Shaping Levels of City Bus Prices as a Result of Tenders

Aleksander Jagiełło

Abstract The article attempts to verify the research hypothesis formulated by the author stating that the size of the tender (understood as the number of once purchased vehicles) negatively affected the final unit price of the purchase of a city bus. Confirmation of the hypothesis would testify to the potentially greater cost-effectiveness of functioning of large carriers on the urban transport market. In order to verify the above hypothesis, the current situation of the city bus market in Poland, the criteria used in tender procedures and the results of primary research on the correlation between the size of the tender and the unit price that MAXI class buses in Poland had as a result of tender procedures were presented. In the final part of the article, the author presented the discussion and conclusions from the conducted research.

Keywords Rolling stock investments · Tenders for city buses · Prices of city buses · Tender criteria

1 Introduction

In microeconomics, economies of scale are the cost advantages that enterprises receive due to their scale of operation. The economies of scale occur when, together with the increase in the production volume of the enterprise, the average costs per unit of production decrease [1, 2, 15, 16]. This is because, as production volumes increase, long-term average total costs are reduced (fixed costs are distributed to a growing number of goods or services produced). As the analyses made so far on the intensity of this phenomenon on various markets show, the scale of the economies of scale on the level of average costs is particularly high in the automotive industry [3, 4]. In addition, as the volume of production increases, the positive effect of

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specialization and learning increases. This effect results from the greater productivity of the workforce with greater experience in the production of a given goods or service [5, 6, 17].

Considering the above conditions regarding the occurrence of economies of scale in the automotive market, the article attempts to verify the hypothesis that the increase in the size of the tender (understood as the number of once purchased vehicles) negatively affected the final unit price of the purchase of a city bus. The verification of the research hypothesis was used to verify the thesis saying that the size of the enterprise providing public urban transport services, and thus the size of tenders submitted and settled, influences the amount of the company's own costs (assuming the vehicle's own costs as a carrier). The impact of the level of bus purchase costs on the level of the own costs of a company providing public transport services is particularly evident during the calculation of the unit cost of public transport. The price of a new vehicle in addition to the annual depreciation charge is one of the component costs related to depreciation. Depreciation costs, on the other hand, constitute one of the direct costs of the operation of public urban transport [7].

2 The Market of City Buses in Poland in the Light of Tender Allotments

Currently, about 12,000 city buses and over 200 trolleybuses are in operation in Poland [8]. Despite constant rolling stock investments, which are carried out by carriers providing public transport services, there are no significant changes in the age structure of used buses throughout the country. In Poland in 2018, over 1000 new city buses were registered, which means a significant increase in the number of new city bus registrations compared to previous years (2016—723, 2017—771). According to the data of the Chamber of Commerce Municipal Transport presented in Fig. 1, in 2017 the registration of new city buses resulted in the recovery indicator of public transport buses which is a share of purchases in inventory amounting to 5.5 (IGKM in its methodology takes into account the purchase of not only new vehicles but also used vehicles) [9].

The purchase of new vehicles and hence the increase in the recovery indicator of rolling stock results directly in the condition and age of the Polish fleet of city buses. As shown by the data presented in Fig. 2, despite the yearly rolling stock investment, the percentage of buses used in Poland no older than 6 years oscillate between 25 and 30% with a downward trend (32%—2014, 31%—2015, 27%—2016, 25%—2017). Moreover, throughout the entire period under examination from 2000 to 2017, buses older than 10 years accounted for more than 40% of the entire fleet.

To improve the condition of the Polish fleet of city buses and hence the level of quality of the public transport services provided, it is necessary to purchase new vehicles. These purchases take place through tender procedures, most often in an

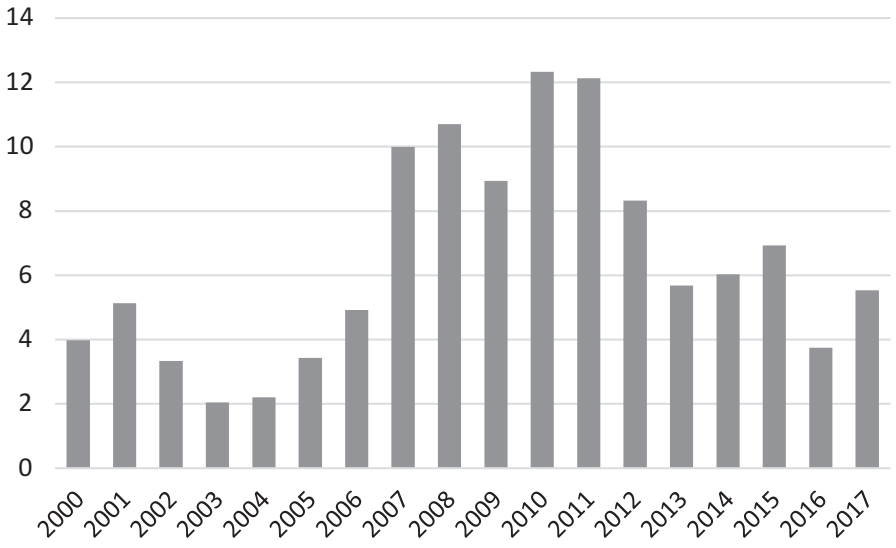

Fig. 1 Recovery indicator for urban transport fleet (calculated as the share of purchases in the inventory) in the years 2000–2017. (Source: IGKM, 2018)

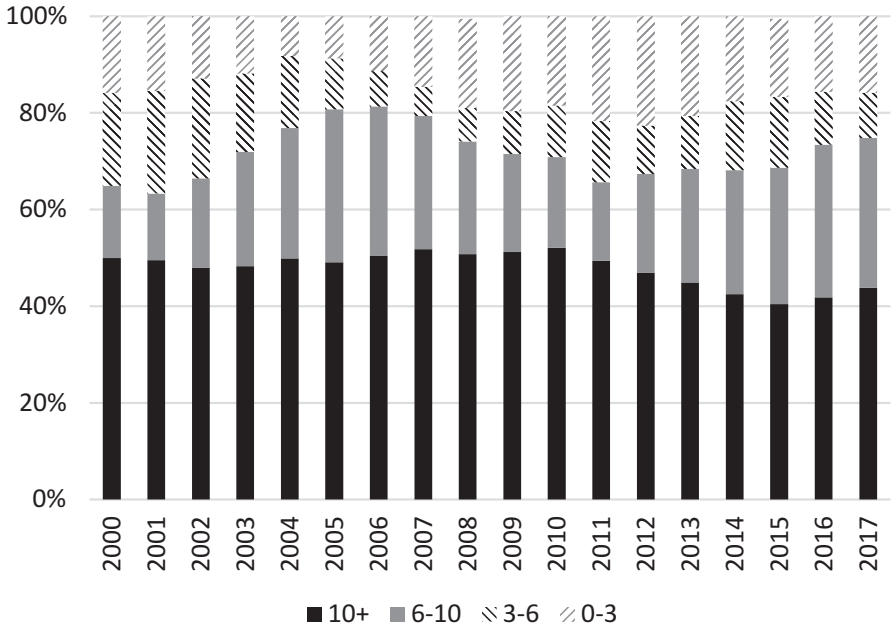

Fig. 2 Age structure of public transport buses in Poland (in %). (Source: IGKM, 2018)

unlimited procedure (in which all interested manufacturers of city buses can participate).

3 Criteria Used in Tender Procedures for City Buses

Through amendments to the law (i.e., the Act of 29th August 2014 amending the act—Public Procurement Law, Journal of Laws of 2014, item 1232) and the Act of 22nd June 2016 amending the Act—Public procurement law and some other acts (Journal of Laws of 2016, item 1020), the legislators limited the selection of the best offer by the contracting authority only on the basis of the lowest price criterion, as shown in Fig. 3, in the majority—68% of tendering procedures for city buses in Poland in 2018 were applied at least two non-price criteria.

Among the applied non-price criteria in tenders for city buses, the highest importance was given in 2018 to the technical parameters of the ordered vehicles (while analyzing individual tenders a large range of this criterion is visible) and conditions for vehicle warranty and service. The environmental aspects of rolling stock, technical readiness, fuel and electricity consumption, comfort and safety offered by the vehicle, prices of spare parts, and unification of engines of delivered buses were also assessed (Table 1).

Figure 4 presents data on 91 tenders for city buses with allotment in 2018. According to them, the price of city buses corresponded on average to 62% of the total offer evaluation submitted by the rolling stock producers for the tender (most often, in 77% of cases the price was 60% of the total offer evaluation price).

In conclusion, it should be noted that the price offered by vehicle manufacturers is still (though to a lesser extent than before the 2014 and 2016 changes) a decisive criterion for the selection of offers in tender proceedings for city buses in Polish conditions.

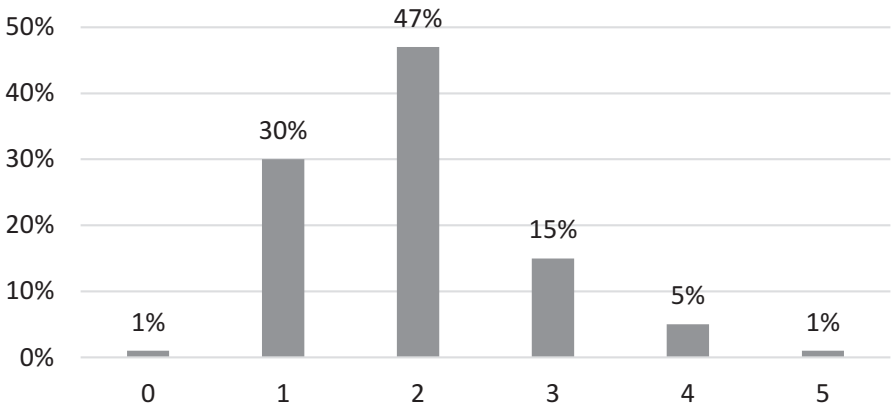

Fig. 3 The number of non-price criteria applied in tenders for city buses in 2018. (Source: own study)

Table 1 Importance of non-price criteria in tender procedures for city buses in 2018 (in %)

Criterion	Measure				
	Minimum	Mean	Maximum	Median	Dominant
Technical parameters	6	30	42	30	40
Terms of warrantee and service	4	11	30	10	10
Fuel/energy consumption	3	8	30	5	5
Delivery date	2	8	40	5	5
Ecology	5	12	35	9	10

Source: own study

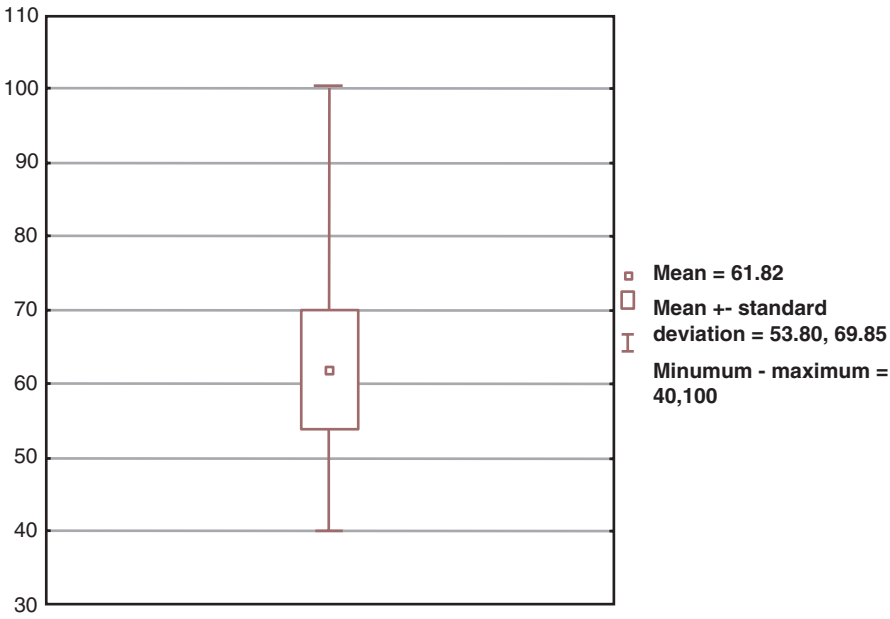

Fig. 4 Percentage of points given for the price in tenders for city buses in 2018. (Source: own study)

4 Results of the Analysis of the Impact of the Size of the Tender on the Unit Price of a City Bus

The data on the results of 180 tenders for 12 m single-stage city buses were subject to the study. These tenders were organized by carriers providing public transport services in Polish cities. The time period of the study covered tenders that took place in 2011–2018, and as a result 1736 city buses were purchased. Only tenders

concerning 12 m buses of the MAXI class were subject to the study, because these buses constitute the most popular and the largest segment of city buses in Poland and their price significantly differs from the price of vehicles of other classes (MINI—below 8 m, MIDI—9–10 m, MEGA—13–15 m, and articulated buses). In addition, MAXI class buses are on offer from the largest number of rolling stock manufacturers, which has a direct impact on the number of tenders, and thus on the intensity of competition and the price level of the vehicles themselves. In order to obtain reliable results, only conventional buses driven by a diesel engine were tested, because their market price clearly differs from the prices of buses powered by LPG/CNG, electricity, or hybrid buses. Thus, shaping the price level of city buses powered unconventionally as a result of tenders requires separate analyses. For the reliability of the results, all bus prices for which tenders were settled in 2011–2017 were adjusted for inflation.

Based on the conducted analyses, the results of which are presented in Fig. 5, it should be stated that there is no negative correlation between the size of the tender and the unit price of a conventional city bus obtained as a result of the tender (coefficient of correlation = 0.21). In addition, the volatility of the price of city buses is only 4% explained by the volatility of the size of the tender (coefficient of determination = 0.044). The results of the regression analysis showed that size of the tender for 12 m buses in Poland has a statistically significant effect on the price of city buses ($p = 0.00481$). The estimated regression parameter b was equal to 2166.

In order to minimize the impact of other variables on the reliability of the obtained results, the impact of the tender size on the price of city buses in the case of tenders won by one producer (in the scope of one model) was also analyzed.

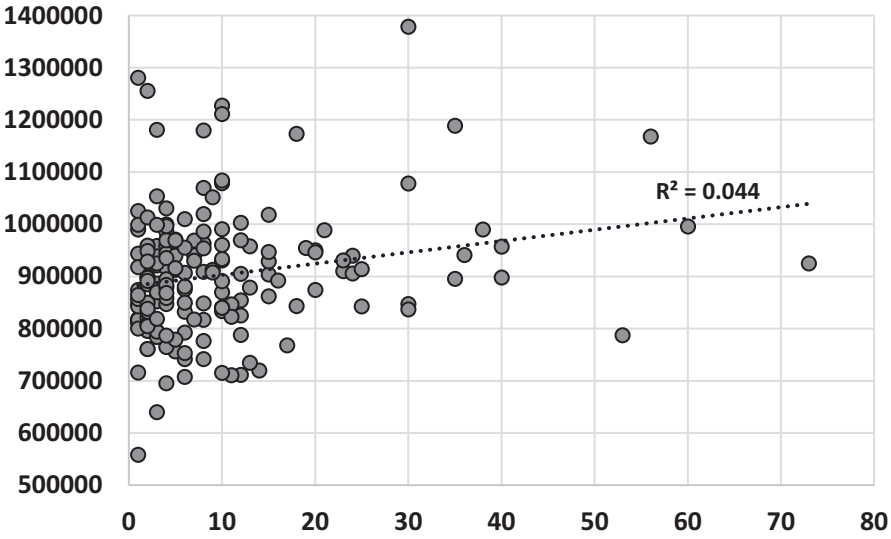

Fig. 5 Scatter chart—unit price of the bus in relation to the number of buses ordered in tenders in 2011–2018. (Source: own study)

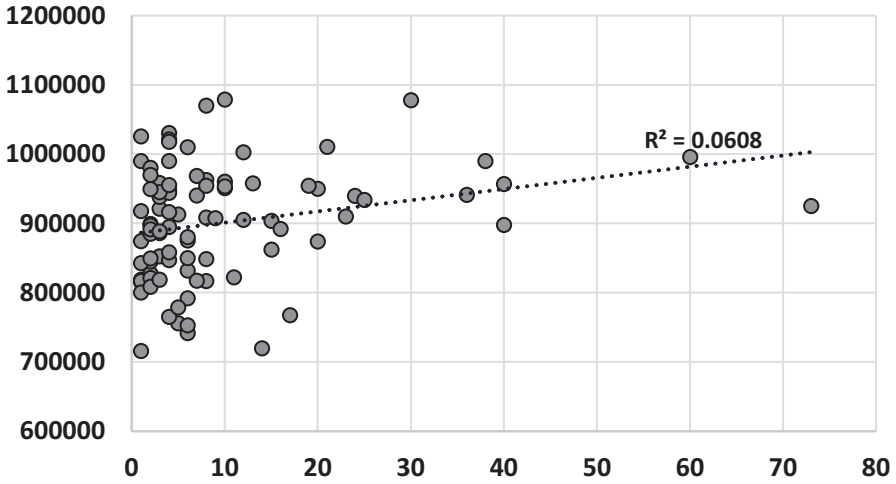

Fig. 6 Scatter chart—unit price of the Solaris Urbino 12 bus in relation to the number of buses ordered in tenders in 2011–2018. (Source: own study)

Thus, 95 tenders (as a result of which 913 buses were purchased) were subjected to analysis for 12 m city buses in which Solaris Bus & Coach SA won by offering Urbino 12 buses (the most popular city bus in Poland). The results of the analysis are shown in Fig. 6. In this case, there was also no negative correlation between the size of the tender and the unit price of Urbino 12 city bus obtained as a result of tenders (coefficient of correlation = 0.16). According to the analyses carried out, the volatility of the price of Solaris Urbino 12 buses is explained only in the 6% variation in the size of the tender (coefficient of determination = 0.06), which is almost the same as for the entire 12-meter bus segment. The results of the regression analysis showed that size of the tender for Urbina 12 buses in Poland has a statistically significant effect on the price of Urbina 12 buses ($p = 0.0185$). The estimated regression parameter b was equal to 1615.

The results of regression analysis and the value of correlation and determination coefficients obtained during the analysis mean that the confirmation of the hypothesis stating that the tender size (understood as the number of one-time purchased vehicles) had a negative impact on the final unit price of the city bus purchase was not obtained. Thus, it was unsuccessful to verify the thesis that the increase in the number of tenders submitted and allotted reduced the company's own costs (assuming the vehicle's own costs as a carrier) related to the purchase and operation of city buses.

5 Discussion

The study and analyses indicate that in the case of the automotive market, economies of scale are a particularly important factor influencing the final price of offered vehicles, and hence are an important factor affecting competition between manufacturers that form the supply side of the automotive market [3, 10, 11]. It results from high costs incurred for research and development of new models of vehicles put into operation, costs related to the development of modern technologies (among others aimed at reducing harmful substances emissions and reduction of fuel consumption), and high costs of creating production lines and their modernization in terms of production of new models and application of new technologies. Despite this, as a result of analyses carried out in this article, it was not proven that the producers of city buses are willing to reduce the unit price level in the case of a single order of a larger number of vehicles (through the tender procedure). Since in Poland so far no analyses have been carried out in the scope presented by the author in the article, it is impossible to confront the obtained results with historical results (from previous years). It is also impossible to say whether the received results were not affected by the exceptional situation on the city bus market. The uniqueness of the state of the Polish city bus market in the analysed period was related to the high level of demand caused by, among other things: European Union funds spent on the development of public transport, national and European policy aiming to protect the natural environment, progressing trends regarding the change of power supply for city buses and operation undertaken in the scope of changing the current modal split for the benefit of greater use of public transport. All the above factors had a positive effect on the volume of demand and thus discouraged the rolling stock producers to compete on price.

6 Conclusions

On the basis of the analyses presented in the article, it can be stated that in Polish conditions, the size of the announced tender is not a factor allowing to reduce the unit costs of buying a city bus. Thus, the research hypothesis was not confirmed at the time of the analysis, saying that the size of the tender (understood as the number of one-off vehicles purchased) affected the final unit price of the purchase of a city bus. Consequently, the thesis that the larger enterprise providing public urban transport services (and therefore the bigger tenders notified and resolved) the lower the costs of purchasing city buses, and hence the own costs of the enterprise (assuming the own vehicle costs as a carrier) was not confirmed. It should be noted, however, that the cost of buying a city bus is only about 20–30% of the total cost of its life cycle (this value is different in various studies due to the analysis method used, variables taken into account, and the quality of input data) [12]. Other important elements of the bus life cycle costs are the costs of vehicle maintenance (which

include labor costs and parts and materials) and energy costs (liquid fuels, gas, or electricity). The amount of individual costs included in the life cycle cost of a bus is strongly differentiated between diesel-fueled, hybrid, CNG/LNG, and electric [13, 14, 19, 20]. The mileage that the vehicle will overcome during its operation also influences the differentiation of the individual components of the bus life cycle costs [12, 18].

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