17. medzinárodná vedecká konferencia
Riešenie krízových situácií v špecifickom prostredí,
Fakulta špeciálneho inžinierstva ŽU, Žilina, 30. - 31. máj 2012

EX-ANTE COMPARATIVE ANALYSIS OF COST AND BENEFITS OF ESSENTIAL RAILWAY INFRASTRUCTURE PROJECTS IN BULGARIA

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ABSTRACT

This study presents the results from ex-ante comparative analysis of costs and benefits of essential railway infrastructure projects in Bulgaria. The analysis was performed in two main steps according to the unified EU methodology for financial and economic analysis which defined the required and eligible amounts of financial support from EU. The results demonstrate the socio-economic benefits from the implementation of projects related to external effects on the environmental protection, transportation safety, time saving and operating costs reduction. In addition, the structure of the financial and economic indicators, and the share of financing from EU funds are also analysed and discussed.

Key words: Cost Benefit Analysis, financial analysis, economic analysis, railway infrastructure, investment projects, transport externalities.

I.   OBJECTIVES AND METHODOLOGY OF ANALYSIS

The development of railway infrastructure is a priority of EU transport policy for
 the period 2007 - 2013. EU finances investment projects in all regions of Europe, including Bulgaria, the Structural Funds and Cohesion Fund in order to reduce the economic and social disparities between Member States and regions. One of the requirements related to the investment options for infrastructure projects financed by the EU is carried out ex-ante analysis of costs and benefits (Cost Benefit Analysis). The objectives of this analysis are:
   - To demonstrate the need to implement projects;
   - To demonstrate the need for financial assistance from the EU;

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-   To determine the necessary and allowable amount of EU co-financing.

The process of analysis development is administered according to the requirements of uniform methodology adopted by the Commission. To determine the output parameters which are not defined in the EU methodology it has been used techniques and approaches adapted to the specificity of investment alternatives.

The analysis involves two basic steps - financial analysis and economic analysis. The financial analysis demonstrates the needs for co-financing from EU funds and determine its size. The economic analysis assess the benefits of the project and demonstrate the importance for society. Financial analysis requires the definition of Operational costs for operation and maintenance of railway infrastructure, the necessary investment costs inflows, financial indicators, financial stability, financial deficit and the establishment of a financial plan for each investment scenario.

The economic analysis determines the real economic flows and calculates economic indicators to assess the options.

In this study the results of analyzes of costs and benefits for seven projects (Figure 1) development of railway infrastructure, financed by the EU are presented:

• "Technical assistance for modernization of trans european network in Bulgaria - the railway line Sofia - Plovdiv"

• "Technical assistance for modernization of trans european network in Bulgaria - the railway line Sofia - Dragoman";

• "Technical assistance for modernization of trans european network in Bulgaria - the railway line Sofia - Pernik - Radomir";

• "Technical assistance for the development of Sofia railway junction";

• "Technical assistance for modernization of the railway line Radomir-Gyueshevo";

• "Technical assistance for the development of Burgas railway junction";

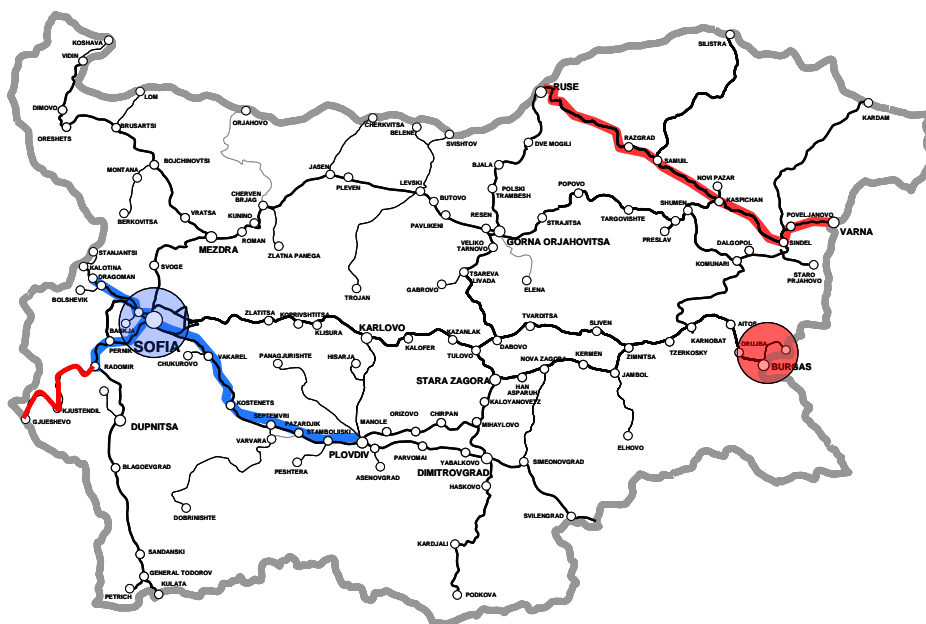• "Technical assistance to rebuild the design parameters of the railway line Varna - Ruse."

Figure 1. Analyzed railway projects

II. FINANCIAL ANALYSIS

The main objectives of financial analysis is the assessment of the financial profitability of investment and national capital, developing a financial plan and check the financial soundness of the project. The results of financial analysis demonstrate the need to determine the amount of co-financing of project proposals from the EU.

The analysis provides information for the entire forecast period and for each of the scenarios in terms of the Beneficiary. Milestones of financial analysis are as follows:

- Identifying and forecasting cash inflows (revenues from infrastructure fees and residual value of investments);
- Identifying and forecasting of cash outflows (operational costs maintenance and operation and investment costs);
- Determination of the incremental cash flows for each of the alternative scenarios such as "No project";
- Definition of financial indicators;
- Develop a financial plan for the allocation of funding sources;
- Assessment of financial stability of the project.

All evaluations are based on the following indicators: financial internal rate of return on investment (FIRR / C), financial net present value of investments (FNPV / C), financial internal rate of return on capital (FIRR / K), financial net present cost of capital (FNPV / K). 5% discount rate recommended for EU countries has been used in the final evaluation of these indicators.

The financial return on investment measured the capacity of net revenues to recoup investment costs. It demonstrates the viability of the project and whether it requires the contribution of EU funds.

The financial return on capital is an estimate of the project in terms of efficiency and return on national capital (public and private).

The assessment of financial stability is determined shortage of funds for the entire period of project implementation, irrespective of EU financial assistance. In addition, financial stability occurs if the cumulative net cash flow is positive in each year during the period.

To assume that a project requires a contribution from the Funds, the indicator FNPV / C should be negative value, the indicator value of FIRR / C must be less than that used for the analysis discount rate - 5%.

The results (Table 1) show these criteria from selected scenarios for the development of all projects.

Table 1. Values of financial indicators

Projects	Values of financial indicators			
	FNPV/C	**FIRR/C**	**FNPV/K**	**FIRR/K**
Ruse - Varna	-366 625 411	-0,02	-74 658 059	0,02
Sofia- Radomir	-117 252 830	-0,02	-23 610 687	0,03
Sofia- Dragoman	-90 694 057	n/q	-2 6081 550	0,02
Sofia- Plovdiv	-1 671 453 874	n/q	-585 608 099	n/q
Radomir-Gyueshevo	-681 003 963	-0,03	-126 272 666	0,02
Sofia railway junction	-408 779 704	n/q	-85 266 114	0,01
Burgas railway junction	-21 429 823	-0,02	-3 445 317	0,03

The values of the profitability of the capital, show that all the projects are unprofitable for private investors and thus to implement public-private partnership.

The results of financial analysis of the projects indicate that the selected scenarios for infrastructure development to meet the criterion for financial stability.

The availability of financial gap proves the need for co-financing (Figure 2). The maximum allowable share of EU co-financing is 80%. The results from analysis define the EU units co-financing for the projects between 58% and 69%. The highest percentage (68.61) is related to Sofia railway junction.
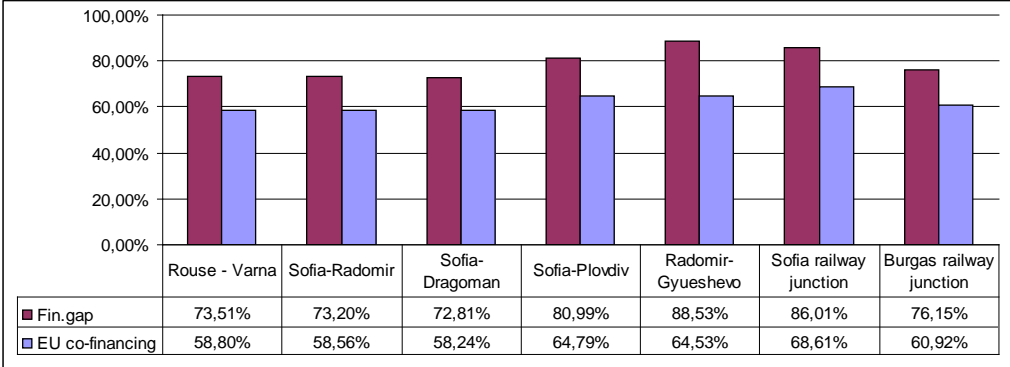
	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction
Fin.gap	73,51%	73,20%	72,81%	80,99%	88,53%	86,01%	76,15%
EU co-financing	58,80%	58,56%	58,24%	64,79%	64,53%	68,61%	60,92%

Figure 2. Financial gap and EU Co- financing

III. ECONOMIC ANALYSIS

The main effects included in the analyses of the costs and benefits that determine the importance of the society are the value of time, security of transport, environmental impact and operating costs for vehicles.

To determine the benefits the analysis apply incremental approach, and assesses the benefits of a project scenarios compared to the existing parameters of the infrastructure. Different factors affect the magnitude of benefits and forecast traffic and specific technical and technological solutions.

• *Benefits of saved time*

Different sources can influence the investment and technological solutions on the economy of time are reducing vehicle distance, reducing the number of changes when improving access to rail, creating links between rail and other modes of transport, increasing the speed of rail transport, reducing congestion of the road. This impact is evaluated for transfer traffic from road to rail and newly rail traffic.

• *Benefits of reducing accidents*

Investment decisions of different scenarios lead to different degrees to increase transport safety and reduction of the number of incidents in the areas through implementation of advanced security systems (ERTMS / ETCS) and telecommunications, removing crossings or equipping them with the ADF and the improvement of the parameters track and facilities (CM, tunnels, bridges, etc.). An impact assessment was made on unit values for passenger transport per passenger kilometer, under "Requirements for preparation of CBA in Transport sector" Table. 6 and freight tonne-kilometer of under the "Handbook on estimation of external costs in the transport sector", Version 1.1 February, 2008.

The impact is specific for passenger and freight on the basis of specific technical solutions for different scenarios and projected traffic for transfer traffic from road to rail and rail traffic for the newly created.

• *Environmental Benefits*

The analysis assesses the impact of investment scenarios on the costs and benefits of external effects: noise, air pollution, climate change, soil and water, nature and landscape. The overall assessment is based on unit costs per passenger-km and tonne under the "Handbook on estimation of external costs in the transport sector", Version 1.1 February, 2008. Quantify the benefits of traffic transferred from road to rail.

• *Benefits related activities (operating cost savings-VoC)*

Operating cost savings are as a result from the transfer of traffic from road to rail. They are calculated for the transferred traffic, as the difference between variable costs for road transport (separately for car, bus and truck) and those for rail. Aggregate estimates include the benefits of investment to implement the recommended scenarios for each of the projects for development and modernisation of railway infrastructure. Project socio-economic benefits from implementation of the projects are judged on the following parameters:

- Value of the benefits of resources and projects;
- Return on investment in terms of socio-economic benefits;
- Structure of benefits by source;
- Economic indicators;

• *Estimated value of benefits*

The total value of incremental discounted benefits from the project exceed 6 billion lev (Figure 3). As it is the largest for Sofia- Plovdiv.
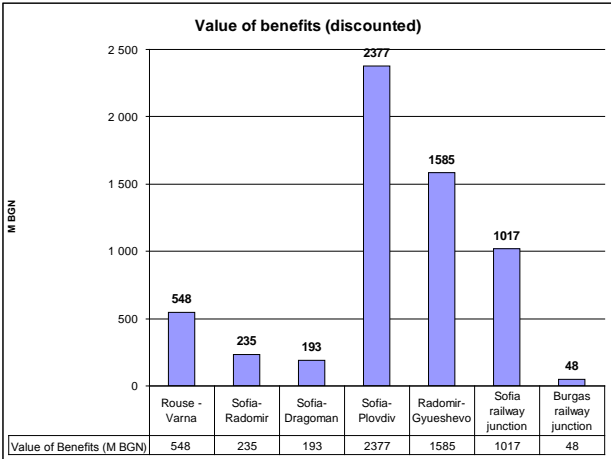
Figure 3. Total discounted socio-economic benefits of the projects

The greatest value of all projects appears the benefits of saved time, followed by the value of environmental benefits. In the third place, for linear rail sections are the benefits of events. However, for railway junctions Sofia and Burgas in third place are the benefits of operating cost savings, which is explained by the intensity of urban traffic. (Figure 4).

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Value of benefits by sources

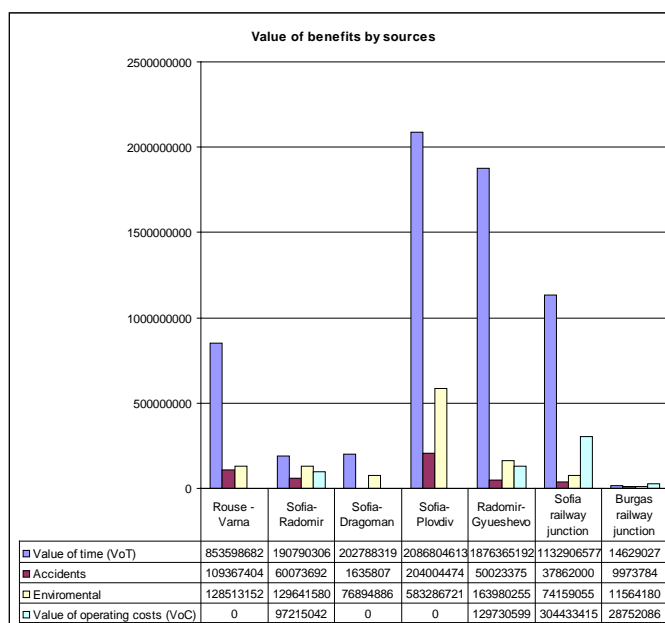|	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction
Value of time (VoT)	853598682	190790306	202788319	2086804613	1876365192	1132906577	14629027
Accidents	109367404	60073692	1635807	204004474	50023375	37862000	9973784
Enviromental	128513152	129641580	76894886	583286721	163980255	74159055	11564180
Value of operating costs (VoC)	0	97215042	0	0	129730599	304433415	28752086

Figure 4. Value of socio-economic benefits by sources

The average value of the benefits of 1 km. track is about 10 million lev. The value of benefits allocated to 1 km. track is greatest for the line Radomir-Gyueshevo that is over 30 million lev. The line Sofia-Plovdiv is set as a second, although with the greatest total value of benefits. The lowest value of the benefit of 1 km. is Burgas railway junction.

• *Return on investment*

The profitability of the projects in terms of socio-economic benefits is determined by the benefits of an index of lev investment (Figure 5). The average return on investment for the projects in terms of socio-economic benefits is 1, 65 lev. For all projects decisions, the value of benefits which will be gained per one lev of investment is over one lev. Profitability is highest (over 2 lev) for line Radomir-Gyueshevo (2.48 lev), Sofia railway junction (2.38 lev) and the Sofia-Dragoman (2.30 lev);

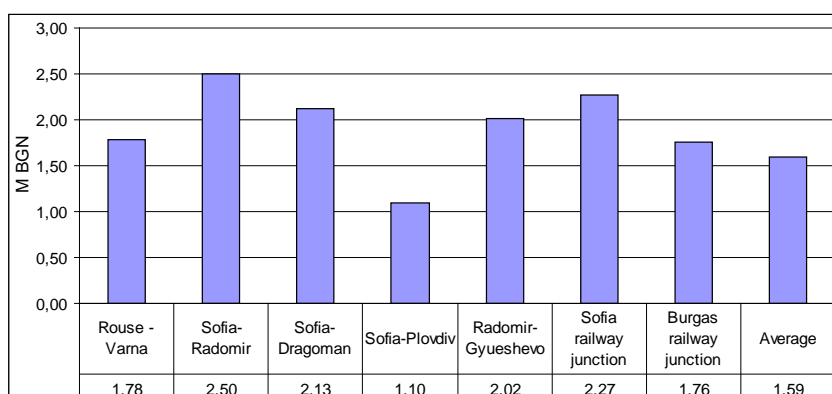|	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction	Average
	1,78	2,50	2,13	1,10	2,02	2,27	1,76	1,59

Figure 5. Economic returns on investments

• *Characteristic of benefits per source*

In average for all projects the time saved is the greatest share the benefits (75%), followed by environmental benefits (13%). The structure of benefits to railway junction Burgas makes an exception, where larger shares of the benefits are estimated of saving operating costs. This structure of benefits is determined by the

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functional and technical specifications of the railway infrastructure in Burgas. The lowest share of the benefits of reducing incidents is between 0.6% and 15%. On the incremental value of this benefit influences the availability of existing and planned projects in technical and technological measures for safety and security of shipments and value of property and personal injury as defined in Bulgaria.

Structure of project benefits

	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction	Средно
□ Value of operating costs (VoC)	0,00%	21,19%	0,00%	0,00%	5,84%	19,65%	44,29%	6,77%
□ Enviromental	11,77%	28,26%	27,33%	20,29%	7,39%	4,79%	17,81%	13,24%
■ Accidents	10,02%	13,09%	0,58%	7,10%	2,25%	2,44%	15,36%	5,70%
□ Value of time (VoT)	78,21%	41,59%	72,08%	72,61%	84,52%	73,12%	22,53%	74,52%

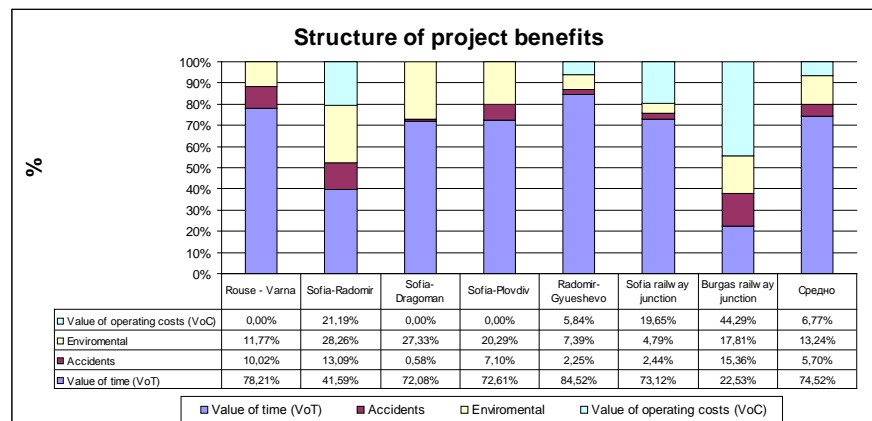Legend: ■ Value of time (VoT) ■ Accidents □ Enviromental □ Value of operating costs (VoC)

Figure 6. Structure of benefits

• *Economic indicators*

The indicators defined in the economic analysis are calculated on the base of actual economic flows and determined by economic adjustments of financial flows and accounting for externalities. The values of economic indicators are appropriate criteria for investment from the perspective of society. The indicators dimensions are "Economic net present value" (ENPV), which must have a value greater than 0, "Economic internal rate of return" (EIRR), which must have a value higher than the recommended discount rate (5.5%) and factor "cost benefit" (B / C), which must have a value greater than 1.

All registered investment scenarios of the projects must meet the criteria for economic viability (ENPV> 0, EIRR> 5,5 and B / C> 1). The greatest value of NPV project has the Sofia-Plovdiv, and the smallest is for Burgas railway junction. The project for Sofia-Radomir is the highest value economic internal rate of return (EIRR) and the highest ratio benefit / cost (B / C). The lower values of EIRR and B / C are the project for the line Rousse - Varna. Comparison of analytical results for the projects is presented in Figures 7, 8 and 9.
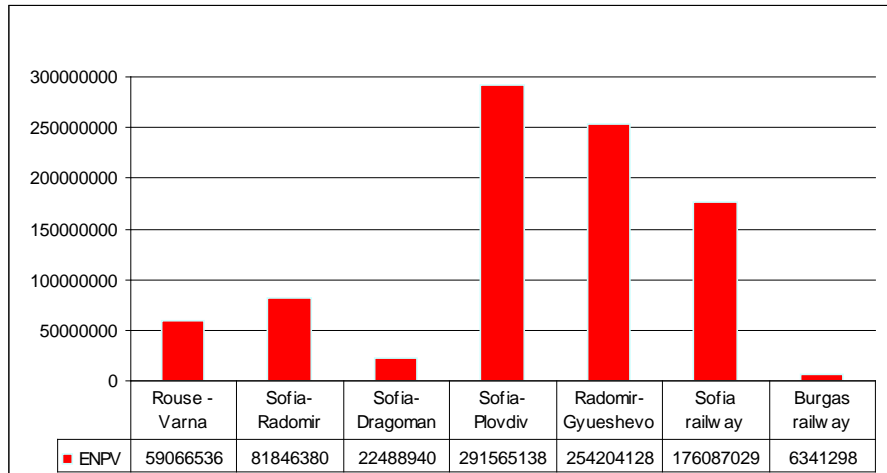
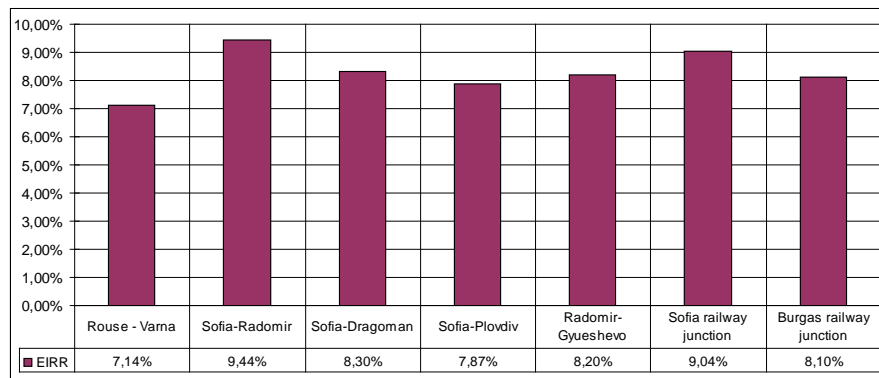Figure 7. Values of Economic net present value of investments

	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway	Burgas railway
■ ENPV	59066536	81846380	22488940	291565138	254204128	176087029	6341298

Figure 8. Rates of economic internal rate of return on investment

	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction
■ EIRR	7,14%	9,44%	8,30%	7,87%	8,20%	9,04%	8,10%
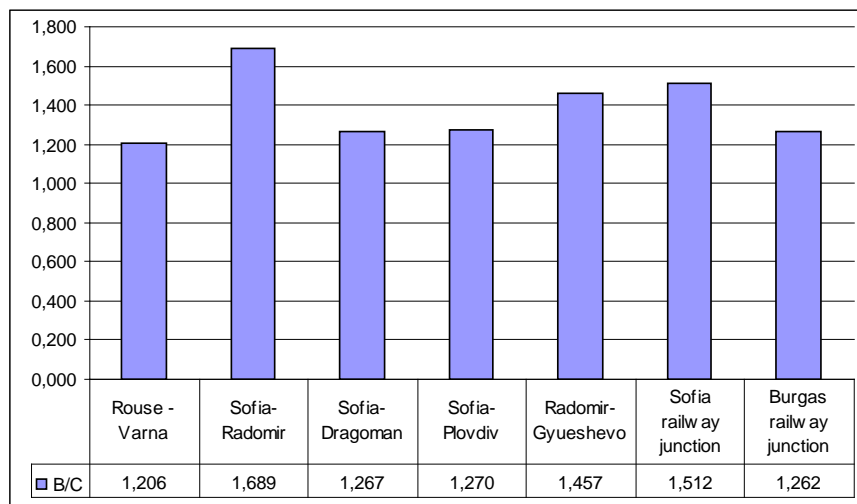
Figure 9. Values of Benefit / Cost ratio

	Rouse - Varna	Sofia-Radomir	Sofia-Dragoman	Sofia-Plovdiv	Radomir-Gyueshevo	Sofia railway junction	Burgas railway junction
■ B/C	1,206	1,689	1,267	1,270	1,457	1,512	1,262

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