



ECONOMIC ACTIVITIES INFLUENCE MODELS ON THE TRAFFIC FLOWS IN BULGARIAN SEAPORTS

Emil Jelezov

“Todor Kableshkov” University of Transport, Sofia, Bulgaria

Gergana Kirilova

“Todor Kableshkov” University of Transport, Sofia, Bulgaria

©MESTE

JEL Category: L92, O18, R41

Abstract

The article presents analysis, assessment, and simple linear regression models of the basic economic activities impact on the volume of the cargo traffic processed in maritime ports of national importance in the Republic of Bulgaria. Dependencies between the industrial development trends and the turnover of the ports Varna and Burgas per main freight groups and directions (import, export and transit) are considered based on correlation and regression analysis. The trends of industry development are represented by industrial production indices by economic activities, classified according to the Statistical Classification of Economic Activities in the European Community (NACE). Trends in cargo turnover changes in ports are represented by indices of the physical volume of processed goods in the ports of Varna and Burgas. An assessment of the strength and directions influence of industry on the maritime cargo turnover of the seaports is made by defining the coefficients of a simple (one-factor) linear correlation between the industrial output indices by economic activity and port turnover load indexes. Verification of the statistical significance of the results and the determination of the linear models applicable for the predicted purposes was made by the F-test.

Keywords: national maritime ports, freight transport, basic economic activities, correlations between the industrial development trends and the turnover of the ports

1 INTRODUCTION

The national ports of Varna and Burgas are of great importance for Bulgaria. Around 75% of the import and over 70% of the export volumes of goods are handled at these two ports. For the period 2007 - 2015 the average annual freight

turnover of both ports amounts at more than 26 million tons, with a slight tendency towards increasing (Table 1).

The freight turnover at the ports is highly influenced by a number of economic, social and political factors. The industrial development is considered the basic factor influencing the generation of freight flows at ports, but the influence of different economic activities is not equal in terms of strength and direction.

Address of the corresponding author:

Emil Jelezov

ajelezov@abv.bg

Table 1. Annual freight turnover at sea ports

Year	Total for the ports in Varna port area	Total for the ports in Burgas port area	Total for the sea ports
	(tonnes)	(tonnes)	(tonnes)
2007	9 314 444	16 179 168	25 493 613
2008	11 070 385	16 065 294	27 135 679
2009	8 871 575	13 400 229	22 271 803
2010	10 558 008	12 873 257	23 431 265
2011	12 061 074	13 595 515	25 656 589
2012	11 690 991	14 971 965	26 662 955
2013	13 592 082	15 953 432	29 545 514
2014	12 178 285	15 792 103	27 970 389
2015	11 691 898	16 220 651	27 912 548

Source: "Integrated Transport Strategy for the period until 2030"

The presented analysis identifies economic activities with considerable influence over the freight turnover in the ports of Varna and Burgas from statistical point of view. Adequate uni-factor regression models of their influence over the port freight turnover are established, applicable to the forecasting purposes.

2 OBJECTIVES

The main objectives of the analysis are as follows:

- determination of the existence of correlation between the economic activities and the freight turnover in the ports of Varna and Burgas;
- evaluation of the strength, ranging and determining the direction of influencing the port freight turnover by the economic activities;
- determination of regression equations of statistically significant dependencies and construction of their single-factor regression models.

3 METHODOLOGY

The dependencies between the industrial development tendencies per economic activities and the freight turnover of Port Varna and Port Burgas have been traced by the options import, export and transit during the period 2007-2015.

The industrial development tendencies are presented by statistical data quoted by the

Bulgarian National Statistical Institute concerning the industrial indexes per economic activities classified according to the Statistical Classification of Economic Activities in the European Community (NACE).

The tendencies of changing the ports' freight turnover are presented by indexes, determined according to the data of the physical volume of the import, export and transit goods handled at the ports.

Table 2. Factor variables

X	Industry total
XB	Mining and quarrying
XB5	Mining of coal and lignite
XB7	Mining of metal ores
XB8	Other mining and quarrying
XC	Manufacturing
XC10	Manufacture of food products
XC11	Manufacture of beverages
XC12	Manufacture of tobacco products
XC13	Manufacture of textiles
XC14	Manufacture of wearing apparel
XC15	Manufacture of leather and related products
XC16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
XC18	Printing and reproduction of recorded media
XC19	Manufacture of coke and refined petroleum products
XC20	Manufacture of chemicals and chemical products
XC21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
XC22	Manufacture of rubber and plastic products
XC23	Manufacture of other non-metallic mineral products
XC24	Manufacture of basic metals
XC25	Manufacture of fabricated metal products, except machinery and equipment
XC26	Manufacture of computer, electronic and optical products
XC27	Manufacture of electrical equipment
XC28	Manufacture of machinery and equipment n.e.c.
XC29	Manufacture of motor vehicles, trailers and semi-trailers
XC30	Manufacture of other transport equipment
XC31	Manufacture of furniture
XC32	Other manufacturing
XC33	Repair and installation of machinery and equipment

The estimation of the industrial influence over the ports' freight turnover is worked out through determining co-efficients of simple (uni-factor) linear correlation between the indexes of change of traffic and the indexes of freight turnover change.

The correlations between the *Factor variables* are studies (economic activities), listed in Table 2 and *Dependent variables* (directions of traffic flows), shown in Table 3 are studied.

Table 3. Dependent variables

Dependent variables					
Port Varna			Port Burgas		
import	export	transit	import	export	transit
Y1	Y2	Y3	Y4	Y5	Y6

The degree of determination of the variables dependent on the factor variables is determined by the coefficients of determination (R-squared).

To assess the strength of influence and the degree of determination of the variables, the scales shown in Table 4 have been applied.

Table 4. Rating scales

Correlation strength	Determination degree
0,3 < R < 0,5 – moderate	0,1 < R ² < 0,25 – moderate
0,5 < R < 0,7 – considerable	0,25 < R ² < 0,49 – considerable
0,7 < R < 0,9 – high	0,49 < R ² < 0,81 – high
0,9 < R < 1,0 - very high	0,81 < R ² < 1 – very high

The verification of results has been tested through F-test (Fisher's criterion) at a confidence interval $\alpha=0.05$. The calculated value of Fcr (Critical Value of the F Distribution) is 5.987.

Statistically significant are considered the dependencies, for which the statistical tests show values bigger than the critical ($F > F_{cr}$). The null hypothesis, defined as accidental is rejected for these dependencies.

For the dependencies selected as statistically significant, the parameters of the linear regression equations are determined and one-factor regression models are constructed.

The algorithm for estimating and determining statistically significant and adequate for the purposes of forecasting single factor linear regression models of the industrial influence on port freight turnover are presented on Figure 1.

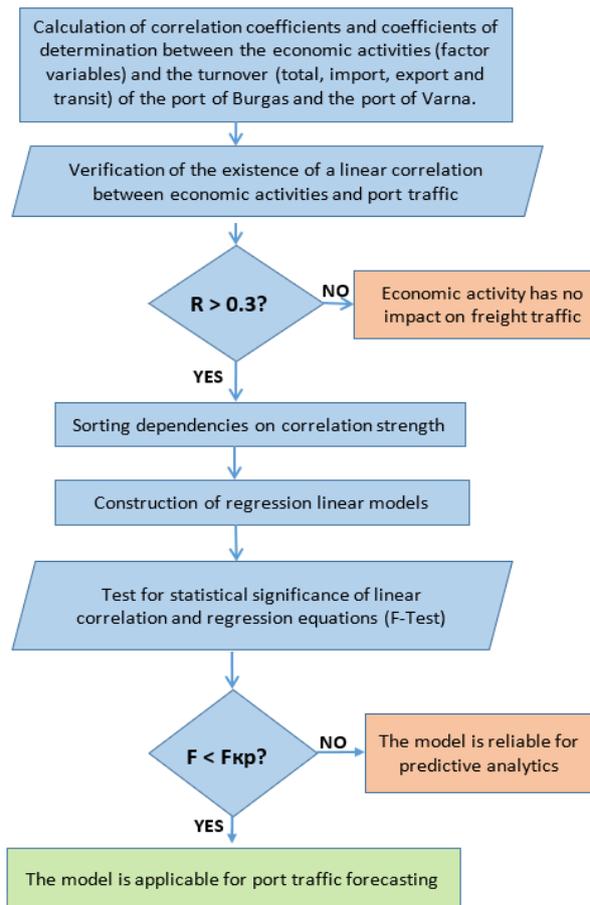


Fig. 1 Algorithm for evaluation and determination of statistically significant linear regression models

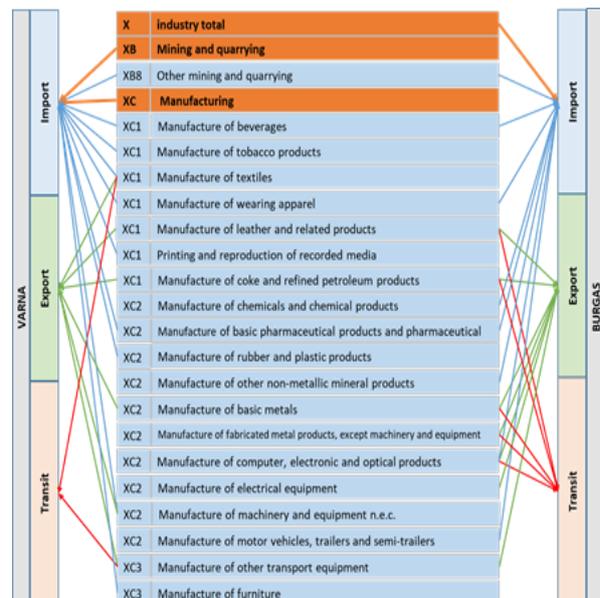


Fig. 2 Statistically significant dependencies

4 RESULTS AND DISCUSSIONS

Figure 2 represents schematically the identified statistically significant correlations between

economic activities and the import, export and transit freight turnover of ports.

The linear one-factor regression models of statistically significant dependencies are applicable for the purposes of forecasting.

The imports in the Port of Varna is influenced by 12 of the studied economic activities, while the imports in the port of Burgas is influenced by 9 of them (Figures 3 and 4).

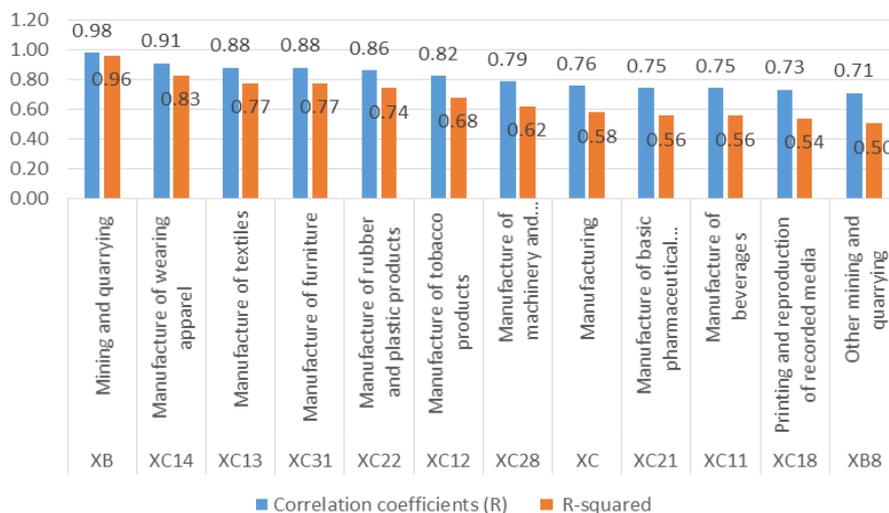


Fig. 3 Statistically significant dependencies for the import of the port of Varna

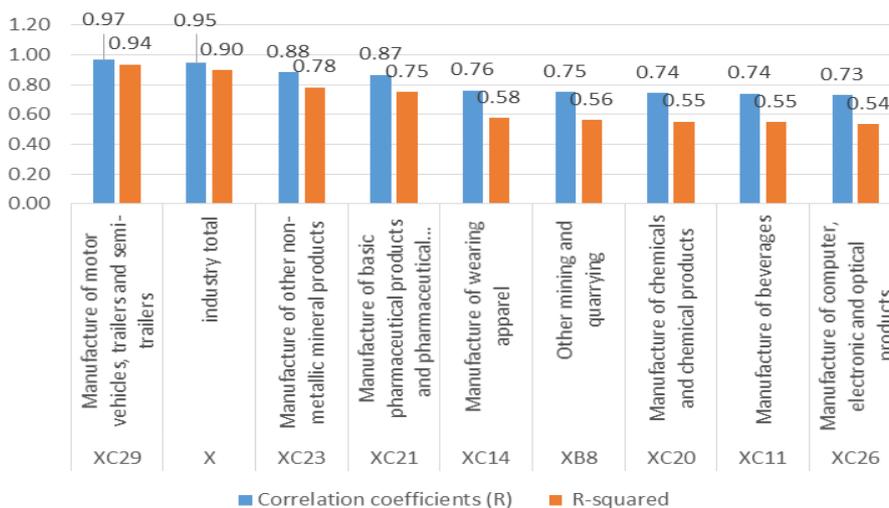


Fig. 4 Statistically significant dependencies for the import of the port Burgas

industry total Burgas import

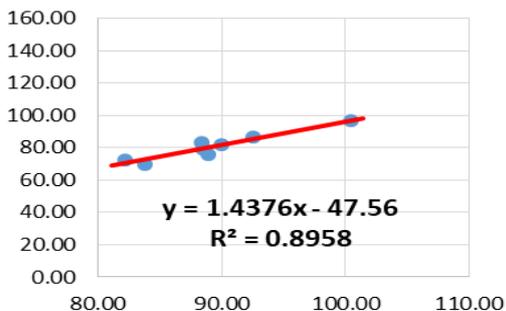


Fig. 5 Regression model of the industrial influence over the imports at the Port of Burgas

The influence of the industry as a whole over the imports through the Port of Burgas can be represented by the linear one-factor model on Figure 5.

Through linear one-factor models the dependencies between the imports through the port of Varna on one hand and the mining and processing industries on the other hand can also be presented (Figure 6)

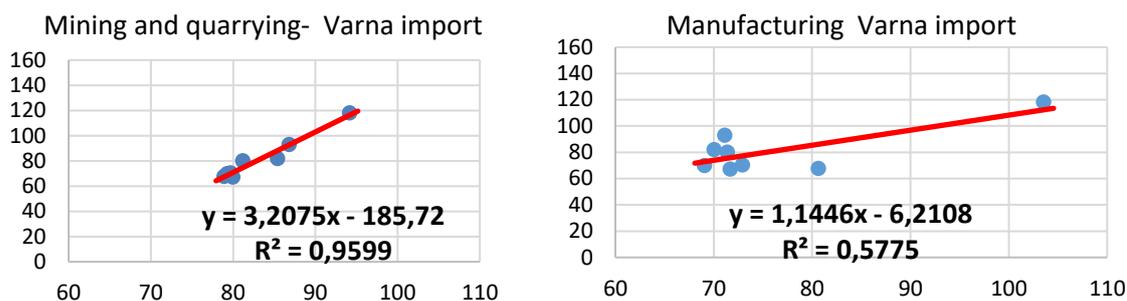


Fig. 6 Regression models of the imports through the Port of Varna

The imports in both ports are influenced by the economic activities “Other mining and quarrying”, “Manufacture of beverages”, “Manufacture of wearing apparel” and “Manufacture of basic

pharmaceutical products and pharmaceutical preparations”. The regression models of those dependencies are presented on Figure 7.

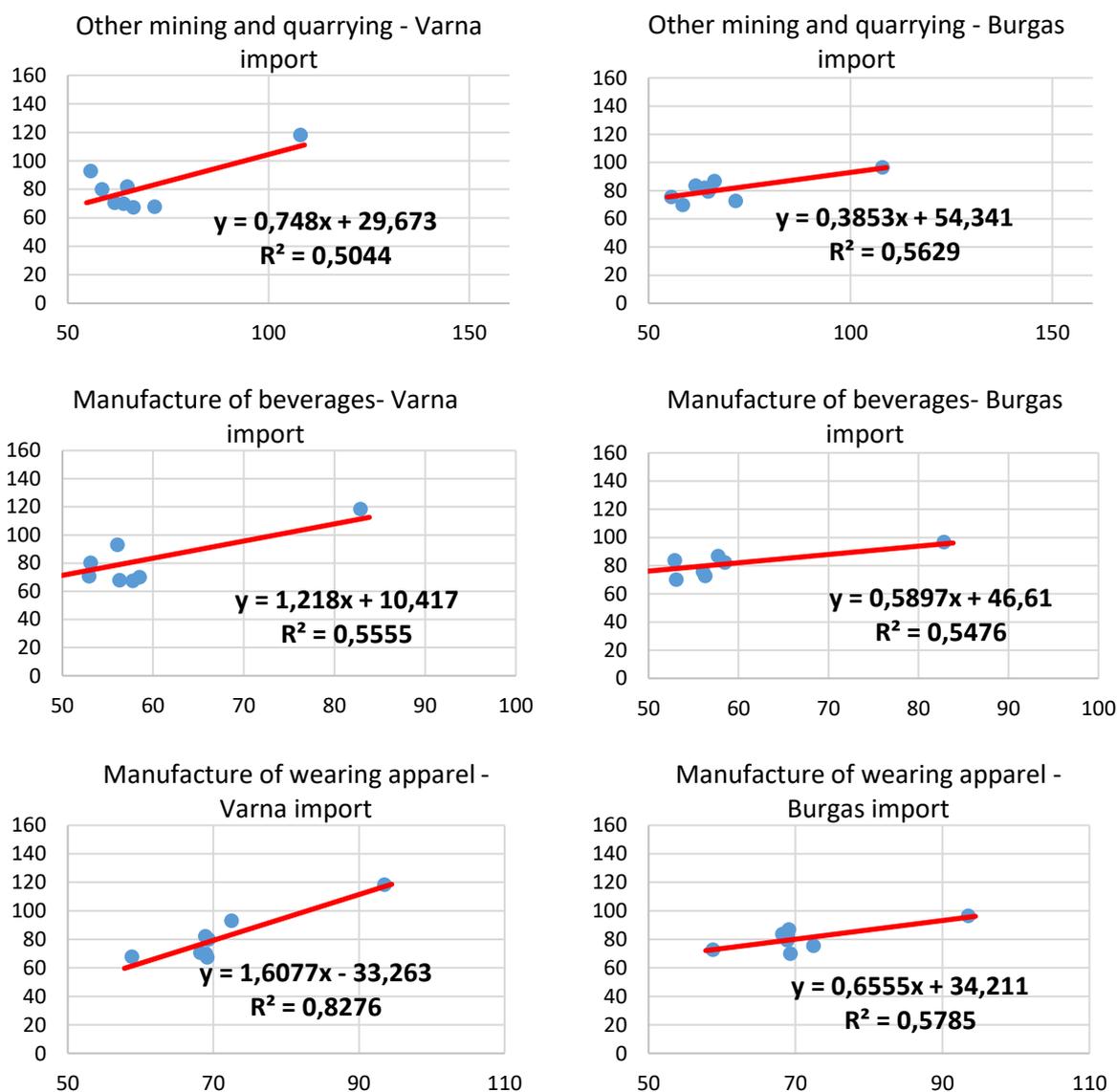


Fig. 7 Regresson models of dependencies of the imports in the Port of Varna and Port of Burgas on the basic factors (Continuation on the next page)

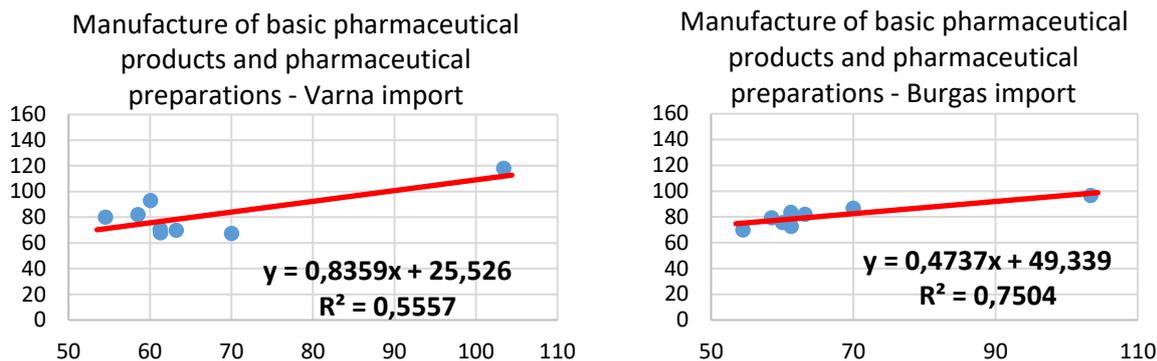


Fig. 8 Regresson models of dependencies of the imports in the Port of Varna and Port of Burgas on the basic factors

Specific factors influencing the imports of the Port of Varna are the following economic activities:

- Manufacture of tobacco products;
- Manufacture of textiles;
- Printing and reproduction of recorded media;

- Manufacture of rubber and plastic products;
- Manufacture of machinery and equipment n.e.c.;
- Manufacture of furniture.

The regression models of those dependencies and their equations are presented on Figure 8.

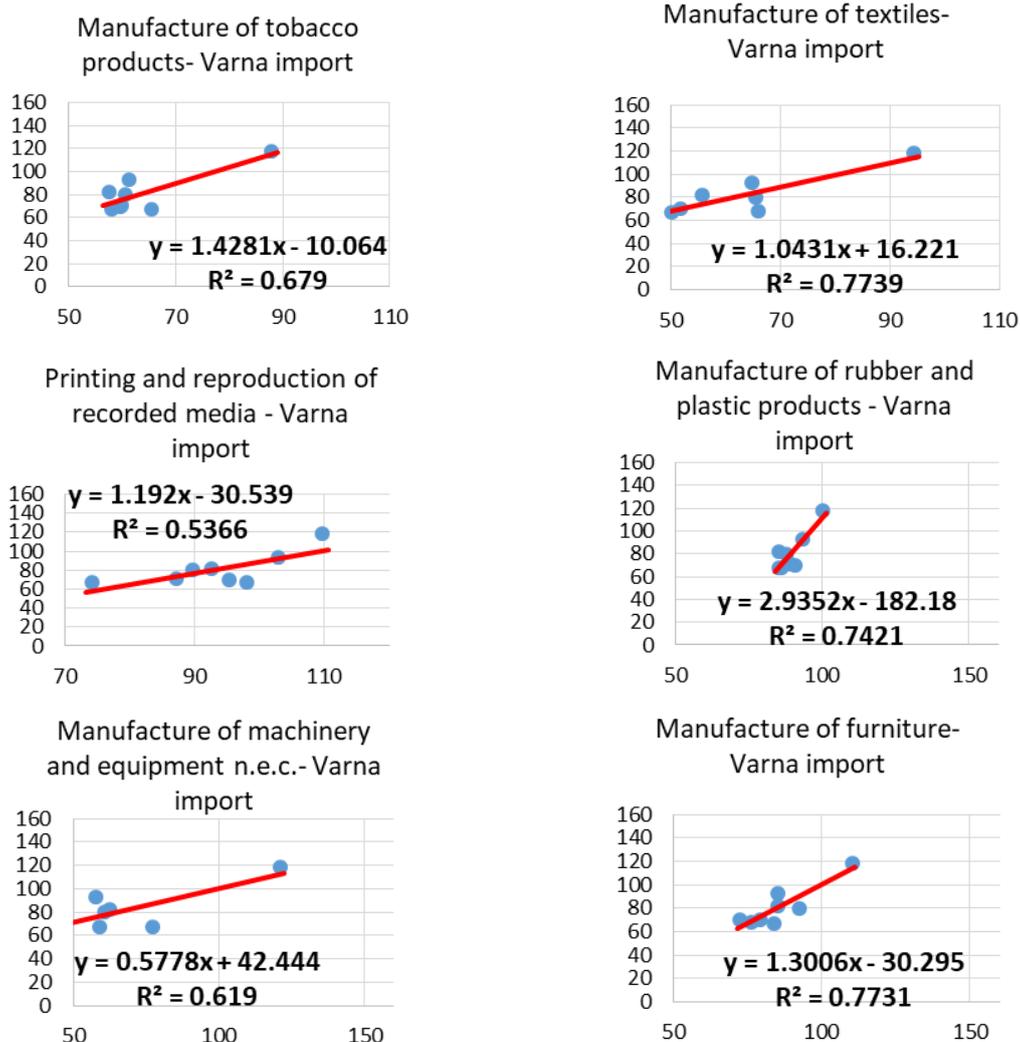


Fig. 9 Regression models of the dependencies between the imports in the Port of Varna and specific factors

Specific factors, influencing the imports in the Port of Burgas are:

- Manufacture of chemicals and chemical products;
- Manufacture of other non-metallic mineral products;

- Manufacture of computer, electronic and optical products;
- Manufacture of motor vehicles, trailers and semi-trailers.

The regression models of those dependencies and their equations are presented on Figure 9.

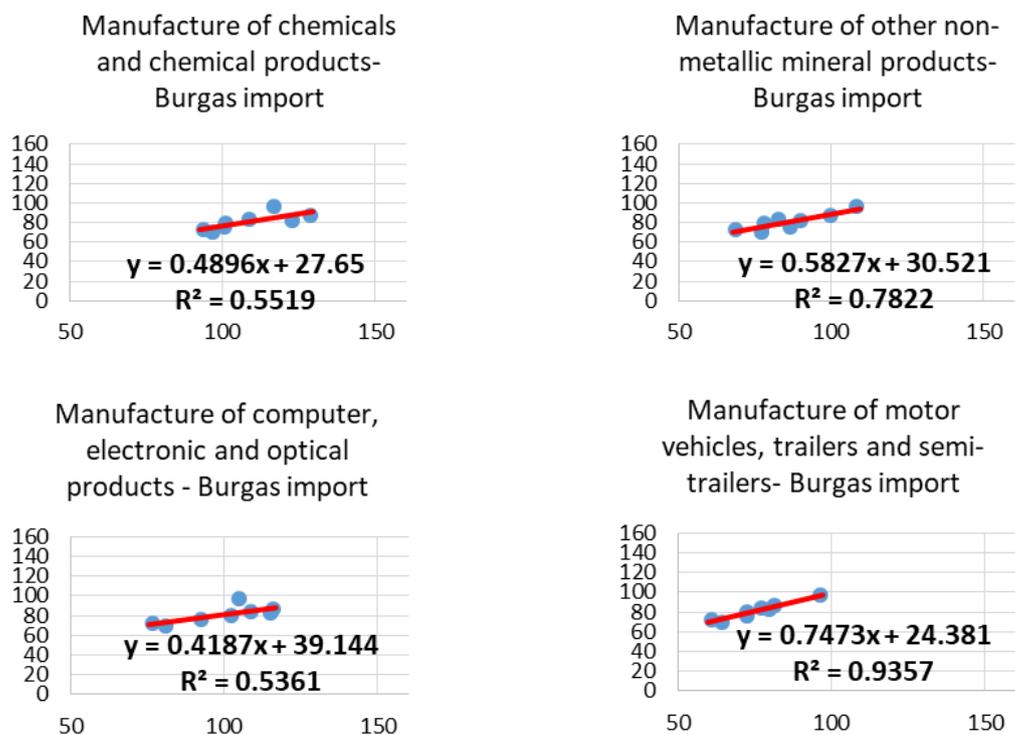


Fig. 10 Regression models of the dependencies between the imports in the Port of Burgas and specific factors

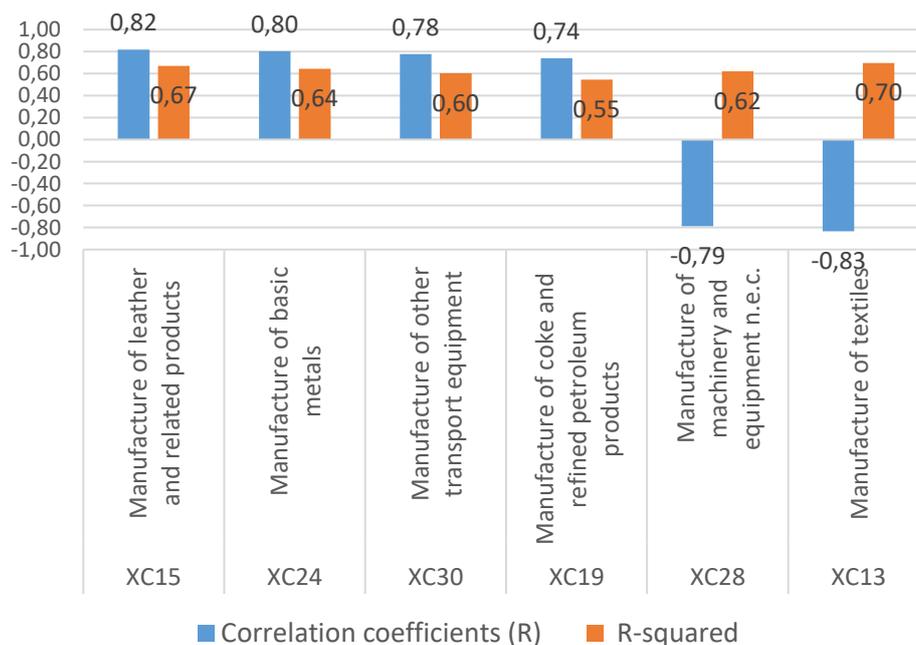


Fig. 11 Statistically significant dependencies for the export of the port of Varna

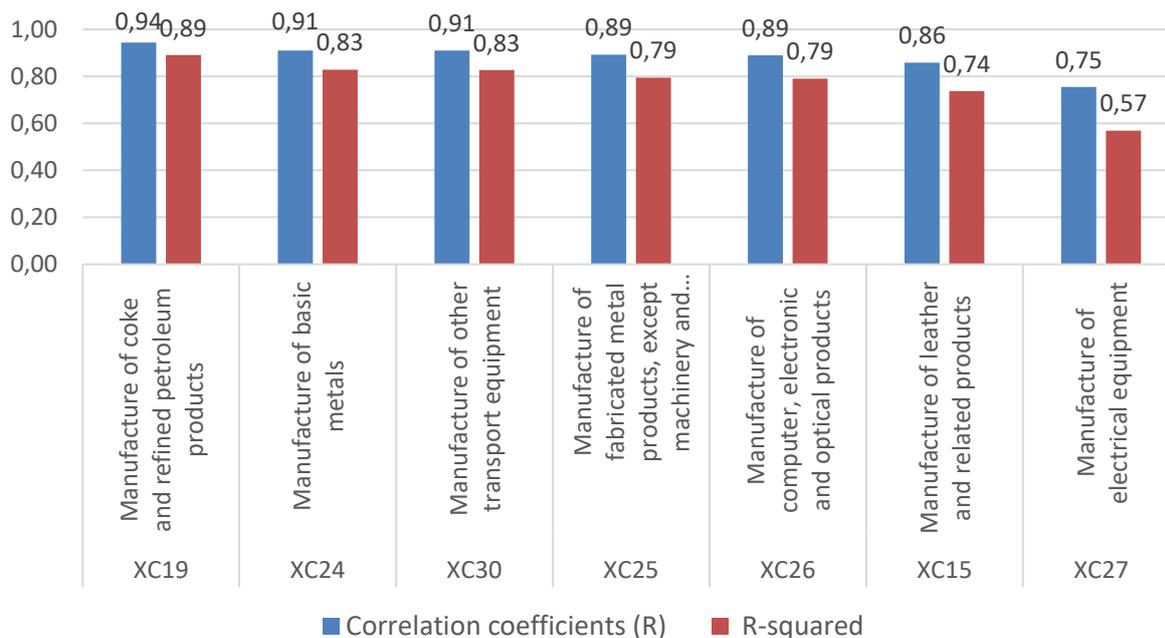


Fig. 12 Statistically significant dependencies for the export of port Burgas

The freight turnover for exports through the Port Varna and the Port of Burgas is highly influenced by 8 economic activities (Figures 10 and 11).

The freight turnover for exports in both ports is positively influenced by the following economic activities:

- Manufacture of leather and related products;

- Manufacture of coke and refined petroleum products;
- Manufacture of basic metals;
- Manufacture of other transport equipment.

The regression models of those dependencies and their equations are presented on Figure 12.

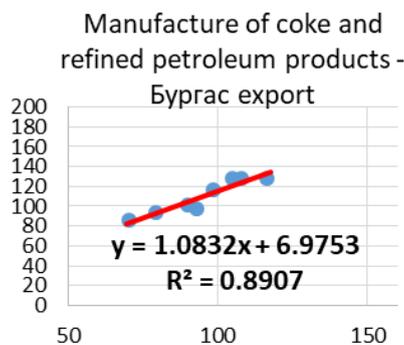
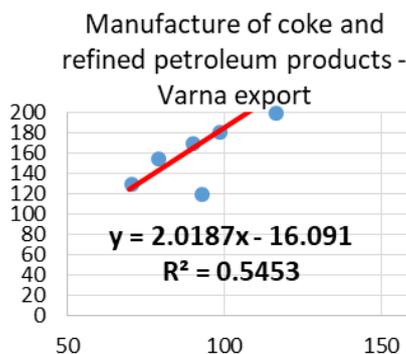
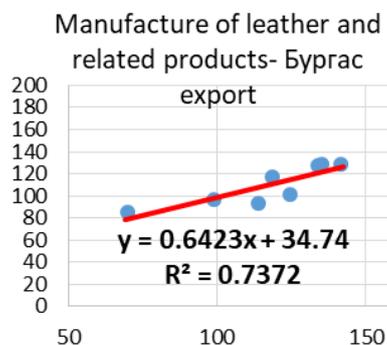
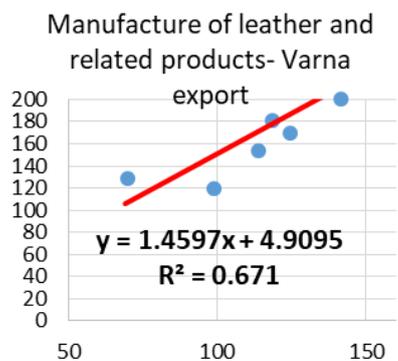


Fig. 13 Regression models of the exports through the Port of Bugas and the Port of Varna and the influence of common factors (Continuation on the next page)

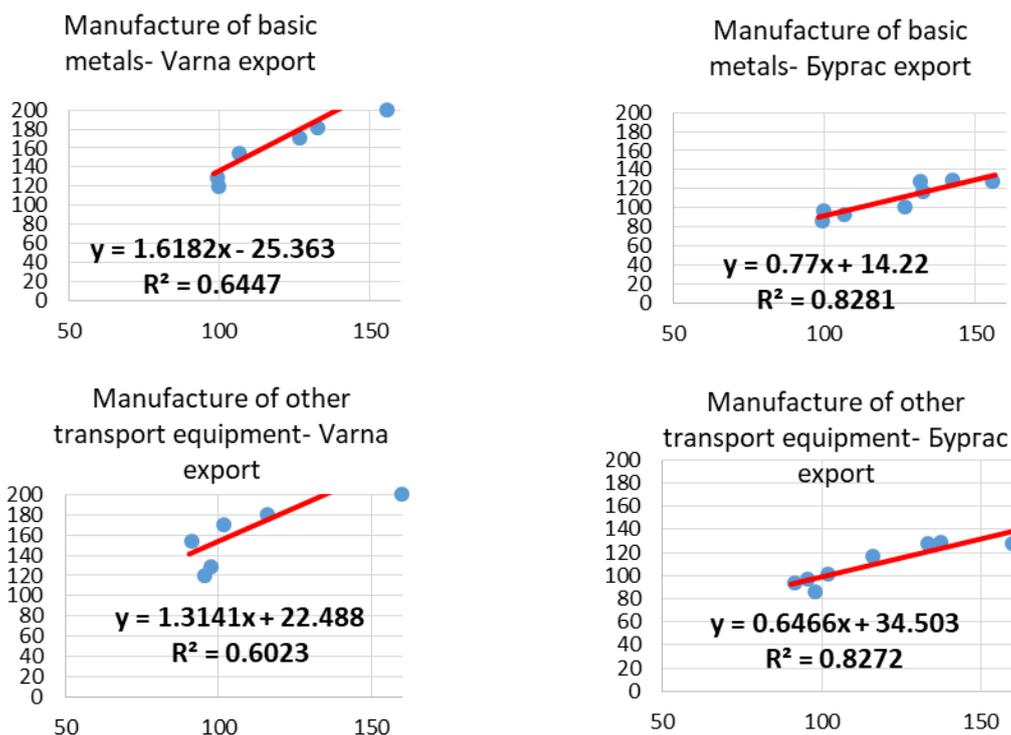


Fig. 14 Regression models of the exports through the Port of Bugas and the Port of Varna and the influence of common factors

Two economic activities with negative influence over the exports freight turnover in the Port of Varna are the following:

- Manufacture of textiles;

- Manufacture of machinery and equipment n.e.c.
The regression models of those dependencies and their equations are presented on Figure 13.

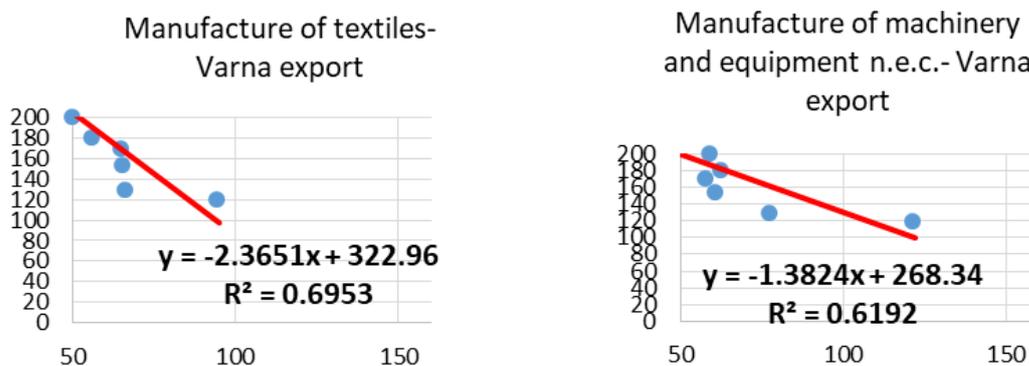


Fig. 15 Regression models of the dependencies between the exports and the significant factor variables for the Port of Varna

The specific factors for the Port of Burgas, influencing the exports freight turnover are presented by three economic activities:

- Manufacture of fabricated metal products, except machinery and equipment;

- Manufacture of computer, electronic and optical products;
- Manufacture of electrical equipment.

The regression equations and the models of those dependencies are represented on Figure 14.

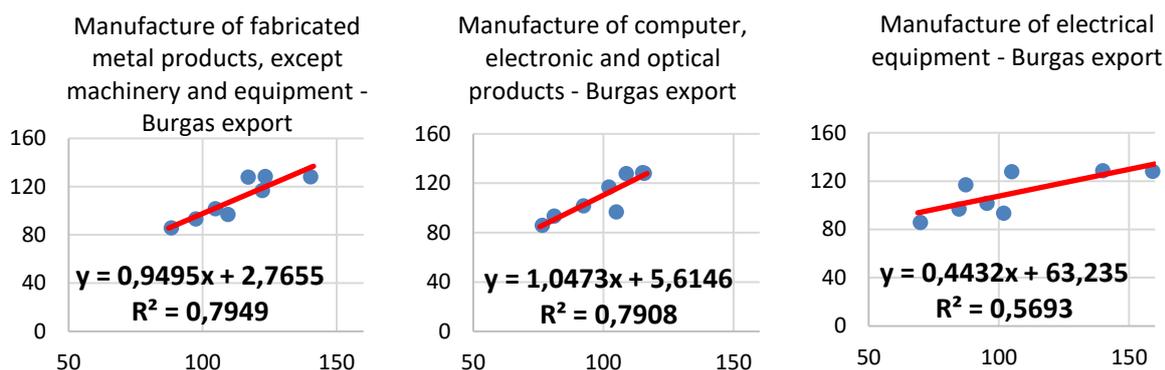


Fig. 16 Regression models of the dependencies between the exports and the significant factor variables for the Port of Burgas

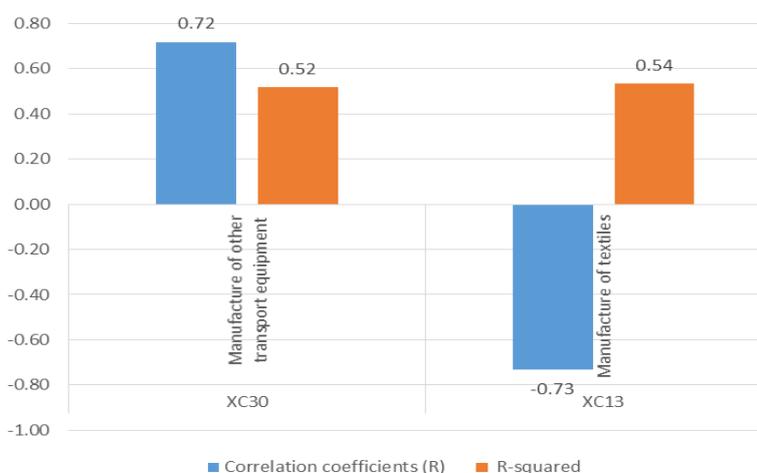


Fig. 17 Statistically significant dependencies for the transit of the Port of Varna

The transit freight turnover through the Port of Varna is highly influenced by two economic activities (Figure 15).

The economic activity “Manufacture of other transport equipment” has a positive influence over the transit freight turnover of the Port of Varna.

The economic activity “Manufacture of textiles”, with positive influence over the imports in the Port of Varna has approximately the same but negative influence on the transit freight turnover of the port.

There are 5 economic activities, significantly influencing the level of the transit freight turnover of the Port of Burgas in negative point of view (Figure 16).

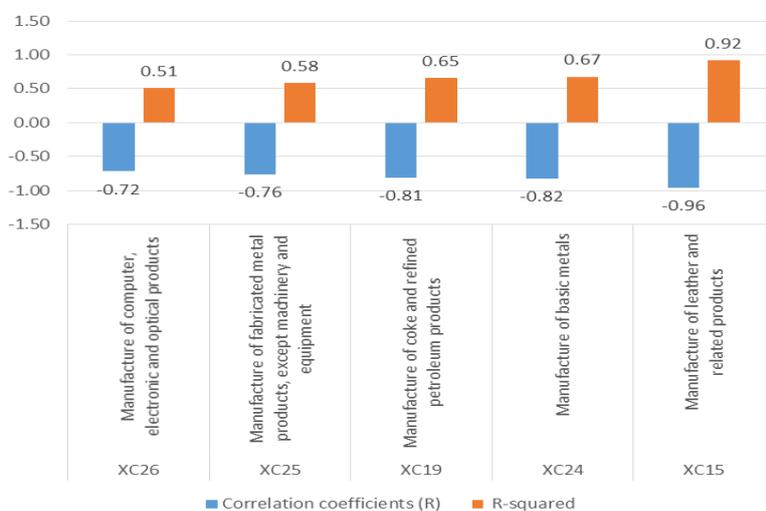


Fig. 18 Statistically significant dependencies for the transit of the Burgas port

The same factors show positive correlation with the export freight turnover of the Port of Burgas, while the economic activity “Manufacture of computer, electronic and optical products” is influencing positively the levels of imports through the port.

The following three activities are influencing positively the levels of exports through the Port of Varna:

- Manufacture of leather and related products;
- Manufacture of coke and refined petroleum products;
- Manufacture of basic metals.

Summarized by type of freight turnover and direction of the influences of the different economic activities the results are presented in Table 5.

Table 5. Direction of economic activity influence on port freight turnover for imports, exports and transit

Factor variables (Economic Activities)		Dependent variables					
		Port Varna			Port Burgas		
		import	export	transit	import	export	transit
X	Industry total	...	...	...	+++	...	...
XB	Mining and quarrying	+++	...	...	...	...	...
XB5	Mining of coal and lignite	...	...	...	...	...	...
XB7	Mining of metal ores	...	...	...	...	...	...
XB8	Other mining and quarrying	+++	...	...	+++	...	...
XC	Manufacturing	+++	...	...	...	...	...
XC10	Manufacture of food products	...	...	...	...	...	...
XC11	Manufacture of beverages	+++	...	...	+++	...	...
XC12	Manufacture of tobacco products	+++	...	...	...	...	...
XC13	Manufacture of textiles	+++	---	---	...	...	...
XC14	Manufacture of wearing apparel	+++	...	...	+++	...	...
XC15	Manufacture of leather and related products	...	+++	...	...	+++	---
XC16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	...	...	...	...	...	...
XC18	Printing and reproduction of recorded media	+++	...	...	...	...	...
XC19	Manufacture of coke and refined petroleum products	...	+++	...	...	+++	---
XC20	Manufacture of chemicals and chemical products	...	...	...	+++	...	...
XC21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	+++	...	...	+++	...	...
XC22	Manufacture of rubber and plastic products	+++	...	...	...	...	...
XC23	Manufacture of other non-metallic mineral products	...	...	...	+++	...	...
XC24	Manufacture of basic metals	...	+++	...	...	+++	---
XC25	Manufacture of fabricated metal products, except machinery and equipment	...	...	...	...	+++	---
XC26	Manufacture of computer, electronic and optical products	...	...	...	+++	+++	---
XC27	Manufacture of electrical equipment	...	...	...	...	+++	...
XC28	Manufacture of machinery and equipment n.e.c.	+++	---	...	...	...	...
XC29	Manufacture of motor vehicles, trailers and semi-trailers	...	...	...	+++	...	...
XC30	Manufacture of other transport equipment	...	+++	+++	...	+++	...
XC31	Manufacture of furniture	+++	...	...	...	...	...
XC32	Other manufacturing	...	...	...	...	...	...
XC33	Repair and installation of machinery and equipment	...	...	...	...	...	...

5 CONCLUSIONS

The results indicate, that all the dependencies between economic activities and the freight turnover of the selected ports, defined as statistically significant have correlation coefficient $R > |0.7|$ and $R^2 > 0.5$.

The research shows, that 23 among the reviewed 29 economic activities have got a statistically significant influence over the freight turnover of the ports and the mutual relations could be adequately represented for the purposes of forecasting by means of uni-factor linear models.

There are no established significant linear links to the freight turnover of the ports for six among the researched economic activities (Mining of coal and lignite; Mining of metal ores; Manufacture of food products; Manufacture of wood and of products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials; Other manufacturing; Repair and installation of machinery and equipment).

The significant correlations for the imports and exports through the ports are positive, while for the levels of the transit freight turnover the observed correlations with the factor variables are mostly negative.

Eight of the researched economic activities turn to be common factors for both ports. Four of them are influencing the import levels of both ports (Other mining and quarrying; Manufacture of beverages; Manufacture of wearing apparel; Manufacture of basic pharmaceutical products and pharmaceutical preparations) and another four are influencing the export levels (Manufacture of leather and related products, Manufacture of

coke and refined petroleum products, Manufacture of basic metals, Manufacture of other transport equipment).

Certain part of the economic activities are negatively or reciprocally influencing the levels of the port freight turnover.

Significant negative influence over the exports levels through the Port of Varna have two economic activities (Manufacture of textiles и Manufacture of machinery and equipment n.e.c.).

The economic activity "Manufacture of textiles" has also a significant negative influence over the transit freight turnover of the Port of Varna.

Significant negative influence over the transit freight turnover of the Port of Burgas have economic activities (Manufacture of leather and related products; Manufacture of coke and refined petroleum products; Manufacture of basic metals; Manufacture of fabricated metal products, except machinery and equipment; Manufacture of computer, electronic and optical products). Simultaneously, these activities have a considerable positive influence over the exports through the Port of Burgas, and the first three are also influencing positively the exports through the Port of Varna.

For both ports, none of the observed economic activities has a significant negative influence over the imports.

For the Port of Burgas, no significant negative influence over the exports is observed on the side of the researched economic activities.

WORKS CITED

- Jezev, E., & Kirilova, G. (2017, January 15). Industrial influence on the international freight traffic of the land transports in the Republic of Bulgaria. (Z. Cekerevac, Ed.) *MEST Journal*, 5(1), 47-56. doi:10.12709/mest.05.05.01.06
- Jezev, E., & Kirilova, G. (2015). Impact of the industry in the Republic of Bulgaria on the transport market demand. 20. Medzinarodna vedecka konferencia Riesenie krizovych situacii v specifickom prostredi. Zilina: Fakulta bezpecnostneho inzinierstva ZU.
- EC. (2018). Eurostat - Industry, trade, and services. Retrieved from Eurostat: <http://ec.europa.eu/eurostat>
- NSI. (2018). Short-term Business Statistics. Retrieved from National Statistical Institute: <http://www.nsi.bg/en/content/6797/short-term-business-statistics>
- EC, (2006). Statistical Classification of Economic Activities in the European Community (NACE). Retrieved December 2018 from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006R1893>