

# RESEARCH OF THE DEVELOPMENT OF PERFORMANCES IN RAIL PASSENGER AND FREIGHT TRANSPORT IN COMPARISON WITH SELECTED ECONOMIC INDICATORS

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**Abstract:** The paper deals with analysis of the development of performances in freight rail transport in comparison with the development of gross domestic product as the main indicator measuring the economic performance of the country and on the other hand the performances in passenger rail transport in relation to the development of the average monthly wage as one of the most important indicator characterizing the living standard. The change in demand for transport services is analysed with respect to the change in the price of the ticket in passenger rail transport and also the change in the price for transport of one tonne of goods in freight rail transport

**Keywords:** MACRO-ECONOMIC INDICATORS, PASSENGER RAIL TRANSPORT, FREIGHT RAIL TRANSPORT, ELASTICITY

## 1. Introduction

The development of the economy in the country is influenced by the effective activity and cooperation of households, companies, the state and foreign countries. These four sectors are affected by each other. Consumers enter the market for their personal needs as a buyers, but also as a sellers. Their receipts from ownership of the production factors use for the purchase of goods, services, or savings. The companies produce goods, respectively offer the services, and come to the market for their sale. [1], [2].

The specific role in this cycle has a state, which should guarantee the appropriate conditions for companies but on the other hand also for the households, which are the main customers. [3].

Transport is one of the most important sectors of the economy. The share of transport in gross domestic product (GDP) is about 6% in Slovakia. According to the Statistical Office of Slovakia were employed almost 99 thousand people in transport sector in 2014 while 12.5% of this number were employed in railway transport. Therefore, it is relevant to examine the impact of economic indicators on the change of performances in rail passenger and freight transport.

## 2. Comparison of the transport performances and macroeconomic indicators

Economic situation of the country can be characterized by a number of basic indicators. The development of freight rail transport is compared in relation to the gross domestic product and the development of passenger rail transport depending on the average monthly wage.

### 2.1 Performances of freight rail transport in comparison with GDP

The most commonly used indicator characterizing the economic situation in the state is gross domestic product. It represents the value of final goods and services produced in the time period on the national territory by production factors owned by the citizens of the country or foreigners working in that country. It is that part of gross production which is intended for final consumption (not to the next production) and satisfies the final consumers. [4], [5].

Figure 1 shows the development of the GDP (in constant prices) and transport performances of freight rail transport (in tonne kilometers).

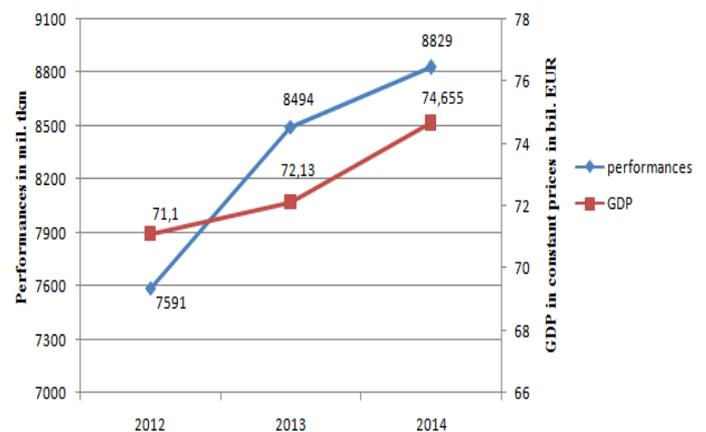


Fig. 1 The performances of freight rail transport in comparison with GDP

The gross domestic product of Slovakia regularly increased by more than one billion eur in the last period, however the most significant increase was between the years 2013 and 2014 (more than 2,5 billion eur) with the assumption of a continuation of this trend in the future.

The same development was also in the performances of freight rail transport in the analysis period when the increase between the years 2012 and 2014 was 1 238 million tkm (almost 17%).

### 2.2 Performances of passenger rail transport in comparison with average monthly wage

Statistics indicate an average monthly level of wages of the employee for the whole economy of Slovakia, therefore include all sectors of economic activities with the exception of management or business receipts and also the receipts of their shareholders, military components, people on maternity and parental leave. The data are classified according to economic activity, geographical area, age groups or education.

Passenger kilometers (pkm) are the most appropriate measure for transport statistics and their comparison in passenger transport because an indicator the number of passengers can bring a high risk of double counting, especially in international transport.

Figure 2 shows the development of average gross monthly wage in the national economy in comparison with the performances of passenger rail transport.

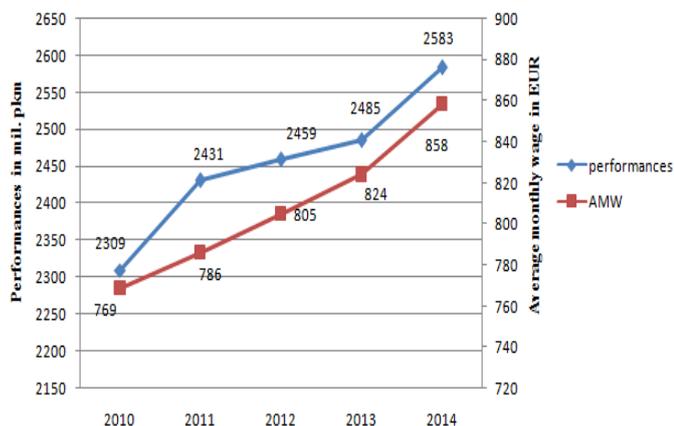


Fig. 2 The performances of passenger rail transport in comparison with average monthly wage

The average monthly wage in Slovakia for the last five years reflects the development of the gross domestic product. An increase of almost 20€ is recorded each year, while the most significant increase was between the last two analyzed years (up to 34€). According to different economic situations of regions is the average monthly wage regarded as substandard in certain areas of Slovakia in relation to others where the wage is much lower.

The development of performances in passenger rail transport (expressed in passenger kilometers) showed a similar trend in the years 2010 - 2014, however the last two months of 2014 were significantly affected by the introduction of free transport for certain groups of passengers.

### 3. Price elasticity of demand for services in passenger and freight rail transport

Price elasticity of demand (PED) shows the relationship between price and quantity demanded and provides a precise calculation of the effect of a change in price on quantity demanded. The degree of response of quantity demanded to a change in price can vary considerably. The key benchmark for measuring elasticity is whether the co-efficient is greater or less than proportionate. If quantity demanded changes proportionately, then the value of PED is 1, which is called 'unit elasticity'.

PED can also be:

- Less than one, which means PED is inelastic.
- Greater than one, which is elastic.
- Zero (0), which is perfectly inelastic.
- Infinite ( $\infty$ ), which is perfectly elastic.

PED on a linear demand curve will fall continuously as the curve slopes downwards, moving from left to right. PED = 1 at the midpoint of a linear demand curve.

#### 3.1. Price elasticity of demand for services in passenger rail transport

Cenová elasticita dopytu po doprave sa vypočíta ako pomer zmeny množstva vyjadreného najčastejšie prepravným výkonom a zmeny ceny. Pri cenovej elasticite sme skúmali závislosť výkonov železničnej osobnej dopravy od zmeny ceny cestovného lístka. Vzhľadom na to, že cestovné je v železničnej doprave stanovené pre jednotlivé tarifné pásma, ktorých veľkosť nie je rovnaká, uskutočnili sme prepočet výšky cestovného tak, aby zohľadňovala rôzne vzdialenosti jednotlivých tarifných pásiem (Fig. 3).

Tariff distance in km (from-to)	Center of interval	2010		2011		2012		2013		2014	
		price of the ticket (2nd class)	Ø price	price of the ticket (2nd class)	Ø price	price of the ticket (2nd class)	Ø price	price of the ticket (2nd class)	Ø price	price of the ticket (2nd class)	Ø price
1 5	3	0,26	0,0867	0,26	0,0867	0,5	0,1667	0,5	0,1667	0,5	0,1667
6 10	8	0,4	0,0500	0,4	0,0500	0,65	0,0813	0,65	0,0813	0,65	0,0813
11 15	13	0,6	0,0462	0,6	0,0462	0,9	0,0692	0,9	0,0692	0,9	0,0692
16 20	18	0,8	0,0444	0,8	0,0444	1,15	0,0639	1,15	0,0639	1,15	0,0639
21 25	23	1,06	0,0461	1,06	0,0461	1,4	0,0609	1,4	0,0609	1,4	0,0609
26 30	28	1,18	0,0421	1,18	0,0421	1,65	0,0589	1,65	0,0589	1,65	0,0589
31 35	33	1,38	0,0418	1,38	0,0418	1,9	0,0576	1,9	0,0576	1,9	0,0576
36 40	38	1,58	0,0416	1,58	0,0416	2,15	0,0566	2,15	0,0566	2,15	0,0566
41 45	43	1,92	0,0447	1,92	0,0447	2,4	0,0558	2,4	0,0558	2,4	0,0558
46 50	48	2,18	0,0454	2,18	0,0454	2,65	0,0552	2,65	0,0552	2,65	0,0552
51 55	53	2,52	0,0475	2,52	0,0475	2,9	0,0547	2,9	0,0547	2,9	0,0547
56 60	58	2,72	0,0469	2,72	0,0469	3,15	0,0543	3,15	0,0543	3,15	0,0543
61 65	63	2,98	0,0473	2,98	0,0473	3,4	0,0540	3,4	0,0540	3,4	0,0540
66 70	68	3,18	0,0468	3,18	0,0468	3,65	0,0537	3,65	0,0537	3,65	0,0537
71 80	75,5	3,72	0,0493	3,72	0,0493	4,02	0,0532	4,02	0,0532	4,02	0,0532
81 90	85,5	4,18	0,0489	4,18	0,0489	4,525	0,0529	4,525	0,0529	4,525	0,0529
91 100	95,5	4,78	0,0501	4,78	0,0501	5,02	0,0526	5,02	0,0526	5,02	0,0526
101 110	105,5	5,1	0,0483	5,1	0,0483	5,48	0,0519	5,48	0,0519	5,48	0,0519
111 120	115,5	5,5	0,0476	5,5	0,0476	5,88	0,0509	5,88	0,0509	5,88	0,0509
121 130	125,5	5,96	0,0475	5,96	0,0475	6,28	0,0500	6,28	0,0500	6,28	0,0500
131 140	135,5	6,3	0,0465	6,3	0,0465	6,68	0,0493	6,68	0,0493	6,68	0,0493
141 150	145,5	6,64	0,0456	6,64	0,0456	7,08	0,0487	7,08	0,0487	7,08	0,0487
151 170	160,5	7,3	0,0455	7,3	0,0455	7,67	0,0478	7,67	0,0478	7,67	0,0478
171 190	180,5	8,02	0,0444	8,02	0,0444	8,48	0,0470	8,48	0,0470	8,48	0,0470
191 210	200,5	8,9	0,0444	8,9	0,0444	9,28	0,0463	9,28	0,0463	9,28	0,0463
211 230	220,5	9,68	0,0439	9,68	0,0439	10,08	0,0457	10,08	0,0457	10,08	0,0457
231 250	240,5	10,48	0,0436	10,48	0,0436	10,86	0,0452	10,86	0,0452	10,86	0,0452
251 270	260,5	11,48	0,0441	11,48	0,0441	11,68	0,0448	11,68	0,0448	11,68	0,0448
271 290	280,5	12,08	0,0431	12,08	0,0431	12,48	0,0445	12,48	0,0445	12,48	0,0445
291 310	300,5	12,48	0,0415	12,48	0,0415	13,28	0,0442	13,28	0,0442	13,28	0,0442
311 330	320,5	13,34	0,0416	13,34	0,0416	14,08	0,0439	14,08	0,0439	14,08	0,0439
331 350	340,5	13,94	0,0409	13,94	0,0409	14,88	0,0437	14,88	0,0437	14,88	0,0437
351 370	360,5	15	0,0416	15	0,0416	15,68	0,0435	15,68	0,0435	15,68	0,0435
371 390	380,5	15,6	0,0410	15,6	0,0410	16,48	0,0433	16,48	0,0433	16,48	0,0433
391 410	400,5	16	0,0400	16	0,0400	17,07	0,0426	17,07	0,0426	17,07	0,0426
411 430	420,5	16,66	0,0396	16,66	0,0396	17,87	0,0425	17,87	0,0425	17,87	0,0425
431 450	440,5	17,18	0,0390	17,18	0,0390	18,59	0,0422	18,59	0,0422	18,59	0,0422
451 470	460,5	17,98	0,0390	17,98	0,0390	19,37	0,0421	19,37	0,0421	19,37	0,0421
471 490	480,5	18,58	0,0387	18,58	0,0387	20,19	0,0420	20,19	0,0420	20,19	0,0420
491 510	500,5	18,98	0,0379	18,98	0,0379	20,87	0,0417	20,87	0,0417	20,87	0,0417
		Σ 1,8111		Σ 1,8111		Σ 2,1453		Σ 2,1453		Σ 2,1453	
		average 0,0453		average 0,0453		average 0,0536		average 0,05363		average 0,0536	

Fig. 3 Calculation of average price for transport

We calculated the average price as the average of the prices for one passenger kilometer in the individual tariff zones. Prices in passenger rail transport are regulated by the state therefore does not change often. Figure 4 shows the price elasticity of demand for passenger rail transport in the years 2011-2014.

	2010	2011	2012	2013	2014
Performances of passenger rail transport in mil. pkm	2309	2431	2459	2485	2583
Average price for 1 pkm in EUR	0,04528	0,04528	0,05363	0,05363	0,05363
Price elasticity	X	0,0257	0,0057	0,0053	0,0193

Fig. 4: Effect of change in performances of passenger rail transport to the price for one pkm

The coefficient of price elasticity is less than one in all cases, what means that the demand for services of public passenger rail transport is inelastic - it is not significantly affected by the change of the ticket price.

#### 3.2. Price elasticity of demand for services in freight rail transport

Price elasticity of freight rail transport is focused on the dependence of the change in the rates for the transport of 1 tonne of goods from the transport performances. The rate for transport of 1 tonne of goods is set out for each tariff zone as well as in passenger transport (Fig. 5). The conversion is processed for each analyzed year, where the result is the average price for one tonne kilometre. The list of rates is referred in Tariff for freight rail transport – TR1.

Tariff distance in km (from-to)	Center of interval	2012		2013		2014		
		Rate for transport of one tonne	Ø price	Rate for transport of one tonne	Ø price	Rate for transport of one tonne	Ø price	
1	10	5,5	5,97	1,0855	6,45	1,1727	6,63	1,2055
11	20	15,5	6,59	0,4252	7,12	0,4594	7,32	0,4723
21	30	25,5	7,44	0,2918	8,04	0,3153	8,26	0,3239
31	40	35,5	8,28	0,2332	8,94	0,2518	9,19	0,2589
41	50	45,5	9,23	0,2029	9,97	0,2191	10,24	0,2251
51	60	55,5	10,15	0,1829	10,96	0,1975	11,26	0,2029
61	70	65,5	11,17	0,1705	12,06	0,1841	12,39	0,1892
71	80	75,5	11,9	0,1576	12,85	0,1702	13,2	0,1748
81	90	85,5	12,64	0,1478	13,65	0,1596	14,02	0,1640
91	100	95,5	13,34	0,1397	14,41	0,1509	14,8	0,1550
101	110	105,5	14,08	0,1335	15,21	0,1442	15,63	0,1482
111	120	115,5	14,84	0,1285	16,03	0,1388	16,47	0,1426
121	130	125,5	15,46	0,1232	16,7	0,1331	17,16	0,1367
131	140	135,5	16,2	0,1196	17,5	0,1292	17,98	0,1327
141	150	145,5	16,96	0,1166	18,32	0,1259	18,82	0,1293
151	160	155,5	17,58	0,1131	18,99	0,1221	19,51	0,1255
161	180	170,5	18,79	0,1102	20,29	0,1190	20,84	0,1222
181	200	190,5	20,16	0,1058	21,77	0,1143	22,36	0,1174
201	220	210,5	21,46	0,1019	23,18	0,1101	23,81	0,1131
221	240	230,5	22,76	0,0987	24,58	0,1066	25,25	0,1095
241	260	250,5	23,96	0,0956	25,88	0,1033	26,58	0,1061
261	280	270,5	25,16	0,0930	27,17	0,1004	27,91	0,1032
281	300	290,5	26,35	0,0907	28,46	0,0980	29,23	0,1006
301	320	310,5	27,52	0,0886	29,72	0,0957	30,53	0,0983
321	340	330,5	28,65	0,0867	30,94	0,0936	31,78	0,0962
341	360	350,5	29,71	0,0848	32,09	0,0916	32,96	0,0940
361	380	370,5	30,77	0,0830	33,23	0,0897	34,13	0,0921
381	400	390,5	31,83	0,0815	34,38	0,0880	35,31	0,0904
401	420	410,5	32,82	0,0800	35,45	0,0864	36,41	0,0887
421	440	430,5	33,74	0,0784	36,44	0,0846	37,43	0,0869
441	460	450,5	34,73	0,0771	37,51	0,0833	38,53	0,0855
461	480	470,5	35,61	0,0757	38,46	0,0817	39,5	0,0840
481	500	490,5	36,56	0,0745	39,48	0,0805	40,55	0,0827
501	520	510,5	37,41	0,0733	40,4	0,0791	41,5	0,0813
521	540	530,5	38,21	0,0720	41,27	0,0778	42,39	0,0799
541	560	550,5	38,97	0,0708	42,09	0,0765	43,23	0,0785
561	580	570,5	39,75	0,0697	42,93	0,0752	44,09	0,0773
581	600	590,5	40,51	0,0686	43,75	0,0741	44,94	0,0761
		Σ	5,6321		Σ	6,0835	Σ	6,2505
		average	0,1482		average	0,1601	average	0,1645

Fig. 5 Calculation of average price for transport

We calculated the average price as the average of the prices for one tonne kilometer in the individual tariff zones. The used list of rates is for railway wagons, which are owned by the carrier.

Price elasticity of demand for freight rail transport in the years 2013 and 2014 is shown in Figure 6.

	2012	2013	2014
Performances of freight rail transport in mil. tkm	7591	8494	8829
Average price for 1 tkm in EUR	0,1482	0,1601	0,1645
Price elasticity	X	1,454431	1,42665

Fig. 6 Effect of change in performances of freight rail transport to the price for one tkm

The coefficient of price elasticity is more than one in both cases, what means that the demand for services of freight rail transport is elastic. Performances of freight rail transport increased every year, although the rate for transport of one tonne of goods also increased also. This fact could be affected by increased interest in intermodal transport.

#### 4. Conclusion

The good economic situation and living standards is also reflected positively on the increasing demand for services in passenger and freight rail transport. The increase in the number of passengers carried in the period was recorded each year during the period, even between years 2010 and 2014 it was more than 11%. Despite this fact, we are concluded on the basis of price elasticity that the demand remains inelastic to change of price in passenger rail transport. This trend indicates that the price in passenger rail transport is not the most important factor for passengers in deciding on the choice of type of transport. The situation in freight transport was similar when the increase of performances was observed in comparing the years 2012 and 2014, despite the changes in the rates for transport of one tonne of goods.

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