Proceedings of 7th Transport Research Arena TRA 2018, April 16-19, 2018, Vienna, Austria

Multidimensional comparative analysis of transport behaviour of urban residents: the case of Polish cities

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Abstract

The aim of the work is to conduct a multidimensional modelling of transport behaviour of residents of cities in Poland. The research was carried out on the basis of the pilot sample survey results conducted by Polish Central Statistical Office in 2014-2015. In the work a correspondence analysis was used to study the transport behaviour of urban residents. In the study the relationship between the frequency of journeys within the city and factors describing them were investigated. The research analysed primarily the interdependence between the intensity of travels made by residents within the city and factors describing these travels, such as structure of travel, destination, time interval of journeys or methods of travel. On this basis, a profound analysis of the transport behaviour of urban residents was carried out. The study results presented in this work can be a useful tool for local authorities in order to forecast the travel behaviour of urban residents.

Keywords: transport behaviour, Polish cities, correspondence analysis.

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1. Introduction

The development of cities is accompanied by an increasing number of obstacles (barriers) requiring integrated actions of various stakeholders (local authorities, municipal organizations, residents, etc.) in order to overcome them. The way to overcome emerging barriers can be considered as one of the dimensions of the pace and direction of the development of modern cities. In the case of cities, travel barriers (traffic congestion) are particularly important. In many cases they impede and sometimes don't even allow them to meet many other needs related to the smooth movement of the city (e.g. the use of available leisure activities or access to cultural goods). This problem is the most acute in large urban agglomerations. Increasing travel congestion is, among other matters, the effect of intensive changes taking place in the travel behaviour of city inhabitants. The modelling of transport behaviour of urban residents has been extensively discussed in literature (e.g. Banister 1995; Aarts and Dijksterhuis 2000; Jakobsson et al. 2002; Bresson et al. 2004; Holmgren 2007; Cameron et al. 2008; Albalate and Bel 2009; Yatskiv and Pticina 2010; Witkowski and Kiba-Janiak 2012; Cheba et al. 2014; Cheba and Saniuk 2016).

In many cities around the world there is a growing level of motorization, but there are also cities where the slower growth rate of the motorization rate (measured by the number of cars per capita) is observed or even lower. This situation in case of Europe mainly concerns Scandinavian countries, but it is also observed in Germany and Austria. The decline in the level of the motorization rate was already predicted in the 1970s by the UK government Centre for Forecasts. The forecasts were based on the saturation of the individual car market around 2010 and according to the statistics they proved to be true for many of the most developed (largest) cities in Western Europe (Anderson et al. 2005; Garcia 2006). These trends, however, differ in Central and Eastern European cities, where the individual motorization rate is still growing and the interest in other modes of transport is decreasing (Cheba and Saniuk 2016).

In both cases (stopping the growth of the motorization rate in Western European cities and its growth in other parts of Europe) are the result of many factors, which are increasingly attributed to cultural and social changes (Anable et al. 2006; Haslauer et al. 2007; Chan et al. 2011; Aron et al. 2015). The factors that may re-stimulate public interest in urban transport or alternative forms of urban mobility of city inhabitants can be innovative solutions for both transport itself and the ability to shape transportation behaviours. Transportation behaviours can be defined as actions that result from different motivations and are taken by people in space and at a certain time to move with the means of transportation chosen by them. Choices made depend on current opportunities, limitations and habits of the people in the region (Anable 2005). Knowing and examining the transportation behaviour of the population is essential for the proper organization and management of public transport at both national and regional levels so that the actions undertaken are not only effective but also in line with social expectations.

Standardized actions to counter congestion by increasing road capacity in many cities are already insufficient. Studies in different parts of the world confirm that increasing road capacity does not lead to permanent improvement and does not provide the possibility of permanent limited congestion. An example may be studies covering the 1973-90 California data, which confirmed that with the 10% increase in road capacity, approximately 9% of traffic growth is expected to be seen after about four years. On the other hand, limiting the road capacity, for example, as a result of their exclusion from traffic may lead to the stopping of alternative streets and then even to a marked decrease in interest in using existing connections (temporarily deactivated) (Banister 2005). A need to find a compromise between citizens' transportation habits and a need to ensure access to city centers, especially large ones, has led to the redefinition of many of the existing principles of transport policy in Western Europe. This has led to greater interest in the potential for more active management of the transportation behaviour of residents, the main purpose of which has been to discourage inhabitants from using private cars, especially in areas with limited access to transportation. This way of shaping transport policy, implemented in order to improve the quality of life of the inhabitants, is defined as a "push-pull method". This term implies, on the one hand, the use of "push" in the movement of cars in the most crowded areas, with the simultaneous "pull" of traffic, mainly by means of transport alternative to passenger cars (Banister et al. 1997). Stimulating people's interest in alternative transport in relation to passenger cars is related to the need to ensure the proper quality of this transport. This is particularly important in public transport, which is the most common alternative to passenger cars.

The aim of the work is the construction of models describing the transportation behaviour of city inhabitants. The research presented in the paper uses the statistical data provided by Central Statistical Office in Poland derived from the project titled “Pilot study of travel behaviour of the population in Poland” carried out in 2014-2015. The analysis of correspondence was used to elaborate models of transportation behaviour of inhabitants of voivodship cities in Poland. In the study the relationship between the frequency of travels within the city and factors describing them were investigated. It analyzed primarily the interdependence between the intensity of journeys made by residents within the city and factors describing these travels, such as structure of travel, destination, time interval of journeys or methods of travel. On this basis, a profound analysis of the transportation behaviour of urban residents was carried out, which can provide additional information about the travel behaviour of urban residents in Poland.

2. Transportation behaviour of urban residents

Comprehensive research on the transportation behaviour of city inhabitants is a subject of many scientific studies as well as economic practices reports (Nilsson and Kuller 2000; Mokhtarian and Salomon 2001; Hagman 2003; Brueckner and Selod 2006; Ozkazanc and Sonmez 2017). Studies of this type are part of thematic objectives indicated in a number of strategic documents, both at the national level, such as e.g.: Development Strategy of Poland 2020 - Active society, competitive economy, effective state (MRR 2012), National Strategy of Regional Development 2010-2020 (MRR 2010) or Transport Development Strategy until 2020 (with a prospect until 2030) (MTBiGM 2013), as well as at European level, e.g.: Europe 2020 Strategy (EU 2007). The total traffic collapse forecasted in the 1960s and 1970s is not currently the most pressing problem for many of Europe's largest cities. Traffic jams paralyzing cities in highly developed countries are basically not talked about and isolated cases are associated with particular situations (Tulpule 1973). Available statistics confirm the forecasts already developed by the UK Center of Forecasting in the 1970's. According to this forecasts, the saturation of the market of individual cars in Western Europe has been expected. An analysis of the dynamics of changes in the motorization rate in the largest cities of Western Europe confirms the accepted assumptions (Fig. 1).

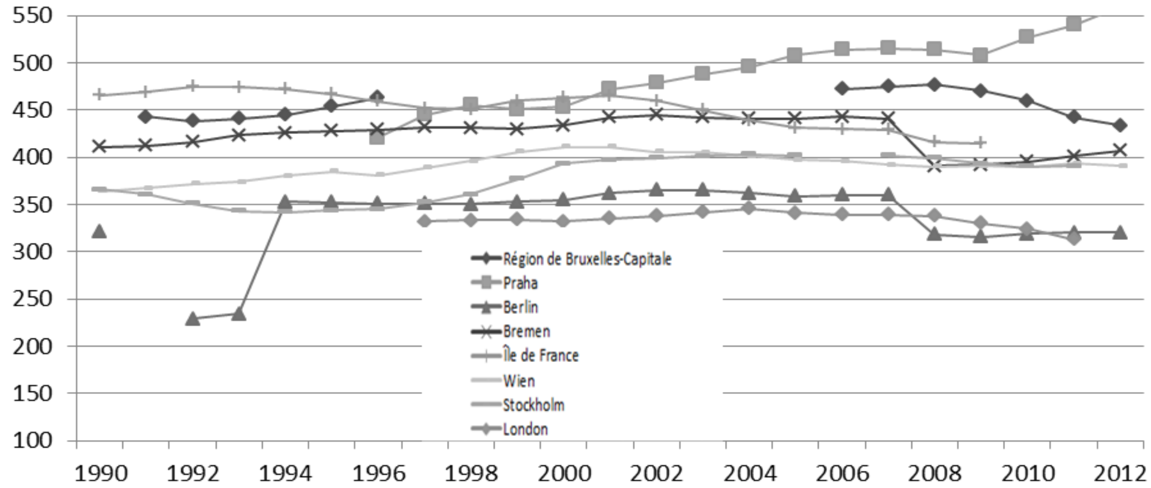

Fig. 1 Motorization rate (the number of passenger cars per 1000 inhabitants) in selected European cities in 1990-2012

Another situation is observed in Central and Eastern European countries, including Poland, where there is an increase in the individual motorization rate (the number of registered cars per 1000 inhabitants) and the decrease in interest in other means of transport. The development of the indices in the largest Polish cities in 2009-2015 is presented in Table 1. On the other hand, Table 2 presents information about the average growth of the motorization rate divided into 3 groups of cities with county status (divided by the number of inhabitants: up to 100 thousand inhabitants, 100-200 and over 200 thousand).

The growth of the motorization rate was recorded in all cities with county status in Poland. In the case of the largest cities (with the largest number of inhabitants) the highest value was recorded in Katowice (an average increase of 24.5 units per capita), and the lowest in Bydgoszcz (11.1). On the other hand, the analysis of the information presented in Table 2 shows that the average growth of the motorization rate does not depend on the average urban size and its average increase at similar level is observed in all groups of surveyed cities. These groups, however, are characterized by a rather high level of variation in the mean growth rates (the variation coefficient for each group is above 15%).

The observed changes (both the decline in Western European countries and the growth in Central and Eastern European countries) have a direct effect on the growth of transport congestion. They are also caused by cultural and social changes (e.g. increase in wealth of city inhabitants, easier access to cheaper used cars). It is important to note that the measures taken to counter urban congestion, mainly through increasing the throughput of modernized roads are currently insufficient. There are numerous examples of this, such as the slowdown in car traffic despite Toronto's subway refurbishment and the increase in car ownership in Marseille, despite the opening of the underground (Raisis 2009). In many works available in the literature, it is also noted that road traffic is increasing as the capacity of modernized roads increases, resulting in a return to the former state of saturation (so-called induced movement) and the continuation of the traffic behaviour of the residents is not only related to the availability of roads but also with living activity by residents (Nordlund and Garvill 2003; Farsi et al. 2007; Huang et al. 2007).

Table 1. Individual motorization rate in the largest cities in Poland in 2009-2015

Cities	Year							Average index growth
	2009	2010	2011	2012	2013	2014	2015	
Warsaw	535.5	547.9	564.8	580.0	598.0	619.7	648.5	18.8
Cracow	463.2	466.6	485.6	503.2	521.2	534.1	557.2	15.7
Lublin	378.7	387.2	409.7	425.0	446.9	463.4	483.1	17.4
Katowice	484.5	491.1	516.3	539.7	571.1	599.3	631.6	24.5
Poznan	514.8	513.7	538.2	554.3	578.1	600.6	625.0	18.4
Szczecin	398.1	399.9	420.8	433.9	448.8	465.9	486.7	14.8
Wroclaw	487.4	498.0	524.8	540.5	558.2	575.4	600.6	18.9
Bydgoszcz	462.5	462.1	473.1	486.1	499.6	510.7	529.0	11.1
Lodz	389.0	408.0	433.6	447.8	466.2	483.2	502.0	18.8
Gdansk	470.9	475.4	496.5	508.6	523.5	542.9	552.0	13.5

Table 2. Individual motorization rate in the 3 groups of cities with county status in Poland

Number of residents	Number of cities	Average increase	Maximum	Minimum	Coefficient of variation (%)
up to 100 thousand,	27	15.9	32.5	11.1	25.1
100-200 thousand,	22	16.5	24.8	5.1	24.3
over 200 thousand	16	16.3	24.5	11.1	19.5

Travel by residents related to these activities can be broadly divided into four groups: travels related to home maintenance, recreation, social life and the rest. The frequency of individual types of travel, in addition to, for example, the nature of the duties performed is also the result of socio-demographic factors such as age, gender, driving license, employment status, having children and, of course, owning a car. The differences in cultural factors also determine the importance of individual factors and their influence on travel behaviours and types of travel.

In the next part of the paper an attempt was made to build models of transportation behaviour of city inhabitants based on data describing these behaviours in selected cities in Poland.

3. Research method

3.1. Statistical material

In the work, the data provided by the Central Statistical Office in Poland from the project "Pilot study of transportation behaviour of the population in Poland" carried out in 2014-2015 was used to elaborate the models of transportation behavior (Central, 2015). The main subject of the study was the transportation behaviour of the inhabitants, e.g. travels and journeys of individuals conducted from Monday to Friday and at weekends (during the last 3 months) as well as occasional trips over 100 km in the past year or recently. The survey was conducted using the representative method based on the survey questionnaire in the drawn sample of 18 thousand households throughout the country and had the character of voluntary anonymous research.

Table 3 presents information on the average mobility of the population surveyed in selected voivodeship cities and in the table 4 the structure of travels in voivodeship cities was presented.

Table 3. Average number of trips per capita in voivodeship cities by time of week

Cities	Overall	Travels		
		at weekdays	on weekend days	occasional*
Bialystok	411	352	58	1
Bydgoszcz	476	417	55	5
Gdansk	422	362	57	4
Gorzow Wielkopolski	430	386	40	3
Katowice	512	451	58	3
Kielce	427	358	66	3
Cracow	463	404	54	4
Lublin	479	403	72	5
Lodz	450	388	59	3
Olsztyn	509	441	62	6
Opole	448	409	33	6
Poznan	438	385	49	4
Rzeszow	437	380	55	3
Szczecin	410	382	24	3
Torun	455	382	68	5
Warsaw	464	398	61	5
Wroclaw	455	394	57	5
Zielona Gora	459	401	55	3

* Traveling over 100 km taken incidentally.

Table 4. Nature of travel in voivodeship cities by selected destinations

Cities	Overall	including:			
		to work	to school	others	returns home
Bialystok	411	99	37	36	205
Bydgoszcz	476	124	20	43	223
Gdansk	422	109	26	31	209
Gorzow Wielkopolski	430	118	10	19	214
Katowice	512	133	23	26	246
Kielce	427	100	27	29	212
Cracow	463	131	26	31	228
Lublin	479	106	25	43	237
Lodz	450	123	14	37	224
Olsztyn	509	149	29	25	250
Opole	448	134	11	22	218
Poznan	438	120	17	47	216
Rzeszow	437	93	29	47	211
Szczecin	410	124	26	12	202
Torun	455	101	37	30	226
Warsaw	464	119	17	41	226
Wroclaw	455	111	36	32	222
Zielona Gora	459	141	14	27	223

According to the information collected during the survey (Central, 2015), there are 452 trips in the voivodeship cities on average per person in the surveyed population for the given period. The largest annual mobility is shown by residents of: Katowice (512), Olsztyn (509) and Bydgoszcz (476) and the smallest: Szczecin (410), Bialystok (411) and Gdansk (422).
The most common motive for the travel, apart from returning home, is commuting to work, to schools (colleges), and after shopping. Commissions to work in individual cities in the total number of journeys account for nearly 31% in Zielona Gora and Szczecin to 21% in Rzeszow and 22% in Lublin and Torun.
The share of commuting to schools in the total number of journeys ranges from 8-9% in Bialystok, Torun and Wroclaw to 2-3% in Gorzow Wielkopolski, Opole, Zielona Gora and Lodz. There is also a significant share of travel to make purchases. The highest is in Poznan and Rzeszow (11%) and the lowest in Szczecin, Gorzow Wielkopolski, Opole, Katowice and Olsztyn (3-5%).
Trips conducted on weekdays in individual voivodeship cities account for 91-93% of the total number of trips in Opole and Szczecin to 84% in Kielce, Torun and Lublin. Average travel time in voivodeship cities ranges from 20 min. in Opole and 21 min. in Bialystok up to 32 min. in Warsaw and 30 min. in Szczecin.
The predominant number of journeys is carried out by means of motorized transport and the highest share of this transport is recorded in Kielce and Gorzow Wielkopolski (89-91%), while the lowest in Olsztyn (69%). The average distance traveled by people in individual voivodeship cities ranges from 10-11 km in Bialystok, Zielona Gora and Kielce to 16-17 km in Warsaw and Cracow. The level of use of a passenger car in commuting to work in individual voivodeship cities is varied. In the largest cities it is lower than the average indicator for the voivodeship, which is the capital. This applies in particular to Gdansk, Cracow, Lodz, Poznan and Warsaw. In other cities the use of cars in commuting to work exceeds the average provincial indicator or is close to the provincial level.

3.2. Analysis method

In the work to build models of travel behaviour of inhabitants of voivodeship cities in Poland, analysis of correspondence was used. The purpose of this method is to identify the simultaneous coexistence of the different categories of nominated nominal variables (Anderson 1959).
The correspondence analysis as a factor method allows the identification of relationships between variables and objects mainly in a graphical form. Determining category coordinates in multiple correspondence analysis is carried out in analogy to the classical approach. The starting point is the choice of the notation of the observed number of category features. There are 4 possible ways (Hair et al. 1998; Stanimir 2005; Sompolska-Rzechuła and Spychalski 2013; Cheba and Hołub-Iwan 2014):

- a record based on the indicator matrix,
- Burt table (matrix),
- multiple analysis of contingency,
- and combined contingency table.

Calculations presented in the paper were based on the basis on a Burt matrix (a symmetric block matrix Z where the main diagonal is diagonal matrices containing the number of each category):

$$\mathbf{B} = \mathbf{Z}^{\mathrm{T}}\,\mathbf{Z} \tag{1}$$

The matrix markers **Z** (system code) is constructed in such a way that each row corresponds to another observation, and the column – to variants of all variables.
Dimension of real space (K) is determined by the formula:

$$\mathrm{K} = \sum_{q=1}^{Q} (\mathrm{J_q}\text{-}1) \tag{2}$$

where: Jq – the number of categories of variable q (q = 1, 2, …, Q); Q – the number of variables.
To select the eigenvalues (λ_k) which are significant, the Greenacre criterion is used on the basis of the following formula:

$$\boldsymbol{\lambda_k > \frac{1}{Q}} \tag{3}$$

where: λ_k – eigenvalues (k = 1, 2, …, K); Q – the number of variables.
In order to improve the image quality, modification of own values is carried out, as proposed by Greenacre on

the basis of the formula (Greenacre 1984; Bąk 2012):

$$\tilde{\lambda}_k = \left(\frac{Q}{Q-1}\right)^2 \cdot \left(\sqrt{\lambda_k} - \frac{1}{Q}\right)^2 \quad (4)$$

Modified coordinate values in k-dimensional space for variable test categories are determined by the formula:

$$\tilde{\mathbf{F}} = \mathbf{F}^* \cdot \mathbf{\Gamma}^{-1} \cdot \tilde{\mathbf{\Lambda}}, \quad (5)$$

where: $\tilde{\mathbf{F}}$ – the modified matrix of coordinate values for the category of the tested variables of the dimension K x k, $\mathbf{F}^*$ – the matrix of primary coordinate values for the category of the tested variables of the dimension K x k, $\tilde{\mathbf{\Lambda}}$ – the inverse of diagonal matrix of singular value of dimension k x k, K – the number of dimension.
As proposed in the paper of Bąk (2012) to show the links between the variables of the considered variants the Ward's method was used. On the basis of the results of the analysis of solutions obtained using the multiple correspondence analysis in combination with the results obtained using the Ward's method it can be indicated that there was a link between the categories of the analysed variables.

4. Study results

The multiple correspondence analysis was performed in order to detect correlations between the variables describing transportation behaviour, such as:

- the size of the city: C1 - provincial town up to 200 thousand inhabitants, C2 - provincial town from 200 to 500 thousand inhabitants, C3 - over 500 thousand inhabitants;
- annual number of journeys: J1 - up to 100 thousand journeys annually, J2 - from 100 to 200 thousand journeys every year; J3 - over 200 thousand journeys a year;
- average distance traveled per person in km: D1 - up to 10 km, D2 - 10-15 km, D3 - over 10 km;
- average travel time by car: AT1 - up to 15 min and less, AT2 - from 15 to 25 min, AT3 - over 25 min;
- average duration of journey by public transport: AD1 - 20 minutes and less, AD2 - over 25 min;

For this purpose the Burt table of dimensions: 14 x 14 was created and the dimension of real space coexistence of identifiable answers to questions for 5 analyzed variables was 14. By using the Greenacre'a criterion (significant main inertia is determined by the formula: 1/Q> 1/5 > 0.2) the extent to which the eigenvalues of a lower dimension explain the total inertia was examined (λ=2.2857). The results of this phase of the study are presented in Table 5.

Table 5. The results of the correspondence analysis

Number of dimension K	Eigenvalues γ_k	Singular values λ_k	Percentages of intertia λ_k / λ	Cumulatives percentages of inertia τ_k
1	**0.5542**	**0.3143**	**0.1375**	**13.7507**
2	**0.4619**	**0.2715**	**0.1188**	**25.6289**
3	**0.4149**	**0.2014**	**0.0881**	**34.4402**
4	0.4065	0.1653	0.0723	41.6721
5	0.3971	0.1577	0.0690	48.5716
6	0.3878	0.1504	0.0658	55.1516
7	0.3825	0.1463	0.0640	61.5523
8	0.3799	0.1443	0.0631	67.8654
9	0.3676	0.1352	0.0592	73.7805
10	0.3609	0.1302	0.0570	79.4767
11	0.3588	0.1287	0.0563	85.1074
12	0.3538	0.1252	0.0548	90.5849
13	0.3389	0.1149	0.0503	95.6118
14	0.3167	0.1003	0.0439	100.0000

The information in Table 5 shows that relevant research was the main host of eigenvalues, at most 3. The criterion for selection of the cast also used elbow criterion according to which the correct projection space is the space indicated by the number of eigenvalues, for which there was a fault in the graph of eigenvalues (Clausen 1998). According to this criterion for the proper dimension of space projection the three-dimensional space was assumed for which a degree of explaining the inertia was 34.44%.
In order to improve the obtained solution an 82.26% of the modified total inertia, which meant that the result of the first 3 dimensions could account for greater percentage of the total inertia than before modification. The results of this phase of the study are presented in Table 6.

Table 6. The results of the correspondence analysis after the modification according to the criteria Greenacre'a

Number of dimension K	$\tilde{\boldsymbol{\lambda}}_{\boldsymbol{k}}$	$\tilde{\boldsymbol{\lambda}}_{\boldsymbol{k}}/\tilde{\boldsymbol{\lambda}}$	$\tilde{\tau}_k$
1	0.1301	0.4408	44.08
2	0.1031	0.3494	79.02
3	0.0619	0.2098	100.00
$\tilde{\boldsymbol{\lambda}}_{\boldsymbol{k}} = 0.2950$			

The results allowed the following classes to be defined:

- Class I (C3, J3, D3, AT3, AD2) residents are classified as those with the highest number of journeys per year (over 200,000 per year), with the longest average journey distance (over 10 km), with the highest mean distance travelled over 10 km and the longest travel time by car (over 25 min) as well as by public transport (over 25 min). Residents of large cities are the primary residents qualifying for this group.
- Class II (C2, C1, J2, D2, AT2) residents were classified as inhabitants of medium sized cities of the studied group from 200 to 500 thousand inhabitants. This class also includes inhabitants from the smallest category in the survey of cities (less than 200 thousand inhabitants). For the representatives of this group, the annual number of journeys is usually at the average level for the cities surveyed (from 100 to 200 thousand journeys per year). These are journeys where the average distance travelled per person in km varies between 10 and 15 km. The average travel time by car is usually between 15 and 25 minutes.

A separate group (Class III: J1, AT1) is the inhabitants of different cities according to the number of inhabitants travelling the least in the group of surveyed cities (up to 100 thousand journeys per year) for which the average duration of travel by public transport is 20 min and less. They may be representatives of the smallest cities as well as medium or large cities.

5. Conclusions

The established division of urban inhabitants taking part in the study due to their travel behaviours in the first group is quite obvious. This group is classified by the inhabitants of the largest cities travelling the most during the year for which both the average travel distance and travel time are the highest. This is clearly the case for large cities where long-distance travel and long-distance journeys are the norm.
Characteristics of subsequent classes are no longer as obvious. For the second class representatives of both the medium and the smallest towns in the study group were classified. The characteristics of this class show that the simple relationship between the size of the city and the number of journeys, duration of the journey and the number of miles traveled do not apply to the inhabitants of cities classified in this class. In the case of urban inhabitants of the smallest cities in the studied group, the values of the analyzed variables are medium, which means that there is no significant relationship between the size of the city (average or smallest city in the surveyed group) and the other variables describing the behaviour of city inhabitants. This is important information showing that travel behaviour does not depend only on the size of the city (as measured by population), but also on other factors not directly observed in this study. These may be different conditions such as: the area of the city, its spatial layout, the proximity of, for example, economic zones in which the inhabitants of the examined city are employed, the organization of public transport, etc.
The collected information shows that a comprehensive study of the behaviour of city inhabitants should take into account a much wider range of information. In addition to information collected directly from residents, information from other sources should also be included. In this case, information from, for instance, the relevant city departments dealing with the organization of transport in the city and information obtained directly from the

entities carrying out public transport within the city may be used. It is possible to apply the method to more complex studies.

In Europe, studies of the citizens transport behaviour were the part of many different projects e.g.: Citizen's Network Benchmarking Initiative, CoMET – The Community of Metros, ECMT Urban Travel Survey, EMTA Barometer, Millennium Cities Database, Nova – Metro Benchmarking Website, Scandinavian BEST, Urban Transport Benchmarking Initiative. In many reports dedicated to mobility in European cities, we can find similar research as those carried out in Poland but usually these reports are dedicated to the larger cities, mainly to the capital cities in Europe. However the same problems are observed in the smaller cities. Changes occurring in travel behaviour of urban residents, especially in medium-size cities, seem to be very similar to those ones observed in the larger cities, although the intensity of these problems is on this phase of their development, slightly smaller. Nevertheless, it is also an important area of the functioning of smaller cities (Kiba-Janiak and Cheba 2014).

The development of sustainable transport is also one of the goals of the 2030 Agenda for Sustainable Development (UN 2015). The sustainable development goals for transport have been included in Goal 11 of this Agenda which has been formulated as follows: Make cities and human settlements inclusive, safe, resilient and sustainable. The sustainable development of transport has been included in this goal in the following form: "By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons" (point 11.2). The basis to integrating this goal into the goals of Agenda 2030 has been the dynamic and unprecedented development of cities in recent decades. According to United Nations data (UN 2015), in 2015 nearly 4 billion people lived in cities, which is nearly 54% of the world population. In addition by 2030, the figure is expected to increase to around 5 billion. With urbanization, the challenges which cities face are growing. The increase in the number of inhabitants in cities means, among other things, the increase of air pollution, the spillover of urban development and the lack of adaptation of basic services and infrastructure to the unscheduled urban structure. These problems identified by national governments resulted in the development of urban policies at national level, which 149 countries around the world have started to develop since May 2017.

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