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Centre for Antitrust and Regulatory Studies, University of Warsaw, Faculty of Management
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Estimation of Losses Due to the Existence of Monopolies in Urban Bus Transport in Poland

by

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CONTENTS

Abstract

The aim of this paper is to present the different approaches to demonopolisation used in Polish and European urban public transport, compare the efficiency of these models which have proven popular in Poland as well as to estimate the total losses

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incurred due to the high monopolisation of Polish public transport. The methodology of the research is based on econometric modelling (Stochastic Frontier Analysis) and on a survey conducted by the author among Public Transport Authorities.
The author proves that the modern *London* model (competition for the market) is more efficient in Polish conditions than the classic *German* one (communal monopoly). The very popular in Poland combination of the two above formulas – the co-existence of a Public Transport Authority with a monopolistic publicly owned operator – is surprisingly the least efficient. Total losses due to the existence of monopolies in Polish urban bus transport are estimated for the year 2007 at the level of 10-14% of its total budget (ca. 117-149 m EURO/year). In some cities, the losses can be as high as 20-25% of the total remuneration to the public bus operator. In others, public monopolists can be as efficient as private operators in the competitive model.

Résumé

Le but de cet article est de présenter les approches différentes vers la demonopolisation du transport en commun urbain polonais et européen, comparer l'efficacité de ces modèles, populaires en Pologne, aussi qu'estimer les pertes totales résultant de la monopolisation du transport en commun en Pologne. La méthode de l'analyse est fondée sur la modélisation économétrique (Stochastic Frontier Analysis) et sur l'enquête réalisée par l'auteur parmi les autorités responsable de transport. L'auteur prouve que le modèle moderne de Londres (concurrence pour le marche) est plus efficace dans les conditions polonaises que le modèle allemand (monopole communal). La combinaison de deux modèles, très populaire en Pologne, reposant sur la coexistence d'une autorité responsable de transport avec un opérateur publique, est une solution la moindre efficace.

Classifications and key words: public transport; demonopolisation; Stochastic Frontier Analysis.

I. Introduction

Polish public transport has become in 1990 one of the duties of the newly created communes (local councils) that have generally become the owners of public transport operators[1]. Since then, each of the communes has the freedom to choose how to organise its public transport services in order to ensure their high quality and efficiency.

This approach created a great variety of organisational models in Polish public transport – from a fully communal monopoly to fully competitive models

[1] Act of 8 March 1990 on Communal Government (Journal of Laws 1990 No. 16, item 95, as amended).

– their presentation is the first of the aims of this paper. Presented also will be international experiences which have clearly inspired the chosen solutions.

The variety of urban transport models used in Poland makes it possible to compare the efficiency of particular systems implemented in similar circumstances – the subject matter of the Author's doctoral dissertation entitled 'Economic efficiency of urban transport demonopolization in Poland'[2]. The presentation of the outcomes of this comparison is the second aim of this paper.

The de-monopolization process has currently stopped because of political reasons hence monopolies – at least in parts of the network – still exist in the majority of Polish cities. This paper's third aim is to estimate the losses incurred due to the existence of monopolies on the basis of three detailed case studies of Polish metropolises. Nationwide losses will also be estimated.

The paper is divided into five parts, including this one. Key international model of public transport organisation are presented in part two. The Polish approach, which in many cases differs from the original model and is also often based on a number of hybrid solutions, is described in details in part three.

The fourth part presents the applicable method of econometric modeling, created for the purpose of the aforementioned dissertation, based on Stochastic Frontier Analysis – a state-of-the-art method of efficiency measurement. This part presents also the general assessment results focusing on the comparison between different organizational schemes.

Part five aims to estimate current loses associated with the existence of communal monopolies which still are the dominant form of public transport in Poland.

II. Regulatory concepts in public transport

1. *German* model

The *German* regulatory model of public transport represents the most 'classical' solution in this field. It is based on the monopoly of a publicly owned operator (called 'internal operators'[3] by EU law, referred to in this paper also

[2] M. Wolański, *Efektywność ekonomiczna demonopolizacji komunikacji miejskiej w Polsce,* Warszawa 2011.

[3] Council Regulation (EC) No. 1370/2007 of 23 October 2007 on public passenger transport services by rail and by road and repealing Council Regulations (EEC) Nos 1191/69 and 1107/70, OJ [2007] L 315.

as the 'communal operators'). Such a company is responsible for network planning as well as the execution of transport services. Its supervision by local authorities is based on very general performance indicators although the current trend is to tighten controls over such monopolies because of, among other things, the influence exercised in this field by EU law that demands a higher precision of service contracts[4].

The *German* model has been popular since the beginning of the 20th century after the nationalisation of the initially privately owned tramway operators. Between the 1950's and 1980's, it was the only model of public transport used in Europe in practice.

Until now, this model is widespread in Germany (with some exceptions, e.g. Frankfurt) as well as Spain, Hungary, Italy, Czech Republic etc. In some cases, private companies are used by the monopolists as sub-contractors who execute a proportion of the services or provide drivers. This model is very popular in bigger German cities, such as Berlin, Dresden and Düsseldorf because it helps decrease personnel costs seeing as different labour law regimes apply there to public and private sectors.

More about the newest developments with respect to the German model can be found, among other things, in an extensive study of world experiences in public transport organisation prepared by van der Velde[5]. German authors focus recently more on describing newer developments than on the classic yet still mainstream model[6].

2. *French* model

The *French* model is based on 'competition for the market' whereby the subject of the tender usually concerns both: the management of the entire network as well as the provision of transport services – for a limited period of time. In many cases, the successful operator uses publicly owned depots and buses, a solution that aims to decrease costs (local government is usually able to get cheaper financing) and increase competition by lowering market entry barriers.

This model is widespread mainly in France but a similar formula is also used in Dutch regional bus transport.

Theoretically, the *French* model can be called a monopoly (one operator per city). In practice however, both in France and in the Netherlands, the

[4] Ibidem.

[5] D. van der Velde et. al., *Contracting in urban public transport*, inno-V, Amsterdam 2008.

[6] A. Beck, 'Experiences with Competitive Tendering of Bus Services in Germany' (2010) *Transport Reviews* 1–27.

French model is much closer to an oligopoly than to a monopoly because of the limited number of companies operating nationwide that take part in each tender (Transdev, Veolia and Keoils in France – Connexion, Arriva and Veolia in the Netherlands). With proper anti-monopoly solutions that decrease market entrance barriers (such as a limit on buses covered by one tendering lot), the *French* model can even resemble competition, as shown by the experiences of New Zealand. Nevertheless, competition is difficult to achieve in this framework because small and medium enterprises (SMEs) might find it hard to survive after they fail to win a contract.

More detailed, up-to-date study of the French model is provided among others by D'arcier[7].

3. *London* model

The *London* model is popular since the late 1980's/early 1990's. It is based on the division of the network into a number of bundles, tendered separately between operators. The network is coordinated by a Public Transport Authority (PTA) with a varying scope of responsibilities depending on the city in question. Usually, PTA supervision over the operators is much stricter than that exercised by public bodies in other public transport models. A PTA is responsible also for lines tendering and sometimes, it even retains infrastructure ownership (for example: the Stockholm PTA owns bus and rail transport infrastructure as well as underground and light railway rolling stock).

The *London* model is common in the metropolises of Northern Europe such as London, Stockholm and Copenhagen but it is also used in Frankfurt. A very similar model is in operation in regional railway transport of some European countries, especially Germany and the UK.

The *London* model is potentially much closer to competition than any of the other organisational solutions. The high number of tenders in each city as well as the relatively small size of the tendering lots makes it possible for a number of smaller companies to co-exist. Still, the structure of the market is often closer to an oligopoly than competition because of the existence of 3–5 big transport companies dominating the national market. From another point of view, potential or actual competition from SMEs forces even multinationals to behave as if the market was fully competitive, rather than oligopolistic.

[7] B. D'arcier, *How to Improve the Financial Situation of Urban Public Transport? The French Case*. 11th Conference on Competition and Ownership in Land Passenger Transport Proceedings, Delft 2009.

That is so especially if the PTA continues to ensure that entry barriers remain low.

4. *British* model

The classic *British* model is widespread since the mid 1980's in the UK, except London. Unlike all of the aforementioned formulas, it is based on pure 'in the market' competition ('on the road'). As a result, there can be more than one operator in each city (usually two but their number is not prescribed by law), usually serving similar networks of lines.

The operators are partially co-ordinated by local authorities. It is the role of the latter to contract public service routes (i.e. those that are not profitable for the operators), take care of fare integration (the operators can apply their own fares, cheaper than the integrated ones) and social discounts.

In practice, the *British* model does not lead to perfect competition but to the creation of local duopolies instead. Entry barriers remain relatively high because in order to remain competitive for 'season' tickets buyers, a new operator needs to be able to offer a full network of bus routes, rather than a single line only.

Wider description of both the *British* and the *London* model can be found in the work of White[8] for instance.

III. Public transport regulatory solutions in Poland

Before 1990, public transport companies were government-owned in Poland as there were no local authorities. Shortly after the creation of the communes between 1990 and 1993, three main organizational concepts of public transport were developed across the country:

- in most cities, former state-owned enterprises were converted into budget enterprises[9] that managed and provided transport services in a comprehensive way in line with the *German* model;
- in some cities, those budget enterprises were quickly transformed into commercial law companies with the same scope of powers as their predecessors;

[8] P. White, *Public transport. Its planning, management and operation*, London, New York 2002.

[9] Budget enterprise (in Polish: *zakład budżetowy*) forms a part of a local authority (without its own legal personality) with its own income and expense budget.

- as early as 1992-1993, a few local authorities established a Public Transport Authority (PTA) based on the *London* model; similarly to the initial restructuring stage in London or Copenhagen, PTAs were initially contracting services mainly with their municipal operators that received a fixed fee for serving given bus routes according to a given timetable; soon after, PTAs began to outsource some lines to private companies also.

Private carriers were permitted to operate independent lines with their own fares (including discounts) and timetables. Usually, they had their own buses although in Katowice, for example, the city rented 5 public buses to an independent entrepreneur who could freely choose the routes which he wished to serve.

Subsequently, two main trends were observed dating back to the beginning of the transformation era:

- some cities preserved the municipal monopoly according to the *German* model, usually restructuring their transport companies and transforming them from budget enterprises into commercial law companies;
- other cities decided to create a PTA, generally in the form of a budget entity[10] and to contract-out to private operators (via a tender) usually a minor part of the network, divided into a number of separate tendering lots (usually between 1 and 50 lots), according to the city and particularities of a given tender.

Depending on tender specifics and market entry barriers, the particular segments of the Polish urban bus transport market became either competitive or oligopolistic. In general, the market is relatively competitive because it is not dominated by multinationals. A number of SMEs (e.g. Warbus Warszawa, DLA Wrocław, GRYF Kartuzy, IREX Sosnowiec, ITS Michalczewski Radom, PKS Grodzisk Mazowiecki) compete with the multinationals (mostly Veolia and Israeli Egged) as well as with each other in a number of tenders not limited to 'home cities' only.

In Poland, PTAs usually fulfill the following tasks:

- managing the network (including full time-tabling);
- line tendering, quality control and rewarding the operators;
- the issue, control and sales of tickets;
- marketing.

A growing number of local authorities including Cracow, Poznan, Olsztyn or Rzeszow have recently decided (in particular since 2008) to create a PTA, moving away from the earlier use of the classic *German* model. However, the

[10] Budget entity (in Polish: *jednostka budżetowa*) forms a part of a local authority (without its own legal personality) without its own income or expense budget (it works within the general budget of the local authority).

responsibilities of the new PTAs often do not include time-tabling or ticket sales; they usually co-operate with the internal operator only or tender a very small part of the network only.

Many of the older PTAs have also recently decided to stop tendering and to increase the use and role of their internal operators. There are three main reasons for this:

- the great strength of the labor unions of internal operators, in connection with the wealthy financial situation of local authorities;
- the ease with which EU projects can be implemented by internal operators[11];
- EC Regulation No. 1370/2007[12] and the later Polish Act on Public Transport[13], which were often understood as a special 'permission' for not tendering public transport services as well as an obligation to create PTAs (the latter is especially a misinterpretation).

In some Polish cities, usually small towns, urban public transport was served over the last two decades entirely by a private company, the winner of a tender. Although this solution resembles the *French* model, buses, their depots and other infrastructure are not supplied by the local authority – the operator must provide them independently.

Aside from the aforementioned solutions, some Polish cities also tried to implement a fully deregulated and competitive public transport system, partially inspired by the *British* model and partially by liberal thoughts. A very radical example of such an approach is delivered by the city of Zakopane where public transport is provided by small, independent buses; lines run usually on demand only and solely in the daytime; and there are no monthly tickets. In fact, this formula is closer to the Russian or Ukrainian solutions than to the *British* model. In other cities, commercial lines play an auxiliary role. Nowadays however, many such enterprises are being eliminated due to rising labor and fuel costs.

The table below shows the main organizational models of urban bus transport in Poland.

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[11] R. Tomanek, B. Mazur, *Raport na temat wsparcia dla sektora transportu publicznego w ramach programów operacyjnych współfinansowanych ze środków Unii Europejskiej*, Katowice 2009, pp. 19–21.

[12] Council Regulation (EC) No. 1370/2007 of 23 October 2007.

[13] Act of 16 December 2010 on Public Collective Transport (Journal of Laws 2011 No. 5, item 13).

Table 1. Main organizational models of urban bus transport in Poland

Model	City / Metropolitan Area	Authority	Bus operators	Strategy of contracting services	Selected cities with a similar model
'*London* model' (competition for bundles of lines, seprated PTA)	**Warsaw**	Public Transport Authority (ZTM) – budget entity	One internal operator – a municipal company (other municipal companies for trams and tube); 3 private bus operators (at least 100 buses each), private companies with core business in Warsaw public transport	Tendered contracts for 8-10 years, and 50 buses each, low-floor, new buses required (ca. 25% of the network); the rest gets an internal operator under a directly awarded contract	Kraków (but the same internal operator for buses and trams, only one private operator)
	Elbląg	Public Transport Authority (ZKM sp. z o.o.) – a limited liability company	Only private bus operators (3 firms) – one of them is part of the former internal operator	3 tenders organized at the same time, lowering of an average age of fleet during the contract is required	–
	Gdynia	Public Transport Authority (ZKM) – budget entity	2 internal bus operators (and one trolleybus); a number of private carriers for whom public urban transport is not a core business	Usually short-term (up to 3-4 years) contracts for one or a few buses on a given route; used fleet is usually accepted but quality requirements are rather high; internal operators have both – direct awards and contracts won in a tender	Białystok, Szczecin (a split of an internal operator into a number of bus companies), Gdansk, Bydgoszcz, Wroclaw (PTA functions directly exercised by the municipal authority)
	Upper Silesia	Komunalny Związek Komunikacyjny GOP	A number of municipal operators, owned by members of the union (often supported by direct owners' help), as well as local, private companies.	Short-term contracts, different size of bundles (usually single lines), low quality requirements, some carriers have old direct awards but now have to take part in a tender	Gdańsk – Gdynia – Sopot – Wejherowo Metropolitan Area (planned)

Model	City / Metropolitan Area	Authority	Bus operators	Strategy of contracting services	Selected cities with a similar model
Hybrid model – internal operator + PTA	**Częstochowa**	Road and Public Transport Authority (ZTM) – budget entity	One internal operator	Directly awarded contract with an internal operator without a tender	Rzeszów, Olsztyn
‘*German* model’ (internal operator, no authority)	**Legnica**	Municipal authority	One internal operator for trams and buses – a limited company or a budget enterprise	Long-term contract with extensive powers and low operational control over the company	Toruń, Zielona Góra, Bielsko Biała, Siedlce (some of the operators are companies, other – budget enterprises)
Monopoly of a public-private company	**Kalisz (before 2010)**	Municipal authority	A municipal company with a minority shareholding in a private partner	Long-term contract with extensive powers and low operational control over the company	Chełm
‘*French* model’ (monopoly of a private company, limited by an contract)	**Tczew**	Municipal authority	One municipal company – a privatized internal operator	A contract for serving the network for a long period (8 years), requires gradual renewal of the fleet; in case of choosing a new operator there will be a problem with current assets (infrastructure and employees)	Lubin, Tarnobrzeg, Swarzędz, Murowana Goślina
‘*British* model’	**Zakopane**	No	Many private entrepreneurs	No contract – only a permit needed	Single lines in Lublin, Katowice

IV. Efficiency comparison of different solutions

1. Method

The efficiency measurement model used in this paper is based on an analysis of the cost of purchase or production of a 'bus-kilometre' in different towns. It is consistent with other Polish research, among others, the work of R. Tomanek[14]. The most important novel aspect of the method used in this analysis is the consideration of the fact that cost differentiation may result from many other factors besides the organizational model used in any given city including determinants such as vehicle type, its size, age and equipment.

The cost-based approach is reasonable because in the majority of Polish towns it is the public side that determines qualitative aspects of the carriage offer, preparing at least a time-table outline, putting forward specific quality requirements and finally, shaping the pricing policy. Therefore, a public body usually 'buys' bus-kilometres and makes its own decisions concerning their use. The quality of this use, that is, adapting the offer to the needs of the market, does not directly result from the operator's ownership issues.

The disadvantage of this analytical approach is the impossibility to take into account those Polish cities where local governments settle the accounts with their transport operators on a net basis (the operator gets actual income from ticket sales and a fixed subsidy). Nevertheless, only very few cities use the latter solution and it is thus possible to assume that their exclusion from this analysis would not lead to statistically significant results.

Using the cost-based approach, it is appropriate within the scope of modeling to use Stochastic Frontier Analysis (hereafter: SFA). This is a state-of-the art parametric method of efficiency analysis that has been used before in transport for benchmarking of the performance of British railways[15]. This method has also been used in Poland for efficiency benchmarking of libraries[16] and electricity distribution sector[17]. Nevertheless, SFA has not been

[14] R. Tomanek, *Konkurencyjność transportu miejskiego*, Katowice 2002.

[15] A. Smith, P. Wheat, *A quantitative study of train operating companies cost and efficiency trends 1996 to 2006: Lessons for future franchising policy*, London 2007.

[16] J. Osiewalski, A. Osiewalaska, 'Ocena efektywności kosztowej bibliotek akademickich na podstawie danych przekrojowo-czasowych' (2003) 628 *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie* 13.

[17] J. Nazarko, J. Chrabołowska, 'Benchmarking w ocenie efektywności krajowych spółek dystrybucyjnych energii elektrycznych' [in:] K. Jajuga, M. Walesiak (eds), *Taksonomia 12, Klasyfikacja i analiza danych – teoria i zastosowania*, Wrocław 2005, pp. 26–38.

used in urban public transport before[18]. Wider review of economic efficiency measurement methods is given by Coelli et al[19].

SFA is based on the assumption that the cost function may be defined by an equation:

$$y_i = \beta' x_i + v_i + u_i$$

where in this case:

- y – the cost of a bus-kilometre for given services;
- $\beta' x$ – parameters of a given transport service (such as bus length, age, etc.), multiplied by their estimated influence on costs (negative or positive);
- v – random variable with normal distribution, showing different kinds of objective cost deviations, not providing for inefficiency but resulting from factors not included in the model;
- u – inefficiency, a random variable with half-normal distribution, thus accepting only non-negative values.

The first element denotes the deterministic part of the cost, which together with *v,* creates the so-called cost frontier (an ideal minimum cost). After its deduction, each observation is characterized by non-negative inefficiency u[20].

The variable u in this paper is defined as 'absolute inefficiency' in contrast to 'relative inefficiency' denoted by:

$$\frac{u_i}{\beta' x_i}$$

Therefore u itself illustrates the value of inefficiency expressed in currency (PLN – Polish zloty). On the other hand, 'relative inefficiency' is a non-dimensional value showing inefficiency in relation to the deterministic element of the cost frontier. As a result, relative inefficiency amounting to 24% means that – excluding the random element v – the real remuneration paid to the operator equals 124% of the deterministic element of the cost frontier, while relative inefficiency equaling 50% means that the remuneration equals 150% of this element.

[18] Some similar studies has been conducted at the same time, especially in Germany, but did not consider such a complex sample containing both tendered and directly awarded services – for example M. Walter, *Some Determinants of Cost Efficiency in German Public Transport,* 11th Conference on Competition and Ownership in Land Passenger Transport Proceedings, Delft 2009.

[19] T. Coelli, D. Pasada Rao, C. O'Donnell, G. Battese, *An Introduction to Efficiency and Productivity Analysis*, Springer, New York 2005.

[20] Ibidem.

W. Greene[21] stresses that as a rule, especially in the case of the classic Cobb-Douglas's production function, particular explanatory variables ($\mathbf{x_i}$) may denote logarithms of particular inputs. The choice of parameters of vector **ß** is estimated by using the method of maximum likelihood, so that the most probable set of values has been chosen. For a simplification maximum log-likelihood formula has been used:

$$\ln L(\beta; y) = \sum_{i=1}^{n} \ln f(y_i; \beta) \rightarrow max$$

An essential advantage of using SFA is the possibility of taking into account that not each variation from the forecasted value means inefficiency, which is ensured by the random variable *v*. It should be remembered however when using SFA that defined coefficients ß do not mean average dependence, because the deterministic element of the equation is closer to the 'ideal' than to a 'typical case', as for example in the case of linear regression.

In order to carry out the research, first set out was a list of potential variables explaining the price of a bus-kilometre or the ability to differentiate the effectiveness of transport contracts, such as the vehicle's age or size, the period of the contract, average speed on given routes etc.

The necessary data that made it possible to create a database for the model was then collected later. Some data was taken from a statistical journal published by the Polish Chamber of Urban Transport (IGKM)[22] – this information was available only in the case of carriers operating without the PTAs. The remaining data was collected from a questionnaire conducted in the first half of 2008 and directed to all Polish PTAs that were members of IGKM as well as to some other smaller transport authorities.

The database record was a single value of dependent variable, that is, a gross price expressed in PLN per kilometer, paid to the operator by its PTA (adjusted by the municipal company's profit or loss), or an average cost of performing a service in a municipal company acting in an organizational model without a PTA (*German* model). This value might refer to the whole network or even to a single service. Therefore, it was necessary to weight the data implicitly using the number of services that the given rate concerned. The term service is in principle understood as one bus in motion, although in some cases, it is possible for one vehicle to perform two services obtained in different bids (e.g. daytime and night lines) but this is a very rare occurrence.

A database was created covering 281 transport service rates – therein, transport services were provided for 12 PTAs by 4002 buses. The above

[21] W. Greene, op. cit., pp. E33-4.

[22] (2007) 2 *Komunikacja miejska w liczbach*.

information was complemented by secondary data for operators acting without a PTA in 18 additional towns that together run 1546 buses on an average working day. The difference of scale was unavoidable as it resulted from the specifics of the Polish de-monopolization process of urban transport.

An assumption of creating two models has been adopted on account of the diversity of the dependent variables in the case of towns where transport services are performed directly by public companies (without PTAs) and towns where transport authorities exist (with PTAs). Accordingly:

- the first general model concerns all towns irrespective of whether a transport authority exists or not;
- the second model relates solely to contracts concluded within tenders by operators and transport authorities (irrespective of their organizational form – this criterion should be treated as functional), where a set of potential dependent variables may be somewhat larger.

In practice, these two models emerged as much more similar than expected. Nevertheless, their separation was maintained in order to obtain more precise results.

2. Results

2.1. Created models

Three statistically significant models were ultimately created: one concerned the whole scope of the scrutinized services; the remaining two referred only to transportation tasks granted in the course of a tender (not covered by this paper).

Table 2. Stochastic bus-kilometre cost frontier – all service

Variable	Value	Standard deviation / error	Significance level
Cost / price of vehiclekm [PLN] (dependent variable)	5.448	1.272	-
Constant	3.750	0.536	0.0000
Average length of a bus [m]	0.130	0.016	0.0000
Average log of bus age [years]	–1.038	0.302	0.0146
Annual bus mileage [km/year]	–0.007	0.002	0.0006
Share of low floor buses [%]	0.641	0.153	0.0016
Average speed (incl. stops) [km/h]	–0.027	0.015	0.0000
Model paramters			
Log-likelihood value	–405.45	–	–
Likelihood ratio test result (λ)	3.296	0.479	0.0000

The obtained general model is presented in the following table. All shown relations are significant at 0.0146 level or less, what means reliability level of 98.54% or more. The Likelihood test ratio shows, that the model itself is statically significant with reliability of over 99.9% (compared with a null model).

Trials with both linear and logarithmic dependence were simultaneously conducted for some variables – the chosen ones guaranteed higher reliability. Logically correct and statistically significant dependencies were not found in any of the models between cost and, among other things:

- the size of an order granted to a given operator – in this case, an inverse proportionality was even observed in a parallel linear regression model potentially at least because the setting of the cost frontier was obstructed by the existence of groups of big and inefficient public operators; it must be stressed however that a similar proportionality was already observed by D. Miller[23];
- the amount of the average wage in a given region – this is logical, as the average wage can vary more between regions than between the wages of the drivers because of differences in the professional structures of the inhabitants of various regions (for example, the average wage is high in Katowice because of the high pay in the mining industry; the average pay is also high in Warsaw because of high wages in private corporations accumulated therein, this does not greatly influence labour costs of drivers or generally workers);

In order to get statistically significant models, it was also necessary to give up the assumed weights in the form of the number of services and to substitute them by a logarithm of the same value.

2.2. An analysis of efficiency of organizational models

The created models make it possible to draw a number of important conclusions. First of all, the comparison of relative efficiency depending on the organizational scheme employed in different regions with respect to the ownership structure of the operator and award type (compare graph 1) indicates a much higher efficiency of private entities and those public operators that gain contracts by way of a tender than of the remaining public companies.

It must be kept in mind though that in the following graph:

- a scheme with a PTA, public (internal) operator and the direct award of transport services contracts – refers to a Polish hybrid model, a

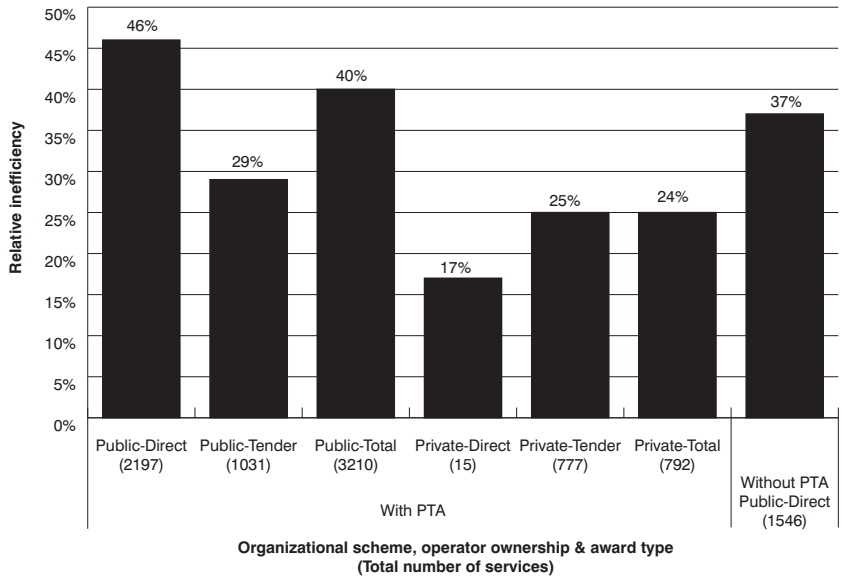
[23] D. Miller, 'Differences Among Cities, Differences Among Firms, and Costs of Urban Bus Transport' (1970) 1 *The Journal of Industrial Economics* 22-32.

communal monopoly as in the *German* model with a separated PTA as in the *London* model;
- a scheme with a PTA, a public operator and the tender – can mean a very similar situation as the above (when the tendering requirements are from the start more favourable to the internal operator and usually only one bid is placed), as well as (in minor cases) a system resembling the *London* model, in which the communal operator succeeds; initially, the Author wanted to differentiate those two cases but within the surveys very few PTAs answered the questions concerning the number of bids placed;
- both schemes with private operators – refers to the *London* model (direct awards of transport services contracts for the private operators were possible before 1997 according to the old Public Procurement Act);
- the last scheme means a pure *German* model.

As mentioned above, other schemes couldn't be included, as they occur very rarely.

It can be concluded that if a public operator gains a contract by way of a tender in areas supervised by a PTA, the cost is 12% lower than the cost of a direct award of a transport contract (an average cost equalling 129% of the cost frontier instead of 146% of the cost frontier).

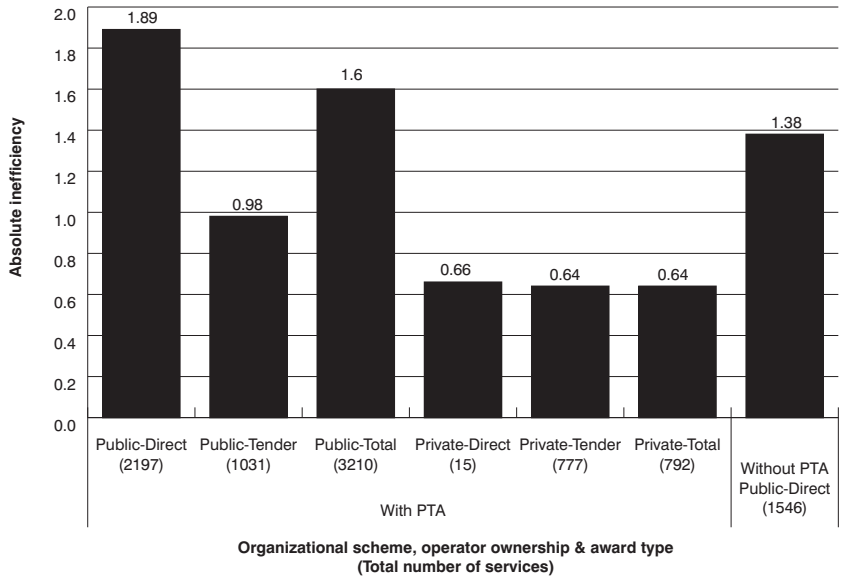
Graph 1. Relative inefficiency according to the organizational scheme, operator ownership & award type



If a private operator wins the tender, the cost is on average lower again by another 2%. In the case of private operators who received contracts under the direct award procedure, attention should be drawn to the small number of their services. Also relevant here is the fact that these orders were placed in the mid 1990's, when the Public Procurement Act was not yet in force. Still, those contracts were preceded by negotiations. Hence, the efficiency of private operators should be considered jointly, on the assumption that they were chosen in a competitive manner in both cases.

Surprisingly, public companies operating without a PTA are much more efficient than those operating within a PTA direct award procedure despite the fact that a part of the competences and costs are taken over by PTAs. This means that the most popular form of transport organization in Poland is the least efficient one as it results from an 'artificial' establishment of PTAs, which are anyway forced to outsource the transport services of a particular operator and have limited influence on them. Clearly, this is merely a confirmation of how things are in most cases. In theory, and in some practical cases, it is possible to establish healthy relations between a PTA and the operator, as between a normal customer and a seller – the possibility of external quality control is an essential advantage in such cases.

Graph 2. Absolute inefficiency according to organizational scheme, operator ownership & award type



The situation looks somewhat different if absolute efficiency expressed in Polish zlotys is considered (comp. graph 2, 1 PLN ≈ 4.0 EUR). In this case, the difference between efficiency of private and public operators receiving contracts by way of a tender becomes more pronounced. This discrepancy may be the result of a number of issues:

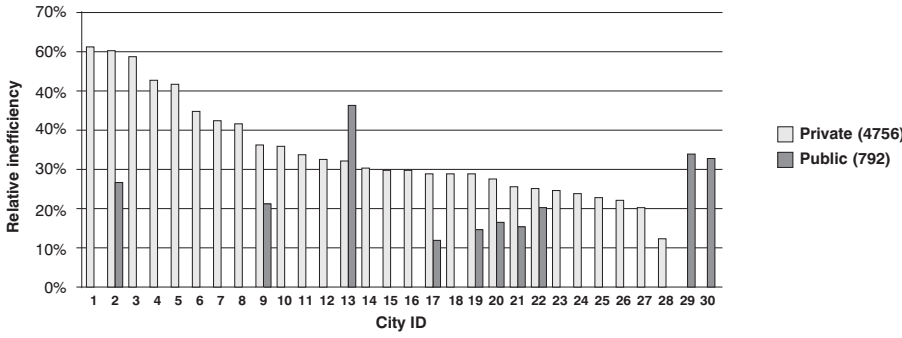
- private operators provide services with a lower cost frontier and thus of lower quality (e.g. older bus fleet) or on more advantageous conditions (e.g. longer-term contracts or higher yearly mileage);
- public operators provide twice as many services won in the course of a tender than private operators, a realisation that can be attributed to the fact that private operators can find it difficult to satisfy the criteria of a certain number of tenders (e.g. bus fleet ownership requirement applicable at the moment of the tender); this causes an 'overvaluing' of the cost frontier in case of specific contracts for public operators.

Also of relevance is the fact that some municipal operators provide services both on the basis of direct awards and tenders – in this case, higher incomes from direct awards may allow them to offer lower prices in tenders, a practice that creates an illusory efficiency of the latter. This realisation has been proven by an analysis of single operators.

It is also worth paying attention to the fact that the shown bus-kilometre cost of public operators does not illustrate the entire costs incurred by local authorities, including costs of lost opportunities to which the author had no access. For example, private operators purchase or lease land on their own while municipal operators may use plots contributed to the company by the relevant town.

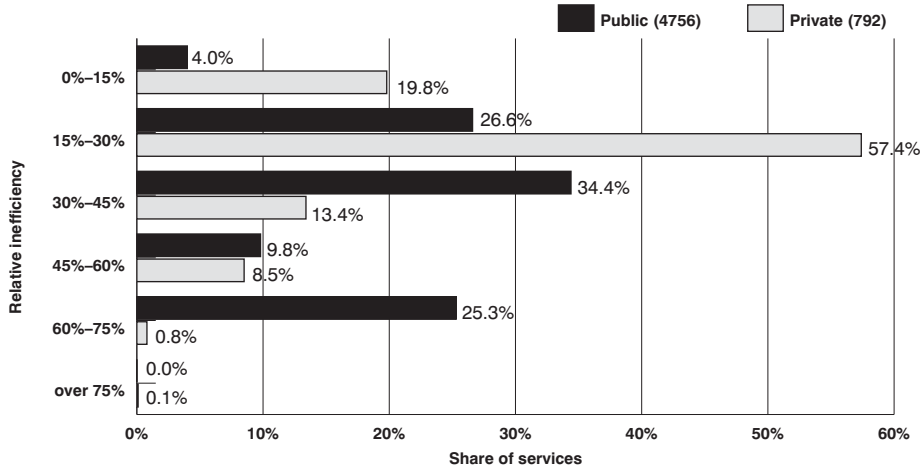
Some interesting data is also provided by comparing the efficiency of private and public operators within the range of individual towns (comp. graph 3). It clearly shows the diversity of absolute inefficiency between the scrutinised cities as well as local differences between private and public operators.

Graph 3. Relative inefficiency in subsequent cities



Private operators were more expensive than the public one in one town only (No: 13). However, the former held a mere 0.5% of the market share in this town at the time and serviced a very specific segment of the market. Their market presence has now significantly increased since they clearly won against the public operator in two big tenders, conducted in 2008.

Graph 4. Distribution of relative inefficiency – private vs. public



Graph 4 conveys well the diversity in the efficiency level of private as opposed to public operators. It shows that: if in the case of private operators over 75% of their tasks reach an inefficiency level not exceeding 30%, almost 70% of public operators exceed this value. Still, there is a group of communal operators who maintain very high efficiency, a fact worth stressing especially because in some cases, they have a wider scope of tasks (there is no separate PTA).

V. Estimation of losses nationwide and in selected cities

1. City X

It is possible on the basis of the above research to estimate the losses resulting from the monopolisation of public transport in selected Polish cities. The first case study concerns City X[24] where the majority of the bus transport market is restricted to the internal operator, in other words, a typical case of a monopoly.

[24] The names of the cities are not stated in this paper because the estimations are based on confidential data; City X, Y and Z are however among 5 biggest Polish cities.

The rest of the market is tendered according to the *London* model – over 5 bids are usually placed in each tender also by companies that do not already operate in city X seeing as entry barriers remain low (no excessive tender requirements). This makes this market segment closer to perfect competition than to an oligopoly, which is typical for the sector.

In City X, the difference in efficiency between the public and private operators easily shows the losses of the monopoly because all of the operators act in very similar conditions.

The relative inefficiency of the public operator amounts to 60% while private entities reach a mere 27%. This indicates that if the services that are delivered by the public bus operator were to be subject to a tender, a saving of over 26% would be possible. In other words: 26% of the total bus transport budget in City X remains a monopoly premium for the internal operator.

Considering absolute inefficiencies –the difference amounts to 1.52 PLN/vehicle-km (0.38 EUR/vehicle-km – 2.53 PLN/0.63 EUR for public, 1.01 PLN/0.25 EUR for private). Compared with the price of a vehicle-km paid to the public operator (ca. 7.40 PLN/vehicle-km, so 3.70 EUR/vehicle-km), this leads to the conclusion that the cost level of this particular internal operator is over 20% higher than the cost of private operators in the same region.

Moreover, the aforementioned losses are somewhat underestimated because of a number of considerations that separate the public and private operators in this city:

- the public operator uses bus depots free of charge from the city while private entities must buy/rent them under normal market conditions;
- only the employees, and their families, of the public operator can use public transport free of charge;
- the share of dead runs is higher for private operators than for the public one.

Therefore, if it is impossible to restructure the internal operator in City X, the market should be tendered as soon as possible because of excessive costs for the community[25].

2. City Y

The internal operators in the following two cities – City Y and City Z – had a full monopoly in 2007 (a pure *German* model). Both operators were at that time responsible for network planning as well as the execution of transport services.

[25] The legal aspects of this situation are not the subject of this paper.

In the city Y – the rate per vehicle-km equalled ca. 5.80 PLN (1.45 EUR) with an inefficiency of 1.52 PLN (0.38 EUR). This gives a relative inefficiency of 36%.

Thus, the relative inefficiency of the internal operator in City Y is not much higher than the relative inefficiency of private operators in City of X (27%). In fact, it is not much higher than the average inefficiency of public transport operators nationwide (25% see graph 2). The difference of 8% is fully justified because City Y has no PTA. Its costs (e.g. time-tabling, bus stops maintenance etc.) usually amount to 5-8% of the public transport budget, are in this case included in the operator's costs.

This example proves that public monopolies are not always worse than private operators. A detailed analysis can show that monopolists have on the one hand slightly higher administration and labour costs than private operators, but on the other hand, they can save money thanks to efficient network planning.

These include measures such as shorter stops at terminals, e.g. the PTA of City X (previous example) can plan a timetable for a bus running 60 minutes with a waiting time of 30 minutes at the bus terminal – totally unnecessary rule especially during the weekends with their lesser traffic. Seeing as a PTA does not cover the additional costs of long stops and only pays the operator a fixed fee for each vehicle-kilometer, this approach is neutral for the operators short term but obviously generates additional costs in the system long term. This problem does not arise in City Y (this case) where real costs – rather than a lump sum – are considered at the stage of time-tabling.

3. City Z

City Z was in 2007 very similar to city Y but its absolute inefficiency equalled 2.125 PLN/vehicle-km (0.53 EUR/vehicle-km) and its relative inefficiency was 51%. This is an example of one of the least efficient internal operators in the *German* model. This means, that the costs of the public operator in City Z are 20%-25% higher than the costs of the purchase of the same services from a private operator.

Taking into account the higher scope of the competences of the internal operator in City Z, the above difference is overestimated and is in fact probably between 15% and 20% - still a relatively high difference.

A detailed analysis showed that the internal operator of City Z has a much lower budget discipline than its counterpart in City Y. It also does not benefit from integrated services planning (e.g. as opposed to City Y) whereby one bus usually serves only one line per day – making City Z similar to City X.

The Cities Y and Z show two different starting points to the potential process of de-monopolisation – while it can be potentially successful in City Z, private operators probably will not bring great savings for City Y.

In fact, both of these cities created a PTA after 2007 but have not tendered many of their routes – a fact that could have a negative influence on the economic efficiency of the public transport system especially in City Y. Simple observation of cost changes in these cities proves that the costs seem to increase faster than the quality of services but this hypothesis needs further research.

4. Nationwide

The nationwide estimation of loss will be based on the average between weighted absolute inefficiencies of private (0.643) and monopolistic public operators (i.e. direct award – 1.678). This difference amounts to 1.035 [PLN/ vehicle-km], so 0.259 [EUR/vehicle-km].

According to the data available from the main Polish statistical office GUS (in Polish *Glowny Urzad Statystyczny*), at least 782 million bus-kilometres were driven in 2007 in Polish urban public transport[26]. Assuming that its communal monopolies had a 67.5% market share – the loss associated with their existence can be estimated at ca. 466 million PLN (ca. 115 million EUR).

Compared with the general budget of Polish public bus transport of 4,250 m PLN or 1,063 m EUR(782 m vehicle-km multiplied by 5.45 PLN or 1.36 EUR/ vehicle-km), this equates to over 10% of the entire Polish public transport budget.

The overall losses can be even higher seeing as the above estimates do not include communal operators which won contracts by way of a tender. In fact, the communal operator was often the only participant of these tenders because their requirements included the need to own a bus depot in the given city or a precisely described bus fleet. Alternatively, public operators could win the bid because they were able to offer lower prices since their fixed costs were covered by other contracts.

Taking into account the difference between all public and private operators, the former have an 86% market share and a cost difference of 0.883 PLN or 0.221 EUR/vehicle-km (1.526 - 0.643 in PLN). That gives a total loss of almost 595 m PLN/ year (it equals to almost 149 m EUR and 14% of the entire bus public transport budget).

It should be stressed however that the above estimation covers urban bus transport only. Other kinds of collective passenger transport in Poland (urban

[26] *Transport – wyniki działalności 2007 ,* Warszawa 2008, p. 171.

and regional rail transport, regional bus) are also highly monopolised and similar monopoly losses can occur also there.

VI. Conclusions

The conducted analysis leads to the following conclusions:

- the efficiency of monopolistic public bus operators is highly differentiated – some of them are as efficient as private operators acting in a pro-competitive model – others have costs of up to 25% higher than similar private entities;
- the hybrid model (a PTA with an internal operator, that is, vertical disintegration with no competition between operators), despite its great popularity in Poland, even growing since 2007, has generally proven to be the least efficient model of urban public transport seeing as it disintegrates the planning process and does not bring any benefits for competition;
- nationwide losses due to the existence of monopolies in Polish public bus transport in 2007 are estimated at the level of 10-14% of its total budget (ca. 466-595 m PLN/year or 117-149 m EUR/year); this number might have even risen since this date because of the popularity growth of the least efficient organisational model as well as the generally increasing budgets in public transport.

Literature

Beck A., 'Experiences with Competitive Tendering of Bus Services in Germany' (2010) *Transport Reviews* 1–27.

Coelli T., *A guide to FRONTIER version 4.1*, Armidale 1996.

Coelli T., Pasada Rao D., O'Donnell C., Battese G., *An Introduction to Efficiency and Productivity Analysis*, Springer, New York 2005.

D'arcier B., *How to Improve the Financial Situation of Urban Public Transport? The French Case*, 11th Conference on Competition and Ownership in Land Passenger Transport Proceedings, Delft 2009.

Greene W,. *Limped version 9.0, Econometric modelling guide*, *vol. 2*, Plainview 2007.

Greene W., *Econometric Analysis,* 7th Edition, Prentice Hall 2011.

Komunikacja miejska w liczbach [Public Transport in Numbers](2007) 2.

Miller D., 'Differences Among Cities, Differences Among Firms, and Costs of Urban Bus Transport' (1970) 1 *The Journal of Industrial Economics*.

Nazarko J., Chrabołowska J., 'Benchmarking w ocenie efektywności krajowych spółek dystrybucyjnych energii elektrycznych' ['Benchmarking in efficiency assessment

of domestic electricity distribution companies'] [in:] K. Jajuga, M. Walesiak (eds), *Taksonomia 12, Klasyfikacja i analiza danych – teoria i zastosowania* [*Taxonomy 12. Classification and data analysis – theory and application*], Wrocław 2005.

Osiewalski J., Osiewalaska A., 'Ocena efektywności kosztowej bibliotek akademickich na podstawie danych przekrojowo-czasowych' ['Efficiency assessment of academic libraries based on cross-sectional time-series data'] (2005) 628 *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie*/

Smith, P. Wheat, *A quantitative study of train operating companies cost and efficiency trends 1996 to 2006: Lessons for future franchising policy*, London 2007.

Tomanek R., *Konkurencyjność transportu miejskiego* [*Competitiveness of public transport*], Katowice 2002.

Tomanek R., Mazur B., *Raport na temat wsparcia dla sektora transportu publicznego w ramach programów operacyjnych współfinansowanych ze środków Unii Europejskiej* [*Report on the support for public transport sector within EU co-financed operational projects*], Katowice 2009, p. 19–21.

Velde van der D. et. al., *Contracting in urban public transport*, inno-V, Amsterdam 2008.

Walter M., *Some Determinants of Cost Efficiency in German Public Transport*. 11th Conference on Competition and Ownership in Land Passenger Transport Proceedings, Delft 2009.

White P., *Public transport. Its planning, management and operation*,London, New York 2002.

Wolański M., *Efektywność ekonomiczna demonopolizacji komunikacji miejskiej w Polsce* [*Efficiency of demonopolisation of urban public transport in Poland*], Warszawa 2011.