

Micro- and Macroeconomic Factors of Fares Changes in Urban Public Transport

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Abstract Organization of urban public transport is the municipality's own task. It is expected that fares will not only provide appropriate income, but also will become a relevant tool for the development of transport policy in cities. Decisions concerning ticket prices for urban public transport demand taking into account numerous factors and variables, among others, those concerning costs of service provision, financing possibilities, potential demand for services, and several social postulates concerning transport services offer. The aim of the paper is to make an attempt to identify the micro- and macroeconomic factors influencing changes of fares in urban public transport, as well as to examine their influence upon the development of ticket prices in Poland.

Keywords Urban public transport · Microeconomic factors · Macroeconomic factors · Ticket prices · Transportation · Fares · Pricing

Introduction

In most cities worldwide, the provision of urban public transport is a task of public authorities and—in accordance with the principle of subsidiarity—that task is most often executed by towns or unions of towns. Towns have the assets that serve the purpose of providing urban public transport services, they decide about the size of transport offer and quality of services, and they also are entitled to decide about price level. It is expected that prices for urban public transport services on the one hand will provide the required revenues, and on the other hand, the prices of services are meant to promote the use of public transport. Prices of urban public transport tickets are also a part of the public authority policy concerning redistribution of funds between various social groups. The latter is most often manifested

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by the scope of reduced rates and fully subsidized free ridership, the consequence of which, in turn, is the necessity of subsidizing such services by means of public funds.

Urban public transport, like other sectors of the economy, is also influenced by various other factors, both the macroeconomic ones, which are of global and aggregated type, and microeconomic ones, which have their sources in decisions taken by specific parties, and consumers/passengers.

The issues of pricing have their scientific output in urban transport economics [1–6]. On the other hand, the literature of the subject hardly deals with issues connected with factors that influence such decisions, as well as the importance that the influence of those factors has on changes in prices of urban public transport services. The paper identifies the basic micro- and macroeconomic factors, which influence fares changes in urban public transport, and attempts to make a preliminary assessment of the influence those factors have upon ticket price development in the biggest Polish cities.

Macroeconomic Factors of Fares Changes in Urban Public Transport in Poland

Macroeconomic factors result from macroeconomic environment, in which the organization is located. They are factors defined at the level of state, upon which organizations have no influence, which they have to adjust to. Those factors are due—among other things—to the economic policy of the state, legal acts and regulations, economic standing of the state, demographic trends, and the development of new technologies and their accessibility [7].

Among the macroeconomic factors that have marked influence upon the development of prices for services of urban public transport, one should list first of all those, which influence the costs of provision of such services. In towns, in which transportation authorities have been established, the macroeconomic factors will be those that influence the expenditures of transport organizers, who commission transport services from urban public transport operators. The basic unit used in settlements between urban public transport organizer and operator is—first of all—the rolling stock operations, which are ordered, at appropriate rates. The level of rates is usually one of the crucial parameters used for the overall assessment of rationality and capability of purchasing transport services.

Table 1 presents the annual average rates per 1 vehicle-kilometer paid to the biggest transport service providers in selected Polish cities, in 2007 and 2014. The focus has been on data concerning cities with the biggest populations in Poland (exceeding 300 thousand inhabitants), for which information on rates in the studied time was available. In big cities, the urban public transport systems are indispensable parts of the urban fabric, and to a large extent, they are necessary for its efficient functioning. The economic standing of biggest cities thus substantially

reflects the general economic trends in the sector of urban public transport in Poland. In case of Katowice, the information concerning the organizer of urban public transport has been taken into account, that of the Municipal Transport Union of the Upper Silesian Industrial District (Komunikacyjny Związek Komunalny Górnośląskiego Okręgu Przemysłowego—KZK GOP), which at present contains—besides Katowice—29 municipalities located in the central part of the province of Silesia.

It results from the comparison made in Table 1 that over the examined period of 7, the transport rates per 1 vehicle-kilometer, paid to service providers, increased significantly. In bus transport, the average increase noted in 2014 was 44.5% in comparison with 2007, while in case of trams, the growth over the same period amounted to as much as 96.3%. The average price was calculated as weighted operations provided by the companies examined.

The level of rates depends on the costs that operators bear, which in turn are influenced by numerous macroeconomic parameters. As can be concluded from standard breakdown of costs in transport, besides the price of fuel or electricity—in case of tram transport—they are labor costs, rolling stock purchase costs, financial

Table 1 Rates per 1 vehicle-kilometer (average for 12 months) paid to the biggest transport service providers in selected Polish cities, in 2007 and 2014

Transport organizer	Means of transport	Biggest transport provider/average	2007	2014	Change 2014/2007 (%)
			Rate (Polish złoty–zł)		
Warsaw	Bus	MZA Warszawa Sp. z o.o.	6.36	9.17	44.2
	Tram	Tramwaje Warszawskie Sp. z o.o.	6.88	13.90	102.0
Gdansk	Bus	ZKM Gdańsk Sp. z o.o.	5.02	8.02	59.8
	Tram	ZKM Gdańsk Sp. z o.o.	4.05	8.30	104.9
Szczecin	Bus	SPA “Dąbie” Szczecin Sp. z o.o.	4.50	5.32	18.2
	Tram	Tramwaje Szczecińskie Sp. z o.o.	5.28	13.03	146.8
Bydgoszcz	Bus	MZK Sp.z o.o. Bydgoszcz	5.28	6.90	30.7
	Tram	MZK Sp.z o.o. Bydgoszcz	3.04	8.59	182.6
KZK GOP Katowice	Bus	Total	3.60	5.59	55.3
	Tram	Tramwaje Śląskie S.A.	6.39	10.44	63.4
Bus transport		Average rate	5.13	7.41	44.5
		Average yearly dynamics of changes			5.4
Tram transport		Average rate	6.02	11.82	96.3
		Average yearly dynamics of changes			10.1

Source Own study on the basis of Ref. [8]

costs, and various tax burdens. Additionally, a substantial percentage of transport agreements assumes adjusting the rates paid to operators (as in case of KZK GOP in Katowice) by the price index for goods and services (inflation), as well as liquid fuels price index or—in case of tram transport—prices of electricity. Another model are contracts, which assume the compensation for deficiencies generated during the provision of services in urban public transport. For example, in case of Silesian Trams Company (Tramwaje Śląskie S.A.), the rate is adjusted by the price index for consumer goods and services, electricity prices, increase of remuneration costs, what is also the compensation for the costs of investment activities, costs of loans, as well as taxes and local charges connected with investments in infrastructure and rolling stock.

Table 2 presents selected data and macroeconomic indicators published by the Polish Central Statistical Office (GUS) in the years 2007–2014.

As can be concluded from the analysis of data from Table 2, in the years 2007–2014, the prices of consumer goods and services increased by 23.8%, while at the same time, the prices of diesel fuel increased by 14.5%, and gasoline by 9%. Labor costs increased significantly in the same period analyzed. Minimum gross salary increased by as much as 79.5%, which was a more dynamic growth over the 7 years considered, than that of average gross salary, and the latter increased by 41.3%.

Table 2 Selected data and macroeconomic indicators of GUS

Year	Price index for consumer goods and services (previous year = 100)	Unleaded gasoline, octane number 95, per 1 l (zł/l)	Diesel fuel per 1 l (zł/l)	Average gross salary (zł)	Minimum gross salary (zł)	Price index for rolling stock (previous year = 100)	Price of a single full-fare ticket for travel in city bus (zł)
2007	102.5	4.42	4.20	2672.58	936	98.3	2.02
2008	104.2	3.66	3.69	2942.17	1126	97.3	2.17
2009	103.5	4.29	3.80	3101.74	1276	98.9	2.20
2010	102.6	4.81	4.64	3224.13	1317	99.1	2.23
2011	104.3	5.45	5.61	3403.51	1386	97.2	2.46
2012	103.7	5.53	5.64	3530.47	1500	97.7	2.64
2013	100.9	5.38	5.46	3659.40	1600	99.3	2.73
2014	100.0	4.82	4.81	3777.10	1680	97.7	2.72
Change 2014/2007 (%)	23.8	9.0	14.5	41.3	79.5	-13.6	34.7
Average yearly dynamics of changes (%)	2.7	1.1	1.7	4.4	7.6	-1.8	3.79

Source Own study on the basis of Ref. [9]

Assuming, with a certain level of simplification, that the cost structure of a transport company contains fuel costs—amounting to some 30% of total costs, depreciation—20%, labor costs—40%, and other costs—10% of total costs, one can notice—looking at the increase of fuel costs, labor costs, rolling stock costs, and price index for consumer goods and services, it is significantly lower than the increase of rates for transport services. This may be the cause of considerations concerning the discrepancy between prices of production factors and prices of final products, which would require further in-depth studies.

It can be assumed that to a certain degree, the increase of costs of providing services (among others, the rates paid to operators) leads to increased costs of services, that is, the price of tickets in urban public transport, as it is necessary to obtain funds in order not to reduce the transport services offered. As can be gathered from Table 2, over the study period, the average price of a single full-fare ticket in urban public transport in Poland increased by 34.7% and that increase was lower than the increase of rates paid for transport services to operators of urban public transport. Table 3 presents the prices of full-fare personal (non-transferable) season tickets, monthly or 30-day ones, valid for all means of transport in the entire urban transport network, in eight biggest cities in Poland. When calculating the average ticket price, the number of inhabitants in the analyzed cities has been taken into account.

A significant price increase can also be observed in case of the most common season ticket, namely a monthly or 30-day ticket. In eight of the biggest Polish cities, the price of that ticket was some 56% higher in 2014 than in 2007. In some cities, e.g., in Wrocław or Gdańsk, we can observe a drop in the price of such tickets, which is probably due to the policy implemented, that has the aim to increase the attractiveness and competitiveness of urban public transport, by reducing prices.

Table 3 Prices of full-fare personal (non-transferable) season tickets, monthly or 30-day ones, valid for all means of transport in the entire urban transport network, in selected cities, years 2007–2014

No.	Transport organizer	2007	2008	2009	2010	2011	2012	2013	2014	Change 2014/2007 (%)
		Ticket price (zł)								
1.	Warsaw	90	116	na	116	116	156	196	196	117.8
2.	Kraków	94	126	na	148	148	144	144	144	53.2
3.	Łódź	88	88	na	88	88	96	96	96	9.1
4.	Wrocław	108	98	na	98	98	98	98	98	−9.3
5.	Poznań	65	81	na	81	81	141	185	185	184.6
6.	Szczecin	138	138	na	138	138	162	162	162	17.4
7.	Gdańsk	132	98	na	98	98	102	102	105	−20.5
8.	KZK GOP Katowice	96	104	na	104	112	138	150	150	56.3
Average price		96.8	106.7	na	109.1	111.3	134.5	150.8	151.0	56.0

Source Own study on the basis of Ref. [10]

The development of ticket prices in urban public transport is also influenced by the overall economic situation of the country, which is reflected in the financial standing of municipalities, and revenues generated by municipalities, thus in the possibilities, municipalities have to provide funds in their budgets and to spend the funds on co-financing local public transport.

The overall economic situation in a country also influences the social sphere; thus, by establishing prices for urban public transport services, a substantial percentage (numerous groups in society) of inhabitants is entitled to pay reduced fares or use public transport for free. Sometimes a reason for it is the difficulty in reforming the structure of reduced fares and free ridership, which to large extent are inherited, as they were introduced a few dozen years ago. There are many more examples of extending the entitlements to pay reduced fares, and including more social groups in them, than of reducing such entitlements. For example, KZK GOP tried, several years ago, to reduce the right for using public transport free of charge for people over 70 years of age, and entitle them to 50% reduced fares. That attempt failed, mainly due to concerns related to negative public social perception of such a change.

Table 4 presents, in the form of indicators of dynamics of change in comparison with the year 2007, the challenges concerning financing of urban public transport, faced by Polish cities with populations exceeding 300 thousand inhabitants.

Table 4 Indicators of population density changes, changes in transport services provided, as well as public financing of urban public transport in the biggest cities in Poland in 2014, in comparison with 2007

No.	Municipality	Change 2014/2007			
		Population density (inhabitants/km ²) (%)	Change in vehicle-km amount per one inhabitant (%)	Subsidies to local public transport per 1 vehicle-kilometer (zł/vehicle-km)	Share of subsidies to local public transport in municipality income (%)
1.	Warsaw	1.7	11.6	114.3	9.3
2.	Krakow	0.7	-12.7	222.0	3.7
3.	Łódź	-6.3	-7.4	55.1	-0.6
4.	Wrocław	0.2	-1.0	6.9	-1.7
5.	Poznan	-2.7	-2.1	44.0	0.8
6.	Gdansk	1.3	6.2	137.1	4.1
7.	Szczecin	-0.2	2.2	122.9	2.9
8.	Bydgoszcz	-1.6	-6.7	71.6	0.6
9.	Lublin	-2.9	20.0	118.2	2.6
10.	Katowice	-3.3	11.7	125.4	3.7
Total/average		-0.8	3.0	102.1	4.5
Total/average excluding Warsaw		-1.7	-2.4	76.8	1.5

Source Own study on the basis of Refs. [8–10]

As can be concluded from Table 4, in the majority of cities studied, the population density has dropped, which means that the number of inhabitants has dropped, as the size of the municipality (in terms of territory) remains the same. First of all, this is due to the phenomenon of urban sprawl that is extending the territories of cities. Inhabitants of big cities often change their place of residence and move to suburban areas, which are less densely developed, and commute to work in the city, mainly by car. In consequence, not only the population density gets reduced, but also the number of passengers in urban public transport drops. An increasing problem for cities is, thus, the necessity of providing urban public transport services for suburban areas. This may be proven by increased transport offer, which is confirmed by the higher level of vehicle-kilometers per 1 inhabitant.

Organization of local public transport has become an increasing financial burden for municipalities. The amount of subsidies to local public transport per unit of transport work increased significantly over the period studied, by 102% on average. What is more, the share of subsidies to local public transport in spending from own income of the studied municipalities increased by 4.5% points. In Krakow, despite a significant reduction in the transport offer in the years 2007–2014 (the vehicle-kilometer per 1 inhabitant factor was reduced by 12.7%), the expenditures related to subsidies for local public transport, from municipality own income, increase by as much as 3.7% points.

The Influence of Microeconomic Factors upon Changes in Prices of Urban Public Transport Services

A significant part of the phenomena influencing the increased costs of organization and provision of urban public transport services is due to microeconomic factors, which have their origin in individual decisions of subjects. Microeconomic factors result from the elements of microeconomic environment, in which households and enterprises function, and which they can influence. In case of enterprises, the microeconomic environment involves entities from their immediate surroundings, with which the enterprise enters into interactions (e.g., competitors, suppliers, and customers) [7].

Among the microeconomic factors that have influence upon the development of urban public transport ticket prices, one can include the size of transport operation services ordered, requirements formulated by city authorities as for quality parameters of services provided by operators, as well as other tasks executed by transport organizers, including also investment projects, for example, modern passenger information systems, or IT systems assisting the management of urban public transport.

A crucial microeconomic factor, influencing the level of rates for transport services, are the increasing requirements concerning rolling stock quality, in particular as to the age of rolling stock. Modern rolling stock is, as a rule, fully adjusted

to the needs of the disabled, while buses also comply with stringent flue gas emission norms. The purchase of new rolling stock is, of course, connected with costs for the transport company, and costs that operators bear are then transferred to transport organizers, in the form of higher prices of services. Table 5 lists the information on average age of rolling stock in the years 2007 and 2014 for the biggest service providers in cities in Poland, for which data were available.

As can be concluded from Table 5, most of the service providers analyzed in the cities concerned: over the 7 years replaced the rolling stock with more modern one, which can be proven by the fact that the average age of the rolling stock has not increased in line with the time, over those 7 years. In some cases, e.g., Warsaw, Lublin, Poznan, or Szczecin, the average age of rolling stock was significantly reduced in 2014—in comparison with 2007—which proves the high level of investments in the purchase of new means of transport.

Table 5 Average age of bus and tram rolling stock for the biggest service providers in selected cities in Poland, in 2007 and 2014

Transport organizer	Means of transport	Biggest service provider	2007	2014	Change 2014/2007 (number of years)
Warsaw	Bus	MZA Warszawa Sp. z o.o.	10	7	-3.0
	Tram	Tramwaje Warszawskie Sp. z o.o.	22.4	16.5	-5.9
Cracow	Bus	MPK Kraków S.A.	7	8	1.0
	Tram	MPK Kraków S.A.	27.1	34	6.9
Łódź	Bus	MPK Łódź Sp. z o.o.	7	7	0.0
	Tram	MPK Łódź Sp. z o.o.	22.5	29.7	7.2
Poznan	Bus	MPK Poznań Sp. z o.o.	8	6	-2.0
	Tram	MPK Poznań Sp. z o.o.	29.1	24.4	-4.7
Gdansk	Bus	ZKM Gdańsk Sp. z o.o.	10	11	1
	Tram	ZKM Gdańsk Sp. z o.o.	23.5	24	0.5
Szczecin	Bus	SPA "Dąbie" Szczecin Sp. z o.o.	11	10	-1.0
	Tram	Tramwaje Szczecińskie Sp. z o.o.	24	19.3	-4.7
Bydgoszcz	Bus	MZK Sp. z o.o. Bydgoszcz	7	8	1
	Tram	MZK Sp. z o.o. Bydgoszcz	22.4	31.1	8.7
Lublin	Bus	MPK Lublin Sp. z o.o.	15	8	-7
	Trolleybus	MPK Lublin Sp. z o.o.	15	3	-12
KZK GOP Katowice	Bus	PKM Katowice Sp. z o.o.	n/a	12	n/a
	Tram	Tramwaje Śląskie S.A.	24.9	28.8	3.9

Source Own study on the basis of Ref. [8]

The revenue from sale of tickets, and thus also the decisions concerning prices, is also influenced by decisions taken by households. The decisions taken by the smallest units involved in economic activity, and their economic situation, are decisive for the development of trends in the entire economy of a given country. Table 6 presents the selected data and economic indicators, which influence the decisions of households, and which reflect the consequences of those decisions in the economy.

An average household in Poland has increasing monthly income at its disposal. In the period studied, that is from 2007 to 2014, the average monthly income per one person in the household increased by 44.6%. In the same period, the prices of fuel increased much less dynamically (Table 2). As can be concluded from Table 6 the amount of petrol, in liters, that can be purchased with an average gross salary increased by 29.8% in the years 2007–2014.

In the period analyzed, the price competitiveness of urban public transport, against individual transport, decreased significantly. Fares in urban public transport increased more dynamically than the price of fuel, and in 2014, one could purchase only 5% single full-fare bus tickets more than in 2007. Of course, the average cost of using personal vehicles exceeds by far the cost of fuel, as the costs include—among other things—depreciation, costs of periodic inspections, repairs, parking and garage, or the cost of insurance. Still, one should remember that marginal cost counts for the consumer, and the cost of fuel is taken into account by the consumer. Moreover, the advantage of motorized individual transport over urban public transport lies also in the comfort of traveling, the possibility of getting to the destination directly and quickly, as well as much greater sense of safety. This can be exemplified the best by dynamic growth the number of cars registered in Poland (in the years 2007–2014—increase by 37.1%). As the data from Table 6 indicate,

Table 6 Selected data and economic indicators that describe households in Poland in the years 2007 and 2014

Indicator	2007	2014	Change 2014/2007 (%)
Average monthly income available, in Polish zloty–zł (per 1 person in the household—total)	894.51	1293.32	44.6
The number of single full-fare bus tickets that can be purchased with average gross salary	1323	1389	5.0
How many liters of petrol (95-octane) may be purchased with average gross salary (l)	604.7	783.6	29.8
Price of a taxi ride, day tariff—for 5 km (zł)	13.55	16.19	19.5
Car ownership index (number of personal vehicles per 1000 inhabitants)	383	520	35.8
Registered personal vehicles, in thousand	14,589	20,004	37.1
Number of passengers transported by public transport, in million	4191.6	3858.8	-7.9

Source Own study on the basis of Ref. [9]

every other inhabitant of Poland has a car, which is not without influence upon the number of passengers using local public transport, which dropped in Poland by nearly 8% over the period analyzed.

Reduction in the number of passengers in local public transport and the decreased revenue from ticket sales make it necessary to limit the transport offer, or to obtain additional funding to cover the costs of organizing urban public transport. Obtaining additional financing results in the necessity of increasing the level of subsidizing by the municipality, or increasing the price of tickets.

The decision, made by the organizer of urban public transport, about the price of tickets, also requires taking into account the general relations that occur between price and demand for public transport services. Because one should take into account the price elasticity of demand, that is the change in demand response to the change of price. In line with the law of demand, price increase (with other conditions remaining unchanged and with the exception of non-typical goods) results in decreased demand. The price elasticity of demand decides about the price increase not being translated directly into increase of revenue from ticket sales, due to the drop in demand, caused by price increase. Depending on the location of the point along the curve of price elasticity of demand, demand will have a stronger or weaker reaction to price change, by 1%. Price elasticity of demand for urban public transport services, as in case of most foods and services in the economy, is less than -1 , which entails that those foods and services have elastic demand, and that demand strongly reacts to price change (percent change of demand is greater than the price change that causes it) [11]. Thus, every increase of ticket prices will contribute only partly to the growth of revenue from ticket sales, particularly in the condition of high substitutability of services in urban public transport.

Conclusion

Urban transport is a substantial part of transport sector. From the point of view of the number of passengers transported, municipal economy, and the role it plays in the functioning of towns, it is also an important part of the entire economy. One should not forget that a vast majority of journeys, not only in Poland, but also worldwide, begins and ends in towns.

Besides the quality factors, an important element of the assessment of urban public transport are the prices of the services provided. Those prices are influenced by numerous factors, which may be classified as microeconomic and macroeconomic factors. By its nature, price depends upon costs, so the development of prices of resources is used in the process of providing those services. However, they are not the only factors influencing the entities that determine prices. It is visible that many policies are pursued in the process of price determination: social, development, spatial development or environmental protection policies, causing that the level of public financing in the urban public transport is high. It is also worth noting that other factors, different from material factors of production, are highly

influential for the development of rates for transport services. They are mainly the investment projects, concerning the enhancement of service quality, e.g., passenger information systems.

There is a feedback between micro- and macroeconomic factors and prices of urban public transport services, which the above considerations have disclosed. The prices of services of urban public transport are influenced by decisions of entities and passengers, in which decisions in turn are taken on the basis of analysis of market prices, including prices of services. It is also worth noting that some microeconomic factors, the source of which are decisions of individual entities, form—in aggregated model—the macroeconomic trends.

Certain data have been gathered, and to make the analysis performed possible, they became the basis for drawing some initial conclusions, which would be the starting point for further studies. The relationships between micro- and macro-environment factors and decisions concerning prices in the urban public transport are very complex and changing with time, which causes them to be difficult and complicated, requiring to apply mathematical tools and to construct models, which is connected with a wide range of research work, and with the time-consuming character. Nevertheless, extended studies concerning the factors that influence price development in urban public transport would be important indeed, not only from the theoretical perspective but also from application point of view.

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