MACROECONOMIC MODEL OF DEMAND ESTIMATE FOR RAILWAY FREIGHT TRANSPORT IN CROATIA

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Abstract: The main goal of this scientific debate is to identify a function that describe, the relationship between Gross Domestic Product (GDP) as independent variable and demand for rail freight transport as dependent variable. We use regression analysis to estimate this function and use them to make prediction the demand for rail freight traffic until the year 2020. Forecasts of demand for rail freight traffic point to the doubling of demand by 2020. Despite this Croatian railways will continue to operate below the level of existing capacity.
Key words: railway, freight transport, demand, forecasts

1. INTRODUCTION

In a rapidly changing world, with increasing competition in all sectors of transportation, railways are in a period of restructuring their management and technology. New methods of organization are introduced, commercial and tariff policies change radically, a more entrepreneurial spirit is required (Profillidis, 2006). In this recession time railway sector need to adapt their capacities and costs quickly to the significantly lower demand currently experienced, but in doing so cannot afford to lose sight of the growth expected over the medium – to long – term (booz&co, 2009). As a consequence of the economic crisis, there will also be structural changes in major customer sectors for rail freight (for example, steel, chemicals and automotive). Acros Europe, the sector is now recording an unprecendented collapse in demand due to global economic crisis. In Croatia, the railway freight (down 18,5 % in tonne-kilometres and 20,5 % in goods carried) recorded similary figures in 2009 compared to the 2008. Railway in Croatia is at a critical decision point because *inter alia*: rail freight continues to lag significantly behind road transport, traffic volumes and revenues are in decline, staff morale is poor, operations are, generaly, of a low frequency and traffic densities are low. The aim of this study is to explore the interdependence of railway freight transport and GDP in contemporary Croatia for a period from 1990 until 2009 year to obtain a realistic basis for projecting the transport demands of rail freight traffic until the year 2020. To achieve the goal of research method of regression analysis was applied.

2. SELECT A MODEL FOR THE PREDICT OF RAIL FREIGHT TRANSPORT IN CROATIA

In general, increasing economic activity follows increasing trade, and vice versa. The reason for this lies in the fact that the basis of gross domestic product is industrial production (Pupavac, 2009). Since 2000, industrial production in the Republic of Croatia has increased on average about 5% each year and in 2008 its rate of growth was only 1.6%. Special attention should be paid to the fact that the industrial production in 2009 is declining (9.2%) and will not recover till 2011. To obtain a more accurate assessment of the movement of rail freight in the Republic of Croatia by the year 2020 the models of simple linear regression $Y = a + bx + \varepsilon$ and nonlinear two-dimensional regression model shape $y_i = ax_i^b\varepsilon_i$ where a and b are parameters to rate, x the size of GDP and ε represent a random disturbance, or error, term.

3. TESTING OF THE VARIATION IN GDP AND THE VOLUME OF RAIL FREIGHT TRAFFIC IN CROATIA

At the bbeginning of the 21 century rail transport in the Republic of Croatia is ignored. Rail transport is losing its edge against road. Corridors Vb, Vc and X run trough Croatia, connecting the European west and east and have large potential for traffic growth. It is realistic to expect that the Croatian entry into the European Union and the liberalization of European rail transport markets result in increased rail traffic. Testing of the variation of GDP and the volume of rail freight traffic in the Republic of Croatia is based on data for the period of 1990 - 2009. The data are taken from the Statistics Year-books of the Republic of Croatia – various years (cf. table 1).

Year	GDP (mln HRK at constant prices 1990)	Goods carried (000 t)	Tone – kilometers Mln
1990.	280.5	35796	6535
1991.	221.4	21479	3617
1992.	195.5	9585	1770
1993.	179.8	11685	1592
1994.	190.3	11279	1563
1995.	203.3	13318	1974
1996.	215.5	11061	1717
1997.	229.5	11035	1715
1998.	235.2	11505	1831
1999.	233.1	10349	1685
2000.	239.9	10059	1788
2001.	250.4	10807	2074
2002.	263.5	10654	2206
2003.	274.8	11723	2487
2004.	285.2	12234	2493
2005.	297.5	14333	2835
2006.	311.8	15395	3305
2007.	329.8	15764	3574
2008.	344.1	14851	3312
2009.	324.1	11793	2698

Tab. 1. Interrelation between GDP and the volume of rail freight transport in the Republic of Croatia

Regression analysis of the relationship between GDP and transport of goods by rail and number of tone-kilometers of rail transport makes the following models:

a) for a goods carried since 1990

linear model Y = 6107.54 + 29.88 X (r = 0,25)　　　(1)

non linear model Y = 737.19 x $^{0.519472}$ (r = 0,32)　　(2)

where: X - an index of growth of GDP Croatian (1990 = 100), and Y represent an index of growth of goods transport by rail

b) for a tone-kilometers since 1990

linear model Y = - 703.91 + 12.7 X (r = 0,52)　　(3)

non linear model Y = 1.901 x $^{1.289347}$ (r = 0,67)　　(4)

where: X - an index of growth of GDP Croatian (1990 = 100), and Y is the growth index tone-kilometers of rail traffic.

However, as from 1997 years of railway transport of goods excluded empty private wagons, made a model for the 1997-2009 periods.

c) for a goods carried since 1997

linear model Y = 807.048 + 41,45 X (r=0,82)　　(5)

non linear model Y = 1.8638 + x$^{0.9106}$ (r=0,82)　　(6)

for this two models corrected coefficient of multiple determination is only 0.68

d) for a tone-kilometers since 1997

linear model Y = - 1829.30 + 15.41 X (r = 0,95)　　(7)

non linear model Y = 0.113703 x$^{1.770759}$ (r = 0,96)　　(8)

Low correlation coefficients for the models a), b), and c) suggest that their full statistical uselessness. Models d) confirm similar trends in GDP and the number of tone-kilometers of rail freight transport. Relatively higher values of the R=0.96, corrected coefficient of multiple determination 0.93, F= 143,1 and t = 11,96 point to econometric and statistical usability of the non linear calculated model.

4. FORECASTING OF THE DEMAND FOR RAILWAY FREIGHT TRANSPORT

The conducted statistical testing of the function (8) shows that the function is sufficiently reliable and it can be established that the function adequately reflects the relationship between the number of the tone-kilometers and the GDP in the period 1997 – 2009. It seems appropriate to assume that in the coming period the GDP in the Republic of Croatia will increase. And if the starting point is the assumption that the GDP in 2010 will increase by 0,5 %, in 2011 by 2 % (Gligorov et al., 2009) and after that GDP will increase at an annual rate of 3 %, than the number of tone-kilometers in the railway sector until the year 2020 can be viewed from table 2.

Year	GDP mln HRK	The estimated number of tonne-kilometres (mln)	Index of change (2009=base year)
2010	325.7205	3201.953	118.6788
2011	332.2349	3316.224	122.9141
2012	342.202	3494.423	129.519
2013	352.468	3682.198	136.4788
2014	363.0421	3880.062	143.8125
2015	373.9333	4088.56	151.5404
2016	385.1513	4308.261	159.6835
2017	396.7059	4539.767	168.2642
2018	408.607	4783.714	177.3059
2019	420.8652	5040.77	186.8336
2020	433.4912	5311.638	196.8732

Tab. 2. Demand forecasts for railway freight transport until the year 2020

Forecasts of demand for rail freight traffic point to the doubling of demand by 2020. Despite this, demand will move to the level of 70% of demand predicted by the official planners and railways will continue to operate below the level of existing capacity. Of all the transport modes, the European rail sector has been hard- hit by the recession. It has been the same in Croatia. Croatian railway in this moment has three broad strategic option: 1) „do nothing" – decline of the railway over the time, 2) staying in the game – investing in asset renewal and replacment and accommodating underlying demand growth, 3) going for growth – investing in a expanded capacity and services to increase rail's market share over time. It is a known fact that the new advanced transport capacity, such as the possible new Rijeka railway line, can bring about the attraction of new quantities of transport and change in the existing cargo flows in favor of the Croatian railway. Rail operator, infrastructure company and goverment need to invest consistently in modernisation and expanding the rail network. The two main factors stimulating growth in freigh transport in the EU are: 1) integration of the European market and 2) liberalisation of the transport market. The effects of both of these factors on the growth in demand for rail transport in Croatia are expected in the coming period.

5. CONCLUSION

Demand forecasts serve as input to financial, marketing, and personnel planning. It requires comprehensive scientific research of global and individual influences in a narrow and wider catchment of the railway network. Regression analysis of the macroeconomic model to estimate demand for rail freight traffic has confirmed that the established interdependence between the demand for rail freight transport as the dependent variable and GDP as independent variables in the Republic of Croatia. Best theoretical, statistical and econometric results show a non-linear model $(Y = aX^b)$ where the dependent variable (Y) are number of tone-kilometers of rail freight traffic, and an independent variable (X) is GDP. Acceptable theoretical, statistical and econometrics results are shown by nonlinear model, that in this specific case is $Y = 0,113703 \ x^{1.770759}$.

The main limit of the proposed model lies in the fact that the geographic location of Croatia has not been taken into consideration. In fact, transit transport through the Croatian railway line is more than 40% of the total generated tone-kilometers. This means that transport on the lines of the Croatian Railways directly depends on the movement of GDP in the state of the narrower and wider gravity areas, particularly Hungary, Slovakia, Czech Republic, Austria, Slovenia, Bosnia and Herzegovina and Serbia. Therefore, in future research needs to explore the interdependence of transit traffic on the lines of the Croatian Railways and the trend GDP in those countries.

6. REFERENCES

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