DO MOTORISATION STATISTICS REFLECT THE REAL GEOGRAPHY OF CAR OWNERSHIP IN POLAND?[1]

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Abstract: The article aims to identify the shortcomings of the statistics describing the size and structure of passenger car parc in Poland, and to formulate the consequences of these limitations for geographical research. Analysed in detail, the shortcomings are divided into three groups: (1) 'dead souls', i.e. an overestimation of the number of vehicles which have not been on the road for a long time but remain on the register; (2) 'cars with a grid' (cars registered as trucks in which the cargo part is separated from passenger seats by a metal grid), i.e. an underestimation of the number of passenger cars and overestimation of the number of trucks related to the mass phenomenon of registering passenger cars as large goods vehicles (LGV-approved cars); and (3) company cars, i.e. an overestimation of the number of vehicles in cities where leasing companies and large enterprises owning those cars have their headquarters. The article determines the scale of car ownership overestimation in Poland and the areas where this overestimation is the highest, using districts (PL: *powiaty*) as basic spatial units. We conclude that the present motorisation statistics do not fully reflect the real geography of car ownership in Poland.

Keywords: motorisation statistics, car ownership, geographical distribution, Poland

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Introduction

For many years the annual European Commission reports (e.g. European Commission, 2018) have shown a relatively very high level of car ownership in Poland. According to the 2016 data, Poland was the sixth most motorised EU state (571 passenger cars per 1,000 inhabitants). It was by far the highest value among the post-socialist countries which joined the European Union in 2004. Poland's car ownership rate amounted – in comparison to other socio-economic development indicators, and also in relation to other countries – to an above-average level, which necessitated specific recommendations in terms of transport policy. Likewise, international research on the drivers of change in car ownership clearly showed a non-standard course of this process in the country. In one of the most often quoted automotive articles (Dargay et al. 2007), where the authors compared car ownership changes and per capita national income in 45 countries in the years 1960–2002, the situation in Poland is shown to diverge considerably from the relationship

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between those two variables in the remaining states. It was a single case in the entire set (and the study concerned also a large group of developing countries). The analysis of car ownership changes and the income level in Poland in this period revealed that the income flexibility of car demand was more than twice as high as in the majority of European countries. This is certainly related to the development path Poland chose after 1989. However, what is equally important in shaping such a picture of the process (if not more important) is the quality of the Polish motorisation data used for research and international comparisons, which overestimate the car ownership rates.

For many years the studies on the car market have shown (e.g. Kublik 2005, 2013a, 2013b) that official data on the number of passenger cars do not reflect the actual state of this phenomenon. Professional specialists and car experts are quite well acquainted with this problem (it was also analysed by the Institute of Automotive Market Research SAMAR), but it has not been introduced to scientific discussion on motorisation so far, except in rare cases (e.g. Komornicki 2008, 2011; Menes 2018). This study attempts to fill the gap.

The article aims to identify the shortcomings of the statistics describing the size and structure of passenger car parc in Poland, and to formulate the implications of these limitations for geographical research. What made this objective possible was the creation of a new, increasingly reliable source of information, i.e. the Central Vehicle Register [PL: *Centralna Ewidencja Pojazdów* (CEP)] 2.0, which holds details about all vehicles in Poland. This type of data is used for automotive analyses, including their regional profiles (e.g. Lansley 2016). Such analyses, however, have not been performed in Poland yet.

The analysis presented in the later sections of the article was carried out on the basis of the data obtained from CEP on selected features of passenger cars (the year of the first registration in Poland, the year of production, permissible load capacity, the number of seats and the condition of a vehicle) and their owners (the district[2] of residence or business activity). They have been processed and presented using several methods of statistical and spatial analysis, including indicators of the phenomena structure, cartographic methods and correlation analysis between car ownership rates for different vehicle segments and selected socio-economic features.

The article is composed of four sections. The first section shows the most significant shortcomings of motorisation statistics in Poland based on the review of related literature. Then, in the second section we describe the way of collecting data and keeping records of motorisation statistics in Poland. The in-depth analysis of the CEP data, which makes it possible to estimate the size and structure of selected limitations of motorisation statistics, is dealt with in the third section. Finally, we attempt to determine the implications of these shortcomings for geographical research.

The main shortcomings of motorisation statistics in Poland

To date, the motorisation data have been used in the investigations of a series of socio-economic phenomena and processes. The significant proportion of information on the number of passenger cars in Poland comes from the Statistics Poland [PL: *Główny Urząd Statystyczny* (GUS)] database. The data were accepted rather indiscriminately (with few exceptions), and while their weaknesses were discussed at conferences and professional meetings, they were less frequently analysed in scientific publications. The availability of the CEP data creates new analytical opportunities and allows estimating the size and structure of errors in the data used. When analysing the information on car ownership indicators, which are most often found in the Polish public statistics, one should focus on six major shortcomings.

1. **'Dead souls'**, i.e. an overestimation of the number of vehicles which have not been on the road for a long time but remain on the register. This phenomenon has been presumed to be found in the so-called post-state farm (post-PGR) areas. It was estimated indirectly by Komornicki (2006, 2011) based on the proportion of vehicles over 30 years old, the spatial concentration of which was observed mainly

[2] District (*powiat*) – local territorial unit in Poland (between a commune and a province).

in Polish western provinces (*województwa*)[3], such as Zachodniopomorskie, Lubuskie, Dolnośląskie and Opolskie (the share of vehicles over 30 years old was >10% there). Specialist magazines report that the main reason behind the presence of 'dead souls' on the register can be found in the grey market of the disassembly and scrappage sector. Giving cars back to a 'standard' scrappage point (which means the one unprepared for storing and dismantling used cars and their recycling) their owners will benefit more, and the risk they take is relatively small (there are no sanctions for car scrappage on the grey market). Recycling companies estimate that about 80% of vehicles in Poland are scrapped on the grey market, which results in their not being deregistered (Kublik 2013b). The problem of 'dead souls' translates into the overestimation of the number of passenger cars in each Polish commune, and what is particularly interesting for geography is a spatial distribution of this phenomenon (which will be shown in the later section of the article).

2. **'Cars with a grid'** (cars registered as trucks where the cargo part is separated from passenger seats by a metal grid), i.e. an underestimation of the number of passenger cars and overestimation of the number of trucks related to the mass phenomenon of registering passenger cars as large goods vehicles (LGV-approved cars). This problem, estimated in 2003 at about 15.2% of all passenger cars in Poland (Komornicki 2006: 130, 2011: 40), has been observed at increased intensity (according to these estimates) in urban agglomerations of Warsaw, Poznań, Krakow and Gdańsk, in orchard areas of the districts of Grójec and Sandomierz, and in the mountainous Podhale region. 'Cars with a grid' is a phenomenon that creates an opportunity to deduct part of the purchase costs and car use from income tax by companies. It should be added, however, that the possibility of cost deduction in this respect is relatively small today, which certainly has an impact on the descending scale of the reported shortcomings in the official statistics.
3. **Company cars**, i.e. an overestimation of the number of vehicles in cities where leasing companies and large enterprises owning those cars have their headquarters. This phenomenon relates to the separation of the headquarter of a car owner from the place of residence of its user. In the light of the earlier research, it was a problem observed particularly in Warsaw and Poznań (Komornicki 2006: 130, 2011: 43). The intensification of this phenomenon follows primarily from the development of leasing companies. The development of this market is, in turn, linked to the possibilities of deducting leasing costs from the income generated. The problem of company cars has no impact on the general number of passenger cars in Poland, it is related, however, to the spatial distribution of their use (overestimating the number of cars in large cities and underestimating in other communes).
4. **Cars of internal migrants**, i.e. an underestimation of the number of passenger cars in the largest urban agglomerations as a derivative of undocumented internal migrations. This case is related to a change of the place of residence without reregistering the car in a new region, e.g. because of higher car insurance rates calculated by insurance companies for vehicles moving in large agglomerations. It has not been analysed in scientific publications yet (although it was mentioned by Komornicki 2011) and is virtually absent from the trade press.
5. **'Polish-Ukrainian cars'**, i.e. an overestimation of the number of cars resulting from mass registration of vehicles driving in Ukraine by Polish co-owners. This problem follows from heavy customs duties on used cars applied in the territory of Ukraine. High customs duties made the 'trade' in co-ownership offered by Poles living near the Ukrainian border more and more popular. This question has not been subjected to scientific analyses so far; it was raised exclusively in the everyday and trade press. The number of passenger cars has been overestimated in communes located at the Ukrainian border and has an additional impact on the exaggeration of the car ownership rate in Poland. The problem of Polish-Ukrainian vehicles carries also a different type of implications, namely an increase in queues

[3] Province (*województwo*) – a regional territorial unit in Poland (between a state and a district).

in border crossings because of the mandatory presence of a car registered in Poland at least once every five days (in practice this means that almost all Ukrainians owning a Polish-Ukrainian car have to cross the Polish border every few days).

6. **Used cars brought into Poland by commercial importers**, i.e. an overestimation of the number of vehicles in areas with a high concentration of companies importing passenger cars for commercial purposes. A significant part of used cars is imported by specialised companies and they also register some of them (despite not using them for transport) which is related to the applicable provisions of law. What happens is the overestimation of the number of passenger cars in at least several hundred districts, mainly in Wielkopolskie and Lubuskie provinces. This question is quite difficult to be thoroughly examined and has not been analysed yet in scientific publications.

The impact of the discussed shortcomings and their causes on the number of passenger cars registered in a given territorial unit (e.g. in a commune) is presented in Fig. 1.

All the six shortcomings identified in the motorisation statistics significantly influence the research conducted in passenger car parc in Poland and the type of knowledge that is developing. Unfortunately, even CEP cannot fully recognise their entire scale and structure. This article will analyse the first three shortcomings in detail (i.e. 'dead souls', 'cars with a grid' and company cars). The remaining three shortcomings are far more difficult to be analysed in depth here, as they require different research techniques.

Central Vehicle Register: History and information value

As was mentioned earlier, Polish car ownership research has been primarily based so far on the data published by GUS. This information on vehicles (including passenger cars) is made available as at 31 December each year. These data were obtained from various sources (Table 1). Until 2001 they had been kept by provincial agencies, called the Provincial Vehicle Register [PL: *Wojewódzka Ewidencja Pojazdów* (WEP)], and the data sent by car registering bodies were maintained by the following agencies over a certain periods: up to 1990 these were commune offices of a car owner's domicile, then subregional

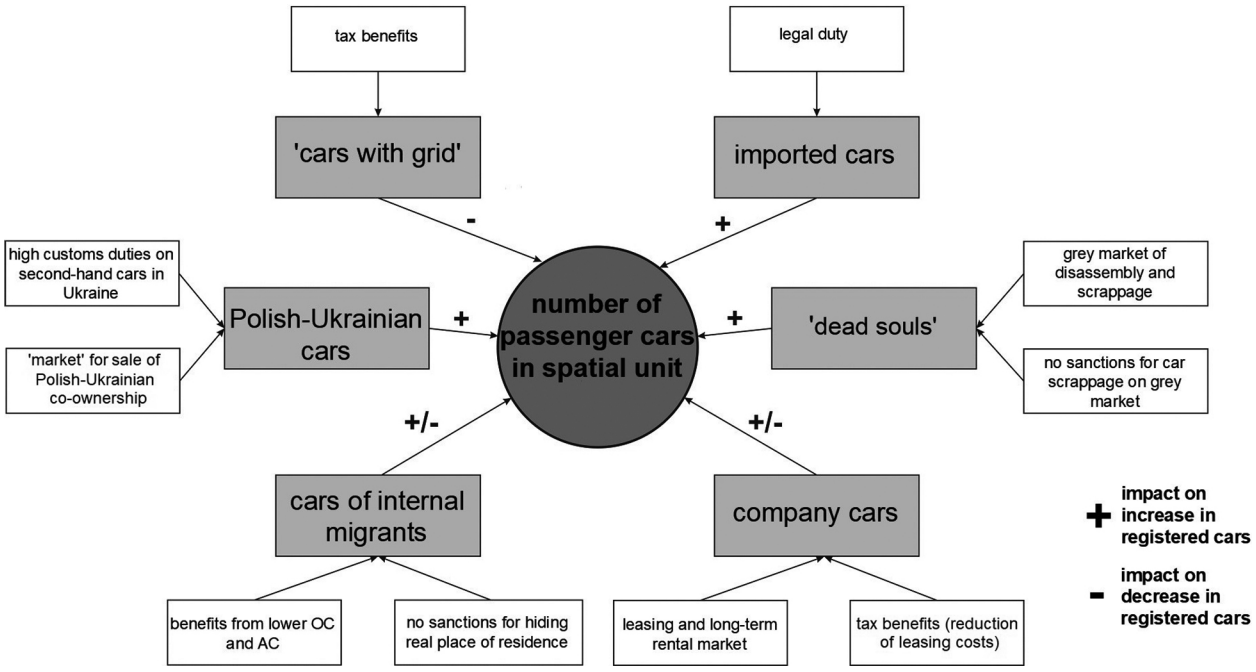

Fig. 1. Impact of the shortcomings of motorisation statistics and their causes on the number of passenger cars registered in a given territorial unit.
AC – autocasco comprehensive insurance, OC – liability car insurance.
Source: own study.

Table 1. Authorities responsible for collecting and sharing motorisation statistics in Poland.

Period	Place of vehicle registration	Vehicle register	Source of GUS data
Until 1990	Commune office	Province (n = 49)	WEP
1990–1998	*Rejon** office	Province (n = 49)	WEP
1999–2001	District office	Province (n = 16)	WEP
2002–2003	District office	Province (n = 16)	District databases
2004–2008	District office	Central (version 1.0)	District databases
2008–2017	District office	Central (version 1.0)	CEP ver. 1.0
Since November 2017	District office	Central (version 2.0)	CEP ver. 2.0

CEP – Central Vehicle Register; GUS – Statistics Poland; WEP – Provincial Vehicle Register.
* – a subregional administrative unit.
Source: own elaboration.

administrative area (*rejon*) offices from 1990 to 1998, and from 1999 – districts' authorities. The scope of the collected information about vehicles in the register included mainly basic technical data, i.e. a vehicle brand, a model, a type, the year of production, engine capacity, permissible load capacity, type of fuel, etc. In contrast, GUS, shared information about the number of cars (by type) at national and provincial levels.

The way of gathering and sharing car data was to change considerably after the establishment of the Central Vehicle Register. It was initially assumed that it would take place in the middle of 1999, pursuant to the Act of 1997 on the Traffic Code, introducing the provision for termination of WEP as of 30 June 1999. This fact caused widespread consternation because until that day the contractor for the new central base had not even been appointed (Centralna Ewidencja…, 2003). The Act of 1997 stated that from July 1, 1999, the Central Vehicle Register would start to operate (and thus the day before WEP would cease to function). However, it turned out quite impossible. Therefore, a few months later the provisions were amended (the Act of 31 March 2000) and WEP was reinstated alongside the need to update the regulations by heads of districts and cities' mayors. Nevertheless, districts' authorities were not obliged to enter the data on registered vehicles into WEP for almost a year (some of them publicly informed that they did not do it because there was no legal basis – *cf.* Bienias 1999; Burzyński, Bienias 1999). Given the circumstances, the continuity of the information collected was disturbed, and as a result, district and province databases varied in content.

In 2003, the Ministry of the Interior and Administration [PL: *Ministerstwo Spraw Wewnętrznych i Administracji* (MSWiA)] began consultations on the conception of the establishment, implementation and exploitation of a new IT system for the central registration of vehicles. The initial materials published by MSWiA revealed a series of problems which made the integration of district and province data difficult. This was so because local and regional records were kept in six different programming languages, seven operating systems and five database environments (some local units created systems based on their own, individual database solutions). There were also problems with the possibility of exporting local databases, the use of different dictionaries (codes defining particular features of vehicles), and no access to a LAN (Local area network) in about 1/5 of district authorities (Centralna Ewidencja…, 2003: 12). Notwithstanding, MSWiA signed an agreement with a contractor on the activation of the first CEP version until the end of December 2003. The database was activated on January 1, 2004; its assessments, however, published at the time in the trade and everyday press were very critical. One may even state that the first CEP version was very impractical because of the quality of data collected from local and regional databases. Furthermore, it coincided with the launch of the IT subsystem '*Pojazd*' (the Vehicle), which was responsible for car registration in district offices as well as with a large number of new vehicles on the Polish market following Poland's accession to the European Union. It turned out at the time that a relatively great deal of information about cars (concerning a set of about one million vehicles) had to be entered manually, because a newly created system was not able to implement the existing data (Samcik 2005).

The complete functionality of CEP was originally planned for the end of 2006. This date was postponed several times due to the need to build the related infrastructure (a bunker for storing copies of data from the system and a communication network allowing data to be read and updated in a real time). The integration of the CEP system operated by MSWiA with the '*Pojazd*' system managed by the Ministry of Transport was also troublesome because of difficulties with the cross-sectoral cooperation. Eventually, it was only in 2009 that GUS started to publish CEP data (including those at district level), but this database was still impractical as was expected, which means that it did not integrate information from a number of different relevant data sets, including the database of the Insurance Guarantee Fund (PL: *UFG*, information about OC—liability car insurance) or vehicle inspection stations. This meant in turn that the verification of the number of registered cars would not be possible.

This state of affairs was to change finally after the launch of so-called CEP 2.0. In 2013, the Ministry of the Interior and Administration signed an agreement with the National IT Centre on implementing second-generation CEP, which was to be completed in 2016. This deadline was not met again and CEP 2.0 was launched as late as in November 2017. Since then, much more information on vehicles has been collected in this database, although its quality varies considerably. Today, the Central Vehicle Register is regulated by the amended Act on the Traffic Code (Journal of Laws 2020) and the Ordinance of the Ministry of Digitisation of 25 May 2018 on the catalogue of data gathered in the Central Vehicle Register (Ministry of Digital Affairs 2018). In the light of those two documents, the registry collects information on 60 different features describing technical data of each vehicle. Among them are the following: a vehicle brand, a model, a type, the year of production, engine capacity, permissible load capacity and the type of fuel. Some data, however, have poor information quality due to gaps and erroneous names. The weaknesses of CEP data limit their research use; however, it must be emphasised that despite those difficulties, this registry is a very detailed and precious source of data, making it possible to conduct many car ownership studies which are more reliable than before.

The scale of weaknesses in motorisation statistics in Poland and their spatial distribution

'Dead souls' or the so-called end-of-life vehicles

The development of CEP 2.0 and the integration of different databases connected with vehicles made it possible to verify the number of passenger cars in Poland, which in all likelihood is actually driving on Polish roads. Owing to this change, the so-called vehicle status, or its feature, which takes one of two categories coded as: ZAR-A (a registered end-of-life vehicle) or ZAR (a registered active vehicle)—has been determined since November 2017 for each vehicle registered in Poland. As was mentioned earlier, the ZAR-A code denotes an officially registered car, other than historic, for which >10 years elapsed from the date of its first registration in Poland, and for six years since the current date there has been no updates from a registration body, UFG, a vehicle inspection station or police. Vehicles that fail to meet those criteria acquire registered active (ZAR) status. The end-of-life status can be changed by a district's head, a vehicle inspection station, UFG and police during standard procedures performed by those entities related to car registration.

According to the data of 31 December 2018, over six million passenger cars (i.e. about 26% of all registered) had end-of-life status. This is a relatively high value which increases a car ownership rate in Poland to a considerable degree. It turns out that after deducting end-of-life vehicles the car ownership rate should be about 450 cars per 1,000 inhabitants, which would place Poland somewhere around the 20th place among the EU states. This is quite a significant change, considering the multitude and importance of decisions taken on the basis of this rate value (it is a separate question whether the same phenomenon occurs on a similar scale in other post-socialist countries).

The age analysis of end-of-life vehicles (Fig. 2) confirms that these are mainly very old cars (*cf.* Komornicki 2011). Nearly 64% of end-of-life vehicles are those produced before 1990 (i.e. >30 years old). In contrast, cars manufactured after 2000

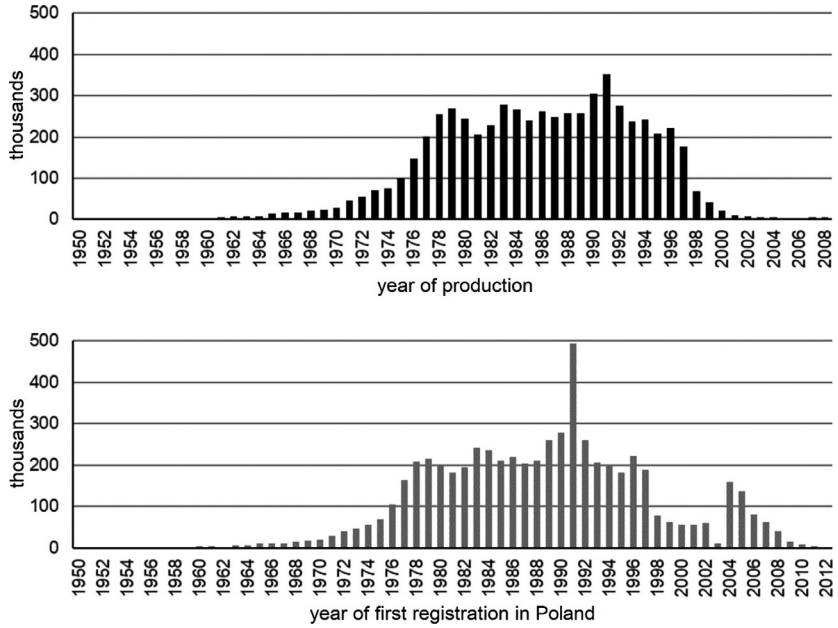

Fig. 2. End-of-life vehicles by their years of production and first registration in Poland (as at 31 December 2018).
Source: authors' own elaboration based on CEP data.

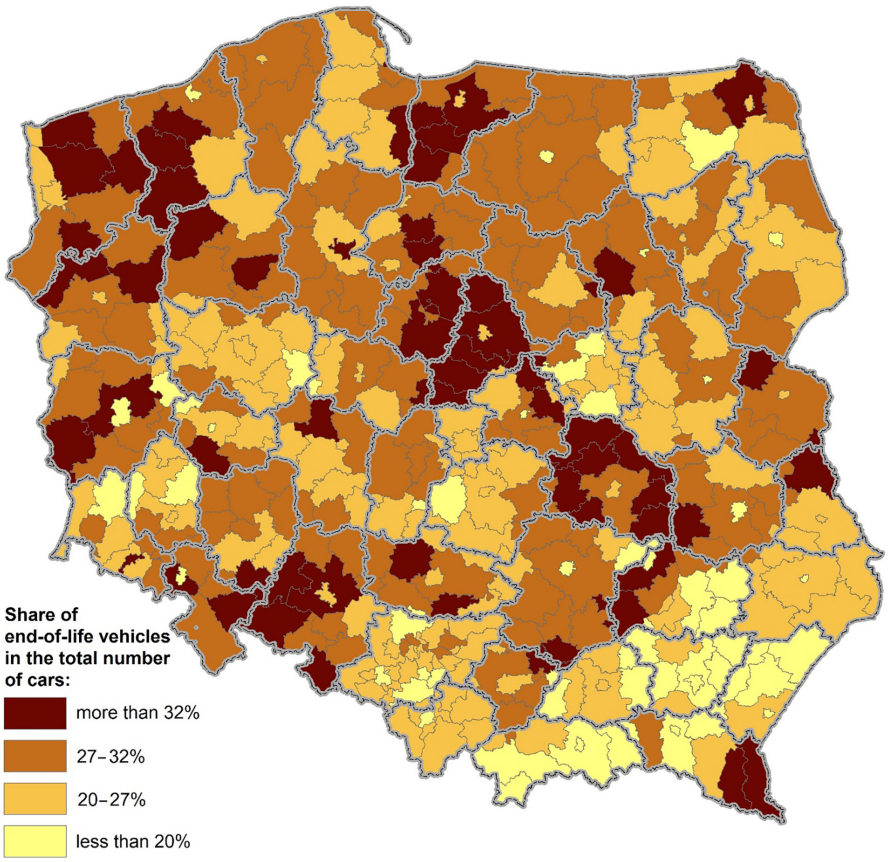

Fig. 3. Spatial distribution of end-of-life cars in Polish districts (as at 31 December 2018), in line with the country's former administrative division into 49 provinces (1975–1998).
Source: authors' own elaboration based on CEP data.

make up only about 1% of all end-of-life vehicles. The analysis of makes and models proves that Fiat 126 P, Fiat 125 P and Polonez are in the lead among end-of-life cars. Therefore, these are cars largely manufactured in Poland and registered there for the first time (72% of end-of-life cars are those registered in Poland for the first time in the year of their production or the year later). For that reason, it is very likely that the majority of more than six million of end-of-life cars have not been driving on Polish roads for at least 20 years. Among 'dead souls' there is quite a large number of imported cars, registered in Poland during important institutional changes, that is in the years 1990–1991 (beginning of the transformation) and 2004–2006 (first years of the EU membership) (Fig. 2). The data show that almost 0.5 million passenger cars registered for the first time in 1991 have been recognised as 'dead souls'.

The spatial distribution of end-of-life vehicles in relation to the total number of passenger cars (Fig. 3) shows that this phenomenon is concentrated only in particular areas. However, as assumed by Komornicki (2006, 2011), they seem to have little connection with the location of state farms (*Państwowe Gospodarstwa Rolne* — PGR). In the former provinces of Szczecin, Koszalin, Słupsk and Gorzów (areas with the highest concentration of PGR land) the share of end-of-life vehicles is close to the country's average (about 26%). The map indicates more clearly the spatial regularities related to the historical administrative system of 49 provinces. The highest concentration of end-of-life vehicles can be therefore observed in the former provinces of Płock (34%), Radom (31%), Elbląg (30%) and Wałbrzych (30%). This can be most probably attributed to the fact that in the 1990s, some province offices made improvements to the records kept, while others did not do it, which was indicated by Komornicki (2011).

'Cars with a grid' or LGV-approved passenger cars

The second element affecting the quality of motorisation statistics in Poland is the underestimation of the number of passenger cars related to the phenomenon of 'cars with a grid', that is those approved as LGVs. These are officially trucks (and registered as such), but in practice they perform the function of passenger cars, or passenger and goods vehicles simultaneously. Statistics showing car ownership in Poland do not include them (although they should), thus reducing its rate. This underestimation varies in particular parts of Poland.

According to CEP data, on 31 December 2018 there were over 3.3 million trucks registered in Poland, of which just over 1 million (30%) were so-called 'dead souls'. This means that truck parc in Poland is made up of about 2.3 million vehicles in real terms, and some of them are *de facto* LGV-approved passenger cars. The underestimation of the number of passenger cars related to 'cars with a grid' can be identified by permissible load capacity. In a nutshell, it determines the difference between the maximum permissible total weight and the unladen kerb mass of a vehicle and is one of the information about a car gathered in CEP data. The boundary established so far to separate cars approved as trucks and used as passenger cars from the group of LGVs was most often permissible load capacity <1.5 tonnes. As at 31 December 2018, there were about 1.88 million such cars registered in Poland. One needs to add, however, that this is quite a broad set comprising several subsets in which the probability of using vehicles as passenger cars varies. Therefore, a more in-depth analysis is required allowing not only for a criterion of permissible load capacity but also for the number of passenger seats.

With regard to the type of vehicle, trucks with permissible load capacity not exceeding 1.5 tonnes can be divided into three groups using popular segmentation of vehicles (e.g. Baltas, Saridakis 2013; Lansley 2016):

1. medium-sized vans (e.g. Volkswagen Transporter, Fiat Ducato, Ford Transit, Mercedes Sprinter, Renault Master and Peugeot Boxer);
2. leisure activity vehicles (LAVs, e.g. Citroen Berlingo, Peugeot Partner, Renault Kangoo, Volkswagen Caddy, Fiat Doblo and Opel Combo);
3. other cars representing various basic segments of passenger cars[4] (including the most

[4] We identify the term 'basic segments of passenger cars' with the car segmentation used by the European Commission embracing segments from A (so-called mini cars, e.g. Fiat 500) to F (relatively large luxury cars) (Thiel et al. 2014). This is a classification that includes vehicles used exclusively for transporting people, both leisure activity vehicles and vans.

popular such as Fiat Panda, Skoda Octavia, Fiat Seicento, Skoda Fabia, Opel Astra, Renault Megane and Ford Focus).

Of all the 1.88 million trucks with a permissible load capacity of <1.5 tonnes, the vast majority of vehicles can be found in the first (about 64%) and second (about 18%) group, because they are difficult to be automatically included in the group of passenger cars. Some of them are practically used only for transporting cargo. In that case, the number of passenger seats can be applied as an additional criterion for distinguishing passenger cars from trucks. With regard to medium-sized vans, the lower limit of their passenger use can be determined at the level of three passengers (in general, cars in this segment have three seats in the first row, including one for a driver) and for LAVs—at the level of two. Therefore, when including the entire third group mentioned above and also medium-sized vans having at least four seats, as well as LAVs with a minimum of three seats (including the driver's seat), we obtain a figure of about 750,000 vehicles, which may represent the maximum limit of the number of LGV-approved passenger cars.

The spatial distribution of LGVs with a permissible load capacity up to 1.5 tonnes, which are divided into the distinguished groups, are shown in Fig. 4. The highest ratio of cars from basic segments and LAVs are observed in large cities and suburban zones (noticeable particularly in the case of basic segment cars). This is linked to the location of leasing companies and the market of so-called ex-lease cars that are bought mostly by residents of those territorial units. In contrast, the above-average representation of the

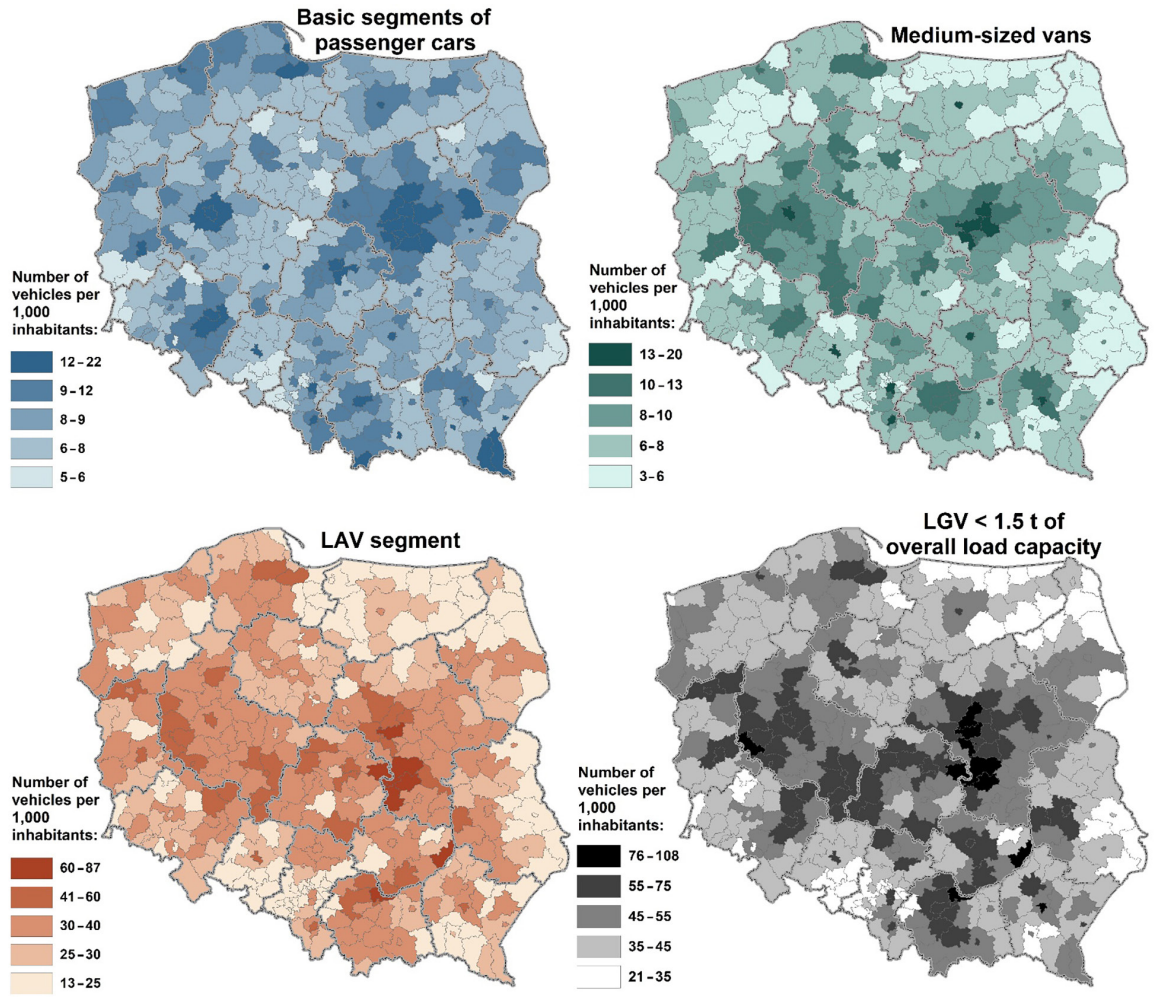

Fig. 4. Spatial distribution of LGVs (permissible load capacity <1.5 tonnes) in Poland by three selected groups (as at 31 December 2018).
LGV – large goods vehicles.
Source: authors' own elaboration based on CEP data.

Table 2. Correlation coefficients between the number of LGVs (permissible load capacity <1.5 tonnes) per 1,000 inhabitants by their segments and selected socio-economic features.

Segment	Population density	Revenues from vehicle tax per inhabitant	PIT revenues per inhabitant	Share of orchards in total area
Basic segments	0.312**	0.328**	0.603**	0.088
LAVs	0.271**	0.456**	0.564**	0.075
Medium-sized vans	−0.128*	0.383**	0.063	0.502**

*Statistically significant correlation at the level of $\alpha < 0.05$.
**Statistically significant correlation at the level of $\alpha < 0.01$.
LAVs – leisure activity vehicles; LGV – large goods vehicles.
Source: authors' own elaboration based on CEP data.

medium-sized cars is visible in so-called orchard districts (Grójec, Białobrzegi, Rawa Mazowiecka, Sandomierz, Opole).

These conclusions are confirmed by a simple correlation analysis between the number of LGVs per 1,000 inhabitants in particular segments and four selected indicators (Table 2). A variable describing the share of orchards in the total area proves a relatively strong and statistically significant relationship with the number of cars in the segment of medium-sized vans. Furthermore, PIT (Personal Income Tax) revenues per capita (the highest in large cities and their suburban zones) show a relatively strong relationship with the number of cars in the basic and LAV segments.

Company cars

'Dead souls' and 'cars with a grid' are vehicles which significantly affect the general number of passenger cars in Poland, used to compare car ownership in international research. The third shortcoming analysed, i.e. that related to company cars, does not change this overall value of this indicator, but has an impact on its spatial distribution, increasing the number of cars in a relatively small group of communes and districts. In the motorisation literature, company cars are often analysed separately and constitute in a sense an 'autonomous' variable influencing car ownership (de Jong et al. 2004; Whelan 2007).

Company cars are used mainly in medium-sized and large enterprises as a kind of 'additional remuneration' for middle- and high-level staff or sales representatives. This is typical not only of Poland, but also of many other countries, e.g. the United Kingdom (Whelan 2007). Company cars are registered according to the location of car owners' business offices, i.e. a leasing company.

As at the end of 2018, there were nearly 1.5 million company passenger cars registered in Poland

Table 3. The 15 cities and communes in Poland with the largest number of company cars.

No.	City/commune	Number of passenger cars registered by		Number of passenger cars per 1,000 inhabitants		
		natural persons	business entities	natural persons	business entities	Total
1	Warsaw	591,643	424,988	337	242	578
2	Poznań	192,088	96,411	356	179	535
3	Wrocław	223,571	89,406	350	140	490
4	Krakow	269,860	88,201	352	115	467
5	Katowice	101,949	59,623	343	201	544
6	Gdańsk	148,380	46,056	320	99	419
7	Łódź	241,237	43,812	348	63	411
8	Szczecin	134,205	27,073	332	67	399
9	Rzeszów	67,972	24,474	359	129	489
10	Lublin	122,279	24,424	359	72	431
11	Gdynia	83,067	24,194	337	98	435
12	Kampinos	2,261	21,456	527	4,998	5,525
13	Bydgoszcz	114,726	21,438	325	61	385
14	Bielsko-Biała	67,901	20,150	395	117	512
15	Opole	48,270	16,671	377	130	507

Source: authors' own elaboration based on CEP data.

(about 10% of all the registered passenger cars except for end-of-life cars). The size of the company car fleet in 15 communes recording their greatest numbers is given in Table 3. It is clearly visible that about 30% of all company cars are registered in Warsaw and another 30% in five large Polish cities: Poznań, Wrocław, Krakow, Gdańsk and Łódź. Out of 15 communes with the greatest number of company cars there is only one small commune—Kampinos, located in the vicinity of Warsaw. The high car ownership rate in this unit results from the tax policy adopted by the local government that attracted leasing companies as to increase revenues from vehicle tax which is a local tax (although passenger cars are not subject to it, but leasing companies usually offer both passenger cars and trucks). A similar phenomenon can be observed in the suburban communes of: Cedry Wielkie near Gdańsk, Nadarzyn near Warsaw and Suchy Las near Poznań. The second factor determining the high number of company cars is communes' greater economic activity and presence of many large enterprises (this can be illustrated again by big cities or heavily invested suburban communes, such as Tarnowo Podgórne near Poznań or Kobierzyce near Wrocław).

Owing to the clearly uneven spatial distribution, company cars should be excluded from car ownership analysis especially in communes or districts. This is so because it is known that a significant proportion of those vehicles are used in a completely different location than the city/commune of registration.

Summing up: Consequences of motorisation statistics shortcomings for geographical research and planning practice

In the light of a rapid growth of statistical data, their increasingly easy acquirement and processing, one may observe a relatively low interest in their quality. This relates also to the application of over- or underestimated values of statistical indicators in geographical research, which may lead to a distorted spatial picture of the occurrence and dynamics of a given phenomenon or process, and as a result, to wrong interpretations and inappropriate practical measures. In this article, we have presented evidences that motorisation statistics do not fully reflect the real geography of car ownership in Poland.

The implications of the distortion of car ownership rates are twofold: direct and indirect. The direct consequences mean that the correction of the indicator's value often drastically change the spatial distribution of the level (or dynamics) of car ownership and the position of a given territorial unit (country, province, district and commune) against other units. This discrepancy can be illustrated well by the comparison of Polish car ownership maps made using both GUS and CEP data, corrected by the authors of this article (Fig. 5). This correction consists in deducting end-of-life and company cars from the total number of registered cars and adding LGV-approved passenger cars (by criteria defined in section *'Cars with a grid' or LGV-approved passenger cars*). For both variants of the car ownership rate we use a decile system, i.e. the set of districts was divided into 10 groups equal in number, ordered by the rate of cars per 1,000 inhabitants.

The scale and spatial distribution of the discrepancy in the assessment of car ownership are shown in Fig. 6. It demonstrates the shifts of particular districts in the decile system after the authors' correction of the car ownership rate, that is a change in the position of a given district against all such units in Poland. In the significant proportion of districts (256, i.e. about 66%), those changes have not occurred or are very small, and fall within the range of <−1; +1>.The most substantial shifts *in minus* can be observed in large cities (Sopot, Warsaw, Katowice, Wrocław and Poznań), which 'are losing' mainly because of deducting company vehicles, and in the group of districts with a large percentage of 'dead souls' and the relatively low number of 'cars with a grid' (e.g. the districts of Głubczyce, Przysucha, Sztum and Świdnica). An increase in the car ownership rate is noticeable among districts with reverse features, i.e. a small share of end-of-life vehicles and LGV-approved passenger cars.

The indirect implications are linked to the fact that geographical research results concerning the level and dynamics of car ownership are used frequently in other broader studies related, e.g. to regional and local development factors, delimitation of peripheral areas, spatial accessibility as well as in planning and decision-making

activities (e.g. construction projects of new transport infrastructure in areas with the greatest or lowest concentration of car ownership). The adoption of inadequate car ownership rates may lead to misguided transport investments. This is so because there are government studies (e.g. Strategia rozwoju…, 2013: 36, 53), which refer to misleading statistics of individual car ownership in Poland (but also to the overestimated number of LGVs and buses), and on that basis inaccurate diagnoses were provided. This has far-reaching implications. In recent years the opinion-forming

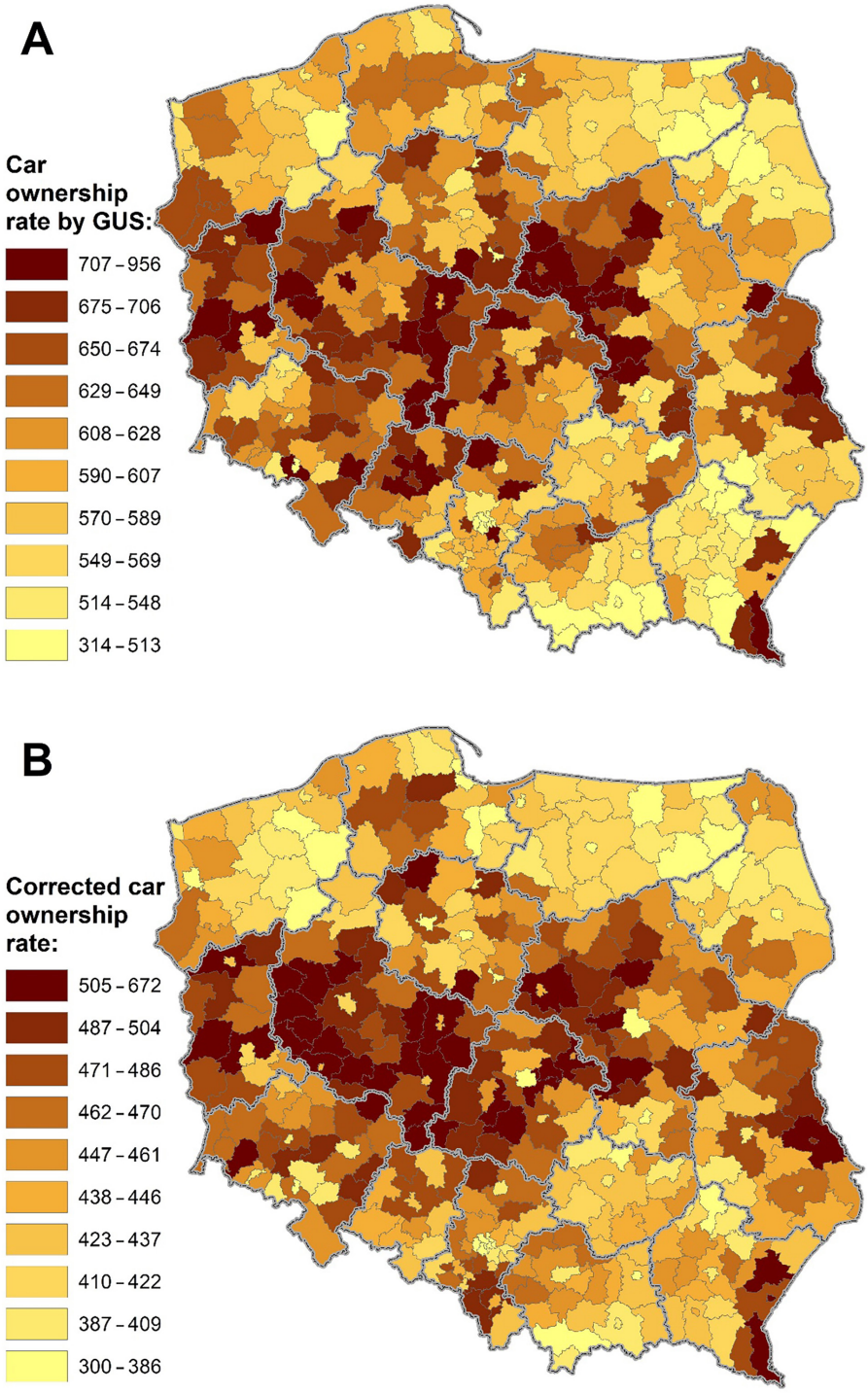

Fig. 5. Spatial distribution of car ownership rate values in Poland, in line with data from GUS (A) and CEP, as corrected by the authors (B) (31 December 2018).
Source: authors' own elaboration based on GUS and CEP data.

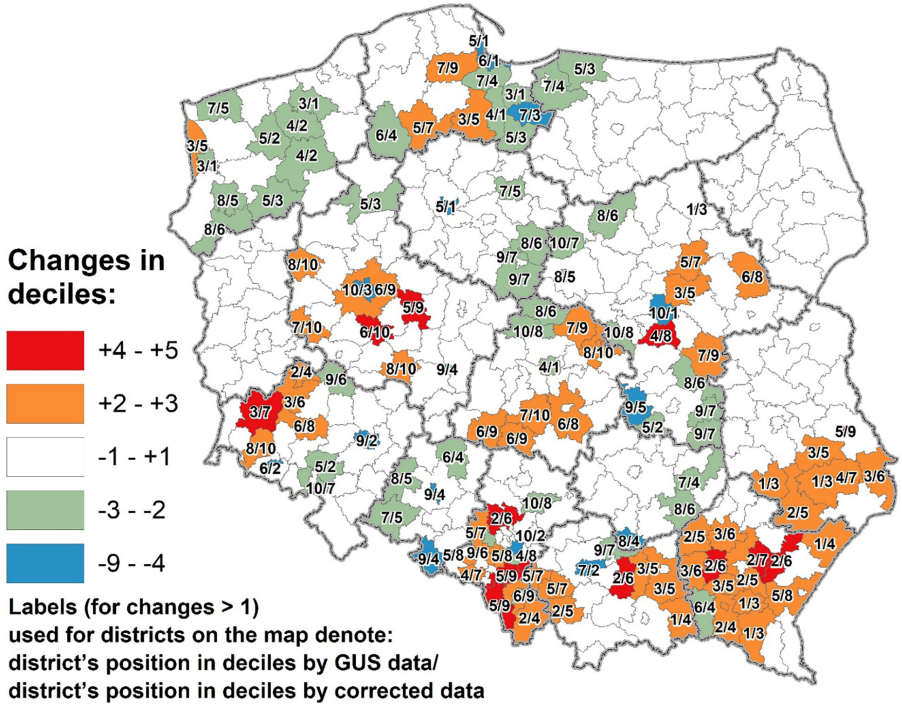

Fig. 6. Collation of the spatial distribution of car ownership rate values in Poland, in line with GUS and CEP data, following the authors' correction (31 December 2018).
GUS – Statistics Poland; CEP – Central Vehicle Register.
Source: authors' own elaboration based on GUS and CEP data.

media has produced texts that are completely divorced from reality, e.g. *The most motorised countries in the EU. We rank high, but we drive junk* (Forsal 2017), *Poles are one of the most motorised nations in the European Union* (Bankier 2018), *Warsaw has almost three times more cars per 1,000 residents than New York does. Cars devour Polish cities* (Pacholski 2018), which in turn have formed public opinion and the perception of transport problems in the country, regions, or cities.

The need to eliminate these shortcomings of motorisation statistics (especially when these shortcomings are relatively serious as in Poland) is also driven by the needs of an ever more rapidly developing market geography, including the geography of car market and car ownership. For instance, car dealers should be accurately informed in which regions the passenger car market is saturated and where there are particularly big 'relative shortages' of car supply. This knowledge in turn entails further decisions, concerning, e.g. location of car dealerships and other services related to their operation. The studies of geographers, making data about car ownership credible in spatial terms, their correct interpretation and recommendations for planning and decision-making, may contribute significantly to enhancing the prestige of our discipline and increasing its social importance.

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