and intelligent transport systems. Its emphasis is on improving the regional connectivity and socio-economic development of the district of Vidin.

Another Bulgarian author - Dimitrov, D. (2017) - assesses the transport and geographical position of Northeastern Bulgaria as a key factor for its regional development. It offers three forecast options (favourable, moderately favourable and unfavourable) for the spatial development of the transport infrastructure of this region.

The above literature review can be summarized as follows: _First_, there are no publications on the topic addressed with this publication. _Second_, our study is based on econometric analysis methods following the models of the existing publications but enhanced by adding new variables. _Third_, the proposed ideas for linking regional development with the deployment of both a TEN-T network and multimodal freight villages discussed in those publications can be adapted successfully to the present study.

2. Sectoral analysis of railroad transport in the context of Bulgaria's regional development policies

In terms of territorial distribution and geographical location of the railway network, the largest share of railway lines is located and used in the Southwestern region - 864 km. or 21.1% (NSI, 2020). The lowest is their relative share in the Northeastern region - 478 km or 11.8%. On the other hand, the provision of railway services to the population in Bulgaria is distributed relatively evenly - approximately 6.4 km per 10,000 persons.

According to the National Railway Infrastructure Company (NRIC, 2019), about 66% of Bulgaria's railway infrastructure capacity for freight and passenger transportation is used effectively. In the years to come, this share should increase, as a key corridor of the main Trans-European Transport Network - the Orient-East/Mediterranean Corridor - passes through the country. This is why a certain part of the rail highways and railways 1st and 2nd category, especially in the Northwestern, Southwestern, South-Central and Southeastern regions, were reconstructed or are currently being upgraded.

These activities are financed mainly under the Operational Programme "Transport and Transport Infrastructure 2014-2020" as well as under the Connected Europe Facility and cover the main European transport infrastructure. Bulgaria can also take advantage of the opportunities for financial assistance offered by the European Bank for Reconstruction and Development (EBRD, 2019), as long as the conducted national policy in the field of railway transport aims:

- To reduce the regional discrepancies in terms of availability and exploitation of railroad infrastructure;
- To increase the number and the share of private providers of freight and passenger transportation services;
- To reduce the harmful effects on the environment and to promote social responsibility and digitalization.

Regarding the digitalization of railway transport in Bulgaria, according to the latest data, the country together with Austria and the Czech Republic, is one of the three European countries along the Orient-East/Mediterranean corridor, which was created as a part of the European rail traffic management system. As of 2019, approximately 20% of the country's railways – those in the South Central region – were equipped with ETCS applications (EC, 2020). For the period 2020–2023, digitalization of railway sections in the Northwestern, the Southwestern and the Southeastern region is also envisaged.

Another important international corridor that runs through the country is TRACECA. It is essential as it ensures the freight transport between Europe - the Caucasus and Asia (TRACECA, 2021). Considering the growing influence of the People's Republic of China in the global economic, trade and transport relations, the importance of the TRACECA corridor is growing as well. In this respect, we should emphasize the role of Bulgaria, which is determined by its relatively well-developed infrastructure and capacity to provide multimodal transportation services, especially those including sea and rail transport.

The maintenance of a well-developed and upgraded infrastructure is crucial for achieving high levels of reliability and safety of the offered transport services, as well as for providing door-to-door just-in-time shipment (Prodanov, 2017). The infrastructure projects, especially those implemented in Bulgaria during the last programming period (2014–2020), for rehabilitation and development of the railway network in the individual regions make up approximately 30% of all funds allocated under OP "Transport and Transport Infrastructure 2014–2020 "(OPTTI, 2014-2020).

Specifically, 19% of the funds are intended for improving the condition and operation of sea and river transport and 14% - for the road

transport. In addition, funding from the Connecting Europe Facility is mainly aimed at supporting and developing energy-efficient and environmentally friendly modes of transport - five of the projects are in the field of rail transport and one in the field of maritime transport (MTITC, 2021).

The above facts reflect the government's policy, which is gradually beginning to match the European priorities for the implementation of the concepts of circular and low-carbon economy. In this sense, the country's Railway Infrastructure Company has planned the construction of intermodal terminals for receiving, processing and sending goods for transportation by rail, road and water (NRIC, 2019). Currently, such terminals exist and operate in the Southeestern region (the Dragoman Ro-La terminal) and in the South-Central region (the intermodal terminal in Plovdiv). Ideas have also been proposed for the construction of an intermodal terminal in the North Central region in Ruse, as well as a second terminal in the Southwestern region in Sofia. These are still at their "Technical research and preparatory activities" stages.

According to EC data, about 100% of the country's railways along the Orient-East/Mediterranean corridor are connected to Bulgaria's seaports of Varna and Bourgas (EC, 2020). In general, there is no railway connection with the cargo terminals at Sofia Airport, and the approach infrastructure to the river ports is obsolete, poorly maintained or decommissioned.

The Memorandum of Understanding signed by the governments of Bulgaria and Greece in 2017, has an indisputable contribution to the development of the Southeastern, the Northeastern and the North-Central regions. It aims to build a high-speed railway section connecting three seaports in Greece (Thessaloniki, Alexandroupolis and Kavala) with the two Black Sea ports in Bulgaria (Varna and Bourgas) and the Danube River Port of Ruse (MTITC, 2017). On the one hand, the project is expected to attract investments from the Middle East, China and Russia through the implementation of this project. On the other hand, it is intended to increase the volume of freight transport by rail and reduce the amount of harmful emissions into the atmosphere.

According to the priorities set in the national strategic document for the development of the transport system until 2030, approximately 30% of long-distance road freight transport should be transferred to rail or water transport (MTITC, 2018). By 2050, this percentage should reach 50%.

According to NSI, by 2019 the domestic road freight transport represented 90.7% of the total volume of transport and rail transport accounted for only 9.3% (NSI, 2021). This means that for the next ten years - until 2030 - and based on officially published statistics, the volume of freight turnover in rail transport should increase by an average of 24% annually, and

the average annual growth of road transport should be 9%. Therefore, the government must have clearly defined measures to ensure that the relative shares calculated above can be achieved. Unfortunately, such specific steps are not included in the adopted "Integrated Transport Strategy for the period up to 2030", which is the main strategic document for the future development of the national transport system.

According to the provisions of the National Program for Air Pollution Control in Bulgaria for the period 2020–2030 (MoEW, 2019), the harmful emissions in the atmosphere should be reduced by approximately 48.2% by 2030. The latest data published by NSI (2021) show that the amount of harmful substances released by road transport increased by 5% in 2018 compared to 2015, while in rail transport for the same period there was a decrease of 4%. This fact is confirmed by the increased kilometres of electrified railways for the period 2009-2019.

As can be seen from Fig. 1, the Southeastern region has the highest relative share of electrified railway sections (83.3%), followed by the Northeastern region with 77.2% and the Southeestern region with 76.4%. The lowest is the relative share of electrified railways in the South Central region - 51.4%, but this is logical, as the provision of the population with railways in this region is one of the lowest in the country - 5.57 km per 10,000 persons.
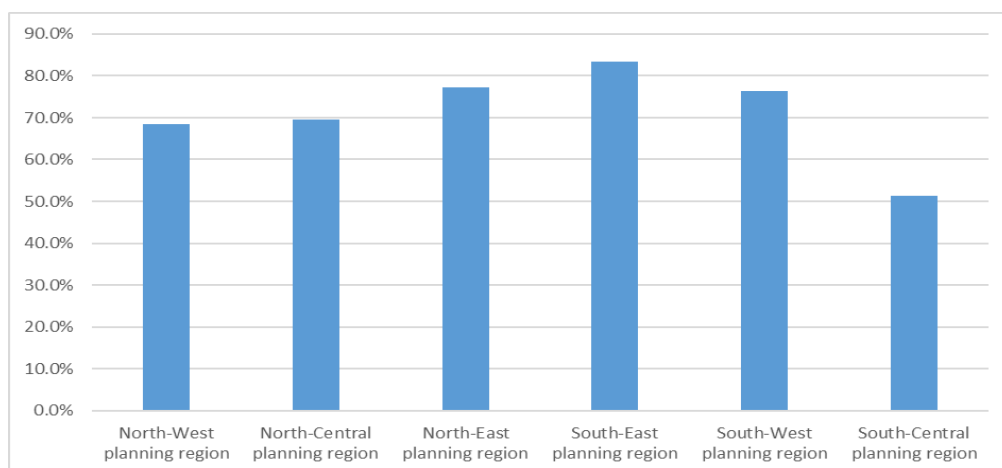
Source: NSI data and author's calculations

Figure 1. **Relative share of electrified railway sections by regions
in Bulgaria in 2019**

Obviously, these indicators reflected the dynamics in the development of social and economic indicators such as mechanical population growth rate, GDP by statistical regions, etc.

With regard to the internal migration of the population, there is a constant trend of emigration of persons mainly from the Northwestern and North-Central regions to the Southwestern region. In 2019, for example, the mechanical population growth rate in the Northwestern region was -2.27, while in the Southwestern region it was +1.58 per one thousand persons (NSIa, 2021). An interesting fact is that the mechanical growth rate in the South Central region in 2019 increased 14 times compared to 2017, while in the Southwestern region, where the country's capital is located, it decreased by 18% over the same period. Therefore, the quality of the living environment is essential and is determined by population density, air quality, safety, unemployment and employment levels, and last but not least, by the municipal financial management policies and indebtedness (Zahariev, 2010).

The liberalization of the rail freight market after 2007, resulted in a significant improvement of the safety of freight services offered. For example, in 2019 the total number of railway accidents in the country was 284, of which 122 were in the Southwestern region, 97 - in the South-Central region and 65 in the North-Central region (EARA, 2020). Approximately 14% of these accidents were significant and fatal and occurred mostly due to reckless actions of road vehicle drivers. These numbers decreased by about 7% compared to 2015, which means that the upgrade of the railway lines with communication applications and the control through annual inspections of the extension of safety certificates of railway operators are effective measures.

According to official data of the Executive Agency Railway Administration, in 2021 the number of licensed carriers who have the right to carry out freight transport by rail is 14. Seven of them have registered headquarters and main activity in the Southwestern region, two railway operators are registered in each of the North-Central, the Southeastern and the South-Central regions and there is one operator in the Northwestern region.

Table 1

Number of employees of licensed railway operators[2]

	2015	2016	2017	2018	2019
BRC AD – Sofia	318	339	408	389	297
Bulmarket Rail Cargo EOOD - Rousse	124	135	170	192	199
BDZ Cargo EOOD – Sofia	234	241	246	227	223
Gas Trade AD – Sofia	232	246	256	248	228
D B CARGO Bulgaria EOOD – Karlovo	279	284	280	267	250
Port Rail OOD – Burgas	79	93	102	134	160
Rail Cargo Carrier Bulgaria EOOD – Sofia	4	30	37	45	50
TBD Tovarni Prevozi JSC – Pernik	27	131	211	268	289
PIMK Rail EAD – Plovdiv		6	12	18	49
DMB Cargo Rail EOOD – Vratsa		9	9	18	13

Source: Commercial Registry, 2021

As can be seen from Table 1, the turnover in the number of personnel in the freight railway transport largely follows the dynamics in the internal migration in the country. There is also a trend of continuous increase in the number of employees of the railway operators Port Rail OOD (the number of employees doubled between 2015 and 2019) and PIMC Rail EAD (the number of their employees increased 8 times between 2016 and 2019.) This is due to the fact that the companies are registered in regions that fall within the scope of the Orient-East/Mediterranean Transport Corridor. On the other hand, multimodal terminals were built in the vicinity of the headquarters of some railway operators, which allowed them to combine railway and road transport (Plovdiv) and railway and sea transport (Burgas).

Employees directly engaged in rail freight transport represent 2% of those working in the transport sector. Approximately 62% of the employed workforce is concentrated in the Southwestern region, 17% in the South-Central region, 11% in the North-Central region, 9% in the Southeastern region and only 1% in the Northwestern region.

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[2] Table 1 shows information for only 10 of the 14 licensed freight railway operators, as for the rest of them there is no information regarding this indicator in the Commercial Registry.

Table 2

**Income from sales of the licensed freight railway operators,
in BGN thousand[3]**

	2015	2016	2017	2018	2019
BRC AD – Sofia	39490	38020	48027	37552	27019
Bulmarket Rail Cargo EOOD - Rousse	7814	26667	25455	21751	29635
BDZ Cargo EOOD – Sofia	124573	106341	109636	124436	129040
D B CARGO Bulgaria EOOD – Karlovo	36698	31380	25078	24500	21507
Port Rail OOD – Burgas	3497	3888	4670	5927	12623
Rail Cargo Carrier Bulgaria EOOD – Sofia	342	5459	6044	7654	9524
TBD Tovarni Prevozi JSC – Pernik	794	9564	19723	16502	17410
PIMK Rail EAD – Plovdiv	0	418	2143	7912	18881
DMB Cargo Rail EOOD – Vratsa		0	33	1253	439

Source: Commercial Registry, 2021

Table 2 shows that 50% of all services are provided by the national railway carrier - BDZ Cargo EOOD, followed in terms of market share by BRC AD with 16% and DB Cargo Bulgaria EOOD with 11.7%. For the period 2015–2019, a significant increase in the revenues from railway transport activity was reported by PIMC Rail EAD (8.8 times), Bulmarket Rail Cargo EOOD (3.8 times) and Port Rail OOD (3.6 times.) This indicator also shows a trend of increase in the volume of freight transport services in the South Central, North Central and Southeastern regions, i.e. in regions where intermodal terminals are built and operate or there is a direct connection between rail and water transport (sea and inland waterway).

3. Econometric analysis

This section presents the econometric analysis carried out to determine which of the indicators used in the sectoral analysis of railway transport in the previous section has the strongest impact on Bulgaria's regional development. For this end the indicators *number of staff, income from sales of the railway operators, length of electrified railways (in km), and internal migration rate*

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[3] Table 2 shows information for only 9 of the 14 licensed freight railway operators, as for the rest of them there is no information regarding this indicator in the Commercial Registry.

were selected and analysed as time series for a ten-year period. These indicators are indicative for the economic and social development of the individual regions in the country, especially in terms of employment and unemployment rates, GDP, protection of the environment and the health of the population, emigration and immigration rates. In the regression analysis the dependent variable (Y) is the *internal migration rate* and the independent variables are respectively the *number of employees* (X_1), the *income from sales of the railway operators* (X_2) and the *length of electrified railways in km* (X_3). When using a multifactor regression model, the presence of the phenomenon of multi-collinearity was established, as a result of which the obtained results cannot be interpreted. This necessitated the application of single-factor regression analysis, which shows that there is a significant relationship between only one of the dependent variables (X_3) and the independent variable (Y).

Table 3
Results from the single-factor regression analysis
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.879675
R Square	0.773828
Adjusted R Square	0.745556
Standard Error	0.062663
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.107477	0.107477	27.371304	0.00079118
Residual	8	0.031413	0.003927		
Total	9	0.13889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	12.72677	2.325836	5.471913	0.0005931	7.36338585	18.09	7.3634	18.09
X variable	-0.00426	0.000814	-5.23176	0.0007912	-0.0061368	-0.0024	-0.006	-0.002

As can be seen from Table 3, there is a linear dependency between the length of the electrified railways and the internal migration factor, as the significance level for the F test is 0.00079. This value is less than α (0.05), which means that the results obtained are significant and can be interpreted. The correlation coefficient (Multiple R) of 0.88 indicates that the dependency between the two variables is strong. The coefficient of determination (R Square) is 0.77 and takes into account that over 75% of the variations in the values of the internal migration rate are due to the electrification of the

railways in the different regions. Based on the obtained values, the dependence between the indicators can be represented by a linear function as:

$Y_{\text{(internal migration rate)}} = a + b * X_{\text{(electrified railway lines)}} + \varepsilon,$ where

a is constant (not mandatory);

b is a regression coefficient for the independent variable;

ε is the residual.

When the data from Table 3 is applied in this equation, we get:

$Y_{\text{(internal migration rate)}} = 12.73 - 0{,}004 * X_{\text{(electrified railway lines)}} + \varepsilon$

The above linear equation shows that each increase by 1 km of the electrified railways (e.g. in the Northeastern Planning Region) will decrease the internal migration rate in this region by 0.004. This, in turn, will have a positive impact on the processes of modernization of the railroad between Rousse and Varna, which is essential for the establishment of multimodal transportation scheme including river, sea and rail transport. This will create: *first* - conditions for attracting transit freight flows in the Northeastern region, especially along the TRACECA corridor in accordance with the Memorandum of Cooperation between Bulgaria and Greece, and *secondly* - grounds for licensing of more railway operators, which will create new jobs and contribute to the increase of the share of rail transport in the region's GDP. An upgrade reconstruction of this railroad will raise the level of employment in the Northeastern region and reduce the external negative effects of transport activities by limiting the amount of harmful greenhouse gas emissions.

Conclusion

The relationship between the transport sector and regional development has been studied by a number of authors. However, the publications that take into account the impact of rail transport - and in particular of freight rail transport - on the development of the regions are few. The present study aims to assess the impact of a set of indicators characterizing the transport activity and infrastructure provision of railway transport has an impact on the socio-economic and demographic development of the regions in Bulgaria. The author has tried to enhance the methodology for assessing the relationship between the transport sector and regional development by adding additional variables in the sectoral and econometric analyses. The proposed indicators, such as dynamics of the incomes from transport activity of the operators, number of employees, length of electrified (rehabilitated, upgraded) railway lines, can be used to study the impact of

other modes of transport on regional development on both national and European levels.

The main conclusions of the publication are that there is a need for a more multimodal terminals or freight settlements in the Northeastern and the North-Central regions, which fall into the scope of trans-European and international transport corridors (TRACECA, Orient-East/Mediterranean). The results of the sectoral analysis clearly show that only in the Northeastern planning region there are no registered freight railway operators as well as that the length of the electrified railway lines is the smallest. This fact definitely has a negative impact on the development of the national transport system, as the region includes the seaport of Varna and a number of public river ports of national importance, and rail transport in this case is the only environmentally friendly option to establish multimodal transport infrastructure with these facilities. The need for a more comprehensive electrification (upgrade, enhancement) of the railway network in the country was confirmed by the conducted econometric analysis. The results prove that the emigration and immigration among in the regions depend on the improvement of the transport infrastructure.

Undoubtedly, the results of such studies can be used both for development of strategies for regional and spatial planning and the implementation of policies for development of the national transport system.

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