Modelling Transport Demands in Maritime Passenger Traffic

Modeliranje potražnje prijevoza u putničkom pomorskom prometu

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Summary

In this paper, the research has been carried out on the impact of gross domestic product (GDP) and the number of tourist arrivals (TA) on traffic demand in maritime passenger traffic in the Republic of Croatia. The initial assumption of this study is that the number of passengers carried in Croatian maritime transport (NP) depends on the number of tourist arrivals and the gross domestic product. The results are based on statistical methods of regression and correlation analysis. Tha analysis period spans over the years 1979. – 2013. The obtained insights could help help shippers in maritime passenger transport, and managers at all levels in maritime industry.

KEY WORDS

model
maritime passenger transport
demand
gross domestic product
tourists

Sažetak

U ovom je radu istražen utjecaj bruto domaćeg proizvoda (BDP) i broja dolazaka turista (DT) na prijevoznu potražnju u pomorskom putničkom prometu u Republici Hrvatskoj. Polazna pretpostavka ovoga rada je da broj prevezenih putnika u pomorskom putničkom prometu (BP) u Republici Hrvatskoj ovisi o broju dolazaka turista i bruto domaćem proizvodu. Rezultati istraživanja temelje se na statističkim metodama regresijske i korelacijske analize. Statističkom analizom obuhvaćeno je razdoblje od 1979. do 2013. godine. Dobivene spoznaje mogu pomoći brodarima u pomorskom putničkom prometu, odnosno menadžerima na svim razinama u pomorskom gospodarstvu.

KLJUČNE RIJEČI

*model
pomorski putnički promet
potražnja
bruto domaći proizvod
turisti*

1. INTRODUCTION / *Uvod*

With more than 27 million of passengers carried in maritime transport, the Republic of Croatia is in the top class of 28 EU countries. Regarding the number of passengers carried in relation to the number of inhabitants, with 6.4 passengers per capita, Croatia also belongs to the top class EU-28. Countries with higher ratio in 2013. are Malta, with 20.8 passengers per capita, Estonia with 9.8, Denmark with 7.3 and Greece with 6.6. Italian and Greek ports each handled roughly twice as many maritime passengers in 2012. as in any other EU Member State, there 76.7 million and 72.8 million passengers accounting for 19.3 % and 18.3 % of the EU-28 total respectively. Denmark (41 million passengers) had the next highest number of maritime passengers, followed by Germany, Sweden, the United Kingdom, Croatia, France (data are for 2012.) and Spain, which each handled between 30 million and 23 million passengers in 2013.[1] Data refer to the number of passengers „handled in

ports" (the sum of passengers embarked and then disembarked in ports). The number of maritime passengers carried in the EU-28 fell for four consecutive years, with passenger numbers down overall by 9.4 % between 2008. and 2012. The main objective of Croatian maritime policy perhaps should be an increase of this ratio to 7, that is an increase of passengers in maritime transport above the limit of 30 millions passengers.

Accordingly, the main objective of this study is to develop an appropriate econometric model to estimate the maritime and coastal transport of passengers in order to find out whether Croatia can achieve this increase, and if so, to determine the period in which it can be done. The correlation analysis was used to determine crucial factors in passenger transport demand[2] and in maritime transport demand, while the regression model was used to analytically express the relation between the number of tourist arrivals and the number of passengers carried from 1979.

[1] Cf. more: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Passenger_transport_statistics

[2] Cf. more: Pupavac, D. (2009): Načela ekonomike prometa, [Principles of Transport Economics], Rijeka, Veleučilište u Rijeci, [Polytechnics of Rijeka].
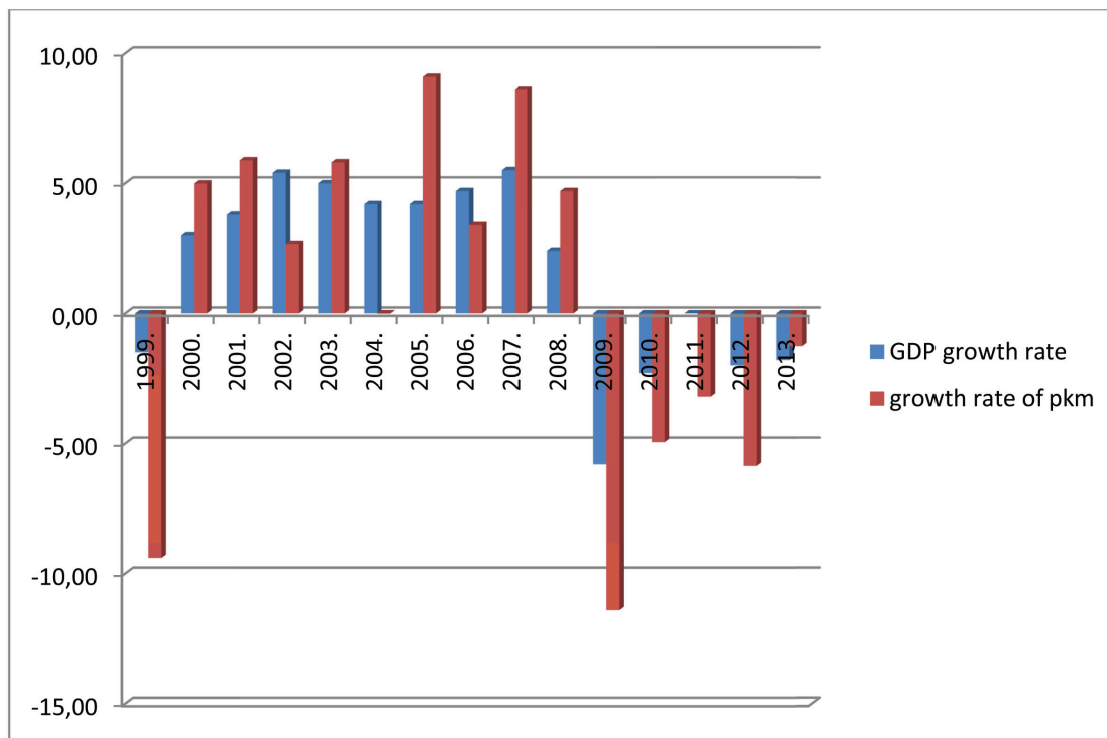
Figure 1 The interrrelation of annual GDP growth rates in actual prices and realized growth rates of passengers per kilometer from 1999. to 2013.
Slika 1. Međuodnos godišnje stope rasta BP po aktualnim cijenama i realizirana stopa rasta putnika po kilometru od 1999. do 2013.

to 2013. Data analysis and numerical calculations are performed using Statistica software.

2. PARAMETERS AFFECTING PASSENGER DEMAND / *Parametri koji utječu na potražnju putnika*

Transport is found to be closely related to the economic activity.[3] Both passenger and freight transport generally follow

[3] ECMT (European Conference of Ministers of Transport) (2001), Assessing the Benefits of Transport, OECD Publications, Paris.

the rate of economic development. Passenger transport is directly influenced by increased income and quality of life. One of key impacts on traffic demand is attibuted to GDP, because it typically generates an increase in travel. Recent researches within the European Union indicate a lag of growth rate of passenger transport demand compared to the GDP growth rate. Thus, for example, the passenger traffic in 2007. compared to that in 2000. has increased by only 9,33%, while the GDP of European countries in 2007. compared to that in 2000. has increased by 16,61%. The interrelation of annual GDP growth
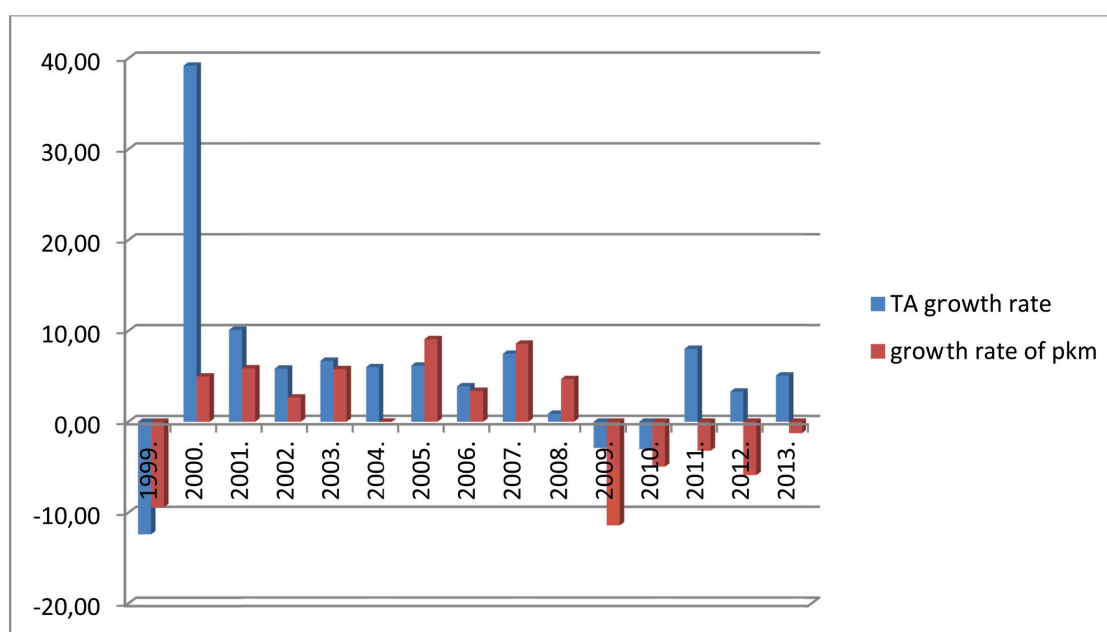

Figure 2 Interrelation of annual growth rates of tourist arrivals and passenger kilometers from 1999 to 2013.
Slika 2. Međuodnos godišnje stope rasta dolazaka turista i kilometara putnika od 1999. do 2013.

Table 1 Gross domestic product, tourist arrivals and seawater and coastal transport of passengers in Croatia from 1979. to 2013.

Tablica 1. Bruto domaći proizvod, dolasci putnika i pomorski i obalni prijevoz putnika u Hrvatskoj od 1979. do 2013.

Year	Tourist arrivals in 000	GDP (000 HRK at constant prices 1990)	Maritime passengers (in 000)
1979	7912	270873.52	8002
1980	7929	277591.22	7251
1981	8333	282220.66	6545
1982	8042	287810.1	6584
1983	8268	290761.67	6731
1984	9146	298659.81	7151
1985	10125	292006.43	7620
1986	10151	302134.8	8025
1987	10487	302525.04	8022
1988	10354	300807.94	8055
1989	9670	297392.4	8243
1990	8497	276277.54	8101
1991	2297	217982.98	4138
1992	2135	192478.97	6244
1993	2514	177080.65	5839
1994	3655	187528.41	5396
1995	2610	200280.34	5591
1996	4186	211968.42	5979
1997	5585	226346.67	6715
1998	5852	231158.76	6923
1999	5127	227685.12	6647
2000	7137	234589.65	8009
2001	7860	243585.96	9009
2002	8320	256841.78	9721
2003	8878	269575.02	10429
2004	9412	281031.02	10908
2005	9995	292859.83	11440
2006	10385	306739.8	12079
2007	11162	323522.76	12723
2008	11261	331155.41	12861
2009	10935	308305.68	12550
2010	10604	301214.65	12506
2011	11456	301214.65	12926
2012	11835	295190.36	12474
2013	12441	292238.45	13110

Source: Authors prepared according to: Statistical Yearbook of the Republic of Croatia, diferent years

rates in actual prices and realized growth rates of passengers per kilometer (pkm) in all transport sectors in Croatia is presented on Figure 1.

Data from Figure 1 show a correlation between the actual GDP growth rates and realized growth rates of passenger kilometers. This correlation is rather strong, as the number of realized passenger kilometers is growing at a higher rate when there is a growth in GDP. And vice versa, when the rate of GDP growth is negative, the total number of realized passenger kilometers shows greater negative rate.

Croatian economy is peculiar because tourism is one of the most important economic sectors, so further on, the number of tourist arrivals will be considered as a potential variable of an econometric model. Interrelation of annual percentage growth rate of tourist arrivals and growth rates of total realized passenger kilometers in all transport sectors in Croatia is presented in Figure 2.

3. CHOICE OF MODEL AND STATISTICAL DATA FOR MARITIME PASSENGER TRANSPORT DEMAND IN CROATIA / *Izbor modela i statistički podaci potražnje pomorskog putničkog prijevoza*

In order to make an objective forecast of seawater and coastal transport of passengers demand in Croatia, a theoretical model should be defined first. This study investigates dependance of realized seawater and coastal transport of passengers demand on the Croatian gross domestic product and the number of tourist arrivals. Accordingly, a model to estimate maritime passenger demand can be written as a function

$$NP = f (BDP, TA) \tag{1}$$

Where:
NP – maritime passenger demand,
GDP – gross domestic product,
TA – tourist arrivals.

Variable NP is a dependent variable, while GDP and TA are independent or explanatory variables.

Supposing that the number of passengers in maritime transport depends on the GDP and the number of tourist arrivals, its linear form would be as following:

$$Y = b_0 + b_1 BDP + b_2 DT \tag{2}$$

Data required for analysis are shown in Table 1.

Pearson's correlation coefficient was calculated from statistical data in Table 1 to determine the correlation between the maritime passenger demand as a dependent variable and of the gross domestic product and tourist arrivals as independent variables (cf. Table 2).

Data in Table 2 confirm the statistically firm correlation between the gross domestic product and the maritime passenger demand (r=0,69; p<0,05), and the number of tourist arrivals and maritime passenger demand (r=0,81; p<0,05). However, since there is a high correlation between these two independent variables (r=0,93; p<0,05), perhaps it is more suitable to apply only one of them (tourist arrivals) in construction of an econometric model.

Table 2 Correlation analysis
Tablica 2. Analiza korelacije

Variable	Correlations (Pomorski sta) Marked correlations are significant at p< .05000 N=35 (Casewise deletion of missing data)				
	Means	Std. Dev.	TA	GDP	NP
TA	8130.2	2964.10	1.000000	**0.939709**	**0.811194**
GDP	268275.3	41600.30	**0.939709**	1.000000	**0.692746**
NP	8701.3	2646.53	**0.811194**	**0.692746**	1.000000

Table 3 Regression analysis between seawater and coastal transport of passengers and tourist arrivals
Tablica 3. Analiza regresije između pomorskog i obalnog prijevoza putnika i dolazaka turista

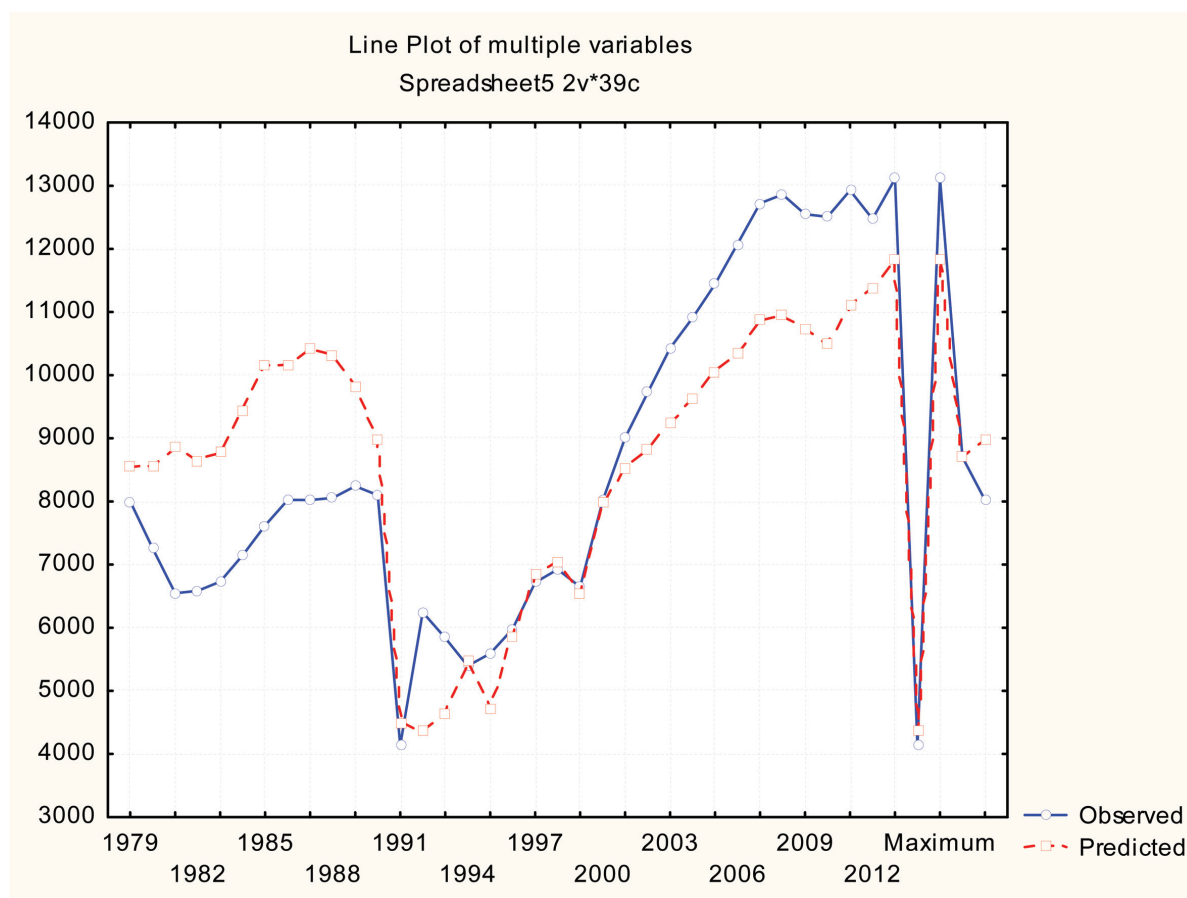| N=35	Regression Summary for Dependent Variable: NP (Pomorski R= .81119425 R2= .65803611 Adjusted R2= .64767357 F(1.33)=63.501 p<.00000 Std. Error of estimate: 1570.9					
	Beta	Std. Err. of Beta	B	Std. Err. of B	t(33)	p-level
Intercept			**2812.784**	**785.2130**	**3.582193**	**0.001082**
TA	**0.811194**	**0.101797**	**0.724**	**0.0909**	**7.968778**	**0.000000**

Figure 3 Comparison between the econometric model and the real data for the seawater and coastal transport of passengers in Croatia
Slika 3. Usporedba između ekonomskih modela i stvarnih podataka za pomorski i obalni putnički prijevoz u Hrvatskoj

Table 4 Estimate of maritime passenger demand by 2025 in Croatia
Tablica 4. Procjena potražnje za putničkim prijevozom do 2025. u Hrvatskoj

Year	TA		
	3%	4%	5%
MP_{2015}	12368.61	12555.06	12743.31
MP_{2016}	12655.29	12944.75	13239.84
MP_{2017}	12950.56	13350.03	13761.19
MP_{2018}	13254.69	13771.52	14308.61
MP_{2019}	13567.95	14209.87	14883.41
MP_{2020}	13890.61	14665.76	15486.94
MP_{2021}	14222.94	15139.87	16120.64
MP_{2022}	14565.25	15632.96	16786.04
MP_{2023}	14917.82	16145.76	17484.7
MP_{2024}	15280.97	16679.08	18218.3
MP_{2025}	15655.02	17233.74	18988.57

4. RESEARCH RESULTS AND DISCUSSION / *Rezultati istraživanja i diskusija*

After conducting correlation analysis, we decided on a one-dimensional model of linear regression in the following form:

$$Y = a + bX + u \qquad (3)$$

Where: X – independent variable, Y – dependent variable, u – deviation from the functional relation, a, b – parameters.

The number of tourist arrivals was selected as an independent variable, while the parameters were evaluated on the basis of statistical data from Table 1. In assessing the value of parameters in function (3) the method of regression analysis was applied, while the numerical computation was performed by *Statistica* software (cf. Table 3).

Regression analysis of the correlation between seawater and coastal transport of passengers and the number of tourist arrivals gives the following model of simple linear regression:

$$NP = 2812,784 + 0,724TA \qquad (4)$$

Results of regression analysis (cf. Table 3) indicate that there is a statistically significant correlation between seawater and coastal transport of passengers and the number of tourist arrivals (R=0,81; F(1,33)=63,6; p<0,01). Correlation between the total number of passengers carried and the number of tourist arrivals is positive, indicating that the increase in seawater and coastal transport of passengers is linked with an increase in the number of tourist arrivals. An increase in the number of tourist arrivals of one thousand leads to an increase in demand of approximately 724 passengers in the first year (B= 0,724; SE=0,0908; p<0,01).

An increase in seawater and coastal transport of passengers with 64,7% of variance can be explained by the number of tourist arrivals. Figure 3 shows a comparison between the actual and model predicted values of the dependent variable. Figure 3 also shows a satisfactory adaptation of the model to real data.

Based on the given model, an estimate maritime passenger demand by 2025. was made (cf. Table 4). The estimates are based on the assumption that in the forthcoming period the number of tourist arrivals will increase at an annual rate of 3,4 i 5%.

CONCLUSION / *Zaključak*

This study presented a simple linear regression model for forecasting seawater and coastal transport of passengers in Croatia. The model in which the tourist arrivals considered as an independent variable were made and tested. Model shows satisfactory theoretical, statistical and econometric values, and a high level of practical applicability in projecting seawater and coastal transport of passengers in Croatia. Optimistically, an increase in the number of passengers carried in Croatian maritime transport could be achieved by 2020. (provided that the average growth rate of tourist arrivals is 5%). In the same spirit, by 2025. the total number of passengers in maritime transport will be increased by 38,9 % compared to 2013.

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[4] Statistical Yearbook of the Republic of Croatia, different years