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## IMPACT OF POLISH MEMBERSHIP IN THE EU ON TRANSPORTATION SECTOR

**Abstract.** Poland's decision to join the European Union exerted a strong influence on the functioning of Polish economy. The structure of foreign trade showed significant changes in both the pre-accession period and after 1 May 2004, modifying the composition of exports and imports and the directions of foreign trade. The changes made some branches re-adjust their production, as well as affected economic sectors, other than manufacturing. The paper analyses the influence of economic restructuring on the functioning of cargo transport by branch, paying special attention to road transport and rail transport. It presents the basic characteristics of Polish transport and contrasts them with appropriate measures describing EU member states. A regression analysis was applied to capture the causal relations explaining the functioning of transport. The analysis corroborated the hypothesis that Poland's EU membership influenced Polish transport, but only with respect to road transport.

**Key words:** the structure and dynamics of the Polish transport, cargo tonnage, regression analysis.

This year Poland is celebrating the 20<sup>th</sup> anniversary of her systemic reforms. They have remodelled the functioning of the country's economy toward ensuring, *inter alia*, free operation of the market mechanisms. The goal has been achieved through mass privatisation of the state-owned assets. As a result, the public sector's share in total output went down to 18.1% in 2007<sup>1</sup>. Other factors of significant impact on the functioning of Poland's economy included the country's efforts to join the European Union, awarded with a membership in the Community in 2004. That period substantially changed the sphere of goods production and the sectors' shares in economic activity underwent major changes. This article concentrates on transport, treating it as a branch of economy that primarily deals with the carriage of cargo and passengers and adjusts its services to meet demand reported by industry, trade or building (cargo) as well as the general public (passengers). Because cargo transportation plays a crucial role from the perspective of

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<sup>1</sup> See Statistical Yearbook of Poland 2008, GUS, Warsaw 2008, p. 684, table 5(571).

economic processes, we shall focus our attention on this type of transport<sup>2</sup>, setting it against the output of other branches.

All transport activities can be divided into the following branches: road transport, rail transport, pipeline transport, sea and inland waterway transport, and air transport. The division refers to a means of transport as well as the type of a road it uses. Table 1 characterizes the activity of the distinguished branches and other transportation services in Poland and the entire EU, using data such as the numbers of employees and enterprises, and turnover.

Table 1. The structure of transportation business in Poland and the EU in 2006 (%)

Type of activity	No. of employees		No. of enterprises		Turnover	
	Poland	EU27	Poland	EU27	Poland	EU27
Road cargo transport	38.1	31.9	55.5	52.6	42.0	23.1
Road passenger transport	25.2	20.7	34.7	28.9	10.3	7.5
Rail transport	20.5	10.1	0.1	0.1	13.3	6.4
Pipeline transport	0.6	0.2	0.0	0.0	3.2	0.7
Inland waterway transport	0.2	0.5	0.4	0.1	0.4	0.5
Sea transport	0.5	1.9	0.1	0.9	1.5	7.4
Air transport	0.9	4.6	0.1	0.3	4.1	9.9
Travel agencies	3.0	5.5	4.1	6.9	5.7	12.7
Other auxiliary	11.1	24.6	5.1	10.2	19.4	31.8

Source: developed by the author based on: [www.stat.gov.pl/gus/eurostat\\_PLK\\_HTML.htm](http://www.stat.gov.pl/gus/eurostat_PLK_HTML.htm)

The turnover data are the most diverse, particularly the Polish share of road cargo transport significantly exceeds (42%) its EU equivalent (23.1 %), whereas the turnover for other auxiliary business is definitely lower for Poland (19.4% against 31.8% in EU27). The Polish structure and the EU structure are quite similar as far as the numbers of enterprises are concerned, but then the shares of turnover by type of business reveal an overwhelmingly large proportion of enterprises providing road transport services – in Poland the proportion is over 90%, whereas in the EU it slightly exceeds above 80%. The different shares of employees could

<sup>2</sup> „Revenues from the sale of transport and storage products and services include payments received for transporting cargo and passengers (including municipal transport), luggage and mail, trans-shipment, forwarding, freight storing and warehousing and other services to transport, as well as the receipts from services rendered by travel agencies, couriers on package tours, tourist guides” (see Notes on Chapter XVIII Transport and Communications, Statistical Yearbook of Poland 2008, GUS, Warsaw 2008, p. 520). In 2007, revenues from cargo transport made up only 41.9% of the branch’s total revenue, whereas the passenger transport revenues stood at merely 12.9%.

be explained in relation to the varying shares of the numbers of enterprises. An exception is rail transport where the proportions of the numbers of enterprises are at the same (very low) level in Poland and the EU, even though the Polish share of the number of employees is twice as large as EU's. A positive phenomenon is that Poland and the EU have similar volumes of turnover, as this proves comparable productivity of labour.

The situation is quite different when transport services are measured in terms of transport performance (in tonne-kilometres), that is without the auxiliary services and passenger transport. To illustrate the Polish transport evolution, Table 2 presents its structure in the years 1997 and 2007 against the EU.

Table 2. The structure of cargo transport (tonne-km) in Poland and the EU in 1997 and 2007 (%)

Type of transport	Poland		EU (27)	
	1997	2007	1997	2007
Road transport	19.3	59.7	42.0	45.6
Rail transport	20.8	20.3	12.6	10.7
Inland waterways transport	0.3	0.5	4.0	3.3
Sea transport	55.0	10.7	37.5	37.3
Pipeline transport	4.5	8.8	3.8	3.0
Air transport	0.0	0.0	0.1	0.1

Source: developed by the author based on: [www.stat.gov.pl/gus/eurostat\\_PLK\\_HTML.htm](http://www.stat.gov.pl/gus/eurostat_PLK_HTML.htm)

The structure of EU cargo transport changed insignificantly between the compared years – the share of road transport slightly grew at the cost of rail transport. In Poland, however, road transport substantially increased its share, while the sea transport's share declined steeply. This situation mainly arises from the applied measure that takes account of distances and from the rearrangement of Poland's partners in foreign trade, favouring the EU member states. The large share of sea transport services in 1997 is determined by the fact that the distances travelled by ships are incomparably longer than in road transport. Poland's share of sea transport expressed exclusively as the volumes of transported goods (tonnes) was 1.8%, declining to 0.7% in 2007.

The structural differences caused by the application of two different measures are also reflected in the dynamics of the categories, as illustrated by figure 1.

Because cargo tonnage decreased between 1997 and 2003, the volume of cargo transported in the year 2007 exceeds its 1995 level by merely 11.6%. However, when the distances travelled by trucks are taken into account, cargo volumes grow in the entire period in question and the 2007 volume given by tonne-kilometres is three times as large as in 1995. The year 2004 was a turning point in road transport, because cargo tonnage increased then by 4.9% against the previous year, and by as much as 28.5% regarding tonne-kilometres.

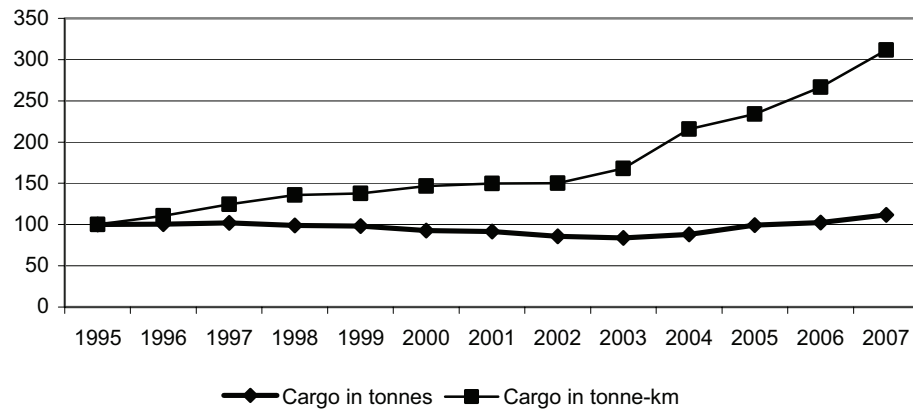


Figure 1. Dynamics of cargo volumes transported by road by Polish enterprises, years 1995–2007 (year 1995=100)

Source: developed by the author based on data derived from GUS Statistical Yearbooks.

A distinctive feature of cargo transport in Poland is that its volumes grew much faster than GDP in the recent years, while in EU27 as a whole the two indicators rose at a similar rate (see figure 2).

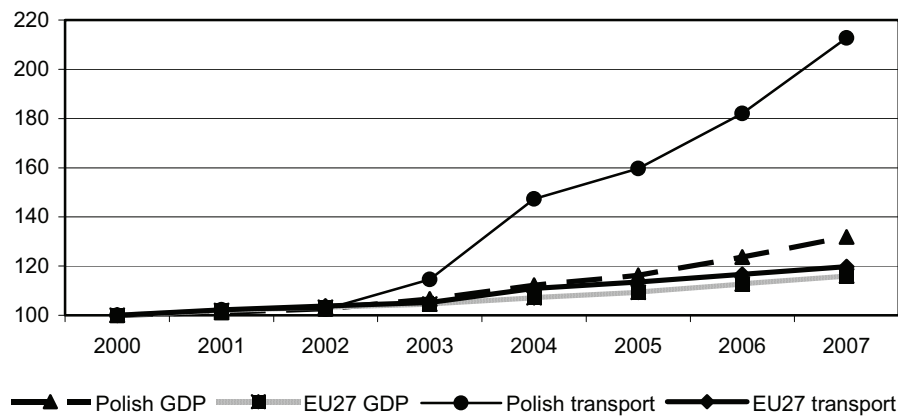


Figure 2. The dynamics of cargo volumes transported in Poland and the EU (year 2000=100)

Source: developed by the author based on data derived from GUS Statistical Yearbooks and [www.stat.gov.pl/gus/eurostat\\_PLK\\_HTML.htm](http://www.stat.gov.pl/gus/eurostat_PLK_HTML.htm)

The difference between GDP dynamics and transport dynamics in EU27 in 2007 stands at 3.7 percentage point in favour of transport services, whereas in Poland it is 80.8 p.p. A similarly large difference appears between the years 1995 and 2007 after comparing the annual average rates of growth for GDP and transport (see table 3).

Cargo transport by road prevails in the EU as a whole and in Poland, because it offers a whole range of benefits, mainly the possibility of delivering goods to any point of destination. A motor vehicle is the only means of transport having this capability.

Table 3. Annual average rate of changes in GDP and cargo volumes transported by road in Poland and EU27, years 1995–2007 (%)

Category	Poland	EU27
GDP	4.6	2.5
Cargo transport	9.9	2.7

Source: developed and calculated by the author based on GUS Annual Yearbooks and [www.stat.gov.pl/gus/eurostat\\_PLK\\_HTML.htm](http://www.stat.gov.pl/gus/eurostat_PLK_HTML.htm)

To avoid sea transport interference in the structure of cargo transport, we shall compare Poland and EU27 again, but this time taking only land transport. Figure 3 presents the two structures for the years 1997 and 2007 in terms of transport performance.

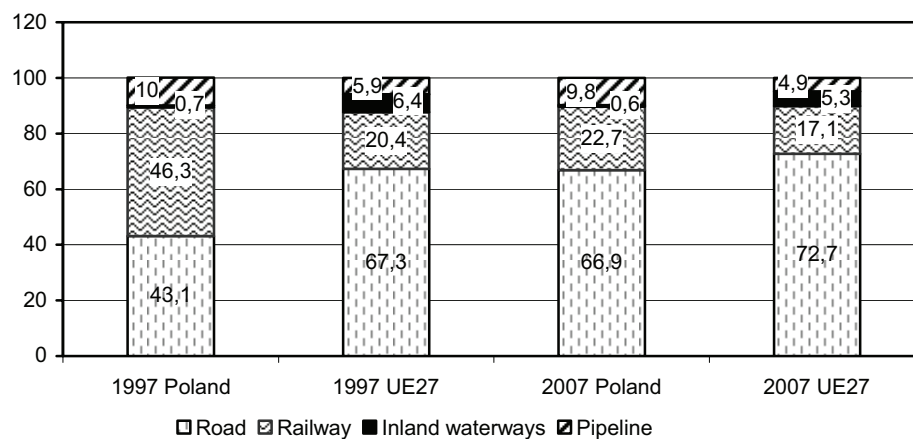


Figure 3. The structure of cargo volumes carried by land (tonne-km) by transport type in Poland and the EU, years 1997 and 2007 (%)

Source: developed and calculated by the author based on GUS Statistical Yearbooks and [www.stat.gov.pl/gus/eurostat\\_PLK\\_HTML.htm](http://www.stat.gov.pl/gus/eurostat_PLK_HTML.htm)

Because of the changes that Poland introduced in 1997 and in the following years, the structure of the Polish cargo transport in 2007 largely resembled that in the EU ten years earlier. An exception was the share of inland waterway transport, which was insignificant in Poland.

The growing role of road transport in Poland should be attributed in the first place to the increasing share of services delivered under transnational transport. One of the factors behind this increase was the expanding foreign trade activities following the opening of the Polish economy. Another element associated with Poland's EU membership was that the Polish firms were allowed to provide transport services, other than those related to Polish export or import, outside the country, for instance between foreign countries, and cabotage. The data in table 4 show how the opportunities were used.

Table 4. The characteristics of Poland's road cargo transport

Year	International transport services as a share of total transport (%)		Transport services between foreign countries / cabotage as a share of international transport (%)	
	tonnes	tonne-kilometre	tonnes	tonne-kilometre
2004	5.8	42.8	13.2	12.5
2005	6.1	45.5	22.3	22.2
2006	8.3	53.7	28.7	27.1

Source: developed and calculated by the author based on *Transport – Wyniki działalności z lat 2004–2006*, GUS, Warsaw 2005, 2006, 2007.

Considering that the data span a short period, the structural changes should be viewed as considerable, regarding both cargo tonnage and distances. For transport analysed in terms of tonne-kilometres the 2007, share of international transport services exceeds 50%. This fact positively characterizes the quantitative aspect of development of the branch 'transport' and the effectiveness of its functioning. Empty trips plotted on figure 4 as a share of total transport services (in million truck-kilometres) suggest a much higher operational efficiency of international transport.

### ECONOMETRIC ANALYSIS

To see which factors elicit transport changes the most clearly, a regression analysis intended to explain the evolution of cargo transport based on 1995-2007 time series was conducted. Cargo transport was examined using two variants of the quantitative approach, i.e. tonnes and tonne-kilometres. An attempt was made to explain the total cargo volume (i.e. an aggregate of all modes of transport), but separate models for road transport and railway transport were also constructed. It was assumed that cargo volumes were determined by the following factors:

- the value of output minus exports, in constant prices (prodex),
- foreign trade turnover (export plus import), in constant prices (impex),
- variables representing changes in the assortment structure of produced goods, as well as export and import.

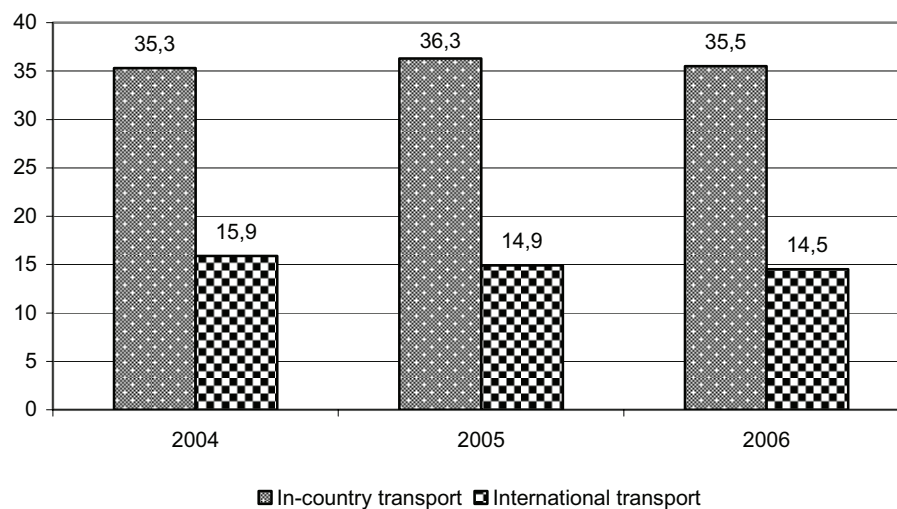


Figure 4. The share of empty trips in total road transport services (%)

Source: developed and calculated by the author based on *Transport – Wyniki działalności* from the years 2004-2006, GUS, Warsaw 2005, 2006, 2007

Although the effect of EU membership was already embodied in the structural changes, a dummy variable (*unia*) was additionally applied, which took the value 1 in the years 2004-2007 and 0 for the earlier period. The linear function parameters were estimated by means of an ordinary Least Square Method, using the software DEMS (Zatoń W. [2004]).

A large number of the tested variants turned out to be unacceptable, regarding both the fundamental evaluation of the estimated parameters and their statistical properties. A regularity that was common to different estimates was definitely inferior results obtained for cargo volumes expressed in tonnes. In this case, the level of explanation was too low and the variables representing economic factors affecting cargo volumes did not prove that such an existence did exist. An exception was road cargo transport, whose regression line can be deemed good.

For total cargo volumes (million tonne-km), the best of the variant results was:

$\text{totalcargo2} = -370872.8381 + 0.7737 * (\text{prodex}) + 16345.4248 * (\text{uei1})$				
SE =	18249.220	R <sup>2</sup> =	0.718	r = -0.100
MAPE =	4.585	KR <sup>2</sup> =	0.662	DW = 2.199
J-B =	4.726	p-ist(J-B) =	0.094	F = 12.752
				p-ist(F) = 0.002
Variable	Reg. coefficient	Elasticity	t - stat	P - ist(t)
constant	-370872.8381		-2.179	0.054
prodex	0.7737	0.5319	2.350	0.041
uei1	16345.4248	1.7873	4.429	0.001

Cargo volumes are positively correlated with output and the modifications in the structure of goods traded with abroad (uei1) that aimed to enlarge the share of consumer products made cargo volumes grow. Both the variables exert a strong influence on cargo volumes. However, the downside of the presented results is the low level of explanation; the determination coefficient indicates that the model accounts for less than 72 % of changes in transport. This is shown on figure 5, where the actual values and the theoretical ones arising from the model are plotted.

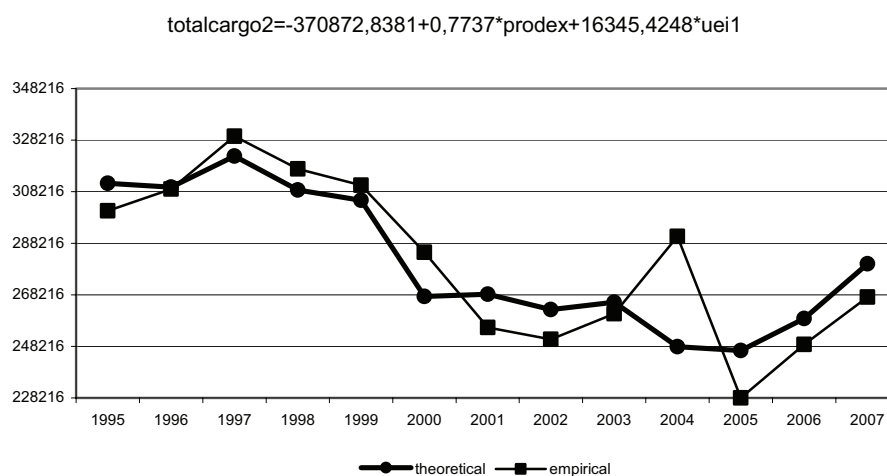


Figure 5. Estimates for the model of total cargo volume (million tonne-km)

Source: calculated by the author.

The figure reveals that transport changes are irregular and thus difficult to describe. Two typical values are particularly notable, i.e. the years 2003 and 2004, when the downward trend that had been developing over several earlier years collapsed twice. The presented model omits the influence of foreign trade turnover –



this variable did not markedly affect cargo volumes. The attempt to identify the changes resulting from Poland's EU membership also failed.

Foreign trade is not important for rail cargo transport, as it was not important for total transport volume discussed above. Two variables explaining rail transport are output manufactured to meet the domestic demand and changes in the output's assortment structure:

$\text{rail2} = 203079.4561 + 0.1416 * (\text{prodex}) - 3386.9275 * (\text{up2})$					
SE =	2539.324	R <sup>2</sup> =	0.914	r =	0.400
MAPE =	3.245	KR <sup>2</sup> =	0.897	DW =	1.201
J-B =	0.540	p-ist(J-B)=	0.763	F =	53.219
				p-ist(F)=	< 0.001
Variable	Reg. Coefficient	Elasticity	t - stat	p - ist(t)	
constant	203079.4561		13.986	< 0.001	
prodex	0.1416	0.4854	3.517	0.006	
up2	-3386.9275	-3.0860	-8.833	< 0.001	

In this case, structural changes bring down rail cargo volumes as expected. Bulk goods intended for further processing predominate in rail transport and so the parameter at the variable up2 is negative. The model's statistical properties are satisfactory and the determination coefficient exceeding 90% should be accepted as good enough, especially that the explained category shows atypical changes in some years.

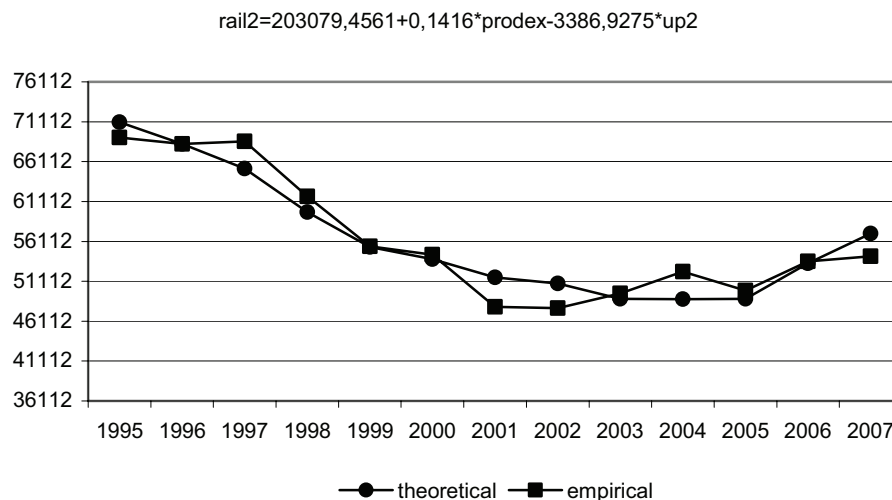


Figure 6. Parameter estimates for the rail transport model (million tonne-kilometres)  
Source: calculated by the author .

The attempt to capture the foreign trade impact on road cargo volumes also failed for volumes expressed in tonnes of carried cargo (road1):

Road1 = 3293484.3257 + 1.2102 * (prodex) - 55289.4907 * (uei2)					
SE =	27497.019	R <sup>2</sup> =	0.912	r =	-0.029
MAPE =	1.596	KR <sup>2</sup> =	0.894	DW =	2.059
J-B =	14.619	p-ist(J-B)=	< 0.001	F =	51.814
				p-ist(F)=	< 0.001
Variable	Reg. Coefficient	Elasticity	t - stat	p - ist(t)	
constant	3293484.3257		12.360	< 0.001	
prodex	1.2102	0.2228	4.408	0.001	
uei2	-55289.4907	-2.3604	-9.393	< 0.001	

Interestingly, a changing foreign trade structure has a significant and negative effect on the volumes of trucked cargo, which is contrary to expectations. The explanatory variables' parameters in this model are statistically significant and the level of function explanation is similar to that in the rail transport model. Unfortunately, the model fails to meet the assumption of distribution normality of the free term as proved by the value of the Jarque-Bera (J-B) statistics.

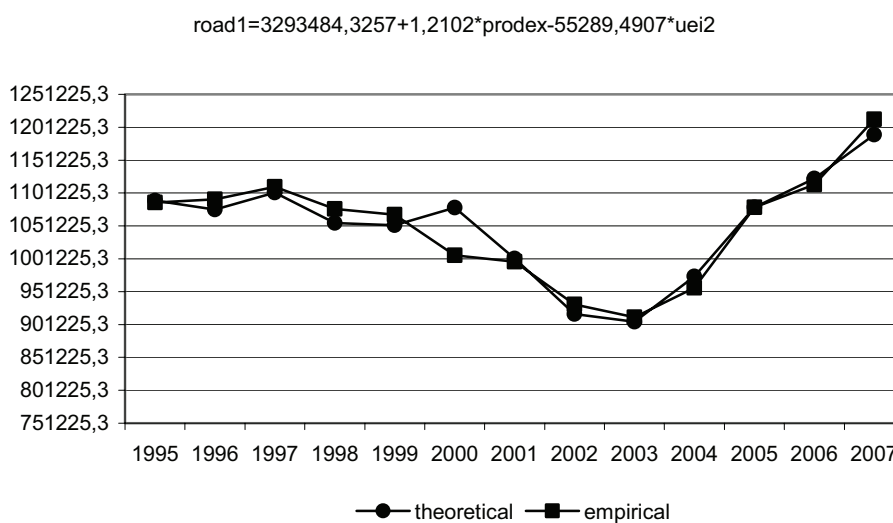


Figure 7. Estimates for the model of road cargo transport (in thousand tonnes)

Source: calculated by the author.

In this case too the effect of foreign trade turnover was not statistically significant.

Much better results were obtained for trucked cargo volumes expressed in million tonne-kilometres. Several alternative models are available, but their quality is similar, which impedes choosing the best of them. All the models show that both foreign trade turnover and cargo volume rising from the year 2004 exerted a positive influence (which should be attributed to Poland's membership in the European Union). One of the calculated results was as follows:

Road2 = -111078.3052 + 0.2342 * (prodex) + 0.2237 * (impex) + 13615.7937 * (unia) + 2807.0917 * (uei1)				
SE =	2110.667	R <sup>2</sup> =	0.997	r = 0.090
MAPE =	1.902	KR <sup>2</sup> =	0.996	DW = 1.820
J-B =	1.067	p-ist(J-B)=	0.587	F = 726.690
				p-ist(F)= < 0.001
Variable	Reg. Coefficient	Elasticity	t - stat	p - ist(t)
constant	-111078.3052		-4.608	0.002
prodex	0.2342	0.5106	4.459	0.002
impex	0.2237	0.7217	10.120	< 0.001
unia	13615.7937	0.0473	5.253	< 0.001
uei1	2807.0917	0.9737	4.315	0.003

All factors addressed within the model have a positive effect on cargo volumes and are statistically significant. None of the published statistics stirs any doubts and the level of explanation exceeds 99%. Figure 8 shows this as coinciding actual and theoretical values of the explained variable. The variable impex (import plus export) was expected to exert a significant influence, because cargo traffic between EU member states, prevailing in our foreign trade, is mainly handled by this branch of transport. The results show that cargo volumes were rising from 2004, unaffected by either output or export and import. It has already been mentioned that even before that time Polish companies had started to provide transportation services between foreign countries, or inside foreign countries (cabotage). This business remains outside the volume of domestic output and imports. Its additional contribution to cargo volume is shown by the parameter at the variable unia. The parameter's value somewhat exceeds the average volumes of cabotage (in the years 2004-2006), but the upward trend characterising this type of transportation service allows assuming that its 2007 value was much larger than a year before, thus increasing its average annual volume. The very similar estimates of the parameters indicating the impact of domestic (prodex) and foreign (impex) demand on cargo volumes are somewhat surprising. The two categories were treated separately to demonstrate that transport services provided abroad had

a stronger effect. It turns out, however, that the distinction between in-country and international transport becomes irrelevant when the applied measure is distances.

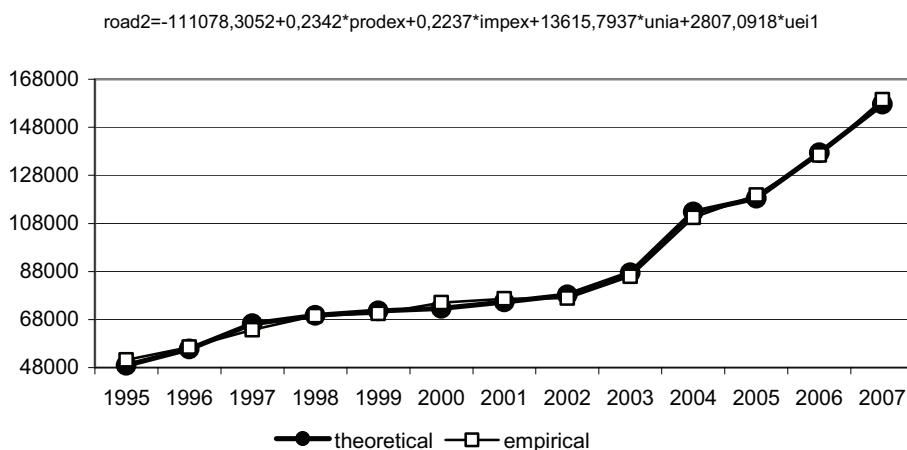


Figure 8. Estimates for the model of road cargo transport (in million tonne-kilometres)

Source: calculated by the author.

The alternative models to the above variant differ in the type of variable used to account for changes in the assortment structure of products. The variable uei1 represents jointly treated export and import. Output changes or changes in import alone turned out to be significant too. The type of the variable standing for the share of consumer goods slightly modifies the estimates of the parameters at other explanatory variables. The statistical evaluation of the alternatives is as good as of the equation that has been discussed in detail above.

## CONCLUSIONS

Transport is one of the branches in Polish economy that have changed substantially over the last dozen or so years. The changes became especially distinctive after Poland joined the European Union. In trying to capture the changes, the paper goes beyond a set of simple statistical measures, e.g. structural indicators or dynamics indicators, which are extremely useful, but do not answer the question about the sources of the occurring processes. A regression analysis applied especially to the road cargo transport revealed several factors that significantly contribute to the evolution of the transportation business.

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**WPŁYW CZŁONKOSTWA W UNII EUROPEJSKIEJ NA USŁUGI TRANSPORTOWE  
W POLSCE**

Podjęcie decyzji o przystąpieniu Polski do Unii Europejskiej wywarło duży wpływ na funkcjonowanie naszej gospodarki. Zarówno w okresie przedakcesyjnym, jak i po 1 maja 2004 roku zauważyć można istotne zmiany w strukturze wymiany handlowej z zagranicą, zarówno z punktu widzenia asortymentu eksportowanych i importowanych towarów, jak też kierunków tej wymiany. Zmiany te wymusiły reorientację produkcji niektórych branż, ale wpłynęły też na inne (poza przemysłem) działy gospodarki. W referacie analizowany jest wpływ restrukturyzacji gospodarki na funkcjonowanie transportu w zakresie przewozu ładunków, z uwzględnieniem gałęzi transportu, a przede wszystkim z wyróżnieniem transportu samochodowego i kolejowego. Zaprezentowano podstawowe charakterystyki aktywności transportu w Polsce dokonując porównań odpowiednich miar wyznaczonych dla krajów Unii Europejskiej. W celu uchwycenia związków przyczynowo-skutkowych opisujących funkcjonowanie transportu zastosowano analizę regresji, która potwierdziła hipotezę o wpływie członkostwa Polski w Unii Europejskiej na aktywność polskiego transportu, jednak jedynie w stosunku do transportu drogowego.

**Słowa kluczowe:** struktura i dynamika transportu w Polsce, przewozy ładunków, analiza regresji