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CONTENTS

PART I
CRUCIAL ISSUES IN CONTEMPORARY TRANSPORTATION SYSTEMS
Guest editor: Szymon WIŚNIEWSKI

PART II

BOOK REVIEW

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PART I

CRUCIAL ISSUES IN CONTEMPORARY TRANSPORTATION SYSTEMS

Guest editor: Szymon WIŚNIEWSKI*

FOREWORD

When we assume that a transport system is a constituent within the general socio-economic system, we may state that there are relationships between the transport system and other systems (subsystems) which impact the global shape of the socio-economic world. The issue of transportation is researched in numerous scientific disciplines, including geography (Śleszyński, 2014; Weber and Kwan, 2003), spatial and land management (Bruinsma and Rietveld, 2012), and transportation engineering (Sierpinski, 2010). Moreover, it constitutes an important part of professional activities focusing on spatial planning at a local (Noworól, 2007) and regional (Śleszyński, 2009) levels, and related to the evaluation of a given location in regard to the profitability of conducting business activities there (Komornicki, 2011). When described by geographers, space is characterised by three fundamental properties: diversity, resistance, and possessing boundaries. The first two have a major influence on the demand for transport, which is a response to the spatial incompatibility between the elements necessary for the socio-economic system to function properly. Thus, spatial diversity generates conditions for the

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development of transport, while the resistance of space – which is not always identical everywhere – determines if there are any journeys, and if so, what mode of transport and route are chosen. In this context, the third property of space, i.e., its boundaries, may take various forms since borders can constitute firm barriers in transportation or they can be set arbitrarily only for the sake of research procedures. The aforementioned arbitrariness exists as studies need to display transport-related phenomena in particular territorial units or it may be one of the methodological assumptions which enable the researcher to demonstrate spatial phenomena in narrower spatial aspects.

The articles in this issue of European Spatial Research and Policy cover an extensive spectrum of transport-related problems, which perfectly illustrates how diversely the issues of transport and its infrastructure are perceived in Europe. The authors focused on such topics as the implementation of electric public transport, its transformation in post-Soviet countries, the accessibility of its infrastructure, but also on transport behaviours and sea container transport. Bezruchonak conducted a synthetic review of electric bus technologies available on the market and provided a spatial analysis of the deployment of various vehicles of that type in Europe. His study indicates that appropriate legislative solutions and clear strategic planning, combined with effective co-operation between local authorities and regional decision-makers, are major factors facilitating the dissemination of innovative technologies and public support related to electric transport. The author also scrutinised other crucial elements regarding the implementation of zero-emission transport, e.g. the conditions for its infrastructural construction. The case study is of the transport system in Minsk, on the example of which the author illustrated the barriers in the implementation of electric transport within the urban space and develops guidelines for the strategy of sustainable mobility.

The issue of transport in a post-Soviet city was also discussed by Radzimski and Gadziński, whose article focuses on the analysis of the travel behaviours of residents. The study was based on information obtained through a questionnaire and on data retrieved from GPS logfiles recorded in Poznań. The authors proved that the proximity of public transport and cycling infrastructure seems to be one of the most essential factors determining transport behaviours. What is more, their accessibility also has an influence on the preferences regarding the selection of the location of one's home. Nevertheless, commuting by car still plays a leading role in the modal division of city journeys.

Michniak and Székely analysed the accessibility of public transport in Slovakia. The results indicated a decrease in connectivity within the network of direct bus and train connections, and a drop in the number of direct connections between Slovakian regional centres in 2003–2017. The authors stated that the phenomenon was a result of a growing level of motorisation, an increase in the importance of individual car transport, an extension of the motorway network, and the liberalisation of the public transport market.

The article in which Rudakevych, Sitek and Soczówka presented the changes introduced within the urban transportation system in Ukraine after 1991 identified the conditions for the system in reference to the transportation policy, with a particular focus on legal and financial aspects. In this context, the quoted statistical data for the period of 25 years was of exceptional value, since it enabled them to apply a synthetic indicator. On the basis of such a vast diagnostic material, the authors listed the challenges faced by electric urban transport in Ukraine.

The main subject of the article by Serry was the development of the container transportation system in the region of the Baltic Sea. The study focused primarily on the most recent organisational transformations and operational conditionings for this branch of the cargo transportation industry. The author proved that within the last decade, the maritime transport in the region has undergone considerable changes. Geopolitical transformations have contributed to the development of new Baltic harbours and terminals, and to the demarcation of new export routes for petroleum, gas, and streams of containers.

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Arnaud SERRY*

CONTAINERISATION IN THE BALTIC SEA REGION: DEVELOPMENT, CHARACTERISTICS AND CONTEMPORARY ORGANISATION

Abstract. The main focus of the paper is on the container system development in the Baltic Sea Region studying cotemporary changes and organisation, as well as explaining the main driving forces of this situation.

The Baltic Sea is a transport corridor between Eastern and Western Europe. Over the last decade maritime transport in the Baltic Sea area has changed significantly. The disintegration of the Soviet Union forced Russia to start developing its own Baltic ports and terminals and to find new routes to export its oil and gas. The Baltic ports have welcomed a remarkable growth, especially in oil transportation and containerised flows.

The geographical configuration of the region naturally places it away from major global shipping lines. This situation is accentuated by the organisation of maritime regular lines, centred in Northern European ports. For this reason, the regional container network is mainly made up of feeder services.

Key words: the Baltic Sea, containerisation, ports, maritime transport.

1. INTRODUCTION

Ocean shipping is the most important mode of transport in international trade (around 90 per cent of the total). Since its introduction in the shipping industry in the 1960s, containerisation has supported the expansion of the world economy. The development of liner (containerised) shipping in the last 30 years has exceeded the growth of world trade volumes (Ducruet and Notteboom, 2012). Two factors largely explain the success of containerisation: the productivity gains in cargo handling in ports and a more gradual process which involves the refinement of the container networks of the major shipping lines (Frémont, 2007). As container ship-

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ping is characterised by a constant search for economies of scale (Merk, 2018), the introduction of mega containerships on the main international sea routes between major seaports has made it necessary to distribute containers on short-sea routes. Therefore, regional feeder services collect and deliver containers in a specific region with small and medium-sized container ships and feed mega containerships so as to avoid their calling at too many ports (Polat, Günther and Kulak, 2014).

In a new political and competitive environment, the Baltic Sea Region (BSR) is today completing its full European integration. After innumerable and consequent political and economic changes, this space has recovered its vocation of interface (Escach and Serry, 2015). In the region, transport and logistics sectors are omnipresent economic challenges. The ports of the Baltic Sea Region handled in 2016 around 8.4% of the world total. Even if, as elsewhere in the European Union (EU), road transport is very widespread, it is followed by short sea shipping (SSS) distance. In the BSR, SSS can be split into two segments. On the one hand, Roro transport is one of the specificities of the Baltic area. On the other, feeder containerised services have quickly developed. Feeder services connect transhipment hubs to smaller ports and vice versa. These services can be arranged on a direct hub port to feeder port or can follow a line bundling set-up with several feeder ports of call per vessel rotation. They tend to use regular containerships, but of smaller sizes (often aptly called feeder ships) (Rodrigue, 2017).

Thus Baltic ports as nodes of a regional maritime network are integrated into a larger system. Indeed, the port development and the evolution of maritime traffic are symptomatic of economic and territorial mutations.

Although the maritime traffic in the area is relatively diversified, the paper will focus on containerised flows. It aims to provide an analysis and an empirical study of the container network in the region. This study is based on a literature review and mainly on the analysis of a database developed by the author. This database contains structured, comparable data (port facilities, traffic statistics, etc.) from 1989 onwards for approximately 115 Baltic ports. It also includes all regular lines in 2013 and 2015, and such details as frequencies, capacities, and operators obtained using AIS data, as well as some from a database on ships.

The paper proceeds as follows. Section 1 covers general characteristics of maritime transportation in the BSR. Section 2 focuses on the feeder market, while the section 3 analyses the regional port system.

2. GENERAL CHARACTERISTICS OF THE BALTIC REGULAR LINE TRAFFIC

The Baltic Sea is very transport-intense. Maritime traffic is relatively diffused throughout the whole of the Baltic Sea, despite a distinction of maritime and port activities within the Baltic Sea, mostly between southern and northern shores. Baltic Sea traffic growth is particularly significant in the field of containerisation (Serry and Transnav, 2017).

2.1. From shared growth to more competition?

Since the mid-1990s flows in the ports of the Baltic Sea have been grown quite constantly which (inevitably) demanded a necessary modernisation of harbour facilities and their extensions. That dynamism has been, with a few exceptions (Ventspils), closely shared by the whole BSR (Fig. 1). Thus the maritime traffic almost doubled between 1997 and 2018, from 420 million tons (Mt) to nearly 800 Mt while during the same period, the growth of world maritime traffic increased by nearly 65%.

This development can be attributed to three factors:

– Global economic growth has led to an increase in the volume of goods carried by sea;

– The deep geopolitical changes in the region have (re)opened the eastern shore to the market economy;

– The vital needs of port capacity for Russia to export raw materials and import manufactured products.

Indeed after the collapse of the USSR the main Baltic ports were outside the Russian Federation (Pavuk, 2017). The BSR has an interesting geographical position within the Eurasian transport system, connecting Russia with the European markets (Kabashkin, 2012).

Fig. 1. Evolution and traffic in 2017 of the top 20 Baltic Sea ports

Source: own work based on European Sea Ports Organisation, Eurostat, Port Authorities.

Container volumes around the world have witnessed a tremendous growth in the last 50 years, with an accelerated growth since the mid-1990s (Notteboom and Rodrigue, 2008). That rise of containerisation was the result of the interplay of macroeconomic, microeconomic and policy-oriented factors (Notteboom, 2004).

The amount of containers shipped in the Baltic Sea is determined by the proximity of consumer markets, Russia being the key destination point. Only a handful of ports handle large quantities of containers. The largest regional container port, Saint-Petersburg, stands only 15th in Europe. In 2017, the number of containers handled among Baltic Sea ports amounted to 9.5 million TEUs. The composition of the 20 largest container ports remained stable: St. Petersburg is clearly the undisputable leader in this segment, while Gdansk recorded considerable and continued growth in container traffic (Serry, 2017).

Furthermore, the number of ships in the Baltic Sea has increased. It is also the case of the ships' sizes, even if the shallow depth of the Kiel canal and the Denmark Straits limit vessels to 15 metre draught. The example of the containership size in the Lithuanian port of Klaipeda clearly shows that evolution (Fig. 2.) Using Automatic Identification System (AIS) data, the average sizes of containerships in the port during the last decade were calculated, as well as the size of the biggest ship. Even if Klaipeda is not the largest container port in the region, ship size is steadily growing as throughout the BSR.

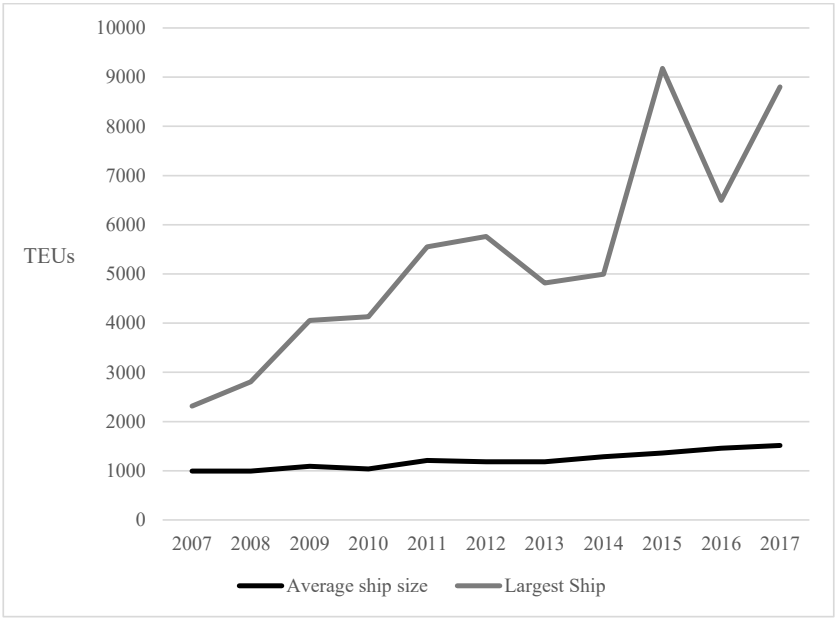

Fig. 2. Containership size in Klaipeda from 2007 to 2017
Source: IHS Maritime, 2018.

2.2. Concentrated containerisation

The Baltic Sea Region has a regular rise in containerised transport. Today, containers are handled in more than 60 ports across the region (Wolff, Herz and Flamig, 2011). But in the BSR, cargo requirements remain modest even though the eastern shore is making significant progress. This partly explains the difficulty in build sizable ports in the region. Thus, in 2017, the container traffic of Gothenburg reached 644,000 TEUs, Hamina-Kotka 690,000 TEUs, and St. Petersburg 1,920,000 TEUs, with a decline due to the crisis in Russia (Fig. 3). Container flows in the Baltic Sea were growing roughly in line with the worldwide market from 2010 until 2014 but suffered a severe downturn in 2015. This decline was mainly connected to the Russian economic situation and was evident in both containerised tonnes and in the volume of TEUs transported by sea. In addition, there was a substantial imbalance in containerised cargo flows: empty containers accounted for approximately 25% of the traffic (Ojala, 2016). In reality, developments throughout ports in recent years have come mainly from changes in dry and liquid bulk. Containerised cargo has not been of major importance for any ports, as on the eastern coast of the Baltic Sea major container volumes are handled through the largest container ports of St. Petersburg and Gdansk (Bolevics, 2017).

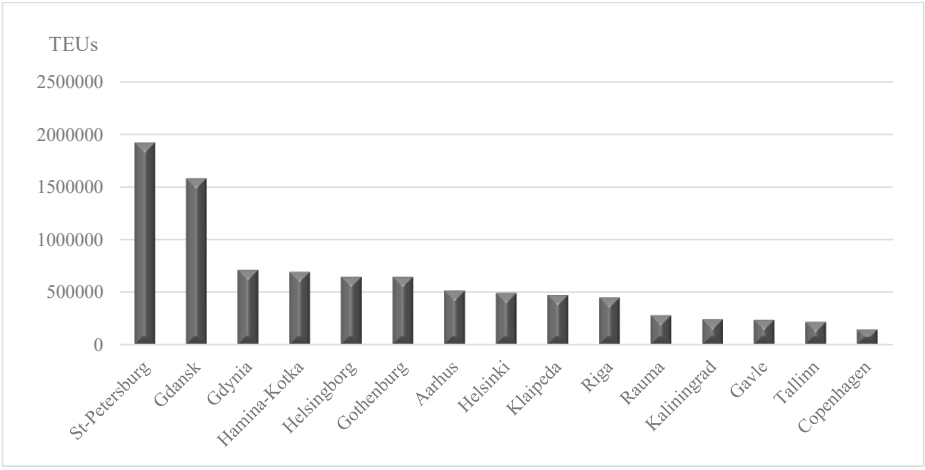

Fig. 3. Traffic in the main container ports in 2017 (TEUs)
Source: ESPO, Port Authorities, 2018.

The BSR dominates the Russian containerised traffic and accounts for nearly 70% of the total (Lorentzon, 2014). Currently, the Russian market of container traffic includes more than 11 operators and over 40% of Russian containers belong

to operators with container terminals in the ports of St. Petersburg and the Leningrad Region (Yudnikova and Aleksandrova, 2016). The port of Saint-Petersburg remains the most important even if its traffic declined in 2015 (27.8% less than in 2014). The Russian containerised port system in the Gulf of Finland is complemented with the *Ust-Luga Container Terminal* with a capacity of 400,000 TEUs. Ust-Luga is a solution to face the constraints imposed on maritime traffic in St. Petersburg, including the lack of space and the competition of metropolitan flows. The ambitions for Ust-Luga are considerable. Ubiquitous investment already placed the port as the regional leader in terms of total volume with 103.43 Mt in 2017. These two ports provide 70% of container traffic originating from or destined to Russia in the BSR. The rest of Russian traffic provides transit traffic mainly to Hamina-Kotka (Finland), Riga (Latvia), and Klaipeda (Lithuania).

The Polish ports, Gdansk and Gdynia, were originally mainly connected to the Polish hinterland and Central European market. They are now becoming new transhipment ports for the regional traffic. It is especially the case for Gdansk which benefits from the choices and investments of *Maersk shipping lines* and from its alliance with *Mediterranean Shipping Company* (MSC). In 2017, nearly 2.3 million TEUs were handled in the two Polish ports. Gdynia's container terminals are currently on its way to achieve a good position among secondary ports in the BSR and the *Deepwater Container Terminal* in Gdansk is slowly aspiring to the role of one of the biggest handling bases in the Baltic Sea (Romanow, Fras and Kolinski, 2015).

Nodality (the degree to which a place is a point of convergence for different routes) is the main strength of the place of Gothenburg, and also Helsingborg. These ports take advantage of their locations near the Danish straits. They are the main gateways for the Swedish market, but also offer some relevant solutions for regional regular lines or even at a global scope (Guillaume, 2012). However, the competition of the Polish ports is omnipresent and today Gothenburg sees its container traffic decreasing.

Container flows in other Baltic ports are still modest and often have a minor share in the structure of the traffic. Some ports like Kaliningrad, largely dependent on maritime coverage for its supplies, or Rauma reach significant traffic. In any case these trades are usually provided by small and medium size vessels connecting the Baltic ports to largest European ports.

2.3. A foreland concentrated on northern Europe

Geographically, maritime traffic has evolved considerably over the last few decades. The largest ships operate on multi-port itineraries calling at a limited number of ports (Ducruet and Notteboom, 2012). The main transoceanic connectors link a series of key ports in Europe. These ports connect regional port systems, including the Baltic one, to transoceanic and circum equatorial routes, mainly through hub-and-spoke services (Rodrigue, 2017). Extensive hub-feeder container sys-

tems and short-sea shipping networks developed to cope with increasing volumes and to connect to other port ranges (Rodrigue and Notteboom, 2010).

The Baltic Sea as a basin for ocean-going container ships is restricted by physical prerequisites. Small markets and limited hinterlands may also reduce the competitiveness of ports (Lorentzon, 2014). Baltic ports are therefore essentially served by a feeder network. The BSR was mainly connected to Europe with less than 10 regular container lines to the rest of the world in 2015. Starting from Northern Range ports, the rotations of the feeder ships are either circular, serving a few ports, either direct to one or two ports. So Baltic ports are not relays of large European and global flows but rather secondary nodes in the maritime network, even the most developed of them are connected through feeder services to some other ports' range. Thus, in mid-2015, the first connected port was St. Petersburg with 48 direct lines, including five destinations outside Europe. It had twice as many lines as the other container ports: Helsinki (21 lines), Klaipeda and Gothenburg (20 lines) or even Gdansk (11 lines). The case of Gdansk is interesting as in spite of the low number of lines its traffic was relatively high since of its new role as a regional transhipment hub. Non-European connections are very poor: out of 126 regular containerised lines listed in mid-2015, only 10 went beyond the European horizon.

If regular lines are dominated by relations with the north-western Europe, intra-Baltic lines (mainly roll-on roll-off and ferries) are also well developed. This clearly marks the Baltic paradox: while the Baltic economy goes global, its transport system is regionalising (Escach and Serry, 2015). This phenomenon is reinforced by the strategies of shipping companies: Western operators are investing in the eastern shore, as *HHLA* (a Hamburg-based stevedoring group) that participated in the expansion of container terminals in the port of St. Petersburg. These examples show how both the geopolitical strategies of states along with the behaviour of private actors seeking to diversify maritime routes and conquer position beyond Russian borders may differ/ may be different / are different (Thorez, 2011). It explains the temptation to orbit marine services related to extra-European services by a network of feeder lines starting in German or even Benelux ports. We are here in the heart of a peripheral location, which cannot hope to attract direct overseas services (Guillaume, 2012).

3. SPECIFICATION OF THE FEEDER MARKET

In Europe, cabotage restrictions were lifted by the end of the 1990s, and the liberalisation has become almost complete. Furthermore, the European Commission is working to develop cabotage, including through the creation of the Motorways of the Sea (MoS) (Rodrigue, 2013). Scandinavia and the Baltic area represent in volume the leading European feeder market with strong growth (+ 10% during the last 10 years, 20 million TEU expected in 2020).

3.1. German ports, main hubs for the Baltic Sea

In the Baltic Sea, feeder lines are concentrated in some ports, mainly near the Danish straits and on the south-eastern shore of the Baltic, as well as in the Gulf of Finland (Fig. 4).

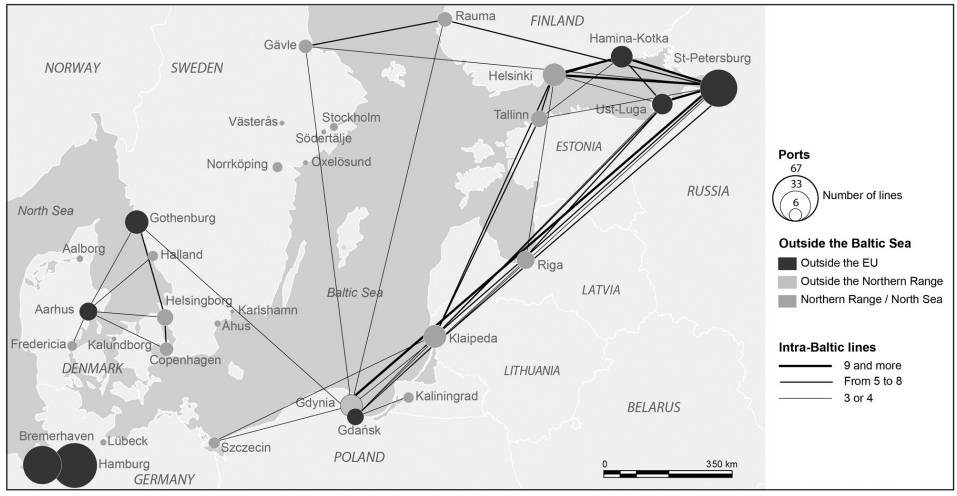

Fig. 4. Container lines in the Baltic Sea in mid-2015

Source: own work based on Baltic Transport Map, Autorites portuaires, Compagnies maritimes.

Feeder lines overwhelmingly start in north European ports. In 2011, around 50 ports have been identified as maintaining container flows with the Port of Hamburg (Wolff, Herz and Flamig, 2011). In 2015, 88% of Baltic container ports maintained at least a link with Hamburg. 34 ports were served by regular lines departing from Hamburg (12 in Sweden, 9 in Finland, 4 in Denmark, 3 in Russia and Poland, 1 in Estonia, Latvia or Lithuania), 33 from Bremerhaven but only 17 from Rotterdam or 15 from Antwerp.

The situation is still sharper if we consider the theoretical capacity offered by Hamburg. This capacity is calculated using the number of regular lines identified in July 2015. For each line the frequency as well as the capacity offered by ships used on these rotations is determined. In Hamburg, this capacity was around 5.1 million TEUs per year while that proposed in Bremerhaven is 4.3 million or 4.4 for Rotterdam and only 1.8 in Antwerp. This result plainly identifies the role of the port of Hamburg as the hub of the Baltic Sea. Its location enables efficient loading and unloading of goods from global to local destinations. By the way the relatively large capacity offered by Rotterdam is explained thanks to the types of services offered: Hamburg and Bremerhaven especially welcome feeder lines whereas Rotterdam is involved in lines with larger-sized vessels like the *Maersk AE1* service.

Transhipment is vital for the port of Hamburg: according to the Hamburg port authority 30% of containers are transhipped. Undoubtedly Baltic trade (1.77 Million TEU'S in 2017) is one of the main pillars of the Port of Hamburg's container handling. In 2017, the BSR was the second market of the port behind North East Asia. This situation is not new (Vigarie, 1979) as indeed Hamburg is known for having a *wet transit* tapped into the Baltic and Scandinavian world (Weigend, 1956). In fact, the rapid growth of container traffic in the port of Hamburg, in the last twenty years (less than 2 million TEUS in 1990, 8.8 million TEUS in 2017) is mainly due to this rediscovery of the traditional hinterlands of the port, following German reunification and collapse of the Soviet Union.

During a round trip, the time of which ranges usually from 1 to 2 weeks, ships can call at up to 7–8 ports. The main function, i.e. the forwarding of containers from/to the hub port, makes a ship's transport capacity during a round trip limited to a double load capacity (Kotowska, 2014). Consequently, freight rates are independent of the distance between the hub and the feeder port: this is the case in the ports of Denmark (Copenhagen, Fredericia...), East Germany (Lübeck and Rostock), and Poland (Szczecin). Transportation cost is certainly one of the major factors to explain the situation. Using the method developed by Sevin (Sevin, 2011), we can compare transport costs between Rotterdam or Hamburg and Baltic ports (see Table 1).

On the basis of a ship of 1,085 TEU (average capacity of ships in 2015) we obtained the following results: for shipping companies, it costs about €44.9 less per TEU using the port of Hamburg than using the port of Rotterdam (Table 1) (Serry, 2016). For Baltic feeder market served via existing hubs, feederships incur additional costs as a result of transit via the Kiel Canal. These additional costs relate to both the operating cost of the ship, based on the time taken for the canal transit, plus canal fees and expenses (Baird, 2006).

Table 1. Comparison of maritime transport costs in 2015 (€)

Costs	Copenhagen	Helsinki	Saint Petersburg
Cost per TEU from Rotterdam	109.5	208.1	233.3
Kiel canal fees	35.9	35.9	35.9
Total cost per TEU from Rotterdam	**145.4**	**244**	**269.2**
Cost per TEU from Hamburg	69.9	161.5	186.6
Kiel canal fees	35.9	35.9	35.9
Total cost per TEU from Hamburg	**105.9**	**197.4**	**222.5**

Source: own work based on Sevin 2011 and http://www.kiel-canal.de.

This cost advantage partly explains why the role of Hamburg as the transhipment hub for the BSR has intensified over the years. Another conclusion is the following

one: when it is possible, using the Kiel canal is economically the economical most interesting solution: at least 7 € by TEU shipper. Our analysis also enlightens the new role of the port of Gdansk which offers economic advantages even if a port like Gothenburg offers lowest cost for its direct connections (24.8 $ per TEU from Hamburg). But its location (outside the Danish straits), quite far from the other main container ports of the region, is a handicap. For instance, to reach Helsinki from Hamburg, it cost 6.2 € more per TEU via Gothenburg than via Gdansk.

3.2. Main actors of the feeder market

According to our data, 28 companies were present on the Baltic container market in 2015. Among them renown feeder companies (*Unifeeder*, *Team Lines*) and global carriers such as *MSC* were very well established. Several regional companies completed the offer, e.g. *Seagoline*, *Containerships* (Finland), *Mannlines* (Germany) or *Tschudi Line* (Norway). The largest fleet of feeder ships was controlled by *Unifeeder* with 30 ships (annual theoretical capacity of 1.53 million TEUs) ahead of *MSC* (1.4 million TEUs). The dynamics of the market regularly attracts new players and this despite the crisis in Russia. For example, *China Shipping Container Lines* (CSCL) developed its feeder *Golden Sea Shipping* company which offers a weekly rotation between St. Petersburg, Hamina-Kotka and Hamburg.

To refine the analysis, thanks to AIS data, we determined all container ships that called at a BSR port between 1 November 2015 and 1 November 2016 (Fig. 5).

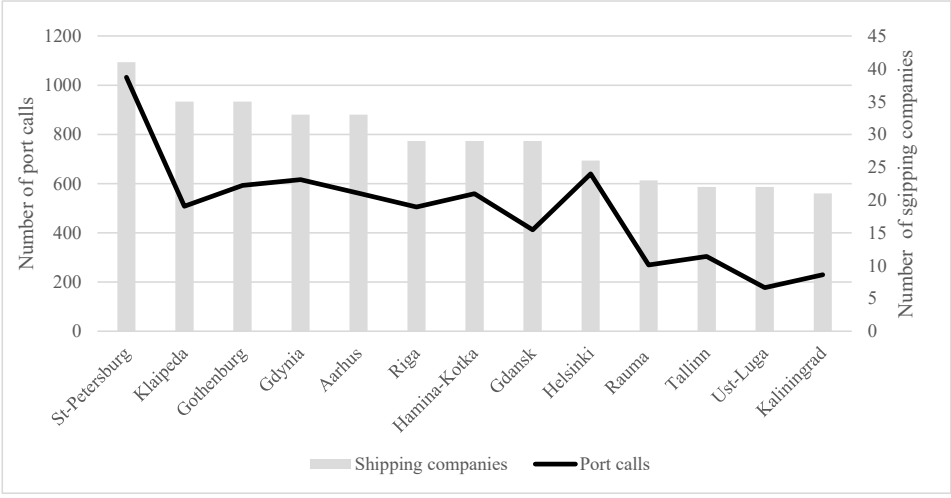

Fig. 5. Container ships' port calls and operators from January 1st to November 1st 2016
Source: IHS Maritime, 2018.

We can establish that in the studied period, 60 different operators provided containerised services to ports. Some companies such as *Containerships* have quite local strategies with ships calling only at 3 ports (Helsinki, St. Petersburg and Riga) when other, for instance *MSC,* propose services to almost the entire BSR. In addition, it is also possible to determine the capacity offered by each company in each port. For instance, *Maersk Line* offered a capacity of 966,336 TEUs in the port of Gdansk but only 40,233 TEUs in Kaliningrad. It is an interesting way to focus on the three different types of actors present in the region. It clearly appears that companies have different strategies: global carriers concentrate their flows on some ports as the Gdansk hub while companies specialised in feeder services have a more decentralised network.

To understand how the containerised market works in the BSR we also need to focus on port activities and more particularly stevedoring companies. The arrival of foreign investors in container terminals is a new reality in the BSR: Hutchinson (Hong Kong) at Gdynia (GCT) and Stockholm/Nynäshamn (CTN), Macquarie (Australia) at Gdansk (DCT) (Charlier, 2014). The German group *Eurogate* operates the container terminal in Ust-Luga whose planned capacity is 3.5 million TEUs. St. Petersburg also attracts some major international investors. For instance, *HHLA* has invested in one of the terminals in the Russian port. However, St. Petersburg may not attract a hub for regional containerised traffic because of its location at the easternmost point of the Gulf of Finland and its constraints. In fact, investments are increasing in the ports of the Eastern shore and they now include the logistical dimension. For example, the Finnish company *SRV* launched an A class logistics centre (120,000 sq. m) in St. Petersburg (Grzybowski, 2013). This type of logistical development spreads to almost all container ports in the region placing them as major nodes in distribution networks.

Finally, the BSR bears the marks of being an integrated periphery, with relatively low needs. Containerised transport actors have, therefore, adopted efficiency strategies that are not without impact on the organisation and evolution of territories. Especially as they must be careful of road transport competition and its possible complementarity with ro-ro (*DFDS*, *Tor Line*) and ferry lines promoted by powerful regional companies (*Color Line*, *Stena Line*, *Finnlines*, or *Tallink-Silja Line*…). Moreover, these ro-ro services utilise the success of door-to-door delivery (Guillaume, 2012) and the network of ferry connections includes 60 services with 116 ferries operated (Urbanyi-Popiołek, 2018).

4. CONTAINERISATION AND REGIONALISATION OF THE PORT SYSTEM

Baltic regionalisation is evident because of the concentration of sea connections on a low number of north European ports. However, the Baltic Sea remains a heterogeneous space.

Providing services to many areas, feeder ships are the latest tools in the process of trade globalisation. This activity displays the international port hierarchy (Tourret, 2008). Global and regional contemporary upheavals redraw and complicate the map of this interface: new emerging nodes tend to centralise sub-regional dynamics (Marei and Ducruet, 2014).

4.1. Towards a port sub-regionalisation?

Container traffic displays a weak integration at the Baltic level because of the concentration of flows in the *Northern Range* according to the *hub-and-spoke* model. It thus introduces a clear differentiation of maritime and port activities in the BSR (Fig. 2). The ports of the eastern Baltic as Saint Petersburg, Ust-Luga, Klaipeda, Helsinki and, Gdansk, but also Gothenburg, appear as the major nodes. By modernising, they manage to attract international forwarders, new industry, and economic actors as *DP World* or *GEFCO*.

In addition, the increasing connectivity of the network shows the restructuring of regional logics. On the eastern shore as in the Danish straits, the reinforcement of an intra-Baltic network of ports is obvious (Fig. 4). The Gulf of Finland and more widely the south-eastern Baltic are thereby two particularly active and attractive areas within the Baltic networks: the centre of gravity of the Baltic transport space is shifting eastwards.

The analysis of the containerised traffic in the Baltic ports distinguishes four types of ports in the region:

– Traditional regional ports, as Gothenburg whose location and the early integration in containerised networks explain its contemporary importance. Gothenburg has early historically benefitted from its location: in front of the Danish straits, without draught constraints, and a location near the *Norden (*Denmark, Finland, Island, Norway, and Sweden) with 50% of the industries located less than 300 km away, and 70% within 500 km;

– Regional or national ports, mainly located on the western shore of the Baltic Sea. The often modest traffic of these ports must not minimise their role in the regional economies, for instance, in the Gulf of Bothnia, transport system which includes numerous seaports in Sweden and Finland (Wiśniewski, 2015);

– Ports of "Russia" are made up of Russian, Baltic and Finnish ports. (From Hamina-Kotka to Kaliningrad) Those ports are also the most dynamic ones in the BSR. They have similar combinations, exploiting at least partially the same hinterland. That allows one to speak of an eastern Baltic port range (coastal system of interdependent ports) (Vigarié, 1979);

– Emerging regional hubs such as the port of Gdansk (Fig. 4). In recent years the cargo turnover of Gdansk has increased significantly. It rose almost 16 times in 2005–2015. Gdansk has technical features which make it possible to accommodate Triple-E container carriers with a depth to the point of 16.5 m. This fact became one

of the most fundamental in the decision on the inclusion of *Maersk Line* in Gdansk linear ocean route AE10 from Southeast Asia to Europe (as the final ship entry port). That fact allowed the Gdansk port to start specialisation in transhipment operations and transit in Russia, Sweden, Finland and the Baltic countries. With the introduction of the *Maersk Line* direct vessel calls, the transhipment level has risen in the Gdansk port. The percentage of the cargo transhipment in the total cargo turnover increased from 5% in 2004 to 60.3% in 2013 (Gultyaev, 2018).

Therefore, on a global scale, the reorganisation of traffic has generated standardisation on all shores of the Baltic Sea, responding to the hub and spoke mode (Serry, 2017).

4.2. Some factors of explanation and driving forces

In such a scheme, the question of port competitiveness is central for port authorities and operators. It especially includes port operation efficiency levels, handling charges, reliability, and landside accessibility. Regarding the Baltic ports, we can analyse port efficiency using the duration of port calls offered by AIS data. Baltic container ports appear very different (Fig. 6): two ports in particular, namely Gothenburg and Gdansk, are served by ships offering a larger capacity than in the other ports.

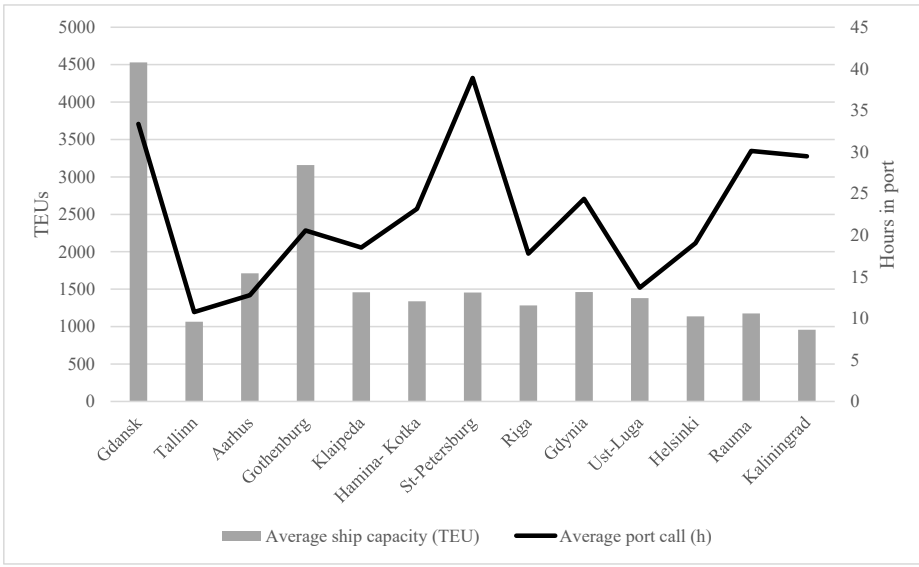

Fig. 6. Containerships' capacity and duration of port call from January 1st to November 1st 2016
Source: IHS Maritime, 2018.

Combining this analysis with operator strategies is also interesting. In the case of Gdansk, the situation is clearly the result of the choice of *Maersk Line* to make the Polish port its Baltic hub. During the considered period, AIS data showed that 35% of all port calls were carried out by *Maersk Line* with an average capacity of 4,530 TEUs.

By integrating the port traffic in the research process, it is also possible to estimate the average length of handling of one TEU in each port. In the study, container traffic has been weighted by the estimate share of ro-ro traffic. Such an analysis could be more precise with the number of cranes used in each terminal for instance. Despite these few restrictions, the results are remarkable and give an interesting order of magnitude. Container terminal efficiency is very variable in the BSR (Table 2): in the port of Gdansk, it takes three times less than in Kaliningrad to operate one TEU. The average operational speed is 1.56 min per TEU and only five ports offer a better efficiency. Gdansk is clearly more efficient than other Baltic ports which also explains the quick expansion of its container flows.

Table 2. Determination of average speed per TEU according to AIS data

	Gdansk	Gothen-burg	Klaipeda	Hamina--Kotka	St. Petersburg	Riga	Ust-Luga
Average port call (h)	33.37	20.55	18.5	23.15	38.9	17.77	13.68
Average TEU's per call	2,358	919	708	836	1,378	619	385
Average speed per TEU (minute)	0.85	1.34	1.57	1.66	1.69	1.72	2.13

Source: IHS Maritime, 2018; author's calculations.

The competitiveness of containerised cargo shipping compared to that of the direct road transport depends primarily on the cost and time of the whole land-sea transport chain (Kotowska, 2014). Even if it is difficult to know the reality of the cost and to have a forecast, we can try to make a short analysis using some recent data. According to the Chinese *Kinglee Company Limited* price proposal between China and the BSR for a 40 foot container in July 2018, two interesting results help us to explain traffic organisation:

– the lowest rates are located in the Gulf of Finland with a considerable advantage for Hamina-Kota (1,353 USD) over St. Petersburg (1,530 USD);

– prices in the rest of the BSR are higher than in the Gulf of Finland (1,421 EUR on average). But the rates are quite variable between southern ports, such as Gdansk (1,394 EUR) or Klaipeda (1,397 EUR), and northern ports like Riga or Tallinn (1,446 EUR).

In fact, the rates are the lowest where traffic is higher because of potential market proximity or transhipment possibilities. Freight rates match port traffic or port potential in the regional containerised system.

5. CONCLUSIONS

Economic and political changes have created new conditions for the development of trade and transport in the Baltic Sea Region. The expansion of international trade has led to an increase in the cargo turnover in the Baltic ports, primarily due to the active development of Russian ports as well as new transhipment activities. Consequently, the collapse of the Soviet Union and EU enlargements have favoured the northern ports, especially Hamburg, and forced Russia to recover its lost port capacities.

Today several multi-port ranges can be separated. These are Kattegatt/The Sound, Gdansk Bay, Gulf of Finland / Eastern Baltic, and Bothnian Bay. They are strongly connected to Heligoland Bay (Hamburg, Bremerhaven/Bremen) which is the dominating multi-port gateway. This position is underlined by the leading role of Hamburg as a hub for traffic inside and outside of the Baltic Sea (Lorentzon, 2014).

The competition between ports is evident, as can be seen between Gdansk and Gothenburg or between the ports of the Baltic States and between them and Russian terminals. In that case, calls of large container ships confirm the ability of ports inside the BSR to compete as hubs in international transport networks illustrated by the port of Gdansk. The competition between the ports of the Baltic Sea Region consists of ports which can handle container ships and the distribution of goods to close markets.

Another aspect applies to the regionalisation of the port system which shows that the Baltic Sea is a major example of geographical "in-between" space characterised by interrogations on division and unification, opening and closing, or networks and territories. It is today an entire part of the global maritime network and an open system but its location near major European ports and its situation in a maritime "cul de sac" create a unification through external forces.

By its connections to the global container-shipping network, the Baltic Sea has gained in maritime efficiency what it has lost in direct access to the vast world. New reticular compositions have not caused geographical isolation or economic overloads. On the contrary, they have deepened the relations with the world oceans as regional hubs emergence prove it.

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RELATIVE ACCESSIBILITY OF DISTRICT CENTRES IN SLOVAKIA BY PUBLIC TRANSPORT IN 2003 AND 2017

Abstract. Transformation of the transport system in Slovakia after 1989 has influenced the pattern of public transport. This article focuses on the analysis of public transport accessibility in district centres in Slovakia. The results show a decrease of connectivity in the network of direct bus and train connections and also a decrease in the number of direct connections between district centres in Slovakia in the period from 2003 to 2017. The main factors that have caused these changes include growing motorisation and individual automobile transport, zero-fare trains for selected categories of inhabitants since 2014, the construction of the motorway network, and the liberalisation of the public transport market.
Key words: public transport, accessibility, direct connections, district centres, Slovakia.

1. INTRODUCTION

The concept of accessibility is one of the basic concepts in human and regional geography. However, it is also one of the most difficult concepts to define. During its several decades of application in geography, there have been a number of understandings and also many different methodological approaches to its study, which were also related to the development of geographical thinking. A relatively flexible understanding of accessibility is advantageous, in terms of the broad possibilities of its application. It is reflected in the existence of a large number of different indicators and measures, with the aim of expressing the meaning of this notion in the most diverse contexts.

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An overview of the different ways of measuring accessibility and the different approaches and applications relating to it were explored in many studies, e.g. Handy and Niemeier (1997), Bruinsma and Rietveld (1998), Halden *et al.* (2000), Spiekermann *et al.* (2002), Michniak (2002, 2014), Geurs and van Wee (2004), Gutiérrez (2009), Komornicki *et al.* (2010), Rosik (2012), Niedzielski and Boschmann (2014) and others. The term 'accessibility' usually refers to the concept of proximity, ease of spatial interaction and the potential contact with various services and activities. Put simply, accessibility can be defined as the ease of reaching a specific location (region) from other locations (regions) using a transport system.

One of the important tasks in studying accessibility is the choice of mode of transport (means of transport). Depending on the mode of transport used, accessibility by public transport and individual transport must be distinguished. Before 1989, public passenger transport had a dominant role in the modal split of the former Czechoslovakia, as well as other socialist countries in Central-Eastern Europe. A significant shift in the demand for different types of transport occurred after 1989. The position of public passenger transport has been influenced by the very fast increase of motorisation levels. The motorisation level in Slovakia increased from 165 cars per 1,000 inhabitants in 1990 to 375 cars per 1,000 inhabitants in 2015. The role of individual transport (mainly personal cars) increased at the expense of public road and railway transport (see Howkins, 2005; Pucher and Buehler, 2005; Lijewski, 2007; Horňák and Pšenka, 2013; Michniak, 2016).

Before 1989, public transport was ruled by the state monopolies: the Czechoslovak State Railways (ČSD) and the Czechoslovak Automobile Transport (ČSAD). Their transformation to companies operating in market conditions was influenced by the division of Czechoslovakia into two independent states. Since the beginning of 1993, Slovakia had to develop its own public transport system in different social, economic, and political conditions. Since 1998, when the political orientation of Slovakia towards accession to the European Union was clearly declared, the transport policy of the EU has significantly influenced the public transport system in Slovakia.

The aim of this paper is to assess the public transport accessibility of district centres in Slovakia, within the network of direct public transport connections in 2003 and 2017, and to identify the factors influencing the changes. The article is organised as follows. We begin by focussing on the problems of the organisation of public transport in Slovakia. Next, the data regarding the public transport connections and methods used is introduced. Attention is paid to the identification of the main changes of public transport accessibility in individual district centres in Slovakia and we compare the situation in 2003 with that of 2017. Finally, we discuss the factors that influenced these changes.

2. CHANGES IN THE ORGANISATION OF PUBLIC TRANSPORT IN SLOVAKIA

The transformation of the state monopoly of public transport (the Czechoslovak State Railways (ČSD) and the Czechoslovak Automobile Transport (ČSAD)) to market-oriented companies was influenced by the division of Czechoslovakia into two independent states.

For a long time, railway transport had been in the hands of the state railway carrier and its transformation was slow. On 1 January 1993, the Czechoslovak State Railways were divided into two separate entities: the České dráhy (Czech Railways – ČD) and the Železnice SR (Railways of the Slovak Republic – ŽSR). ŽSR was established by SR Government decree upon the establishment of a state enterprise. On 1 January 2002, the ŽSR was divided into two separate entities: ŽSR and Železničná spoločnosť (Railway Company – ZSSK) according to the ŽSR Transformation and Restructuring Project. Subsequently, on 1 January 2005, ZSSK was split into the Železničná spoločnosť Slovensko (providing passenger transport) and Cargo Slovakia (providing freight transport) (ZSR 2017). The opening of the passenger railway transport market began in 2012 and the process of liberalisation of passenger railway services has not yet been completed.

The Slovak companies of the Czechoslovak (State) Automobile Transport were divided in January 1994 by transport type and renamed: Slovak Bus Transport (SAD) and Freight Transport (NAD or ND). Bus companies were gradually privatised (mainly between 2002 and 2005) and some of them are in the hands of foreign companies (e.g. Arriva). Nowadays, public bus transport is operated by regional self-governments (NUTS 3 level). Under Act no. 56/2012 Coll. on Road Transport (as amended), the self-governing regions have a legal obligation to provide transport services to the territory of their region by regular suburban bus services. Self-governing regions contract selected transport companies to provide services in the public interest. In 2018, 19 companies provided public bus transport under those contracts. Transport licenses for other companies that provide bus services (on other suburban and long-distance lines) in Slovakia are also the responsibility of regional self-governments and such carriers operate suburban and long-distance bus services on a commercial basis.

However, the organisation of public railway transport lies within the state´s authority, based on the Contract on Transport Services in the Public Interest that exists between the Ministry of Transport and Construction of the Slovak Republic and ZSSK (Železničná spoločnosť Slovensko – state carrier).

The state (Ministry of Transport and Construction of the SR) also creates the conditions for the optimal functioning of public transport at a national level and its regulating measures should contribute to a higher quality of life for its inhabitants. Public transport is one of the services of general interest, defined in the official documents of the EU (European Commission, 2011).

3. DATA ON PUBLIC TRANSPORT CONNECTIONS AND METHODS USED

Slovakia is divided into 79 districts (LAU 1), although 5 of them represent districts within Bratislava (the capital city of Slovakia) and 4 within the city of Košice, which is also the district centre for the Košice-okolie district. There are 71 district centres (DCs) in Slovakia (Fig. 1, Table 1), and each of them can have a maximum of 70 interactions (public transport connections) with other centres. There are 4,970 possible mutual interactions of the district centres in Slovakia.

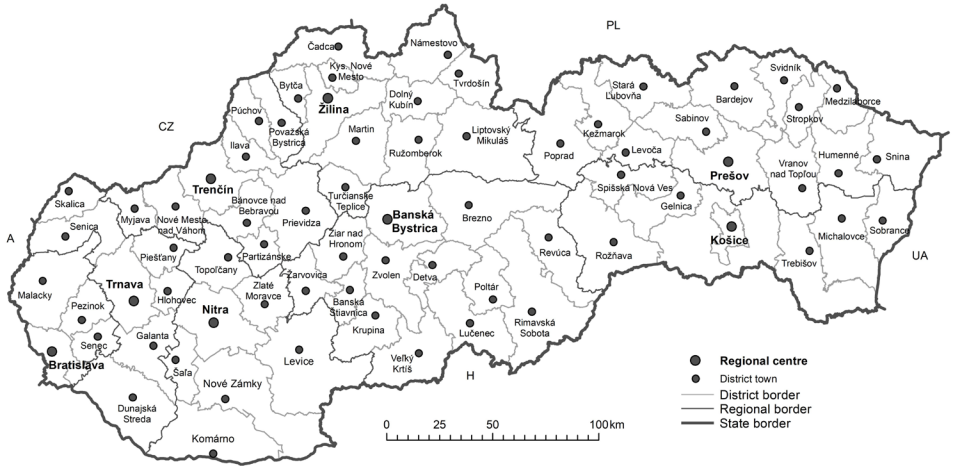

Fig. 1. Districts and their centres in Slovakia

Source: own work.

Table 1. Number of inhabitants in district centres in Slovakia in 2017

No.	Town	Population	No.	Town	Population	No.	Town	Population
1	Bratislava	429 564	25	Topoľčany	25 492	49	Galanta	15 029
2	Košice	239 095	26	Trebišov	24 587	50	Skalica	14 967
3	Prešov	89 138	27	Čadca	24 315	51	Detva	14 751
4	Žilina	80 978	28	Rimavská Sobota	24 010	52	Levoča	14 803
5	Banská Bystrica	78 484	29	Partizánske	22 653	53	Sabinov	12 700
6	Nitra	77 048	30	Vranov nad Topľou	22 589	54	Revúca	12 249
7	Trnava	65 382	31	Dunajská Streda	22 643	55	Veľký Krtíš	12 115

No.	Town	Population	No.	Town	Population	No.	Town	Population
8	Trenčín	55 537	32	Pezinok	22 861	56	Myjava	11 708
9	Martin	54 978	33	Šaľa	22 219	57	Zlaté Moravce	11 583
10	Poprad	51 486	34	Hlohovec	21 715	58	Bytča	11 362
11	Prievidza	46 408	35	Brezno	21 082	59	Svidník	11 096
12	Zvolen	42 476	36	Senica	20 342	60	Stropkov	10 654
13	Považská Bystrica	39 837	37	Snina	20 342	61	Banská Štiavnica	10 097
14	Michalovce	39 151	38	Nové Mesto nad Váhom	20 066	62	Tvrdošín	9 195
15	Nové Zámky	38 172	39	Žiar nad Hronom	19 188	63	Krupina	7 890
16	Spišská Nová Ves	37 326	40	Rožňava	19 190	64	Námestovo	7 876
17	Komárno	34 160	41	Senec	19 410	65	Medzilaborce	6 612
18	Humenné	33 441	42	Dolný Kubín	18 905	66	Turčianske Teplice	6 390
19	Levice	33 332	43	Bánovce nad Bebravou	18 350	67	Žarnovica	6 284
20	Bardejov	32 587	44	Púchov	17 810	68	Sobrance	6 289
21	Liptovský Mikuláš	31 345	45	Malacky	17 430	69	Gelnica	6 099
22	Lučenec	27 991	46	Kežmarok	16 481	70	Poltár	5 693
23	Piešťany	27 666	47	Stará Ľubovňa	16 348	71	Ilava	5 485
24	Ružomberok	26 854	48	Kysucké Nové Mesto	15 132			

Source: SOSR (2018).

The data on direct public transport connections was obtained from online timetables at www.vlak-bus.cz (for 2003) and www.cp.atlas.sk (for 2017). The choice of a specific day and time interval (a representative moment), during which the mutual connections were counted, was the basis for the counting of mutual connections of nodes in a transport network, and their intensity was expressed by the frequency of train and bus connections. To exclude the influence of the different organisation of weekend transport (it also applies to Mondays and Fridays) the equal working days in the middle of the week: Wednesday 10/9/2003 and Wednesday 28/06/2017 were selected for the transport connection analysis.

For this study, two accessibility measures were used. Accessibility measure 1 (*Acc1*) is defined as the existence of direct (bus or train) connections in the direct public transport network for a 24-hour workday (Wednesday). Accessibility measure 2 (*Acc2*) is represented by the frequency (number) of direct (bus or train) connections with other nodes for a 24-hour workday (Wednesday) in the direct public transport network.

The transport connections were counted for both directions and a connection in only one direction (from point A to point B or from point B to point A) was sufficient for the registration of the existence of a mutual connection of two DCs. The acquired values on the existence and the frequency of direct train and bus connections were inserted into matrices that became basic databases for comparative statistical and cartographic analyses.

The basis for the selection of accessibility measures was the definition of accessibility by Ingram (1971) that distinguishes relative and integral accessibility. Relative accessibility is the degree to which two places on the same surface are connected and is represented by *Acc1*. Integral accessibility is the degree of interconnection of one point with all other points on the same surface and is represented by *Acc2*.

The results of this study could be influenced by the territorial-administrative division of Slovakia because there is a difference between the northern part of Slovakia (with smaller districts) and southern Slovakia (with larger districts). The probability of the existence of a connection between two DCs with the same number of inhabitants at a smaller distance is higher than between two DCs at a longer distance.

There could be some debate concerning the role of direct connections for ensuring accessibility to DCs. In many cases, a change of means of transport entails an increase in travel expenses: there are often problems when purchasing tickets for journeys requiring changes, as well as problems with luggage while embarking and disembarking a means of transport, and many potential consequences caused by delays. Direct public transport connections between two towns enable savings in terms of time, uncertainty, and safety. Only direct links can constitute competitive transport links for inter-regional transport, as one or more changes during a single trip from one region to another may act as a time barrier and bring discomfort for passengers (Horňák *et al.*, 2013). Therefore, the analysis of the existence of direct transport connections between locations and regions by public transport is often regarded as one of the basic transport accessibility indicators and is a frequent subject of scientific interest in Slovakia (Székely, 2004 and 2008; Michniak, 2008; Horňák *et al.*, 2013 and 2015; Horňák and Pšenka, 2013). Fan *et al.* (2012) pointed to the fact that direct rail connections are associated with large, statistically significant gains in accessibility to low-wage jobs.

4. DIRECT PUBLIC TRANSPORT CONNECTIONS BETWEEN DISTRICT CENTRES IN SLOVAKIA

A necessary condition for the direct transport connection of any two towns is their formal status as nodes in a transport network. The shape of the railway network is relatively stable in contrast to the more dynamic road network. The railway network in Slovakia has existed for 160 years and the course of the railway lines has been greatly influenced by the natural conditions of the country and by the spatial distribution of the population. In Slovakia, there has been considerable investments in the motorway and expressway network and other roads that ensure access to newly developed areas.

4.1. Direct train connections of DCs

Only 702 direct train connections were identified among the 4,970 theoretically possible direct train connections between DCs in Slovakia in 2017. Compared to the year 2003 (with 798 train connections), their number had decreased by 12%.

It is important to note that 11 DCs (15.5%) in Slovakia have no train connections (Fig. 2). Four peripherally located districts in the northern and eastern part of Slovakia (Námestovo[1], Stropkov, Svidník, and Sobrance) have never been connected to the railway network. Another three districts (Krupina, Veľký Krtíš, and Levoča), do not have regular public transport. District towns of Skalica, Banská Štiavnica, Rožňava, and Rimavská Sobota are located on regional tracks that only have train connections to other municipalities in the proximity of these railways. When passengers want to travel to other DCs, they have to transfer to other trains.

In the period from 2003 to 2017, the connectivity of the majority of DCs decreased. DCs located on the main railway routes (Bratislava – Žilina – Košice) and in Slovakia are characterised by better connectivity in comparison to the worst connected DCs, mainly in the Banská Bystrica and Prešov regions, where transport exclusion is combined with economic and social exclusion (Székely and Michniak, 2018). One exception, which has better connectivity (in comparison to 2003), is the town of Prešov (from 5 to 20 DCs), where the private carrier Leo Express introduced new direct train connections with DCs on the Košice – Prešov – Žilina – Prague route. Another example of connectivity improvement is the town of Malacky in the Bratislava region, where direct trains connecting Malacky and Trnava (through Bratislava) were introduced. Čadca represents a district centre in Slovakia with poor networking to the other district centres, a decrease from 29 in 2003 to 15 in 2017.

The number of direct trains between individual district centres and all other district centres in Slovakia increased by 17% in the period from 2003 to 2017

[1] There is the narrow-gauge track of the Orava Forest Railway (located in the Námestovo district) used for tourist purposes.

(from 10,876 direct trains in 2003 to 13,142 in 2017). The majority of direct train connections between DCs is concentrated on the main railway routes in Slovakia (Bratislava – Žilina – Košice) (Fig. 3) and the international route (Bratislava – Nové Zámky), i.e. from the Czech Republic to Hungary. There is a visible concentration of trains in Zvolen, an important railway node in the central part of Slovakia. Other DCs have a small number of train connections and the inhabitants of those regions can only use bus transport if it is available.

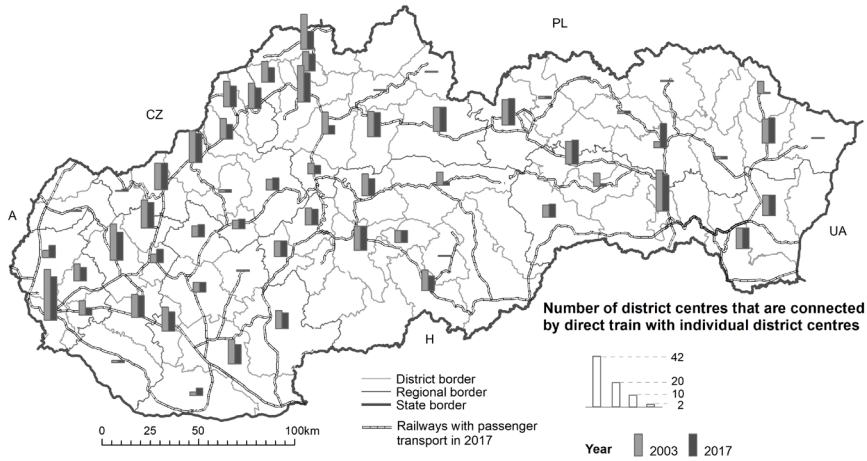

Fig. 2. Number of district centres that are connected by direct trains with individual district centres in Slovakia

Source: own work.

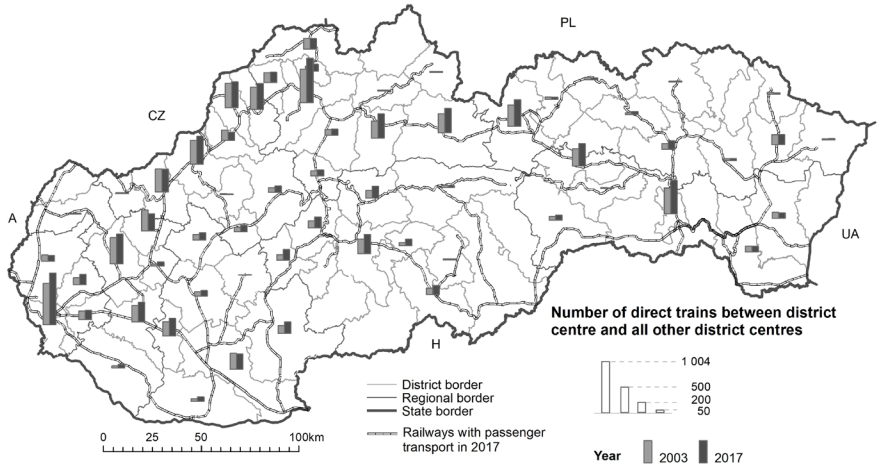

Fig. 3. Number of direct trains between individual district centres and all other district centres in Slovakia

Source: own work.

4.2. Direct bus connections of DCs

DCs in Slovakia are better networked by bus connections than by train connections. In 2017, 1,448 direct bus connections were identified from a maximum of 4,970 theoretically possible direct bus connections of DCs in Slovakia. In comparison to the year 2003, with 2,262 bus connections, their number decreased by 36% and the network of direct bus connections lost more than a third of its connections in the period from 2003 to 2017.

The huge decrease in bus connectivity of DCs was observed in the whole of Slovakia (Fig. 4). The exceptions were four peripheral districts in Eastern Slovakia (Snina, Medzilaborce Humenné, and Sobrance) that only had a few direct buses to other DCs in 2003 and obtained new direct buses to Bratislava and the Czech Republic that served mainly commuters.

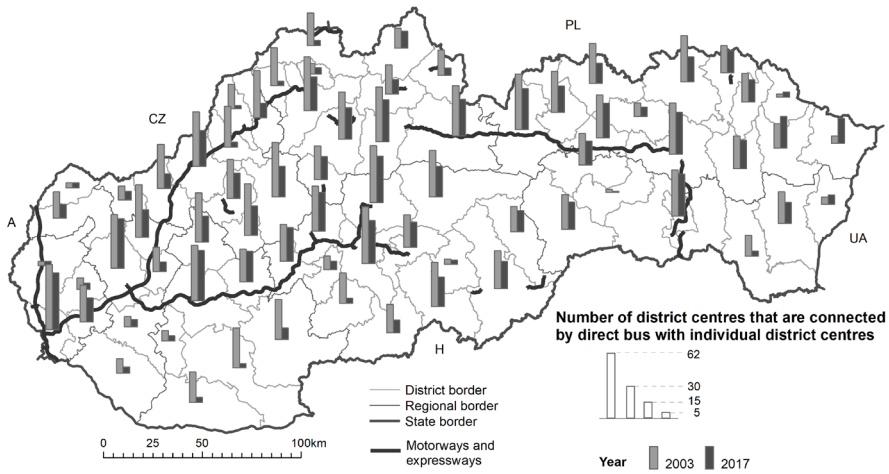

Fig. 4. Number of district centres that are connected by a direct bus with individual district centres in Slovakia

Source: own work.

The regional centres of Bratislava, Trnava, Nitra, Košice, Prešov, Banská Bystrica, and Žilina only had a small decrease in the period from 2003 to 2017 and have the highest connectivity to other DCs. The towns of Ružomberok, Poprad, and Zvolen also have direct connections to other centres at a very good level. Peripherally located small towns, such as Medzilaborce, Sobrance, Gelnica, Poltár, Banská Štiavnica, and Skalica have only direct connections to a small number of other DCs. Centres near Bratislava (such as Malacky, Pezinok, Galanta, Šaľa, and Dunajská Streda) also have limited possibilities when it comes to travelling directly by bus to other centres, but they can use a wide spectrum of direct connections from Bratislava, which is easily accessible from these towns.

The town of Snina is an example of a centre with a substantial improvement of bus services; the number of DCs with a direct bus to Snina increased from 7 in 2003 to 24 in 2017. One of the possible reasons for that change was the re-routing of some long-distance bus connections from eastern Slovakia. DCs in the western and northern parts of Slovakia have better direct bus connections with other DCs, although, in many cases, they lost connections in the period from 2003 to 2017.

An example of worsening connectivity by direct buses is the town of Ilava. The number of DCs with direct busses to Ilava decreased from 39 in 2003 to 5 in 2017. Ilava lost connections to many centres because it became connected to the D1 motorway and, at present, long-distance buses use the motorway without stopping in this small town.

The number of direct buses between individual district centres and all other district centres in Slovakia decreased by 43% in the period from 2003 to 2017, from 35,360 direct buses in 2003 to 19,982 in 2017.

The majority of direct bus connections between DCs is concentrated in the western and central parts of Slovakia (Fig. 5). The greatest number of bus connections are found in Bratislava, Nitra, Zvolen, Banská Bystrica, Prešov, and Košice. DCs in the southern part of Slovakia have only a small number of direct buses to other centres. In the above-mentioned district centres with improved bus connectivity (Snina, Medzilaborce, and Sobrance), the number of connections to other centres is relatively small.

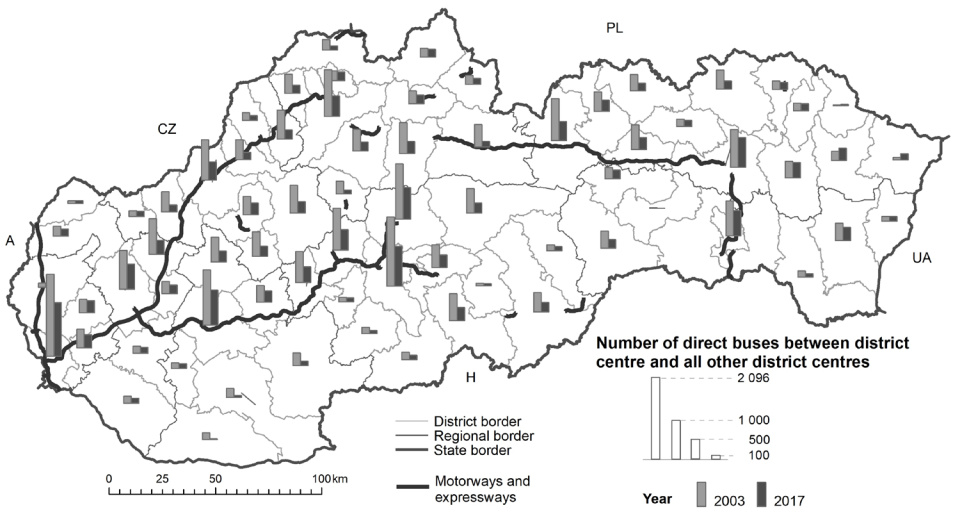

Fig. 5. Number of direct buses between individual district centres and all other district centres in Slovakia

Source: own work.

5. FACTORS OF CHANGES IN DIRECT CONNECTIONS OF DCS BY PUBLIC TRANSPORT

The changes in the direct connections of DCs by public transport for the period from 2003 to 2017 noted above are large and, in many cases, can be regarded as dramatic. In the following part of the article, we will try to answer the question: why there are such changes in the direct connection of DCs.

These changes are the result of many changes in the transport system and the travel behaviour of passengers. There are many important factors.

First of all, after 1989 there was an evident increase in individual automobile transport and a decrease in the importance of public transport in Slovakia, particularly public transport on the road. The decrease of public transport was observable in terms of the number of passengers and also the performance of public transport. The highest increase in individual transport was in the first decade but it grew slowly until 2015 (MDaV SR, 2017).

Railway transport (in terms of public transport) worsened in Slovakia until 2005. This was also related to a decline in the demand for railway transport and the closure of public transport on several regional tracks, with great losses of railway operations. Those railway closures affected railway transport in many regions but they did not influence direct connections between DCs. Then, there was a phase of stabilisation in the railways and, during the last few years, the position of railways improved, especially since 2014. This positive a trend concerning railways is the result of the introduction of the zero-fare public railway transport services for selected groups of passengers. This specific governmental decision is another important factor that influenced the direct public transport connection of DCs.

Zero-fare public railway transport services have been valid on the trains of the state carrier Železničná spoločnosť Slovensko (ZSSK) and on the Bratislava – Komárno route of the private carrier RegioJet since 17 November 2014 (the Day of Struggle for Freedom and Democracy – a public holiday in Slovakia). This form of state support benefits all children under 15 years of age and seniors over 62 without limitation of their citizenship or residence, as well as students and seniors under 62 who are citizens or permanent residents of other EU member states. By the end of 2017, 1.125 million passengers were registered for zero-fare transport. The structure of zero-fare passengers during 2017 (ZSSK 2018) was dominated by-students in the age range 15 to 26 (59%), followed by seniors over 62 years (19%), seniors under 62 years (12%), and children or students under 15 years (10%).

The position of bus transport in public transport in Slovakia worsened until 2010 and then began a phase of stabilisation. Bus transport is within the remit of 8 self-governing regions and the market for bus transport has opened up for private operators.

Since the end of 2014, zero-fare trains also influenced bus links. According to the information from the Bus Transport Association (SITA 2016), suburban regional buses operating on demand and, with the support of self-governing regions,

carried 2.3% fewer passengers in 2015 than in 2014. Long-distance bus services that are not subsidised (by regional governments) transported, on average, 12.7 per cent fewer passengers in 2015 than in 2014. It is evident that zero-fare trains negatively influenced direct connections between DCs.

The liberalisation of the transport market in passenger railway transport started in 2012 but, until 2018, it only functioned to a limited extent. In 2012, the private carrier RegioJet took over operation of the Bratislava – Dunajská Streda – Komárno railway route in the suburban zone of Bratislava. The improved operation of the private carrier has led to an increase in the number of direct connections between these DCs and also the number of passengers (Michniak, 2018). The liberalisation has also contributed to an improvement of the networking and an increase of the number of direct connections, mainly in the case of the regional centre of Prešov because of new trains provided by the private operator LEO Express, from Košice to Prague and also leading through Prešov.

Transport investments in Slovakia after 1989 were oriented mainly to the development of the road transport infrastructure (i.e. the construction of motorways and expressways). Small towns that obtained a connection to the motorway network lost many direct transport connections because before the construction of a motorway buses stopped there, but after the construction buses used the motorway without stopping in the small towns and thus, long-distance buses tried to compete with trains and car transport through better transport times. The town of Ilava is an example of a small town that lost all inter-regional, long-distance bus connections. A similar negative change was observed in the case of towns such as Nové Zámky, Bytča, Považská Bystrica, and Nové Mesto nad Váhom. The town of Levoča is an example of a small historical town (listed as a UNESCO World Heritage Sites) that was negatively influenced by the loss of many direct bus connections and by unfavourable public transport accessibility.

6. CONCLUSIONS

Investments in transport in Slovakia after 1989 were mainly oriented towards the development of the road transport infrastructure (construction of motorways and expressways). Together with growing motorisation, it was also one of the reasons for the strengthening of the position of personal automobile transport to the detriment of public transport.

Changes in transport have also influenced the pattern of public transport, which is what we have observed through the network of direct public connections between DCs in Slovakia. The main results include a decrease of connectivity in the network of direct bus and train connections (by 12% and 36% respectively) and also a decrease in the number of direct connections between DCs in Slovakia (by 17% and 43% respectively) in the period from 2003 to 2017.

Those general trends did not manifest uniformly for all regions and their centres. In some cases, the decrease in public transport was bigger than the general trend was. In the period from 2003 to 2017, the town of Čadca lost direct train connections to almost half of DCs. The town of Ilava lost all direct bus connections with distant centres. A similar situation of the deterioration of bus connections was observed in Nové Zámky, Bytča, Považská Bystrica, and Nové Mesto nad Váhom. All of these DCs are located on the main railway routes in Slovakia and, for their inhabitants, it may not be a problem because they can use train connections. After the introduction of the zero-fare trains in 2014, many bus carriers stopped operating long-distance buses (SITA 2016) or focused on regional lines that go to the centres with railway connections.

Yet there were some exceptions that pointed to better connectivity of some DCs by train (Prešov and Malacky) or by bus (Snina, Humenné, Medzilaborce and Sobrance) that were mainly the result of a change in train or bus routes.

The main factors that have caused changes in the public transport connection of DCs include growing motorisation and personal automobile transport, the zero-fare trains for selected categories of inhabitants since 2014, the construction of the motorway network, and the liberalisation of the transport market.

The role of public transport is to ensure the transport accessibility to places of basic importance and activities for the inhabitants of all regions. Inhabitants need access to shops, services, work, and other social contacts in a safe, convenient, comfortable and relatively cheap manner (Musselwhite and Haddad, 2010). There are many groups of inhabitants that are dependent on public transport, e.g. children and students, the elderly, disabled persons and persons with low income. If public transport does not offer any or suitable connections, such groups become excluded and it is possible that this will lead to transport-related social exclusion (Preston and Rajé, 2007; Lucas, 2012). The results concerning direct public transport connections between DCs in Slovakia point to some aspects of transport exclusion of peripheral centres in the southern of the central parts of Slovakia and eastern Slovakia that are closely related to economic and social exclusion, but this concept is better better applicable to the regional and local levels.

The direct public transport connections of DCs point to the importance of individual DCs in the settlement structure of Slovak towns and cities and their position in settlement hierarchy. Our results confirmed the dominant position of Bratislava as the capital city of Slovakia (Buček and Korec, 2013), and the important position of eight regional centres, and other towns, that have favourable transport locations, e.g. Zvolen and Poprad. Then again, there are many small DCs with a peripheral transport and economic position, e.g. Gelnica, Poltár, Medzilaborce, Sobrance, and others.

An important challenge for public transport in Slovakia is the creation of the integrated transport systems of the regions with the largest cities and towns in

Slovakia. The fact that regional bus transportation is controlled by self-governing regions and regional railways are still under the control of the state is one of the main obstacles for their development. The integrated transport system in Slovakia is developing mainly in the Bratislava region. Integration of transport is not about ensuring direct access to the centre of an area but it is a system of public transport within a region that includes more than one transport mode and some carriers in which passengers are transported under common transport and tariff conditions. It offers better access to the centre but, in many cases, with a transfer between different modes of transport in transfer nodes.

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TRAVEL BEHAVIOUR IN A POST-SOCIALIST CITY

Abstract. Automobile traffic has been recently on the rise in many post-socialist cities despite EU policies fostering public transportation and active modes of travel. Against this background, the contribution of this paper is to look deeper into the travel behaviours of residents using a survey of 887 questionnaires as well as GPS travel recordings (almost 3 billion logs) conducted in the city of Poznań (539,000 inhabitants). Based on our analysis we found that proximity to public transport and cycling infrastructure seem to be among the most important factors influencing travel behaviours of inhabitants. What is more, their accessibility affected also residential locational preferences. However, we also observed that even in neighbourhoods with good accessibility, commuting by car plays a major role.

Key words: travel behaviour, post-socialist city, transport policy, residential self-selection, Poznań.

1. INTRODUCTION

Urban travel behaviour has recently received considerable attention from scholars across the globe (Schwanen *et al.*, 2001; Næss, 2006; Schönfelder and Axhausen, 2016). Yet, within the growing range of studies, relatively little attention has been paid to post-socialist cities of Central and Eastern Europe (CEE). This is surprising given the scope of change in urban transportation, or, in other words, of the "transport revolution" that occurred in these countries (Pucher and Buehler, 2005). The drivers of this change were diverse, but strongly linked to two major factors. The first of them is urban sprawl, which resulted from private sector led housing development under limited planning control (Hirt, 2007; Kok and Kovacs, 1999; Leetmaa and Tammaru, 2007). The second major cause of change in urban transport has been increasing automobile ownership driven by a preference for

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more individualised mode of travel (Komornicki, 2003). Then, some efforts have recently been made to promote the use of public transport and of active modes of travel. These could be seen as part of a broader trend of adopting Western policy solutions and practices, which are considered an expression of modernity.

Set against this background, this paper seeks to explore neighbourhood-level travel behaviour in the post-socialist context using the Polish city of Poznań as a case study. Evidence is drawn from a questionnaire survey of households and from mobile phone GPS recordings. Providing more evidence in this field is urgently needed because the way travel behaviours evolve is very likely to affect the future functioning of urban systems in Central and Eastern Europe. While the sustainability paradigm in general and EU transport policies in particular encourage the use of public transportation and active modes of travel, what has actually been observed in post-socialist contexts is increasing reliance on the private automobile.

2. POST-SOCIALIST PERSPECTIVE ON TRAVEL BEHAVIOUR

For a number of reasons, post-socialist countries offer a unique context for the study of travel behaviour. The transition from central planning to a market-oriented and democratic system has brought manifold consequences, which have translated into various changes in urban space (Borén and Gentile, 2007). Drawing on the seminal model of urban cycles (Berg *et al.*, 1982), it could be hypothesised that until the end of the 1980s, socialist cities found themselves in a prolonged phase of urbanisation. The systemic change has brought about a rapid shift towards suburbanisation, which became the predominant trend of post-socialist urban development (Niedzielski and Śleszyński, 2008; Stanilov and Sýkora, 2014). Accelerating growth of the hinterlands accompanied by a decline of core city areas has been documented in a number of Central and Eastern European cities (Kotus, 2006; Leetmaa and Tammaru, 2007; Ott, 2001). This phenomenon could be interpreted as a way of fulfilling societal aspirations of the nascent middle class (Ourednícek, 2007). While the process as such is not unique to the post-socialist context, what makes it peculiar is the fact that far-reaching changes occurred within a relatively short period.

Changes in the spatial structure of cities in conjunction with evolving consumption patterns were closely linked to changing travel behaviours. While the scope of residential suburbanisation greatly exceeds workplace suburbanisation, relocations to the suburbs are linked to a substantial increase in commuting (Krisjane *et al.*, 2012). Coupled with rising motorisation rates (Table 1), this resulted in a rapid rise in automobile usage. In many cities, individual motorised commuting has become the dominant mode of travel (Novák and Sýkora, 2007). Previous re-

search posited that car ownership in post-socialist countries was driven mainly by economic factors, such as income and costs (Komornicki, 2003). However, more recent contributions pointed out to the importance of the car as a status symbol, suggesting that cars might be owned and used even if they are not necessary from a strictly economic point of view (Pojani *et al.*, 2018).

Table 1. Passenger cars per 1,000 inhabitants in CEE countries in early and late transition period

Country	1994	2014
Bulgaria	188	417
Croatia	150	348
Czech Republic	266	449
Estonia	231	497
Hungary	202	315
Latvia	100	330
Lithuania	196	414
Poland	186	526
Romania	89	247
Slovak Republic	186	360
Slovenia	336	522

Source: OECD (2017).

In socialist times, mobility in urban areas used to be highly dependent on public transportation. During the post-socialist period the usage of public transportation has been generally on decline. However, public transportation infrastructure, and particularly high capacity corridors such as urban light rail, continue to be perceived as important elements of the transportation system (Gadziński and Radzimski, 2016). While suburbanites are likely to rely more on the automobile, lack of alternatives has also been reported as a reason behind the decision to drive (Hirt, 2008; Kährik *et al.*, 2012; Špačková *et al.*, 2016).

Active modes of travel have received very little attention in the post-socialist urban literature so far. Walking remains an important mode of travel in post-socialist cities due to the relative compactness of their built-up structures. Cycling is much less widespread in CEE cities than in Western Europe. This fact seems to be, *inter alia*, linked to concerns about road safety (Evgenikos *et al.*, 2016). It is generally agreed that walking and cycling have not been treated as distinct policy priorities in post-socialist countries. This situation is beginning to change, with increasingly more attention being paid to addressing the needs of pedestrians and cyclists. Compared to the early 1990s, a certain progress is visible, but still the cycling infrastructure often fails to meet modern quality standards (Barnfield and Plyushteva, 2015).

3. METHODOLOGY

To fulfil the adopted research objectives we decided to conduct a case study in the city of Poznań. To present the context, first we focused on the main trends affecting travel behaviours of inhabitants within the city. Secondly, we conducted in-depth comparative studies for selected districts of Poznań. Such an approach allowed a closer look at the local specifics of particular areas, including their unique neighbourhood characteristics and transport system conditions. We focused on three districts located in the northern and eastern parts of Poznań – Naramowice, Piątkowo, and Rataje (Fig. 1). The selected areas are characterised by significantly different levels of accessibility of transport modes. All of them are located outside the city centre and are characterised by the dominance of multi-family buildings, but other conditions (especially transport opportunities) seem to be significantly different. Their more detailed characteristic could be found in the fourth section of the paper.

The paper employs a multi-method approach and combines data from different sources. The main groups of data used in the study and the way they were utilised are presented below.

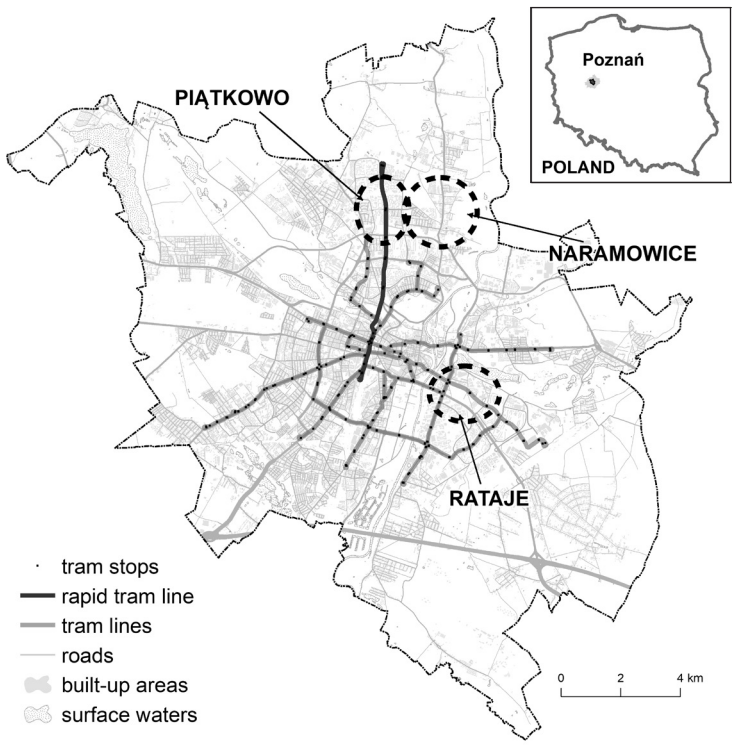

Fig. 1. Study area and selected districts

Source: own work.

The first group of data was collected with the use of face-to-face interviews, which were conducted with the inhabitants of Naramowice, Piątkowo, and Rataje from June 2016 to October 2016. The main objective of this survey was to collect information on the typical travel behaviours of inhabitants, theirs motivations on housing decisions, and subjective opinions on the level of satisfaction with the place of residence. To cover a broad variety of housing types and neighbourhood conditions, we decided to explore the opinions of people living in different parts of selected districts. Therefore, we divided them into smaller parts (housing estate level) and selected respondents proportionally from all designated areas. In total, the opinions of 887 inhabitants were gathered. The detailed socio-demographic characteristics of respondents are presented in Table 2.

Table 2. Socio-demographic characteristics of respondents from selected districts

Category/characteristic	Piątkowo	Naramowice	Rataje
No. of respondents	374	301	212
Gender [%]			
male	42.6	48.2	49.1
female	57.4	51.8	50.9
Age [%]			
< 25	34.0	14.6	19.8
25 – 39	31.0	42.5	40.6
40 – 59	19.1	29.2	30.2
> 60	15.9	13.6	9.4
Education [%]			
elementary	5.7	1.0	2.9
vocational	20.3	4.0	17.7
secondary	43.8	37.9	42.1
higher	30.3	57.1	37.3
Occupational status [%]			
in education	32.7	13.0	23.4
employed	41.2	67.8	59.7
unemployed	2.9	1.00	2.8
pensioner	15.4	10.3	10.6
housewife	7,7	8.0	3.7
Economic situation [%]			
very good	8.9	7.3	7.2
rather good	41.8	41.2	35.9
average	38.1	44.5	48.7

Table 2: cont.

Category/characteristic	Piątkowo	Naramowice	Rataje
rather poor	5.4	4.7	8.2
very poor	1.6	0.0	0.0
no answer	14.3	2.3	0.0
Household size	2.93	2.98	2.67
No. of children per household	0.53	0.83	0.42
Household status – ownership [%]	54.7	74.4	64.2
Household status – rented [%]	45.3	20.9	35.8

Source: own work based on interview results.

In our analyses we also utilised location data obtained in a survey based on a mobile app[1]. The data was treated as supplementary information and used to verify the hypothesis on relationships between housing location and travel behaviour. The survey was conducted only on a group of students and young adults, so it should be treated rather as a pilot study. However, with the use of the obtained data, it was possible (for this particular social group) to identify popular travel destinations and relate them to the type of residential area and the accessibility level. It was particularly important in the case of Piątkowo district where students seem to be a significant group of inhabitants (they amounted to one third of all respondents who participated in the interviews).

In total, we collected almost 3 billion records with latitude-longitude coordinates, precise time and speed information, as well as several socio-demographic characteristics of study participants (104 persons). The collected data was cleaned, arranged in a database, and visualised with the use of GIS software (ArcGIS 10.3.1). To improve the perception, the data is presented in a hexagonal grid.

4. TRAVEL BEHAVIOURS IN POZNAŃ

4.1. Urban context and transport policy

The case study used in this article is the Polish city of Poznań, with a population of 539,000 in 2017. Together with Wrocław, Poznań is considered to be one of two major urban cores in the western part of Poland. Higher education constitutes

[1] Detailed information about the construction of the research tool and the survey methodology was presented in: Gadziński (2018).

an essential function of the city, with about 100,000 students enrolled at local universities. The important academic function of the city combined with its favourable economic development in the post-transition period triggered substantial migration from rural areas. Despite that trend, the population of Poznań declined by 48,000 persons between 1990 and 2015. That was because population growth took place in the hinterland zone while the core city declined. Residential suburbanisation led to an increase of 147,000 persons in the hinterland zone (Fig. 2). Workplace suburbanisation has had a more limited extent (Miasto Poznań, 2014).

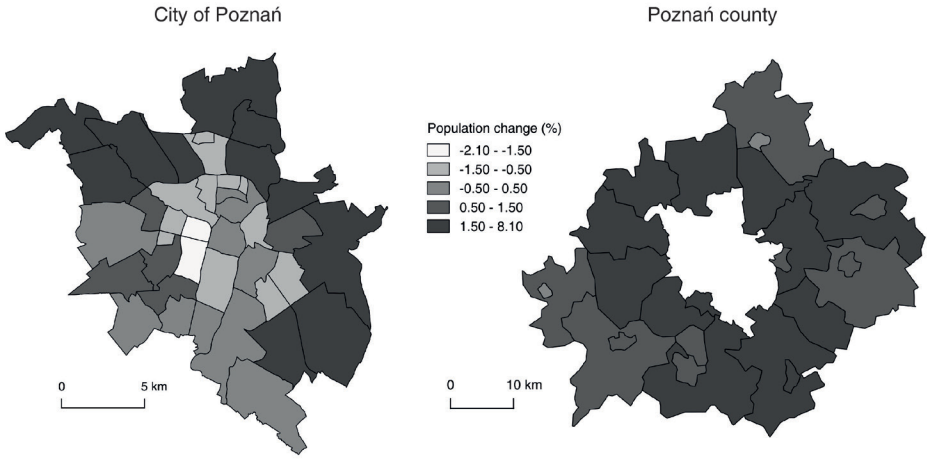

Fig. 2. Population change in Poznań and the hinterland zone (2001–2015)
Source: own elaboration based on GUS (2017) and Miasto Poznań data.

Spatial decentralisation of the resident population within the urban region and longer commuting distances pose increased pressure on the local transport infrastructure. In the course of post-socialist reforms, the responsibilities for urban transportation had been shifted to the local level, but only limited access to external funding was provided. That changed with the accession of Poland to the European Union in 2004, which gave a boost to local transport investment. However, while the principal objective of EU transportation policy is to foster sustainable mobility, in the case of Poznań an increase first occurred in road investments, followed by higher spending on public transportation (Fig. 3).

Prioritisation of road infrastructure as a leading solution to challenges arising from spatial decentralisation was the prevailing, yet contested vision of local transport policy for much of the post-socialist period. A radial model comprising three concentric ring roads guiding automobile traffic away from the city centre dominated local transport planning in the early 2000s. Particularly the third, exter-

nal ring road raised much controversy, since its construction would imply a spending of a least 6.7 billion PLN, i.e. about 1.5 billion euro (Miasto Poznań, 2008). In comparison, the total investment in road infrastructure in Poznań between 2001 and 2016 equalled less than half of that amount. Recently, the ring roads do not appear to be on the local transportation policy priorities list, but road investments continue to constitute an essential part of municipal spending.

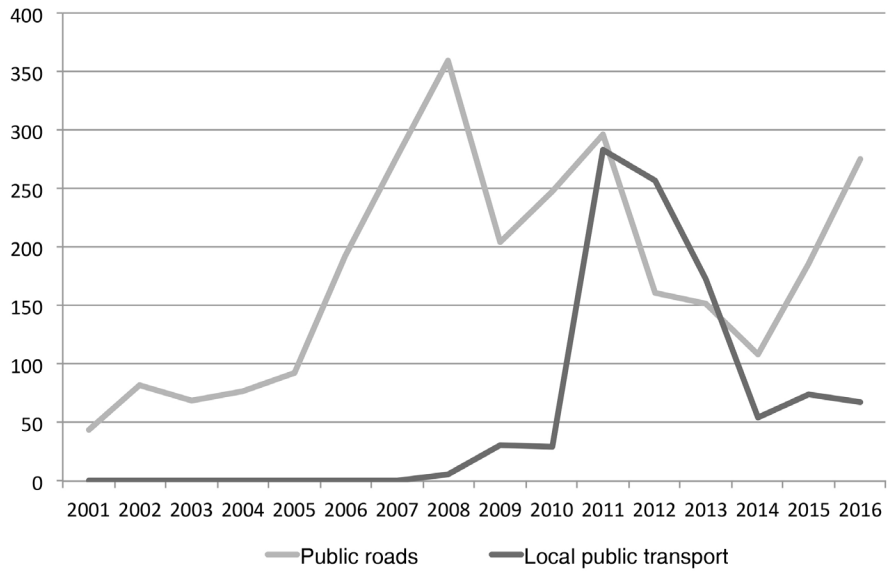

Fig. 3. Investment in transport infrastructure in Poznań (millions PLN)
Source: own work based on Miasto Poznań financial reports.

With regard to public transportation, the largest investment in the 1990s was the Poznań Fast Tram, a project initiated already in the socialist times and accomplished after the transition (Gadziński and Radzimski, 2016). In the period following the EU accession, several other yet smaller-scale projects have been brought into being, including a link of the Poznań Fast Tram to the central railway station, and an extension of the tram network to the suburban retail area of Franowo. Also, EU funds helped the city to substantially modernise its fleet of buses and trams. As of 2017, the public transportation network of Poznań comprised 21 tramlines, including one nightline, and 72 bus lines, including 21 nightlines (Miasto Poznań, 2017).

The cycling infrastructure in Poznań is often considered less developed than in other major Polish cities (Grochowski and Szymczak, 2015). For several years, extensions of the bicycle network were closely linked to investments in road infrastructure, without being explicitly recognised as a distinct policy objective.

The total length of the cycling infrastructure, including cycle tracks, cycle lanes and shared-use paths, amounts to 140 km (Miasto Poznań, 2017). Other source quoted 184 km as the overall length of bikeways and other facilities for cyclists (Grochowski and Szymczak, 2015, see Fig. 4). A bike-sharing scheme has been in operation since 2012, including 88 stations and 923 bikes as of 2017. In 2018, the number of bike-sharing stations increased to 113 providing better coverage particularly in the outer neighbourhoods. Low perception of traffic safety and an incoherent cycling infrastructure network are seen as the major hindrances to bicycle usage (Miasto Poznań, 2017).

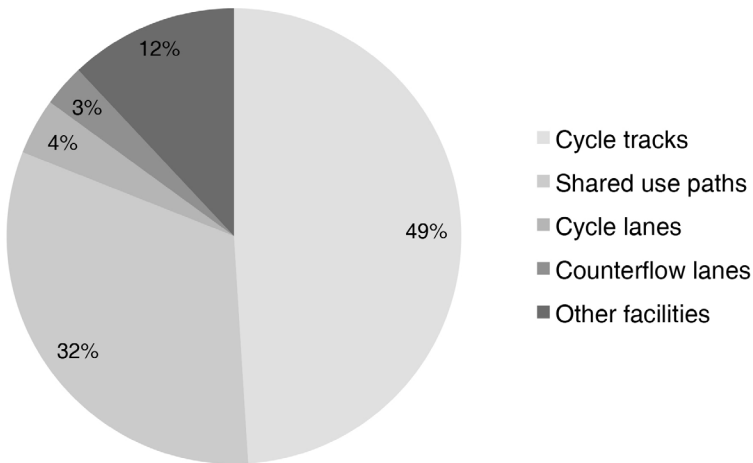

Fig. 4. Cycling infrastructure in Poznań by type
Source: Grochowski and Szymczak (2015).

Until recently, pedestrian traffic in Poznań has not received much attention in the local transport policy. A number of obstacles to pedestrian traffic have been identified, such as the practice of expanding cycling infrastructure at the expense of pedestrian space (Grochowski and Szymczak, 2015). A notable point is that pedestrian traffic is not recognised as a formal part of the local transport policy agenda, which only includes public transportation, cycling, parking, and road traffic as distinct policy fields. While several Polish cities recently appointed a pedestrian officer responsible for consulting planning and policy papers, Poznań has not decided to take this step so far.

To conclude, the local transport policy of Poznań in the post-transition period could be characterised as an assemblage of projects, initiatives, and strategies that were to a large extent driven by external opportunities such as EU funds. These various initiatives only to a limited extent were able to communicate the vision of a comprehensive transport strategy. For several years, the prioritisation of au-

tomobile traffic as the preferred solution in the light of the on-going suburbanisation process constituted a major obstacle for the implementation of a sustainable transport policy agenda.

General information on travel behaviours in Poland is delivered by complex traffic surveys. However, they were organised in Poznań irregularly and with a low frequency (mainly due to their high costs). What is more, the methodology has changed over the years, so in some cases it is difficult to compare the results. Nevertheless, these surveys remain a fundamental source of data that allows some important trends to be indicated (Table 3). The share of car travel has increased significantly since the late-1980s. Only between the years 2000 and 2013 car traffic increased by 57% within the city, and by 83% in the suburbs (Badania i opracowanie…, 2013). This was related to a decrease in public transport usage. However, we should notice that the role of mass transit in urban travel is still considerable, and around 40% of inhabitants use this mode on a regular basis. Together with the decline in public transport usage, we could observe also decreasing popularity of active travel. However, there is also evidence that the number of cyclists has increased significantly in recent years (Badania i opracowanie…, 2013).

Table 3. Modal split and mobility level in Poznań over the years

Year	Modal split			Number of travels per day (without walking)
	car [%]	public transport [%]	active travel (w – walking, c – cycling) [%]	
1988	16	51	31	1.83 (1.28)
1997	48	37	15	-
2000	53	37	10 (w: 8, c: 2)	2.44 (1.99)
2013	39	43	17 (w: 13; c: 4)	1.70 (1.48)

Source: Badania i opracowanie…, 2013; Studium uwarunkowań…, 2014.

The above-mentioned trends seem to be a consequence of the greater prevalence of cars in households, and of the transformation of spatial structures in the city. The suburbanisation process has resulted not only in a decline in population density in the city centre, but it also caused a decrease in the efficiency of public transport. In most cases new residential estates were built in areas without connection to tram or train infrastructure (Gadziński, 2014; Radzimski, 2009). According to legal regulations, there are no requirements to be met with regard to public transportation accessibility when applying for a construction permit. Therefore, in many cases new residents of suburbs became largely dependent on cars in their daily travels.

4.2. Evidence from three neighbourhoods

The analysis of travel behaviour in Poznań is based on a questionnaire-based survey conducted in 2016 in three neighbourhoods. These neighbourhoods differ in terms of their built-up structures as well as with regard to the accessibility of public transport and the active modes of travel[2]. Rataje is a prefabricated housing neighbourhood constructed during the socialist period. It is characterised by typical modernistic design, including the separation of different modes of travel. The construction of Piątkowo started already in the 1980s, but it was completed after the systemic change, whereas the neighbourhood of Naramowice is an example of new developments, as it was built mainly from the 2000s onwards.

In comparing travel times to the city centre with trams and buses (Fig. 5), we found a high level of public transport accessibility in Rataje and Piątkowo, which is provided especially by an extensive tram network and supporting bus connections. Piątkowo has got direct access to the Poznań Fast Tram, which provides a convenient connection to the city centre, while Rataje is served by a regular tram line. Among the three neighbourhoods, Naramowice is the only one not directly connected with the tram network (Fig. 5). Consequently, public transport is only based on bus connections (7 daily lines) and almost all bus routes run through the main axial street, which received attention from the national media in 2014 as the slowest transit corridor in Poland. What is more, Rataje and Piątkowo are connected to the city centre also via a dedicated cycling infrastructure. In the case of Naramowice, separated tracks for cyclists still have not been provided.

Differences between Naramowice, Piątkowo and Rataje in terms of public transport accessibility and cycling infrastructure seem to be among the most important factors influencing travel behaviours of inhabitants. This hypothesis could be proved by the results of our investigations. Table 4 compares the results of the survey based on face-to-face interviews. The results clearly confirm that public transportation is the most popular transport mode in Piątkowo. More than half of the respondents use trams and buses at least several times a week. Public transport was also very popular in Rataje. However, respondents from this district use both cars and public transport comparably often. Thus, the respondents in Naramowice prefer cars in their daily travels (50% of them use cars every day). What is more, they own generally more cars and fewer seasonal tickets than the inhabitants of Piątkowo and Rataje. Regular cycling is rather unpopular in Naramowice, while

[2] For research purposes (to underline the differences between districts) we proposed two measures of public transport accessibility. They are presented in Fig. 5. In the first case, we analysed walking time to the nearest tram stop. Average speed of pedestrian was adopted as 5 km/h. In the second case, travel times to the city centre with the use of trams and buses (including walking time to public transport stops) were estimated. Calculations were based on official timetables. Both accessibility measures were network-based – we assumed that people use existing roads and pavements (OpenStreetMap data was used).

as much as 7% of the respondents from Piątkowo and almost 9% from Rataje declared that they used bicycles every day. These results are strongly linked with the perception of various transport modes. The respondents from Piątkowo and Rataje recognised trams as the most accessible mode of transport, even though they pointed out that the time needed to get to the parking place was much shorter than the walking time to the closest tram stop, while in Naramowice, cars were indicated as the most accessible mode of transport. This opinion was shared by 66% of respondents from this district.

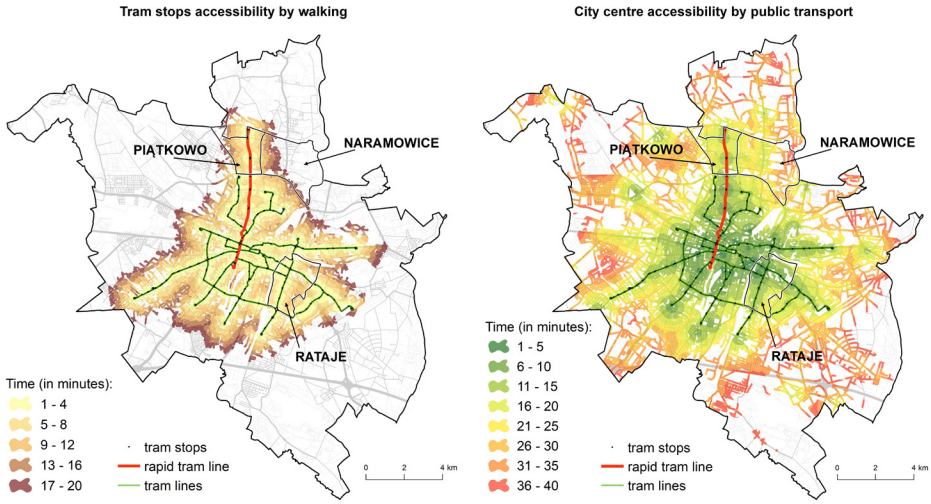

Fig. 5. Public transport accessibility in Poznań

Source: own work based on public transport timetables.

Table 4. Travel preferences declared by the respondents from Piątkowo, Rataje and Naramowice districts

Category/characteristic/declared preference	Piątkowo	Naramowice	Rataje
Travel options in households			
Number of cars per household	0.97	1.20	0.95
Households without a car [%]	31.64	17.28	29.72
Number of season tickets per household	1.60	0.94	1.42
Households without seasonal tickets [%]	21.18	43.19	26.89
Travel modes: use frequency [%]			
Using cars everyday	27.22	49.83	41.83
Using cars at least several times per week	45.01	68.44	58.17
Using buses everyday	28.84	20.93	30.48

Category/characteristic/declared preference	Piątkowo	Naramowice	Rataje
Using buses at least several times per week	51.75	43.19	62.38
Using trams everyday	32.35	5.69	33.33
Using trams at least several times per week	56.33	21.74	62.86
Using bicycles everyday	7.01	2.33	8.65
Using bicycles at least several times per week	25.34	17.33	30.77
Accessibility perception:			
'Car is the most accessible mode of transport' [%]	31.23	65.89	27.35
'Bus is the most accessible mode of transport' [%]	18.90	28.15	34.08
'Tram is the most accessible mode of transport' [%]	46.46	1.99	35.87
Time needed to get parking place (in minutes)	2.59	1.71	3.93
Time needed to get bus stop (in minutes)	6.12	6.52	7.67
Time needed to get tram stop (in minutes)	6.87	24.29	10.01

Source: own work based on interviews results.

4.3. Role of residential self-selection

The concept of residential self-selection might be instrumental in explaining the observed differences among the three neighbourhoods. According to this concept, individual travel preferences and habits might condition the choice of the place of residence (Handy, 1996; Krizek, 2003). People tend to choose residential locations taking into account the accessibility of the preferred transport mode or travel connections to the most popular activities. In other words, they try to maximise their satisfaction with the housing location by choosing the preferred type of neighbourhood (Cao and Ettema, 2014). Previous studies (Kim *et al.*, 2005; De Vos, 2015; De Vos and Witlox, 2016) indicated that: a) areas with a high level of public transport accessibility attract mainly people who prefer mass transit, b) areas in city centre or in mixed land use are attractive for individuals who do not like to travel for longer distances, and c) car-oriented suburbs are selected more frequently by people who like to travel and prefer cars in their daily travels.

When comparing the social and demographic structures of Naramowice, Piątkowo and Rataje with the declared travel behaviours, we found some evidence that the choice of residential locations might have been linked to, or preconditioned by, the preferred travel mode. For example, there is some evidence that a high level of public transport accessibility in Piątkowo attracted a significant number of students. It is reflected by the social structure of the inhabitants interviewed in our survey, but also confirmed by the results of previous studies (Gaczek *et al.*, 2006; Gadziński and Radzimski, 2016). Piątkowo is considered a very attractive

location for students due to its proximity to the Poznań Fast Tram, which provides good access to the largest university campus in the northern outskirts of the city, to the city centre, as well as to the main train station.

This finding is also confirmed by GPS data (Fig. 6), which shows the most popular areas of students' activities. We distinguished two types of such areas. The first category includes locations that are popular during the whole day or night. They could be identified as the places of respondents' residence. The concentration of such areas is visible especially along the Poznań Fast Tram line (e.g. in the Piątkowo district). The second category includes locations that are often visited during the day. They represent such activities as studying, working, shopping, etc. The most popular travel destinations in our survey were the university campus and the city centre area where the cultural and entertainment activities are located. These results show that potentially the most attractive locations for students are areas with good accessibility of public transport and cycling infrastructure.

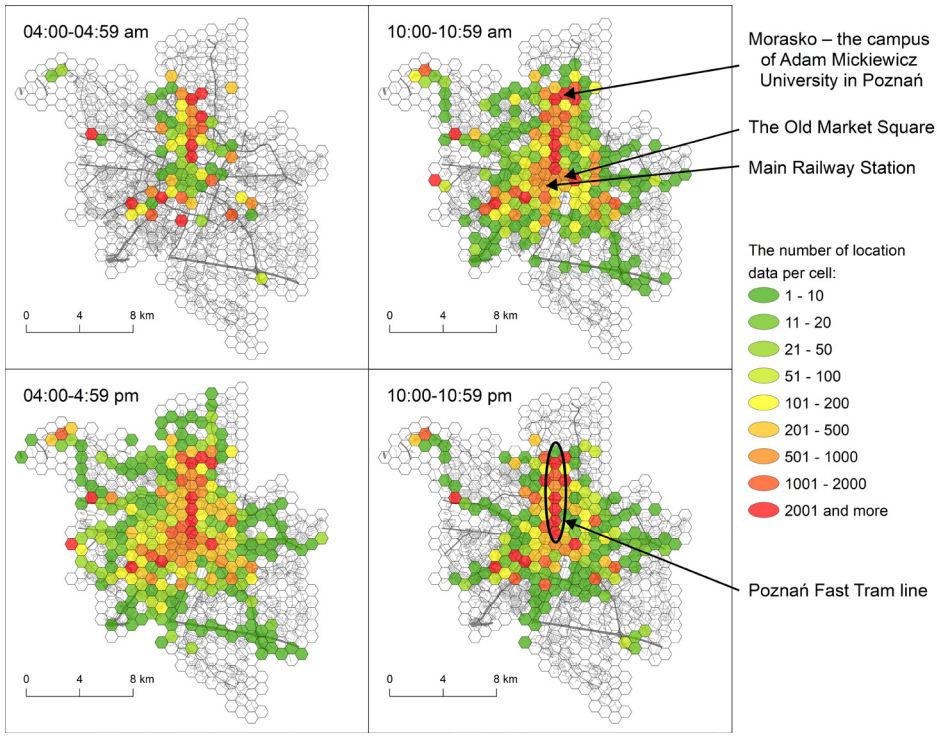

Fig. 6. Spatial distribution of students' activities in selected parts of a day

Source: own work based on GPS data.

Therefore, we could observe an intensive development of the rental market for apartments in close proximity to tram stops (Gadziński and Radzimski, 2016). It should be noted that renters could be more flexible in housing selection (due to a wide offer of apartments on the market and usually short-term contracts) and adjust the place of residence to their current needs. Consequently, it could be easier for them to achieve higher satisfaction with their place of residence. According to our survey, more than 45% of respondents in Piątkowo lived in rented flats, while in the case of Naramowice this share amounted to only 21%. When looking at the renters' characteristics, we noticed that a typical person renting a flat was in education (52% of respondents), was less than 25 years old (54%), and had lived in the current apartment for three years. Most renters, especially from Piątkowo, prefered public transport in their daily travels. 40% of interviewed persons declared to be using trams or buses every day. At the same time, only 17% declared that they were using cars with the same frequency.

5. CONCLUSIONS

In this paper we looked at the travel behaviours in the city of Poznań, which has undergone substantial changes in its spatial structure and transport policy during the post-socialist period. The dominant trend of travel behaviour in Poznań in the last years has been an increase in car travel, which has not been curbed by considerable investments in public transportation. In the paper we extended the analytical framework to focus on the neighbourhood level, which led us to some interesting observations. The results showed that travel behaviour is closely linked to the characteristics of the neighbourhood. Public transport usage and cycling are more common in neighbourhoods with better access to the relevant infrastructure, while residents of neighbourhoods with limited accessibility to sustainable transport infrastructure tend to buy fewer public transport season tickets, to own more cars, and to use them more frequently. These findings could be interpreted in two ways. The first interpretation is that access to good quality public transport and cycling infrastructure encourages sustainable travel behaviour (see Boarnet and Sarmiento, 1998; Jäppinen *et al.*, 2013; Van Acker, 2007). Thus, investments in trams, buses and cycle paths could be expected to reduce car travel and promote the usage of sustainable modes of travel. An alternative explanation is based on the concept of residential self-selection, which assumes that people choose their place of residence in conjunction with travel preferences. If that were the case, providing alternatives to the car would not significantly reduce driving among households whose residential choice was conditioned by

that mode of travel (see Aditjandra *et al.*, 2012; Bohte *et al.*, 2009; Pinjari *et al.*, 2008). The actual character of the causal relationship should be thus subject to further investigation.

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TRANSFORMATIONS OF URBAN ELECTRIC TRANSPORT IN UKRAINE AFTER 1991 IN THE VIEW OF TRANSPORT POLICY

Abstract. The article presents, in a multifaceted manner, the changes that occurred in urban electric transport in Ukraine after 1991. The purpose of the article is to research the diversification of the degree and directions of development and transformation of urban electric transport systems in the context of the transport policy. The legal and financial conditions for the functioning and development of the system are discussed, and a SWOT analysis of the current situation is carried out. In order to assess the direction of the changes occurring on individual networks, a synthetic index was used, constructed on the basis of the statistical data from 25 years available. The research has shown that in 1991–2016, in the vast majority of Ukrainian cities there was a regression in urban electric transport, the largest in the east of Ukraine. That was of a bipartite nature: in the first years it practically applied to all networks, later a polarization in cities occurred – in parts of cities the situation of urban electric transport has improved slightly. In the context of numerous diagnosed problems, the challenges faced by urban electric transport in Ukraine were indicated.
Key words: Ukraine, urban electric transport, tramway, trolleybus, transport policy, economic transformation, electromobility.

1. INTRODUCTION

The organization of public transport in Ukraine differs significantly from the solutions applied in the countries of Central and Western Europe. The public transport system consists of two competing subsystems: urban electric transport, and bus transport, mainly marshrutkas (lines of private companies served by low-capacity

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buses), and sometimes additional bus routes operated by cities. The present model of the organisation of urban electric transport in Ukraine is a consequence of the model of the organisation of public transport in the USSR.

Generally, in the USSR, the state at the central level assured rolling stock delivery. Cities through their companies organised public transport using that rolling stock, e.g. planned routes and timetables. Important infrastructure investments were planned and financed at the central level. Public transport consisted of the metro, trams, trolleybuses and buses but in the largest cities there also operated marshrutkas on commercial terms. In the 1990s communal bus companies or bus divisions of communal companies in Ukraine were privatised. The new owners exchanged large buses for smaller vehicles, which are cheaper to use. The privatisation of the bus system has led to the development of the marshrutkas system.

Municipal electric transport is part of a common transport system, designated for the carriage of citizens by trams, trolleybuses and metro trains, according to the needs of residents (Zakon Ukrainy pro miskyj elektrychnyj transport 2004). Theoretically, the same function in the public transport system is performed by marshrutkas. However, they operate under market conditions. This means that marshrutkas operate only on routes and only in hours that guarantee a sufficient number of passengers ensuring profitability. In many cases they operate on the same routes as trams and trolleybuses, competing with them for passengers. The commercial model of the marshrutkas system does not satisfy all the needs of residents in terms of mobility evenly.

The shaping of urban electric transport is not solely and exclusively limited to the issue of pragmatism that ensures municipal spatial mobility. In the face of growing ecological challenges, it has become a time requirement and it influences the positioning of Ukrainian cities on the European and on the global scale. The current standards of a modern city require efficient and environmentally neutral transport (e.g. Gonzalez-Feliu, 2013; Laterrasse, 2018; Schiller and Kenworthy, 2018). The environmental challenges of Ukraine are significant and they represent one of the most complex areas for the country to address, given the pressures of continuous economic growth and social transition (Dvulit and Bojko, 2014).

One may also look at the issue of urban electric transport in a broader context – regional or local development. The general assumptions of the system that represent the position of the state on transport policy shall be regarded as a macro approach affecting regional development. Concrete implementations at the level of individual cities affect the efficiency of these centres, as well as determine the living conditions therein. As a consequence, they are part of the local development process.

The transport policy refers to the theory of the basic product by H. Innes, which explains long-term factors of economic growth. It indicates the succes-

sive specialisation of selected products and the competitiveness thereof on foreign markets. The benefits of a specialisation are revealed by improving the organisation of production and reducing the costs of commercial transactions (Landes, 2000). The role of public authorities is to strengthen the specialisation trend, to invest in infrastructure (transport, telecommunications), as well as to support institutions in the educational, service, financial, and consulting dimensions (Maliza and Feser, 1999; Grosse, 2002).

The purpose of the article is to research the diversification of the degree and directions of the development and transformation of urban electric transport systems in Ukrainian cities after 1991 in the context of the transport policy. The article is a continuation of a research conducted by Tarkhov *et al.* (2010) in the field of trends in the transformation of urban electric transport systems in Ukraine. The authors of this article began research in 1991, i.e. in the year when Ukraine regained independence. The analyses on a nation-wide scale have focused not only on the changes taking place in individual networks, but also a wider perspective was employed to look at the directions of transport policy set by the state, as well as the consequences thereof in relation to urban electric transport.

As a research area, the authors assumed the borders of Ukraine from before the conflict of 2014, including both the Crimea and the eastern parts of the Donetsk and Luhansk oblasts. There were historically 32 electric tram networks in this area, until the end of 2018 there were 19 networks active, 10 networks were liquidated (after 1991 – solely Kostiantynivka), 3 closed networks are preserved (Kramatorsk, Luhansk, and Molochne), but it is possible to restore them theoretically.

Trolleybus networks are more preferable, where there were 45 networks historically, 41 networks remained active, and traffic was suspended only on 4 networks in the eastern part of the country (Dobropilia, Stakhanov, Toreck, Vuhlehirsk). The list is supplemented by three metro networks (Kyiv, Kharkiv, and since 1995 – also Dnipro). The construction of the fourth metro network in Donetsk has never been completed, and the metro in Odessa remained in the sphere of plans only.

Ukrainian public transport is still rarely addressed in academic literature, especially in English. The barrier to conduct research is primarily and predominantly the poor availability of data, documents from the 1990s, and for foreigners – it is additionally the language and the alphabet. The basis of most of the research in Ukraine is an encyclopaedic guide on urban electric transport (Tarkhov *et al.*, 2010), a study on the history of Kyiv trolleybuses (Kozlov and Mashkevych, 2009) and a monograph on Ukrainian trolleybuses (Bogodistyj *et al.*, 2016). M. Rechłowicz (2016) wrote about the problems of the Donbas tram networks against the background of Poland and the Czech Republic. Research on the economic aspects of the functioning of urban transport in Ukraine was carried out by, e.g. O. Yu. Palant (2016, 2018).

2. DEFINITION OF TRANSPORT POLICY

Public policy can be described as the overall framework within which government actions are undertaken to achieve public goals (Cochran and Malone, 2014). Transport policy is included in the group of public policies. Transport strategy and policy embraces the collection of data and its transformation, the formation of policy objectives, the establishment of institutional structures to carry out these goals, the creation of the resources for these institutions, the carrying out of actions, and the policing and monitoring of outcomes (Button and Hensher, 2005). Sustainable transport is the intersection of three major domains: planning and policy factors, background factors, and technical and infrastructure factors (Schiller, Kenworthy, 2018, p. 263).

In the literature on the instruments of public policies, three perspectives can be distinguished: institutional, normative, and tool-based (Hood, 2008). Therefore, we considered transport policy in three aspects (Schubert, 2004): in the institutional dimension (*polity*), through offices, institutions or institutionalised forums for dialogue, in the process dimension (*politics*) which is a practical implementation of the objectives of sectoral policies through the decision-making process and the implementation thereof, and substantive policy conditions (*policy*), mainly contained in strategic and implementation documents.

In the theory of transport policies the following objectives occupy prominent places: economic efficiency, reflected in the increased competitiveness of regions through an improvement in accessibility and connectivity; social equity, reflected in more equal opportunities for better access both to transport infrastructure and public transport; and environmental sustainability, reflected in greater emphasis on coping with the negative outcomes of the transport sector, such as pollution, noise, landscape decay, congestion, and lack of safety (Button and Hensher, 2005).

One of the most important modern challenges of creating transport policy in cities is the problem of the growing role of personal motorisation. Within a few decades, urban areas across the world, both in developed and developing countries, have become increasingly automobile-dominated and less sustainable (Pojani, Stead, 2015). The contemporary requirement of transport policies is sustainable development of all transport. According to modern scientific literature there are a lot of tools and solutions helping to create such a policy (Attard and Shiftan, 2015; Faulin *et al.*, 2018; Hutton, 2013; Schiller and Kenworthy, 2018). Although some researchers have doubts whether sustainable transport policy is really sustainable (Eliasson and Proost, 2015), one of the most important goals of transport policies should be to reduce greenhouse gas emissions from the transport sector. The implementation of such assumptions is possible by increasing the role of urban electric transport in public transport mobility.

Among the basic criteria for evaluating public policies used by international organizations, such as the World Bank or the UN, the most attention is paid to:

relevance, efficiency, effectiveness, utility, sustainability, and impact. Additional criteria can be: deadweight, additionality, displacement, double-counting, substitution, and the gross and net effect (Turowski, 2014). Evaluative questions shall be constructed at different levels: descriptive, causal, normative, predictive, and critical (The evaluation of socio-economic development, 2003).

Therefore, one shall focus on the measures taken in the field of urban electric transport in Ukraine from yet another point of view: can they, in the understanding of public policy theory, actually be considered a policy, or is the actual policy of transport a lack of this policy.

3. LEGAL ASPECTS OF THE OPERATION OF URBAN ELECTRIC TRANSPORT IN UKRAINE

In the first years of Ukraine functioning as an independent state, there were legal regulations and norms adopted in the times of the former USSR. Only in subsequent years, new legal acts were created as needed. One of the oldest legal acts concerning urban electric transport in Ukraine from the 1990s is the Transport Act (Zakon Ukrainy pro transport, 1994). A review of the documents from those years shows at the same time that, following the USSR model, the Ukrainian state still centrally wanted a system of a number of legal acts of varying significance to regulate all the areas of social and economic life.

According to the Act on urban electric transport (2004), the state policy in the field of urban electric transport is based on the accessibility of transport services for all population groups, the priority of urban electric transport development in cities with high levels of environmental pollution and spa regions, creating favourable conditions for the development of the production of domestic rolling stock and the profitability of carriers' operations.

This policy is to be implemented through appropriate legal regulations, state supervision over the technical condition of infrastructure and rolling stock, traffic safety, supporting investment and innovative projects, domestic rolling stock manufacturers, and ensuring the protection of passenger rights. Entitites responsible for the implementation of this policy are the local government administration authorities and the local government which are supposed to organise urban electric transport according to the directions set out in the Act. The issue of financing comes down solely and exclusively to the general record about funds from the state budget, from local budgets, and other unspecified sources.

Municipal electric transport is organised by cities in the form of municipal enterprises. Most often, such companies serve one city, but there are exceptions, e.g. the trolleybus in the Crimea – one company operates 3 city networks, connected

by an inter-city line. The metro systems are also separate companies. An interesting exception was also a tram line operating in 1989–2014, in the village of Molochne, in Crimea (then the smallest tram network in Europe), which belonged to a sanatorium.

The most important strategic document for transport in Ukraine is the "National Transport Strategy of Ukraine 2030" for all types of transport. The provisions concerning urban electric transport included in the Strategy are, however, very general. The strategy plans to increase environmental safety of transport by incentives to use more environment friendly transport modes, including electric cars, electric public transport, such as metro, trams, trolleybuses, electric buses, and bicycles, but the strategy does not have any specific guidelines for achieving that task (Rozporjadzhennja vid 30.05.2018, № 430-r).

The following should be considered as the most important governmental executive programs for the development of urban public transport after 1991: the program for the development of national production of trams and trolleybuses (Postanova vid 1.07.1998), the concept for the development of urban electric transport for 2006–2015 (Rozporjadzhennja vid 15.06.2006, № 330-r), or the long-term program for the development of the metro network (Rozporjadzhennja vid 28.12.2011, № 1361-r). For Crimea, currently unrecognised by the international community as part of Russia, the trolleybus program on the inter-city line was of great importance, financed not only from the state budget, but also from the budget of the Autonomous Republic of Crimea (Postanovlenie s 20.10.2010, № 1911-5 / 10).

The comprehensive transport policy, based on the experience of Western European countries, indicates a number of instruments supporting the development of public transport. The instruments for influencing the users of personal transport (e.g. Stuart, 2005; Holger, 2010; Santos, Behrendt and Teytelboym, 2010) play an important role. Meanwhile, in the Ukrainian planning documents which include general plans for urban development, there is still more emphasis on the development of road infrastructure, more or less consciously preferring the position of cars in the transport system. Modern conceptions of the development of transport in urban areas, e.g. smart city or electromobility, are currently at a preliminary implementation stage only in major cities (Matyushenko and Pozdniakova, 2016).

4. CURRENT PROBLEMS OF FUNCTIONING AND DEVELOPMENT OF URBAN ELECTRIC TRANSPORT IN UKRAINE

Simultaneously, when there is the renaissance of tram in the Western European countries, particularly visible in France (Groneck and Schwandl, 2014; Konopacki-Maciuk, 2014; Boquet, 2017), suspensions or closures of several tram and trolleybus net-

works are observed in Ukraine. There are some disturbing reports from several other cities that urban electric transport still functions but solely on a small part of the network, in addition, further functioning of these systems for technical and economic reasons is uncertain. What, then, was decisive in terms of the tendencies of the development of urban electric transport that made it different from Western Europe?

One of the basic problems limiting the possibilities of shaping public transport opportunities in many cities is the lack of efficient rolling stock. Due to the lack of resources and limited support possibilities from local budgets, tram and trolley rolling stock are exchanged annually only at 10% of the needed minimum. About 90% of the rolling stock has already exceeded its life cycles and is subject to systematic withdrawal (Rozporjadzhennja vid 15.06.2006, № 330-r). As a result, in both tram and trolleybus transport, the number of vehicles per 1 km of network has been decreasing for the last 25 years, which directly translates into the accessibility and availability of that means of transport. It was one of the factors which impact the total number of passengers of urban electric transport in Ukraine (Table 1).

Table 1. Changes in the number of passengers in urban electric transport in Ukraine

Type of transport	1991	1997	2003	2009	2016
number of passengers (in millions)					
Tramway	1,812.2	1,265.3	1,132.2	787.0	694.0
Trolleybus	2,906.6	2,388.1	1,920.7	1,283.3	1,038.7
Metro	595.3	507.9	872.8	751.9	698.4
Total	5,314.1	4,161.3	3,925.7	2,822.2	2,431.1
change dynamics in per cent (1991 = 100%)					
Tramway	100.0	69.8	62.5	43.4	38.3
Trolleybus	100.0	82.2	66.1	44.2	35.7
Metro	100.0	85.3	146.6	126.3	117.3
Total	100.0	78.3	73.9	53.1	45.7

Source: State Statistics Service of Ukraine.

In 1991–2016, only 195 new domestic tram cars and 249 foreign ones were purchased. At the same time, over 500 second-hand cars were imported. Much more new trolleybuses were purchased. In the corresponding period, 2,258 Ukrainian and around 1,500 foreign vehicles were purchased, mostly Russian. The shortages in the rolling stock were supplemented with second-hand trolleybuses from other countries – within nearly 25 years, almost 300 used vehicles have been brought to Ukraine. Most of the operated rolling stock consists regular vehicles. Electric buses are operated only in Lviv and Vinnytsia, hybrid trolleybuses using alternative power sources (traction batteries, super capacitors or combustion power

generator) are operated in 8 cities: Chernivtsi, Dnipro, Kramatorsk, Kremenchuk, Kryvyi Rih, Odesa, Rivne, and Sevastopol.

The differences in the number of rolling stock throughout the country are extreme. In 1991–2016, the number of trams decreased from 4,988 to 2,222 vehicles (54% fewer), trolleybuses – from 7,399 to 3,373 vehicles (49% fewer). The number of metro carriages increased by only a half – from 795 to 1,195 (Tarkhov *et al.* 2010, Urban Electric Transit). The production of trams and trolleybuses in Ukraine, in the aspect of transport fleet capability, has been discussed extensively by Soczówka, Rudakevych (2018).

All large state investment programs in public transport in Ukraine were to a large extent of the character of interventional ad hoc measures and are often implemented solely and exclusively in selected cities. For instance, at the end of the 1990s, a large intervention program was created to co-finance the domestic production of tram and trolleybus rolling stock (Postanova vid 1.07.1998, № 992). In 2006–2008 a co-financing program was fulfilled for the purchase of a new tram and trolleybus rolling stock, commonly referred to as "50 to 50" (Postanova vid 29.12.2006, № 1855). When buying new Ukrainian production vehicles, 50% of the cost was covered by the state, while the remaining half was covered by municipal budgets. The program was suspended due to the financial crisis. The investments in the form of purchase of domestic rolling stock for the UEFA Euro 2012 only applied to four cities in which the competition was held (Postanova vid 14.04.2010, № 357). The purchase of the rolling stock was also co-financed by large industrial plants (e.g., Severodonetsk, Cherkasy).

Currently, Ukraine is implementing another aid program in public transport, this time co-financed by the European Bank for Reconstruction and Development, worth EUR 400 million. Half of the amount is a preferential loan, half comes from local budgets. The national program is implemented independently of local programs. It supports the modernisation and expansion of tram and trolleybus infrastructures, as well as the purchase of a new rolling stock. Significant effects of the implementation of the program also include the reduction of electricity consumption and carbon dioxide emissions.

Nevertheless, the gradual regression of public transport did not mean that there were no investments in the development of the network whatsoever. New sections of the network were built, especially in the 1990s, when the economy of Ukraine was still in a relatively good condition. In independent Ukraine, e.g. Dnipro metro was built, the metro was extended in Kyiv and Kharkiv, a fast tram line in Kryvyi Rih was established, the left river bank tram network in Kiev was expanded, a new trolleybus network was established in Kerch on the Crimean peninsula, and many cities put into operation new trolleybus network sections. Many of these investments were co-financed from the central budget.

In 1991–2016, the total length of tram lines in Ukraine decreased from 2,171 to 1,776 km (approximately 18%), while the trolleybus lines increased – from 4,044

to 4,349 km (up by 8%) and underground lines increased – from 70 to 114 km (up by 63%) (Tarkhov *et al.*, 2010; Urban Electric Transit and own calculations).

A serious problem in the functioning of the public transport system in Ukraine is the large number of passengers with entitlementto free, or reduced fare. Approximately 30 categories of passengers are entitled to free rides, but their number may vary from city to city. Most of the discounts were approved at the level of central government (parliament, government) in the first years of Ukrainian independence. There are also several additional categories of travellers entitled to discounts granted by local authorities.

The problem of free rides perfectly shows the difficult dependence of local enterprises on the state budget as part of the broadly understood public policies. The discounts were set by the central authorities, but in many cases they were not sufficiently compensated for public transport operators. Compensations for free or discounted rides were only partially paid, which steadily worsened the financial situations of local carriers. Analysing the system of urban transport, Palant (2014) calculated that those compensations covered only 30–40% of actual losses incurred by the companies.

Theoretically, the discounts were supposed to help groups of people who were in a difficult economic situation, in practice they caused the opposite. The municipal companies which were in financial difficulties due to discounts and the lack of investment significantly limited the offer or ceased operations, as a result these groups of citizens found themselves in an even more difficult situation – the remaining private carriers (the so-called marshrutkas) are more expensive, they offer a lower standard of travel, and are reluctant to accept any discounts. Recently, shared taxi service has been completed and it has been approved with some planning or sustainable policy (Vozyanov, 2018).

The obligation to pay financial compensation to businesses for free travel in the past was transferred onto various ministries. In February 2016, further changes were introduced to the budgetary and fiscal legislation of Ukraine. The obligation to compensate for free and reduced rides was transferred from the central authorities to local governments. Some cities attempt to register such passengers, however, this process sometimes violates the permissible rights, which leads to court cases.

However, a SWOT analysis (Table 2), clearly reveals the negative perspective of the development of urban electric transport systems in Ukraine – the advantage of the weaknesses over the strengths and the threats over the opportunities. It indicates a number of serious problems that are difficult to solve in a short time without clearly investing in the entire industry. An additional negative role is played by macroeconomic factors – currently it is the military and economic conflict with Russia, affecting the entire economy and mass economic migrations caused by the attractiveness of EU labour markets. The SWOT analysis for urban electric transport was carried out by Dyvinec' (2015). On many levels, the conclusions and insights from both analyses are convergent.

Table 2. SWOT analysis of the situation of urban electric transport in Ukraine

Strengths	Weaknesses
• Well-developed spatially urban electric transport network in large cities (servicing a large area of the city) • Good service for historically developed industrial districts • Well-maintained and overhauled infrastructure in some cities • Habits of city dwellers to use urban electric transport, e.g. due to the low level of affluence and discounts • Higher transport capacity and lower prices compared to marshrutkas • The cities systematically purchase new rolling stock, more often – trolleybuses, less often – trams or metro cars • After regaining independence, new sections were built on many trolleybus networks, and several tram lines were built	• The shape of many public transport networks does not correspond to the modern transport needs of cities • High degree of depletion of rolling stock and infrastructure on most networks, especially in the eastern part of the country • In many cities, there is a shortage of funds for infrastructure investments, even of a replacement character • Not all cities purchase rolling stock in sufficient quantities; rolling stock shortages are supplemented with second-hand rolling stock from the EU and Switzerland • High energy consumption of old infrastructure and old rolling stock – increase in operating costs • Many years of underinvestment in the urban transport industry by city authorities • Unattractive price plans, promoting direct and single rides, too many people entitled to free travel • Lack of passenger information at bus stops, and often also on the Internet • Unfair competition of private carriers, often treated preferentially by city authorities • Low transport speed in relation to individual transport means and marshrutkas
Opportunities	**Threats**
• Metro systems, as well as a part of tram and trolleybus lines, create the possibility of efficient passenger transport • The possibility of using international credit programs to facilitate investments in public transport • The increase in the popularity of urban electric transport as a result of the increase of ecological awareness of residents • The use of electric traction reduces low stack emissions in cities • Increasedpossibility of using flexible price plan solutions, along with technological progress (popularity of smartphones, proximity cards, etc.)	• Lack of awareness or low awareness of the city authorities about the role of public transport in the functioning and development of a city • Growing level of motorisation, causing a natural drop in the number of public transport passengers • Low management competences, no strategy and no ideas for the development of urban electric transport • Preference for road investments as an antidote to transport problems in cities • Decreasing prestige of poor-quality urban electricity transport – in many centres it serves mainly a community function

Opportunities	Threats
• Possession of domestic rolling stock manufacturers with sufficient experience in the production of trams, trolleybuses, as well as repairs of metro cars • A new way of contracting services is introduced by separating the functions of an organiser and a carrier (billing carriers from the quantity and quality of services)	• Low quality of rolling stock and elements of national production infrastructure – limited durability of investments made • Lack of transparency in management, imperfection of public procurement procedures and conducting investments creating a high risk of corruption • Higher remuneration for drivers and mechanics in neighbouring EU states – labour migration • Obligation to compensate for the right to free travel from the city budgets limits the possibilities of investment

Source: own work.

5. SYNTHETIC INDICATOR OF CHANGES IN URBAN ELECTRIC TRANSPORT

The directions of the changes in the urban electric transport system in Ukraine were examined using a synthetic indicator illustrating the development or regression of these systems. The main problem in the construction of own indicators by authors was the limited amount of available data for 25-years research period. This indicator included a total of 9 features (three analogous features for the metro, for the tram and for the trolleybus): the network density per 1 sq. km of a city, the number of vehicles (or carriages) per 1,000 inhabitants, and the percentage of restored rolling stock in the last 6 or 7 years. In Ukrainian conditions, the tram and trolleybus only partially play a substitutive role in relation to the metro, but very often trams play a substitutive role in relation to trolleybuses and vice versa.

The basic data was collected for the following years: 1991 (year of regaining independence), 1997, 2003, 2009, and 2016. The main source of the data for tramway, trolleybus and metro was the publication of Tarkhov *et al.* (2010). Further and more recent data was completed by own calculations based on the rolling stock database available on the website of Urban Electric Transit and the calculations on the base of city maps. In the case of rolling stock, the data for 1985–1990 was also taken into account. The data for the number of inhabitants and areas of cities was taken from recourses of the State Statistics Service of Ukraine – compilation from national and regional statistics databases. An exception was made in the case of the Crimean network: the number of inhabitants and areas was included in all the cities and villages along the interurban trolleybus network, because this system combines three functions at the same time: of urban, suburban, and interurban transport.

The indicator constructed in such way was designed to assess, in a representative and comparable manner, the changes on individual networks with limited access to long-term, comparable data. The maximum, minimum and average values are presented in Table 3. There is no possibility to obtain a lot of data, for instance about finances (revenues, subsidies, financial results, etc.) or employment in individual cities or companies. The collected data – each feature separately – were subjected to standardisation, in relation to the best value occurring in the 25-year period in all analysed networks. Every feature, after standardisation, assumed a value from 0 to 1, and the value of the indicator is the sum of standardised values of features.

The theoretical value of a standardised indicator should be within the range from 0 to 9. In practice, the empirical values were significantly lower. Firstly, the metro operates only in three cities. Secondly, in the cities where tram systems are better developed, trolleybus systems are less developed and vice versa. Thirdly, with the development of the metro, changes are made to the surface route layout, which eliminates the duplication of connections, and the tram and trolleybus serve a commuting purpose to the metro. In the centres of Kyiv and Kharkiv a lot of sections of tram networks were closed down with the development of the metro network. Finally, there are networks where, in relation to the size of the city, urban electric transport already functions in a symbolic, even rudimentary manner. In the case of the number of vehicles in relation to the number of inhabitants, the second variable was also responsible for the changes in the value of the indicator. The total population in cities with urban electric transport in Ukraine decreased from 20.0 million in 1991 to 18.2 million in 2016. The exception was Kyiv and Sevastopol, where the population within the 25 years increased by 10%.

The conducted research indicated that in the years 1991–2016 the average value for all networks in Ukraine of the constructed by authors synthetic indicator decreased by half, i.e. it fell from 1.63 to 0.84 (Fig. 1). Yet the speed of regression within 25 years was uneven. Until 2003, practically all networks experienced a decrease. Later, there was a certain polarisation – some cities continued the downward trend, and some, as a result of investments, made small progress (Fig. 2).

The biggest drop in the 25 years (from 2.21 to 0.00) was experienced by Stakhanov, in which a tram and a trolleybus were liquidated in a short time. The situation in Kryvyi Rih also deteriorated considerably (decrease by 1.64). There was a slight improvement only in 4 networks – Crimean trolleybus (0.24 more), Kerch (0.21 more – new network), Bila Tserkva (0.09 more), and Kyiv (0.01 more). Kyiv is an especially interesting case , where despite large investments, an increase in the indicator was of a symbolic character.

The synthetic indicator also revealed that there were several networks threatened with decommissioning in the coming years; these were trolleybus networks: Antratsyt (0.12), Makiivka (0.20), Lysychansk (0.29), Khartsyzsk (0.35), Sloviansk (0.40), trolleybus station Horlivka (0.30), and tram station Konotop (0.38).

With the exception of Konotop, all of the above networks are located in the eastern part of Ukraine. The Crimean Peninsula should be considered a special case, as Russia considers it part of its territory. Despite the low value of the indicator of two Crimean networks – trolleybus in Kerch (0.21) and tram in Evpatoria (0.25), the political factor will play a major role and, for propaganda reasons, these networks will be adequately invested and will continue to function.

The regress of urban electric transport is not characteristic only for Ukraine, but for all former USSR republic, with the exception of the Baltic states with access to EU funds, as well as Belarus. After 25 years of economic transformation, at the end of 2016 in Russia, out of 72 tram networks, 11 were liquidated, and of 91 trolleybus networks – 11 were liquidated. In Kazakhstan, there are only 3 out of 5 tram networks, and of the 9 trolleybus – only 1 (*Atlas of Urban Electric Transport* ..., 2016, Urban Electric Transit). Successive networks are threatened by suspension and liquidation. The reasons for liquidation include, obviously: financial problems of companies, poor condition of technical infrastructure, rolling stock, etc.

Table 3. Minimum and maximum values of indicators included in the synthetic index

Indicator	Max. value City	Year*	Min. value City	Year*
Tram				
Network density [km / sq. km]	1.32 – Odessa	1997, 2003	0.07 – Yenakievo	1991
Number of vehicles per 1,000 people	1.00 – Avdiivka	1991, 1997	0.06 – Horlivka	2016
New rolling stock – the last 6–7 years (%)	51.7 – Kryvyi Rih	1985–1991	0.00 – 17 cities	2010–2016
Trolleybus				
Network density [km / sq. km]	2.60 – Lutsk	2016	0.09 – Makiivka	since 2003
Number of vehicles per 1,000 people	0.97 – Alchevsk	1991	0.04 – Antratsyt	2016
New rolling stock – the last 6–7 years (%)	59.2 – Crimean trolleybus	2010–2016	0.00 – 10 cities	2010–2016
Metro				
Network density [km / sq. km]	11.00 – Kharkiv	2016	1.93 – Dnipro	since 1997
Number of vehicles per 1,000 people	0.28 – Kyiv	2016	0.04 – Dnipro	since 1997
New rolling stock – the last 6–7 years (%)	18.9 – Kyiv	1991	0.0 – Dnipro	since 1997

* in the study, the following years were taken into account: 1991, 1997, 2003, 2009, 2016

Source: own work.

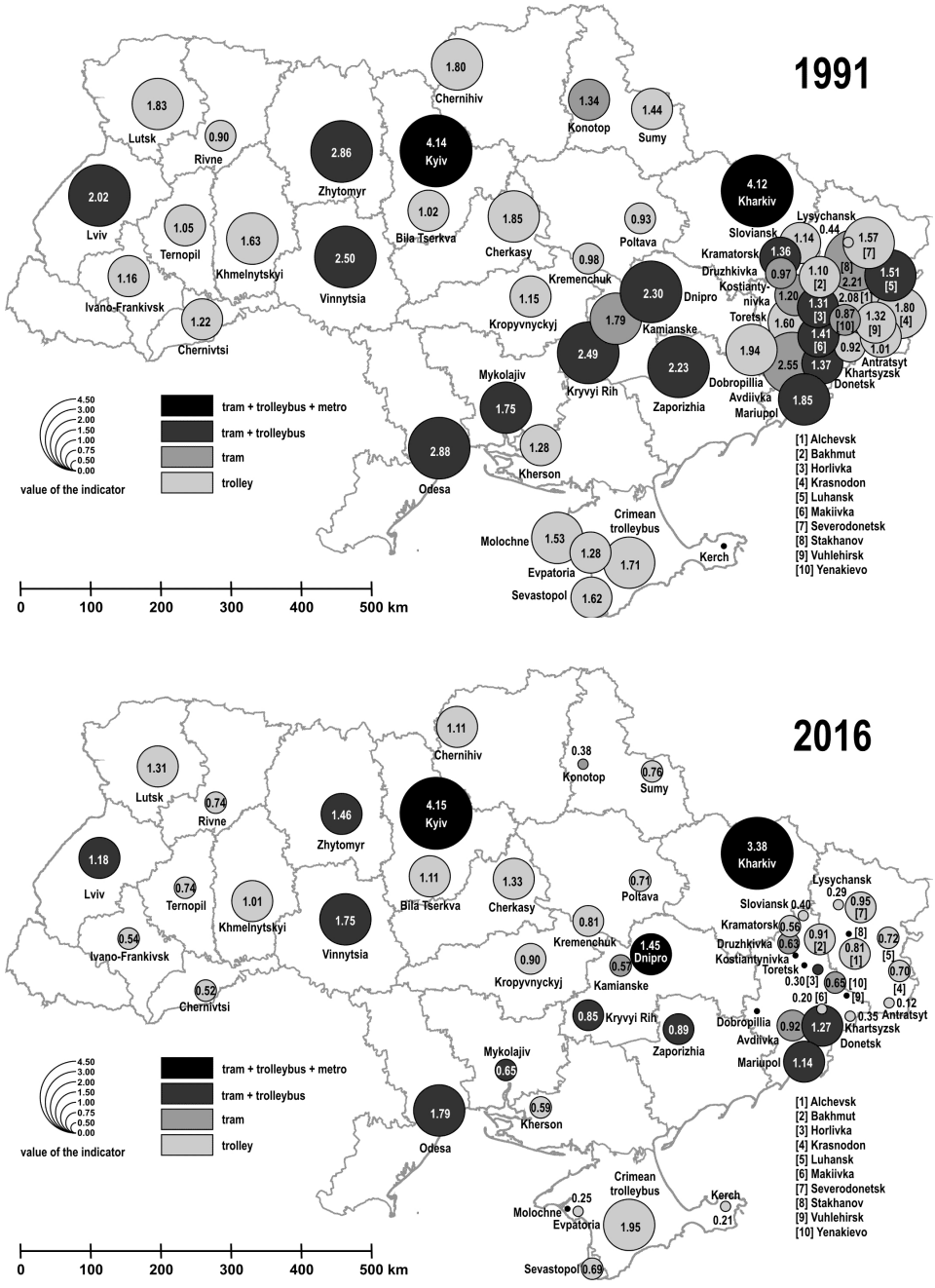

Fig. 1. Synthetic indicator of the development of urban electric transport in 1991 and 2016
Source: own work.

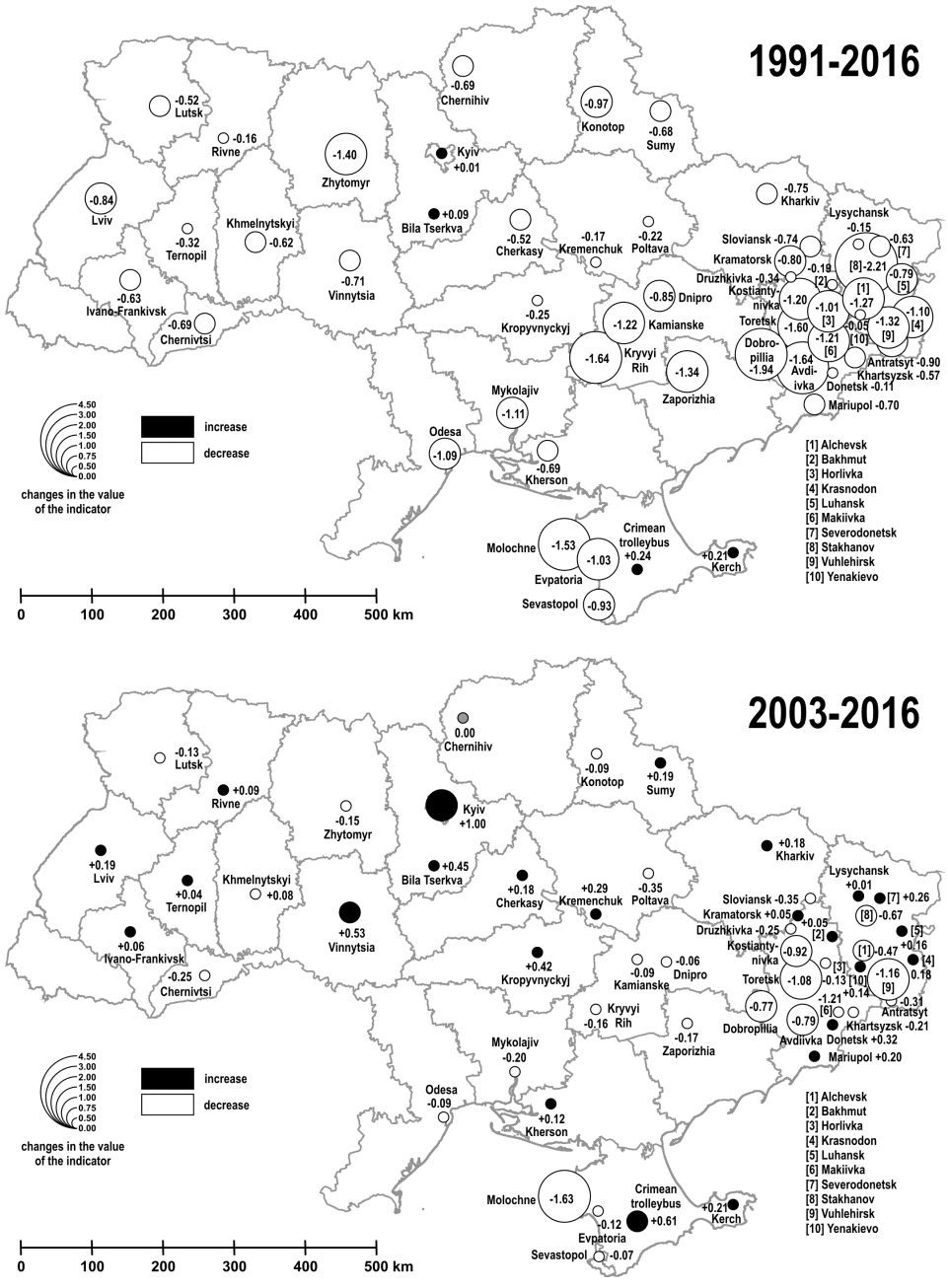

Fig. 2. Changes in the value of the synthetic indicator of the development of urban electric transport in the years 1991–2016 and in the years 2003–2016

Source: own work.

6. CONCLUSIONS

The directions of transport policy designated by key legal acts (laws, strategy) generally guarantee the citizens of Ukraine public, ecological, and sustainable public transport in accordance with the principles of its organisation in the countries of Western Europe. In this system, certainly, public transport should play an appropriate role. However, it is a theoretical system because its creators have not created the right conditions for its implementation.

The division of financial tasks between the state budget and city budgets is a classic mechanism of mutual transfer of responsibility. The basic problem is the long-term underfunding of urban transport infrastructure and companies, which translates into an increasingly difficult economic situation. It has often happened in the modern history of companies urban electric transport that employees did not receive salaries or received them only in part. Often a lot of vehicles were out of service for a long time due to the lack of financial recourses for the purchase of spare parts. At the same time, a high degree of decapitalisation, progressive regression (closing of routes, *dismantling* of infrastructure, lack of rolling stock), combined with a small share of trams and trolleybuses in urban transport, puts the future of several systems in question. Another difficult challenge is the creation of stable mechanisms of long-term financing in conditions of the unstable economic situation in Ukraine.

In the development of public transport, large state programs still play a major role. Local self-governments, except for the richest cities, are not able to finance large transport investments. Bearing in mind the imposed obligations of shaping the local transport policy, proper implementation of those tasks requires the strengthening of the financial situation of local governments. The nature of municipal electric mobility in Ukraine, based on central regulations and their local implementation, means that this process can take various forms, and the differences can be quite significant. Ensuring mobility is a condition for the development of both cities and regions. It allows the allocation of resources on the labour market, and also determines the intensity of interpersonal relations.

In 1991–2016, in the vast majority of Ukrainian cities there was a regression of urban electric transport. It was of a bipartite nature: in the first years it basically applied to all networks, later a polarisation of cities took place and the situation improved due to the investment activities undertaken on parts of the network. The general economic and political situation, in particular the difficult economic relations with Russia, and from 2014 – the separatist conflict in eastern Ukraine – had an impact on this state of affairs. It shall also be remembered that, in contrast to the countries of Central Europe and the Baltic states, Ukraine has never had access to such large financial resources to raise the level of its development.

The regression rate is not the same across the country; it is particularly visible in the eastern part of Ukraine, i.e. in the industrial area of Donbas and Krivbas. Those are particularly problematic, as their local economies are based on hard coal mining, mining and metallurgy, and other heavy industries. Many of the plants is unprofitable (Swain, 2007; The Coal Sector..., 2003), but at the same time they are often the only major local employers. Unemployment was a problem of the cities for many years. The local economy requires large financial expenditures for restructuring, much larger than the financial possibilities of the municipal and peripheral governments. All of those problems have found a global reflection in the condition of urban electric transport.

Since the beginning of the 1990s, in Ukraine, as in most of the post-socialist countries, the number of passenger cars has been systematically growing. Initially, the problems of transport congestion in cities were solved by increasing the capacity of the road system, even at the cost of trams and trolleybuses. It is only recently that car traffic restrictions in districts in city centres or payment for parking have been applied in some cities. However, urban development strategies and other analogous documents lack real elements and the instruments of sustainable development.

The uncoordinated and often ad hoc measures undertaken at various levels in the context of the assumptions of public policy are difficult to assess as a transport policy, actually oriented towards sustainable urban development and shaping sustainable transport systems. There is a clear dissonance between the provisions regarding the role of urban electric transport in the transport system, and the actions taken and the applied transport policy instruments. The authorities of Ukrainian cities, aiming to satisfy car users through road investments, and at the same time in a conflict-free way developing or maintaining urban electric transport, fall into the classic vicious circle of congestion. It is the mechanism when congestion puts strong pressure on road operators to increase their capacity. New capacity often temporarily results in a better quality of road transport. Users, through their modal choices of travelling by cars, cause more congestion and are negatively influencing on the urban transport system (Rodrigue, 2017).

The gap between the demand for transport occurring for many years on the market and the supply from urban electric transport is more or less efficiently filled by private bus carriers, servicing low-capacity rolling stock lines. Marshrutkas can be considered an area of negotiations (Vozyanov, 2018). Marshrutkas are not positively perceived by passengers due to the desire to maximize profits, unpunctuality, lack of training, improper servicing of the rolling stock, and a very low standard of travel (in rush hours, small vehicles are very overloaded). The limited availability of commercial financing in Ukraine, either as corporate debt or lease finance, to purchase new vehicles presents a significant obstacle to contracting with private operators for improved bus services (Sustainable Urban Transport for Kyiv..., 2016). Private carriers operate routes with the highest profitability, they create the wrong belief of politicians about the availability of public transport without subsidies from public funds.

Is, therefore, urban electric transport in Ukraine doomed to fail, following the model of tramlines being liquidated in Western Europe after the Second World War? Not necessarily, however, similarly to the transformation that took place in industry in highly developed countries (transitions from heavy industry to the industry of new technologies), a deep transformation of the transport system will be needed, involving the adaptation of urban electric transport systems to the modern transport needs of residents. Instead of the social assistance function for poor residents, efficiently operating urban electric transport should be an alternative to individual motorisation. However, it requires large financial outlays and general changes in the city planning concept.

Electric mobility is a global trend resulting from the search for alternatives to gradually depleting crude oil (e.g. Attias, 2017; Leal Filho and Kotter, 2015). Urban electric mobility will cover not only public communication, but various forms of energy storage and the widespread use of electric vehicles (Przybyłowski, 2018). According to the assumptions of *A European Strategy for Low-Emission Mobility* (2017), electric vehicles, used among other in the car-sharing model, integrated with intelligent power grids will in the future complement urban transport systems.

Presumably, Ukraine will soon join the group of countries in which electric mobility will gradually develop. For now, Ukraine is less developed in terms of electromobility compared to Western and Central Europe. Electric buses or hybrid trolleybuses popular in Europe are being tested only in a few cities. Spatially well-developed trolleybus networks in city centres, better knowledge in the field of exploitation of trolleybuses and lower purchase prices of trolleybuses compared to electric buses should predestine this type of transport in the development of electric public transport. Positive Czech and Polish experiences should be taken into account in the expansion of trolleybus networks based on hybrid trolleybuses.

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Andrei BEZRUCHONAK*

GEOGRAPHIC FEATURES OF ZERO-EMISSIONS URBAN MOBILITY: THE CASE OF ELECTRIC BUSES IN EUROPE AND BELARUS

Abstract. This article reviews the emerging phenomena of electric buses' deployment in Europe and Belarus within the general framework of the concept of sustainable and electric urban mobility. The author offers a brief overview of electric bus technologies available on the market and a spatial analysis of fleet deployment in Europe. The analysis of the spatial structure of the distribution of e-buses in Europe indicated that, in terms of the number of vehicles in operation, the UK and the Netherlands are the regional leaders, while in terms of the number of cities testing e-buses – Germany, Sweden, and Poland are the leaders. The analysis showed that the main factors supporting the distribution of innovative technology and public support are legislative and regulative framework as well as clear strategic planning and cooperation between local administrations and transportation authorities. Other important aspects, such as network building features, and the location of the charging infrastructure were also discussed. The analysis of the case study of Minsk (the first city to introduce electric buses in Belarus) outlined the typical limiting factors for all types of markets: high battery costs and dependency on infrastructure; recommendations are given to emphasise bus fleet replacement (instead of trolleybus) and to develop a comprehensive sustainable urban mobility strategy.
Key words: electric buses, new mobility, public transit, sustainable transportation, infrastructure, Minsk, Europe.

1. INTRODUCTION

Public transportation is considered as an integral component of everyday urban logistics routine, which meets the growing needs of citizens in private and business mobility. Over the past decades, the share of the global urban population had increased significantly, strongly affecting the way people move within and

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beyond city limits. In 1950, 30% of the world's population was urban, and, by the year 2050, it will reach 68% (UN, 2018). That trend is causing a significant increase in general mobility: by 2050 an additional 1.2 to 2 billion cars will be on the roads globally, which is double of today's global vehicles park (World Bank, 2017; C40 Group, 2017). Urbanisation and motorisation have a negative impact on the economic, social, and environmental dimensions of urban life, including (but not limited to): increased traffic congestion, air and noise pollution, freight and passenger flows, causing lack of space, and deteriorating safety and security (EC, 2007). Considering the main challenges that many urban authorities, planning agencies and stakeholders face (e.g. how to improve mobility while avoiding the problems named above), it is clear that cities must take action and look for more sustainable transport policy options and measures (REC, 2008). In recent years, the "sustainable mobility paradigm" had emerged (Banister, 2008), and many cities of developed and developing countries already joined the discourse of transition to sustainable urban mobility (C40 Cities Climate Leadership Group may be an example), which is understood as the "ability to support the need for people, cargo, and information to move around while doing minimal damage to the environment" (Rodrigue, 2017).

Transportation is considered a significant contributor to global climate change, accounting for 23–27% of total greenhouse gas (abbreviation GHG is also used in the text below) emissions (with the share of buses accounting for approximately 8%, World Bank, 2012; ZeEUS, 2017). With the expected global addition of 1.2–2 billion cars by 2050, the emissions related to the transportation sector may grow within the range between 120–230% (C40 Group, 2017).

In Europe, transportation is a major contributor to climate change and air pollution. Since 1990, carbon dioxide (CO2) emissions from European road transportation have increased by 17% (it is the only sector that has seen an increase in GHG emissions). Road transportation now accounts for roughly one-fifth of the EU's GHG emissions (Miller, 2016). Transportation is the second biggest GHG emitter in the EU (24.2% of total emissions in 2010). It receives special attention regarding the policies of emissions reduction at various spatial scales, from the EU regulations and directives to local cities' initiatives. The EU is committed to the reduction of GHG emissions, aiming at a 20% reduction (to the level of 1990) by 2020 and 80–95% reduction for all sectors combined – by 2050. The 2050 reduction target for transportation is about 60% (CIVITAS, 2013). The EU has clear objectives to increase the share of public transportation in the structure of general mobility. With the introduction of new CO_2 regulations for vehicles, European municipalities will face new challenges making cost-efficient and environmentally friendly decisions.

Reducing emissions, energy efficiency, improving air quality, and reducing noise pollution are priorities for the sustainable development of many states and cities. More than 20 EU policies, strategies, and measures provide the region-

al legislative framework for the development of cleaner public transportation in Europe. Some reflect the general vision on European urban mobility; other address noise levels, air quality, reduction of GHG and CO_2 emissions, and energy security (CIVITAS, 2013). In 2009 the Electric Vehicles Initiative (includes Germany, France, United Kingdom, Netherlands, Sweden, Norway, Finland) was established. It is a multi-governmental policy forum dedicated to accelerating the distribution of electric vehicles worldwide (IEA, 2018).

With the growth of urban population and the increase in rates of urbanisation, the adoption of sustainable mobility has become central to the processes of urban planning (Montero, 2017). Sustainable urban transportation systems will play an increasingly critical role in driving responsible climate action and reducing global emissions (C40 Group, 2017). Nowadays urban transportation is responsible for a quarter of the total CO_2 emissions from transportation in the EU (EC, 2011). It is possible to state that the political target to reduce this share correlates with the shift of public opinion towards the values of sustainable development. Under the influence of such factors as the negative consequences of motorisation, the situation at the energy markets (especially in Central and Eastern Europe), technological progress, and availability of cheaper and greener transportation modes (i.e., electric vehicles), the transformation of public transit is already happening across the region (Fig. 1).

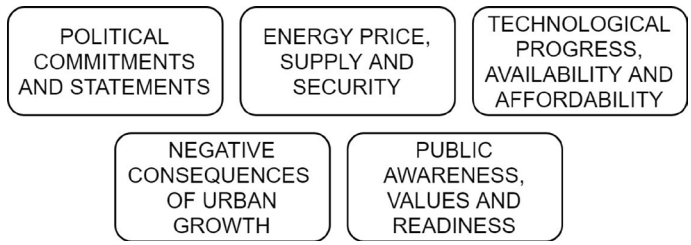

Fig. 1. Factors supporting emissions reduction in public transportation

Source: adopted from FCH JU, 2015.

At the local (urban), level cooperation between cities is trending. More than 80 cities worldwide have joined the network of C40 Cities Climate Leadership Group, focusing on tackling climate change, and initiating practices and actions that reduce the negative impacts of urban socioeconomic activities. The key approaches and strategies the cities use to reduce emissions from transportation include switching to effective modes (e.g. public transit or non-motorised transportation) and enhancing the efficiency of fleets via shifting to zero-emission technologies (C40 Group, 2017). The "Clean Bus Declaration of Intent", signed by 26 cities representing C40 Cities Climate Leadership Group and supported by 10 Latin American cities (Fig. 2), is a good example of an interregional and international

commitment to efforts. Its goal is to improve air quality by introducing low and zero emission vehicles in urban bus fleets. A geographical analysis of the spatial distribution of the signatory cities shows the leading role of Europe in promoting practices and measures to reduce the negative impact of urban transportation. 31% of C40 "Clean Bus Declaration of Intent" signatory cities are located there (Fig. 2).

Fig. 2. C40 Climate Leadership Group cities, supporting "Clean Bus Declaration of Intent", 2017
Source: own work, data obtained from C40 Cities Clean Bus Declaration of Intent, 2017.

2. THEORETICAL FRAMEWORK

Notwithstanding the fact that 40–50% of public transportation in Europe is already electrified (UITP, 2015), buses with internal combustion engines (the main pollutants) are the most economical vehicles in terms of the lowest total cost of ownership. The market price of the Belarusian diesel bus "MAZ" Model 215 is $198,166 USD. It is cheaper than the Belarusian trolleybus "Belkamunmash" Model 321 ($281,000 USD) or electric bus ($450,000 USD). They still serve as the core elements of numerous contemporary urban transportation systems (CIVITAS, 2013). In Europe, 80% of buses have diesel engines, including 50 % with Euro III or older models (ZeEUS, 2017). In less economically developed countries of Eastern Europe, those numbers are higher, especially in smaller and

peripheral regional centres. However, the shift in public awareness and environmental concerns, technological progress, and the growing affordability of cleaner bus technologies (i.e. hybrid or electric buses) change the way urban mobility stakeholders favour the low and zero-emissions transport systems. Over 40% of the operators and transportation authorities surveyed in Europe are keen to switch to electric traction options (ZeEUS, 2017).

According to the estimations and forecast of the Institute for Transportation & Development Policy, the world today is on the cusp of three revolutions in transportation: vehicle electrification, automation, and shared mobility. The scenario, considering all three trends, produces impressive global results by 2050, such as: a) reduction of global energy use from urban passenger transportation by over 70%; b) reduction of CO_2 emissions by over 80%; c) reduction of the measured costs of vehicles, infrastructure, and transportation systems operation by over 40%; and d) savings approaching $5 trillion per year (Fulton *et al.*, 2017).

Electric mobility is considered an effective mechanism of urban transportation transformation and reduction of GHG emissions (Nikitas *et al.*, 2017). Its future depends on the degree of the penetration of renewable energy sources into power systems. If the energy source mix used to produce the electricity that will supply EVs has low (or even zero) GHG emissions, the transition from conventional vehicles to electric will also lead to a reduction of emissions (Millo *et al.*, 2014). As the electric energy supply changes and moves towards electricity production from cleaner sources, the carbon content of the electricity powering electric buses will continuously decrease. This aligns with the goals set at the United Nations climate change conference in Paris (Kinsley, 2017) and in the European Union 2030 climate and energy framework (CIVITAS, 2013).

The benefits of electric mobility include a reduction of GHG emissions, health benefits through improved air quality, decreased noise pollution (like in Shenzhen, China, the first city to electrify 100% of its bus fleet, BNEF, 2018), increased energy security, and a potential for grid balancing. However, despite the potential benefits of electrification, the geographic spread of electric vehicles' deployment is limited by such factors as cost, infrastructure (charging points, grid modification), consumer education, and awareness (C40 Group, 2017). In developing countries, local governments, transportation agencies, and planners are facing enormous challenges finding consensus between receiving secure funding for infrastructure investments and delivering comfortable transit services (Hiroaki *et al.*, 2013).

The nature of the existing technologies (modern diesel buses, trolleybuses, dual modes (trolley/diesel), hybrids) and the emergence of new ones (electric buses, hydrogen fuel cells) means that there is a wide range of options that can replace the aging diesel bus fleet (GWRC, 2014). Among low-emission vehicles, *electric buses* can contribute to the future de-carbonisation of mobility. They can over-

come the existing disadvantages of conventional fossil fuel buses (Nikitas *et al.*, 2017). A rechargeable electric battery powers electric buses; there are two types of e-buses currently in use – *opportunity buses* (recharge at stopping points en-route and carry lightweight battery – thus, increasing passenger capacity) and *overnight buses* (carry heavier batteries and can operate all day without recharging). Opportunity buses depend on the charging infrastructure, and they have a limited geographical route flexibility within the existing network (usually inside city limits where the stations are available). Then, overnight buses have complete *flexibility* within the existing network; it is typical to use them on selected suburban and intercity destinations (GWRC, 2014).

E-buses produce zero direct emissions, they are relatively easy to integrate into existing infrastructure (although, additional infrastructure adjustments are usually required), and they are environmentally and customer-friendly (low-floor, CCTV surveillance, USB charging ports). However, due to expensive technology, the life-cycle costs of e-bus deployment are much higher than of diesel or hybrid buses. The price may vary from $450,000 to $1,1 million USD, excluding charging infrastructure and battery replacement costs (Mahmoud *et al.*, 2016; GWRC, 2014). Transportation planning agencies and authorities should also carefully consider the shorter battery life (especially under low temperatures) and the logistics of the disposal of aging batteries.

3. LITERATURE REVIEW AND METHODOLOGY

3.1. Literature review

This study utilizes the existing academic literature and enhances the existing discourse with a geographic perspective. Some ideas of this article interpret the concepts and methodological approaches of contemporary transportation geographers, planners, and multidisciplinary researchers towards the sustainable mobility paradigm (Banister, 2008; Montero, 2017), the general spatial aspects of urban mobility (Rodrigue, 2017), and sustainable electric mobility (Miller, 2016; Kinley, 2017). Hanson (2003) discussed emerging issues of changing transportation context of sustainable mobility, related to the costs and benefits of transportation investments, including social costs of externalities (air, noise and water pollution, death and injury from accidents, loss of open space). Hiroaki (2013) discussed the spatial aspects and limitations of the distribution of technology due to the financial constraints of sustainable transportation planning (typical for developing countries). Hopkins and Higham (2016) discussed the transition to low carbon mobility. Fernando-Sanchez and Fernandez-Heredia (2018) studied sustainable bus mobility and delivered a detailed review of 10 strategies for sustainable bus

mobility for selected cities, including New York, Memphis, Muscat, Montreal, Santiago de Chile, Bogota, Melbourne, London, Singapore, and Madrid.

The analysis of the existing literature on electric bus mobility revealed the major study directions that influenced the general research methodology of this paper. Numerous works provided a general overview of technology, market analysis, and an overview of motors and barriers for the deployment of e-buses (Fulton, 2015; Nikitas *et al.*, 2017), especially in the European Union (Borghei, 2016). Mwasilu (2014) provided an economic analysis of the infrastructure for electric buses. Some publications delivered findings based on partial spatial analysis carried out for route planning in selected European cities – Perrotta (2014) carried out an analysis of the electric bus performance on three different routes in the city of Oporto, Portugal.

A number of studies applied a geographical approach and a spatial-temporal analysis. They explain the essential infrastructural requirements, required for the electrification of the urban bus network. The research of Xulia (2017) delivered a model for the optimal placing and sizing of fast charging stations for electric vehicles in Stockholm. The study of the urban bus network in Berlin presented an advanced optimisation model for planning a fast charging infrastructure (Kunith, Mendelevitch, Goehlich, 2016). The study of Aachen (Bohnen and Louen, 2017) answered the question of how different charging locations for electric buses affect route planning and travel time for public transport, and how to modify the existing public transportation.

The study of mixed bus fleets of electric vehicles and their conventional counterparts, conducted in Porto, Portugal (Santos, 2016), discussed the general performance, peculiarities of fleet balance (i.e. how many vehicles of each type should be allocated and where), and network optimisation (i.e. energy consumption, environmental impact, overall economic impact, and service quality).

There were quite a few geographic academic works which analysed the emerging phenomena of the new forms of urban electric mobility, including electric buses. However, a study by the Polish geographers identified the main factors and mechanisms behind the development of low-emission public transport vehicles in Polish cities (based on the case studies of Jaworzno and Cracow). They included energy challenges, environmental requirements, governance strategies, and manufacturing capacities (Taczanowski, Kolos and Gwozd *et al.*, 2018).

So far, none of the Belarusian transportation geographers covered the problems of electric urban mobility and the deployment of electric buses in the urban environment, particularly in Minsk, the first city to introduce the new transportation mode. The purpose of this paper was to fill the existing gap and to analyse the spatial structure of the development and distribution of electric buses in Europe. Another goal was to study the factors that influence the spread of this emerging technology. With consideration of demographic trends and the peculiarities of socio-economic development, the results, findings, and recommendations can serve as the basis for further urban transportation development in Minsk, the capital of Belarus.

3.2. Research methodology

The logical structure of this geographical analysis and review of the peculiarities of electric buses distribution in Europe consists of the following steps: a) a general overview of the concept of sustainable electric urban mobility; b) a brief overview of electric buses technology available on the market; c) spatial analysis of the e-buses distribution in Europe; and d) case study of Minsk and the analysis of practical exploitation of electric buses.

The statistical and analytical data on the current state of electric buses market discussed in the article was collected from open access publications and reports provided by the following international agencies and institutions: International Energy Agency, ZeEUS eBus Project, C40 Cities Leadership Group, the official publications of the World Bank, UTIP, Bloomberg New Energy Finance, etc. Other relevant academic publications (see literature review), industry reports, and policy papers provided the author with a better understanding of the emerging phenomenon of bus fleet electrification.

The spatial analysis of the electric bus market applied the open data from the sources named above. The official website of the Minsk transportation agency and Yandex Transport application provided the network data on the routes of electric buses, including configuration, evolution, and stops location. The maps presented in this article were designed in ESRI ArcGIS software using a standard geographical approach towards spatial data visualisation. Measurement units of the indicators studied are provided in the standard metric system.

4. GEOGRAPHIES AND TRENDS OF THE CURRENT MARKET

Although electric buses are an emerging technology, they are improving in commercial feasibility at global markets. The value of the global electric bus market was over $37 billion USD in 2018 (BMA, 2018). The decrease in the price of components (mainly, batteries) leads to the global spread – the global stock of electric buses almost doubled in 2015–2017, from 175,000 to 385,000 vehicles. In many cities, public transit operators and authorities demonstrate commitment to fleet electrification (C40 Group, 2017). Following the pioneers, i.e. the densely populated megacities of China (with severe pollution threats), local officials across the planet have begun working onprocurement plans and tenders to support the introduction of cleaner zero-emissions electric buses for public transport services (ZeEUS, 2017).

The last decade has seen progressive and positive developments in the distribution of e-bus technology, led mainly by China, and followed by Europe and

the USA. The successful deployment of the first full battery e-buses during the Olympic Games in Beijing in 2008 (followed by the launch of a long-range (250–300 km) 12 m full-battery electric bus in 2010) opened up the e-bus market for Chinese manufacturers (ZeEUS, 2017).

Chinese e-bus manufacturers dominate the current global market in terms of vehicles sold. The e-bus industry in China is fragmented: Yutong, the biggest manufacturer, has a share of 19% of the market. The second biggest e-bus manufacturer is BYD. This company invests in electric vehicles and lithium-ion batteries manufacture, both in China and in Europe (BNEF, 2018).

In Europe, the total estimated electric bus stock reached 1,273 units in 2016 (an increase of 100% over 2015), and approximately 1,600 – in 2017. Additional 1,600 vehicles are being on order by mid-2018; since the delay between orders and deliveries is usually 9–12 months, all these electric buses are expected to be on the road by mid-2019 (Transport&Environment, 2018). The increase in European stock suggests that the European market is moving beyond the demonstration phase into commercial development, and by 2030, the share of battery-electric buses will reach 50% (ZeEUS, 2017). The United Kingdom, the Netherlands, Germany, Spain, Sweden, Poland, and Lithuania are the major European markets that order and operate fleets of electric buses (Fig. 3).

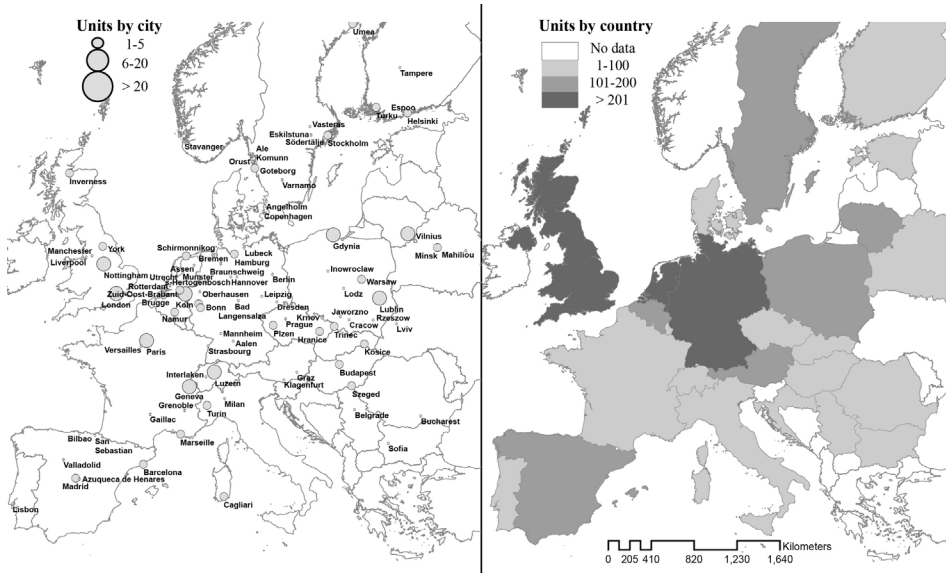

Fig. 3. Geographical distribution of electric buses in Europe, 2017
(note: transit systems with EVs operating in airports only (i.e. in Geneva or Nice) are excluded from the map)

Source: ZeEUS, 2017; Minsktrans, 2018; BNEF, 2018.

Germany (has 19% of European cities, deploying the electric buses technology), Sweden (11%), and Poland (9%) are the leaders by the total number of cities with electric buses. Vilnius, London, Nottingham, Lublin, and Eindhoven have the largest fleets of electric buses (ZeEUS, 2017).

The principal factors that support the deployment of electric buses into the existing urban transportation systems include: availability of additional funding (most of the e-buses in Europe were financed by national and regional grants), existing manufacturing base, liberal industrial policies (supporting local manufacturers), and political aim to reduce dependence on imported energy sources – particularly for the cities of Central and Eastern Europe (BNEF, 2018).

The contemporary geographical picture of the manufacturers' distribution highlights the Chinese domination – more than 98% of all electric buses sold worldwide in 2017 were manufactured in China (mostly for the domestic market). The three major Chinese bus manufacturers are Yutong, BYD, and Zhongtong (all have sold more than 20,000 vehicles in 2015–2016). The recent trend is that those companies have been actively present at the international electric bus markets. For instance, in 2018 Yutong supplied electric buses to the intercity bus company Flixbus (BMA, 2018). Nevertheless, the Chinese companies are facing strong competition in Europe with local manufacturers of electric buses. These include both incumbent bus companies (i.e. VDL, Solaris, Scania, Volvo, MAN, and Iveco) that have begun to offer electric models, and many new entrants focusing on electric buses (BNEF, 2018; IEA, 2018). By mid-2018, the following manufacturers delivered the majority of electric buses in Europe: BYD (approximately 38% of total deliveries), VDL (31%), and Solaris (21%, Transport&Environment, 2018).

5. CASE STUDY: MINSK CITY, BELARUS

In May 2017, with deployment of the first electric bus "E433 Vitovt MAX Electro" on route 59el (instead of the existing trolleybus route), the Belarusian capital, city of Minsk (2 million inhabitants), joined the list of European cities that test the new transportation mode – electric bus (Fig. 4).

The initial length of the first route, operated by four electric buses in trial mode, was 12.3 km. The daily mileage of each electric bus was about 280 km. The battery specifications defined the route selection with the necessary recharging infrastructure located at the final stops of the routes. In August 2017, with the launch of an electric bus on route 43, the network of this type of transport in the city of Minsk expanded to 19.8 kilometres. The reconstruction of the second transportation ring justified the replacement of the closed trolleybus communication with electric buses. However, according to the position of the Minsk transportation agency "Minsktrans", it makes more sense to replace the existing bus routes for

environmental reasons. In 2018, after the deployment of electric buses on route No. 1 instead of existing diesel buses, the network had grown to 29 km, and it connects the geographical, economic, and transportation city centre (main bus and railway terminals) with residential areas and sports infrastructure facilities (Minsk-Arena on route 1).

Fig. 4. Electric bus "E433 Vitovt MAX Electro" in Minsk, Belarus
Source: phot. by A. Bezruchonak.

It is worth mentioning that the city master plan, designed and approved in 2014–2016 (with projections until 2030), does not consider the development of electric buses as a new transportation mode, and has no consistent strategy for their development (Minskgrado, 2016). Nor the city has the approved sustainable urban mobility plan (SUMP), so it may seem that low-emission transport is not an important issue, according to the official documents. That may mean that the first trials were the promotion of the production of the existing manufacturer, "Belkamunmash", with the goal of marketing and selling it (mostly to Russia).

However, the analysis of the current and planned network shows that, despite the absence of electric buses in the official planning documents, the city considers them as a potential replacement of the existing conventional buses. In 2019, "Minsktrans" plans to trial e-buses on additional seven bus routes, aiming to unload the

passenger traffic from the city's major arteries (*avenues*) or to feed them (Fig. 5). That partly corresponds with the development strategy of conventional buses and trolleybuses, presented in the masterplan (Minskgrado, 2016).

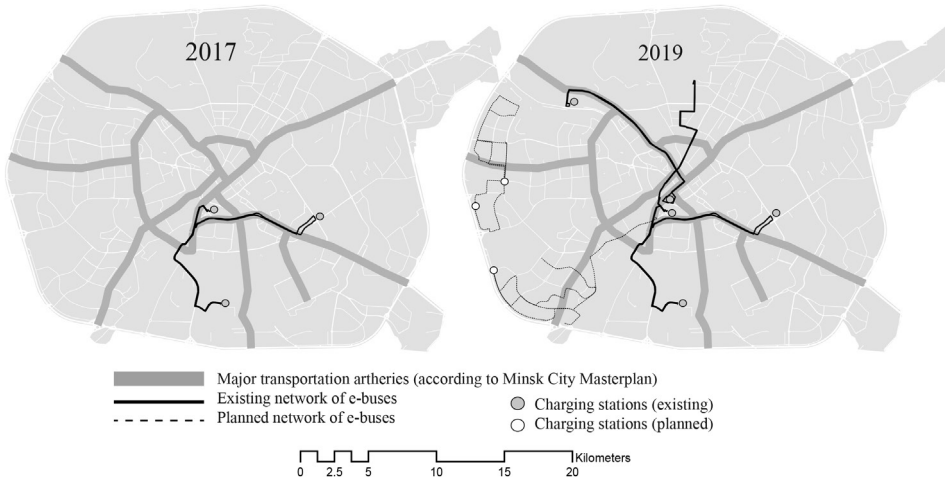

Fig. 5. The evolution of electric buses network in Minsk, 2017–2018

Source: own work.

The total number of electric buses operating in Minsk in 2018 was 20. However, according to the plan, this number will increase to 80 in mid-2019, with 60 electric buses purchased for the Second European Games by June 2019 (BMA, 2018). It is logical to assume that the extended network will reach the venues of the European Games. It is a vivid case of a top-down approach in transportation planning when political will of the senior governing authorities (i.e. the Minsk City administration) is a factor which defines the implementation rate of new strategies and steps in urban transportation development.

It is worth noticing that Belarusian-manufacturing Company "Belkamunmash" (that manufactures electric buses) holds a considerable amount of share in Eastern Europe and is planning to establish a factory in Georgia to meet the increasing demand from Eastern Europe and the Middle East (BMA, 2018). However, the company, targeting mostly regional post-Soviet non-EU markets, endures strong competition from Chinese and EU companies.

The design of e-buses, based on the existing trolleybuses models due to practical reasons, facilitates the registration of technical documentation and permits for deployment. There are four models offered on the market, with the most popular models – E420 and E433 (12.7 m and 18 m respectively). Both versions have 160 kW engines, made of composite materials and equipped with climate control, vid-

eo surveillance and USB charging systems (BKM, 2017). The technical specifications of Belarusian electric buses differ slightly from their foreign counterparts: the length of E420 model is 12.7 m (according to ZeEUS project estimations, 73% of all electric buses in Europe have that length), E433 model is 18 m long (as are 15% of all electric buses in Europe). The battery range of electric buses is enough for 12–16 km (it takes 5–7 minutes to charge the installed Chinese supercapacitor); although, it is significantly less than what is offered by foreign counterparts (the first electric buses deployed in China had the range of 250 km, ZeEUS, 2017).

6. DISCUSSION

This study explained some theoretical and practical aspects of electric bus deployment in Europe, including a brief analysis of the usage in the city of Minsk, Belarus. It demonstrated that the concept of sustainable electric urban mobility is trending among researchers (Fernando-Sanchez, Fernandez-Heredia, 2018), experts (Transport&Environment, 2018), urban officials (C40 Group, 2017), manufacturers (BKM, 2017), and transit companies.

Despite the advantages and benefits of electric mobility, outlined in the theoretical part of this article (Miller, 2016; Kinley, 2017), there are several barriers preventing the growth of vehicle units on the streets of European cities nowadays. The cost of a battery (still accounts for approximately 50% of the total e-bus cost) is still a limiting factor for the distribution of e-buses, not every city administration (especially in developing countries) can afford a fleet replacement (Hiroaki, 2013). Battery capacity and weight have a direct impact on the carrying capacity and the final cost of electric buses. On the one hand, electric buses are still several times more expensive for transit companies in terms of cost of ownership. However, on the other, the picture significantly changes if one calculates and includes the external costs. The calculation of health costs from air pollution and noise, which cause premature death, respiratory diseases, loss of productivity, and other negative impacts, shows that electric buses prove a cheaper option (Transport&Environment, 2018).

Electric buses have no direct emissions, but it is necessary to be careful with the selection of electricity sources. They can be considered as an environmentally friendly alternative to diesel buses only using energy from a clean and renewable source (Miller, 2016). There are several controversial issues regarding power sources for the electric buses of Minsk. Firstly, environmental activists wonder if the popularisation of electric mobility in Belarus is related to the ongoing construction of Ostrovets nuclear power plant (NPP) that can potentially supply electricity into the grid systems. Despite the positive environmental image of electric

buses, one can hardly consider nuclear energy as a clean and environmentally friendly power source, especially after the disaster at the Chernobyl NPP. The second issue is about practical implications of electric buses in Minsk – unlike in the majority of models in the EU, the heating system during winter is working on diesel fuel (banned or planned to be banned in several European countries, like Germany or Norway), a conventional GHG pollutant.

In addition, the estimations show that the increase of battery capacity will significantly increase the weight of the vehicle, reduce energy efficiency and raise the final cost of the product (the current price of the electric bus starts from $450,000 USD, MUP, 2017). Electric buses in Minsk use supercapacitors from a Chinese manufacturer, with a 10-year life cycle (or about 100,000 charge-discharge cycles). That is not enough for the sustainable and self-sufficient financial performance of the transportation agency. Further research should evaluate the long-term economic effects of electric bus deployment in European cities (including Minsk). In Cracow, the deployment of the electric buses is still an experiment, and the city council with transit agency have a careful approach to the replacement of conventional buses (Taczanowski *et al.*, 2018). However, according to the estimations of the Minsk transportation agency, the operation of electric buses on routes 59 and 43 resulted in electricity savings (14% in comparison to the trolleybus usage) and network operational costs savings – the cost of 1 km of the network operation was 3.8% lower (MUP, 2017).

It is important to understand the spatial constraints of the infrastructure: the location of charging stations determines the geography of networks and the network-building features. For instance, the original feature of electric buses in Minsk was, unlike in many European cities (Fulton, 2015; Santos, 2016, Nikitas *et al.*, 2017), the incorporation into the existing trolleybus network and replacement of one environmentally friendly mode of transportation with another. The Minsk transportation agency should use the commonly applied network-building feature, i.e. to develop the network by integrating the zero-emission vehicles into the fleet of conventional buses, like in Porto, Portugal (Santos, 2016). It is necessary to consider the costs of replacing one expensive transportation infrastructure (i.e., the existing trolleybus contact network) with another (charging stations for e-buses).

The distribution of the charging infrastructure is also an important aspect when it comes to transit operations, as the charging of electric buses cannot affect the passengers during the provision of transportation services, so additional schedule planning is required. Regular charging of the opportunity buses can lead to traffic delays. Moreover, the noise from charging stations may cause inconvenience to passengers and residents of the nearby neighbourhoods (actual observation from the trials in Minsk). However, various concepts need to be adapted and reviewed individually for every city. Many factors may affect the decision-making process, such as the type of the battery, urban design, secured funding, and political com-

mitment. The existance of the network infrastructure before the installation of a charging station is an advantage, and each integration of electric bus infrastructure should be verified, like in Aachen (Bohnen and Louen, 2017).

An effective regulation, a clear sustainable urban mobility plan (SUMP), and political support are important factors for the successful deployment of electric buses in a city. Several cities around the world have set clear goals for fleet electrification within the framework of urban transportation planning strategies: Montreal (have plans for 100% electric bus fleet by 2020), Madrid (40%), London, etc. (Fernando-Sanchez and Fernandez-Heredia, 2018). The case of the Polish city of Jaworzno proves the point that the city with clear goals and targets towards low-emission transportation becomes attractive in terms of the implementation of complex investment programs and public perception. According to local data, the share of inhabitants who use public transportation has grown over the trials, and municipal electric buses are perceived more often as an attractive alternative to a private car (Taczanowski, 2018).

The development of SUMP, with clear priorities set for low-emission vehicles and their popularisation among local residents, is recommended for the practical application in Minsk. That will increase the share of the population using public transit (in 2016, a significant percentage of Minsk residents – 59% – used public transportation to commute to work; 39% used it for general mobility (ODB, 2017)). The actions to promote electric buses among citizens may include an introduction of comfortable ticketing systems, a popularisation of the advantages of e-bus usage, and the installation of additional features (wi-fi, USB charging ports, bike racks, etc.). However, it is unclear if people are ready to pay more for cleaner transportation services. The field research proved that electric buses are quieter than their diesel equivalents – that also forms a positive image of the new technology in terms of creating a healthy urban soundscape.

7. CONCLUSIONS

Policymakers and city administrations consider the electrification of public transportation fleet and the reduction of greenhouse gas emissions as steps towards ensuring a healthy environment for the population. Electric mobility, and, in particular, the deployment of electric buses, is internationally recognised as an emerging technology, with strong attractive points and limitations. In recent years, numerous European cities have decided to incorporate electric buses into the existing public transit systems supporting the new technology. More cities have plans to initiate the replacement of diesel fleets with electric buses in the nearest future (ZeEUS, 2017).

The spatial distribution of cities, supporting e-buses, is defined by the consensus between authorities, planners, manufacturers, and citizens. It is typical that central cities (i.e., London, Paris, Madrid, Warsaw, Cracow, or Minsk) take a more cautious approach towards fleet replacements, due to higher costs of deployment. Yet smaller cities demonstrate fast and progressive dynamics (i.e. it is easier to design SUMP or to replace a smaller bus fleet). Polish and European cities with open public transportation systems and a strong position of the municipal transit agencies have favourable conditions for the introduction of electric buses. Then again, urban mobility in the cities with strong vertical planning systems (typical for post-Soviet countries) depends on the political will of the authorities and may ignore international environmental commitments.

The institutional environment together with the regulatory framework plays a dominant role in the development of electric bus systems. The EU 2019 low carbon economy strategy (anticipating the last diesel bus to be sold by 2030) is a good illustration of an international commitment towards the decarbonisation of economic development. The German court ban on diesel vehicles, the commitment of Dutch provinces to zero-emission buses, the zero-emission bus regulation of California – all serve as a good precedents to legislative controls and bans at regional levels.

Despite the fact that e-buses will likely remain expensive for at least one more decade, the general technology cost decline will support the geographical expansion of the promising technology. Altogether, with appropriate regulation improvements, that may have a synergetic effect and positively promote the global expansion of electric buses and low-emission public transit.

The analysis of the e-bus market indicates the leading position of China (manufacturing 99% of vehicles, mostly for the domestic market), followed by the EU and the US. In the EU, the spatial patterns of electric buses deployment have no equal distribution over the Member States: such countries as the UK, Germany, the Netherlands, and Poland have the largest fleets. They are the main markets with the most advanced and progressive practices and policies promoting distribution of electric buses. The projected increase in orders will have a positive impact on the development of the European bus manufacturing market (with BYD, VDL, and Solaris to be the largest manufacturers of electric buses).

Belarus is also trying to find its niche on the e-bus market, and "Belkamunmash" holds a considerable amount of share in Eastern Europe. The trials of e-buses in Minsk and the existing trends of the fleet and network growth show that the effectiveness of e-buses is still a matter of further detailed research and evaluation, but the available data shows that they can be more efficient in comparison to the existing public transit options. Though, at the international markets, the company will encounter heavy competition against the Chinese and European e-bus manufacturers. That will define the potential geography of sales in non-EU markets – Russia, Ukraine, and Moldova.

Finally, despite the fact that the deployment of electric bus vehicles and integration into urban transportation systems should be carefully analysed and evaluated individually for each city, it is vitally important to accept and understand the following: a successful electrification of public buses may not only improve urban life (by reducing air and noise pollution and providing better customer experience) but can serve as a role model for other cities and transportation companies.

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PART II

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INTER-PROVINCIAL MIGRATION IN ITALY: A COMPARISON BETWEEN ITALIANS AND FOREIGNERS

Abstract. Internal migration in Italy increased in the 2000s due to foreigners residing in the country. Foreigners have changed the characteristics of Italy's internal migration. Extended gravity models were run to highlight the differences between the migratory behaviours of Italians and foreigners. The model was implemented to detect the different effects of the Italian and foreign populations, and the distances between the provinces of origin and destinations of the inter-provincial migration of Italians and foreigners. Estimations obtained for the years 1995, 2000, 2005, 2010, and 2015 highlight the different evolutions of the phenomenon.
Key words: Internal migration; foreign population; gravity model; Italy.

1. INTRODUCTION

The analysis of internal migration is an important field of study and allows us to understand the mechanisms underlying territorial differences (Adey, 2009; De Santis, 2010a; Rees *et al.*, 2017; Kulu *et al.*, 2018). Internal migration is an es-

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sential component in the process of population redistribution (Long, 1985; Rees *et al.*, 2017), especially in countries such as Italy where the natural dynamics is very limited (Bonifazi, 1999).

From the 1950s to the early 1970s internal migration was an important factor in the remarkable redistribution of the Italian population (Golini, 1974; Bonaguidi, 1985; Livi Bacci *et al.*, 1996; Mencarini, 1999). From the 1980s to the early 1990s Italy changed from an emigration to an immigration country (Natale and Strozza, 1997; Bonifazi, 1998, 2007, 2013; Pugliese, 2006; Strozza and De Santis, 2017). Since the second half of the 1990s, internal migration has been on the increase and, as a consequence, the interest in this topic has arisen (Piras and Melis, 2007; Golini and Reynaud, 2010; Bonifazi *et al.*, 2012; Lamonica and Zagaglia, 2013; Colucci and Gallo, 2014, 2015, 2016).

The recent internal migration trend has been considerably affected by the increasing presence of foreign citizens, given their greater propensity to move within the country, and structural factors such as a greater incidence of foreigners within younger age groups (Casacchia *et al.*, 2010a; de Filippo and Strozza, 2011; Impicciatore and Strozza, 2016b).

International studies regarding the internal migration of foreigners, and specifically ethnic minorities, were developed at the end of 1990s, in both the United States (Kritz and Nogle, 1994; Frey, 1995; Alba and Nee, 1997) and Europe (Peach, 1996; Kritz and Gurak, 2001). Some studies investigated the relationship between the internal migration of foreigners and the internal migration of natives. The results of these studies show that the presence of large foreign communities can be both a trigger for out-migration for natives and a barrier to in-migration (White and Hunter, 1993; Frey, 1995; Kritz and Gurak, 2001).

It is thus important to verify and possibly quantify how the size of the Italian and foreign populations in the provinces of origin and destination affects the inter-provincial migratory flows of both Italians and foreigners. This can have potential policy implications. The push or pull role of some geographical areas could be useful to policymakers when adopting public policies aimed at increasing the attractiveness of an area, or at least the ability to retain the population of disadvantaged areas.

The main aim of this paper is to contribute to a better understanding of internal migration patterns during high-level periods of foreign immigration. We will study the changes in residence among the Italian provinces from 1995 to 2015 in order to identify the effects of the presence of foreigners[1] on internal migration. Italy is an

[1] A *foreigner* is any person who is not an Italian citizen, including stateless people. Italian citizenship is based upon the principle of *ius sanguinis*, meaning that the word '*foreigner*' also includes those who are not immigrants (because they were born in Italy) but whose parents both have foreign citizenships. At the same time, the word '*Italian*' also includes those who have immigrated from abroad but have acquired Italian citizenship by naturalization, marriage or other means according to national legislation (ISTAT, 2012).

extremely significant case since it became one of the main European destinations for international migration during this period (Sobotka, 2009; Strozza, 2010).

There are two main research questions. Firstly, we want to evaluate the importance of Italian and foreign populations for the internal migration of foreigners. When focusing on foreigners, we aim to evaluate in particular whether the changes in residence between provinces are linked to a process of spatial assimilation or to the attractiveness of migration networks. In the former case, the role of the Italian resident population is likely to be more relevant, with foreigners relocating to areas with better amenities and becoming closer to the territorial distribution of natives (Wright *et al.*, 2005). In the latter, the main emphasis lies on the role of the social network, where foreigners tend to move mainly to places where the presence of foreign communities is already significant (Massey, 1988; Finney and Simpson, 2008). In the second research question, we focus on the internal migration of Italians and its connection to foreign populations. The literature in the U.S. has paid attention to the relationship between internal migration and immigration from abroad (e.g. Frey, 1996; Card, 2001; Borjas, 2006; Ellis, 2012). Some evidence shows that nationals tend to move from areas that are destinations for foreigners (White and Hunter, 1993; Van Ham and Feijten, 2008). In Europe, empirical evidence is more limited. In Italy, Brücker *et al.* (2011) found a relevant relationship between foreign immigration and the interregional migration of nationals. We want to verify possible relationships between Italian flows and foreign populations.

We apply the gravity model in order to answer both research questions, where the dependent variable is the inter-provincial migratory flow of Italians and foreigners and the explanatory variables are the populations of origin and the populations of destination (as masses) and the distance between the place of origin and destination (Andersson, 2012; Beine *et al.*, 2015; Poot *et al.*, 2016). In comparison with previous studies reported in the literature, we also consider the role of the Italian and foreign masses (the populations in the origin and destination provinces) with regard to the internal migration of both Italians and foreigners. We consider socio-economic variables to inset the regional development of origin and destination provinces in the model. We include the unemployment rate and the percentage of highly educated adults as explanatory variables to account for socio-economic conditions. These can play a role in the increase or decrease of migratory flows (Biagi *et al.*, 2011; Piras, 2012; Wajdi *et al.*, 2017). We consider two dummy variables to account for geographical conditions (Lewer and Van de Berg, 2008). These restore the cross-sectional independence of the residuals (Bertoli and Moraga, 2015).

Focusing on the first research question, we assume that the effects of these explanatory variables might be connected to the attractiveness of ethnic and migration networks or, conversely, to a process of spatial assimilation. With regard to the second question, we consider the effects of foreign populations on Italian internal migration through the use of different masses. A unique simultaneous model

for Italians and foreigners is specified, allowing us to assess the significance and level of differential effects. This gravity model allows us to contribute to the international debate on the demographic and geographical factors driving the internal migration of nationals and foreigners.

The paper is organised as follows. Section 2 narrows down the review to focus on the main studies on internal migration in Italy, the main explicative theories on internal migration of natives and immigrants, and the literature regarding the gravity model. Section 3 introduces the aggregate data and the gravity model in its basic and implemented formulation. Section 4 presents the descriptive results, and we discuss the results of the traditional gravity model and its extended version proposed in this article. The final section outlines the main achievements and traces the lines of possible future research developments.

2. THEORETICAL BACKGROUND AND EMPIRICAL REFERENCES

In Italy, internal migration has been the subject of many demographic, economic and social studies (for a review, see Golini, 1974; Mencarini, 1996; Bonifazi, 1999; Etzo, 2008; Reynaud and Tucci, 2014; Piras, 2017). With the growth of foreign immigration in Italy, recent studies have mainly focused on the contribution of foreigners to internal migration (Casacchia *et al.*, 2010a; De Santis, 2010b; Mocetti and Porello, 2010; Brücker *et al.*, 2011; de Filippo and Strozza, 2011; Bonifazi, 2013; Impicciatore and Strozza, 2016b). In relative terms, these studies show that foreigners register a higher level of migration than Italians. This is due to factors such as different social and demographic features: foreign populations are mainly young working adults, being the people more likely to move (de Filippo and Strozza, 2011; Recaño-Valverde and de Miguel-Luken, 2012; Bonifazi *et al.*, 2014). Foreign citizens have also already experienced migration and, therefore, it may be easier for them to migrate again (de Filippo and Strozza, 2011; Impicciatore and Strozza, 2016a).

Considerable attention has been paid in international research to the study of the internal migration of immigrants and to the differences between natives and immigrants (or nationals and non-nationals, majority and minority groups). The main theories on the causes and effects of the internal migration of immigrants are linked to the literature of North American countries, and, more generally, non-European destination countries (Kritz and Nogle, 1994; Frey, 1995; Alba and Nee, 1997). More recently, this issue has been addressed in European countries (Peach, 1996; Kritz and Gurak, 2001; Finney and Catney, 2012). "Ethnic minority and immigrant internal migration is another emerging field of academic interest in many countries, partly as a result of increased political interest in interethnic relations and place-based politics" (Finney and Catney, 2012, pp. 30–31).

The empirical interrelationship between internal migration and the residential distribution of immigrants is the basis of the *spatial assimilation theory* (SAT) (Gordon, 1964; Massey, 1985). According to this theory, the early settlement of immigrants from abroad was generally in large urban cities or areas where their national or ethnic groups were more concentrated (ethnic concentration). Afterwards, immigrants tend to be distributed in a more similar pattern to that of the natives. They leave their areas of first arrival and relocate within the host country through internal migration (Gordon, 1964; Massey, 1985). Geographical migration is a result of the socio-economic upward mobility of immigrants who, through the assimilation process, gain knowledge and are more tied to the host country and the native population. Conversely, this leads to a reduction in ties with the community of origin, less segregation and a convergence of the settlement model of immigrants and natives.

We can hypothesise that the *migration network theory* (MNT) is an alternative to the SAT. "Migrant networks are sets of interpersonal ties that link migrants, former migrants and non-migrants in origin and destination areas through the bonds of kinship, friendship and shared origin of community" (Massey, 1988, p. 396). Networks enable immigrants to accumulate social capital, facilitate the acquisition and the distribution of information, and the availability of ethnic goods and services, and reduce the costs of migration and the risk of discrimination in labour markets. This could, therefore, guide the internal migration of immigrants (Finney and Simpson, 2008). The populations of origin and destination have been considered as explanatory variables in the migratory flows of nationals and non-nationals: they have a direct effect because "the presence of existing communities reduces the costs associated with the migration process" (Recaño-Valverde and de Miguel Luken, 2012).

The *white-flight theory* (WFT) originated from the idea that once the proportion of non-whites exceeds the limits of the neighbourhood's tolerance for interracial living, white people move out (Grodzins, 1958). Some authors have tried to discover whether immigrant communities produce a more substantial barrier effect or even force natives to leave (White and Hunter, 1993; Frey, 1995; Kritz and Gurak, 2001). Some authors have shown a direct relationship between immigration flows and internal out-flows (demographic balkanisation): nationals tend to move from areas that are destination flows for foreigners (White and Hunter, 1993; Van Ham and Feijten, 2008).

There is little research on internal migration in Italy with the aim of verifying the theories described above. We therefore cannot say whether the internal migration of foreigners is more closely linked to and/or depends more on a process of adaptation to the reception reality or if, vice versa, it follows other factors such as network migration. Furthermore, some studies have emphasised the link between international immigration and internal migration through historical reconstructions (Pugliese, 2006). It has also been shown that "the immigration of foreigners

can affect the internal migration of natives in Italy" (Brücker *et al.*, 2011). There is little or no evidence regarding the link between internal migration and different populations.

At the aggregate level, the analysis of migration can be conducted by drawing upon the *gravity model*, taking into account both the origin and destination perspectives. This model is based on Newton's gravitational law. The underlying idea is that the flows between two areas are directly proportional to the masses of the two areas and inversely proportional to the distance between the two. This model was widely applied in the empirical analyses of goods and service flows, particularly within the field of international trade (e.g. Fotheringham and O'Kelly, 1989; Sargento Marto, 2007; Metulini *et al.*, 2018). The gravity model has become common in migration research (Ramos, 2016), being applied in the case of both internal (for an overview, see Foot and Milne, 1984; Flowerdew, 2004; Beine *et al.*, 2015; Poot *et al.*, 2016; Wajdi *et al.*, 2017) and international migration analysis (Kim and Cohen, 2010; Ramos, 2016).

Many issues arise when comparing the internal migration of foreigners and nationals. The propensity to migrate is usually higher for foreigners than for nationals (Finney and Catney, 2012; Silvestre and Reher, 2014). Moreover, the negative effect of distance on internal migration is noted as relevant. With regards to migration distance, the results are controversial: in some countries, such as Germany, foreigners tend to move less than nationals over long distances (Şaka, 2012; Vidal and Windzio, 2012); in other countries, such as Sweden, foreigners always have a higher propensity to move regardless of the distance (Andersson, 2012). In Anglo-Saxon countries, studies suggest that distance has a different effect on the mobility of immigrant communities (Gurak and Kritz, 2000; Finney and Simpson, 2008; Belanger and Rogers, 2009; Lichter and Johnson, 2009).

The gravity model was applied in Italy using different approaches and territorial units, which makes it difficult to compare the results obtained. In particular, recent applications have focused on the study of internal migration between regions[2] (Mocetti and Porello, 2010; Brücker *et al.*, 2011; Etzo, 2011; Lamonica and Zagaglia, 2013; Piras, 2017) or between geographical areas defined on an ad hoc basis (Casacchia and Tagliarini, 2000; Casacchia *et al.*, 2010b). Previous applications of the gravity model demonstrated that the negative effect of distance on migration was stronger for foreigners than Italians (Casacchia *et al.*, 2010b; Lamonica and Zagaglia, 2011). The different importance of distance in the inter-provincial migration between the two groups could be another issue to be evaluated.

[2] At the beginning of 2015, the 20 Italian regions had, on average, about 3,000,000 residents and an area of 15,000 square metres. The demographic dimension of the regions is very different (from the minimum of about 300,000 residents in Molise to 10 million residents in Lombardy).

3. DATA AND METHODS

3.1. Statistical data

Statistics on migratory flows in Italy are based on changes in residence among municipalities. This administrative data source briefly highlights the main aspects, quantity, and characteristics of migratory flows. The individual administrative forms are collected by means of a rolling registration at municipality level and report on both the origin and destination of the migratory flows and whether a person moves within the national territory (from one Italian municipality to another), or to/from abroad. Changes in residence data includes information about the main socio-demographic characteristics of migrants, such as citizenship, place and date of birth, gender, marital status, and educational attainment. The main limitation of this source is that only the legal resident population is included, since non-EU citizens, by law, must provide a residence permit to be included in the population registers[3].

The choice of geographical scale to be used is also important, as it may affect the results. Italy is now divided into five major socio-economic regions, NUTS (Nomenclature of Territorial Units for Statistics) 1: North-West, North-East, Centre, South, and Islands. In the following descriptive analysis, the five major socio-economic regions can be reduced to three by aggregating North-East with North-West as 'North' and South with Islands as 'South'. This results in three major regions North, Centre, and South (hereafter called macro geographical areas), 20 regions (NUTS 2), 110 provinces (NUTS 3), and more than 8,000 municipalities. In this paper, we consider the changes in residence among Italian provinces (inter-provincial migration). The importance of provinces at the geographical and administrative level is the best geographic scale to analyse the internal migration in Italy. This territorial grid allows us to obtain a sufficient amount of migratory flows between the territorial units, which are necessary to achieve robust results and to reduce the number of intra-area flows, intentionally neglected by the model. In 2007, the number of provinces increased from 103 to 110. However we continued to use 103 provinces in our study, even though the analysis considers the period from 1995 to 2015[4]. It was therefore necessary to have data for each year (1995, 2000, 2005, 2010 and 2015) on the changes in residence by province of origin and destination and by citizenship (to compare Italian and foreign citizens), so that we have 103 provinces x 103 provinces = 10,609 x 2 (Italians and foreigners) = 21,218 values,

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[3] Before 2007 this rule applied to all foreign citizens including those with passports of other EU countries.

[4] The 103 provinces have different characteristics, especially with regards to geographical surface area (from 212 square kilometres in Trieste to almost 7,400 square kilometres in Bolzano), number of municipalities (from 6 municipalities in the province of Trieste to 315 municipalities in the province of Turin) and population size (from less than 100,000 in Isernia to more than 4 million in Rome).

from which the 103 x 2 = 206 values concerning intra-provincial migration were excluded (21,012 rows used). The decision to exclude movements within the same provinces resulted from the hypothesis that short-distance movements are mainly caused by the formation and dissolution of families and for housing/residential reasons (e.g. Biagi *et al.*, 2011; Niedomysl, 2011; Bonifazi, 2013).

3.2. Analytic strategy

Firstly, a descriptive analysis was carried out per province. We estimated the in-migration and out-migration rates (number of changes of residence over the average amount of reference resident population) separately for Italians and foreigners. A gravity model was then applied. The model considered the migratory flows as directly proportional to the product of the masses (represented by the origin and destination resident populations) and inversely proportional to the distance (or to a function of the distance) between the place of origin and the place of destination. The population of the origin area represents the pool of potential migrants: the more an area is populated, the bigger the volume of migration from the area will be (Kim and Cohen, 2010). Instead, the population in the destination area may be a proxy for the attraction of potential migrants (Greenwood, 1997). A larger population provides more economic opportunities since the labour market is larger (Etzo, 2011) and consequently a larger population attracts more migrants (Lewer and Van den Berg, 2008). Migration was considered a direct function of the size of the origin and destination population and an inverse function of the distance (van der Gaag *et al.*, 2003). The sizes of populations act as a push factor and the distance as a pull factor for migration flows (Flores *et al.*, 2013). The distance is certainly a difficult variable to evaluate. A greater distance between the place of origin and the place of destination generates a smaller number of migratory flows. This is also due to difficulties in maintaining links with the territory of origin when the distance is great. It represents a synthesis of many aspects, including the cost of territorial movements. This component includes, for example, relocation costs linked to transport, and the psychological costs faced when leaving one's own environment and when adapting to a completely new one. In several cases, the best synthesis is expressed by travel time (Poot *et al.*, 2016). In other cases, significant differences between the criteria used do not emerge (Poulain and Van Goethem, 1980; Garcia *et al.*, 2015).

The classic formula of the gravity model is the following:

$$f_{ij} = \alpha \frac{P_i^{\beta_1} \cdot P_j^{\beta_2}}{d_{ij}^{\beta_3}}$$

where i is the area of origin and j is the area of destination, f_{ij} is the migratory flow between i and j, P_i and P_j are the respective population sizes, and d_{ij} is the distance

between *i* and *j*. In our model, the flows correspond to the number of the changes in residence from province *i* to province *j*, P_i is the size of the total resident population in the province of origin (origin population), P_j is the size of the total resident population in the province of destination (destination population), d_{ij} is the distance between the two provinces. We calculated the distance between the provincial geographical barycentre, defined as the province's geographical centre, adopting the triangular definitions of distance.

Considering the natural logarithm of both parts of the equation, the model may be estimated via a linear regression using the ordinary least squares method (OLS), although the log-linearisation of the gravity model leads to inconsistent and biased estimates in the presence of heteroscedasticity (Congdon, 1992; Metulini *et al.*, 2018). Since the numbers of migrants are integer values that cannot ever be negative, a Poisson-type specification of the gravity model can be used (Flores *et al.*, 2013)[5]. Poisson pseudo-maximum likelihood (PPML) is an estimation method for gravity models belonging to generalised linear models using quasi-Poisson distribution and a log-link (Santos-Silva and Tenreyro, 2011). This is appropriate even when the conditional variance is far from being proportional to the conditional mean. The function PPML was tested for cross-sectional data. Several studies of trade have since then applied the PPML estimator (Metulini *et al.*, 2018). The assumption here is that migration flows f_{ij} have a Poisson distribution with a conditional mean F_{ij}, which is linked to the independent variables through a logarithmic transformation. The model is:

$$\ln f_{ij} = \beta_0 + \beta_1 \ln P_i + \beta_2 \ln P_j - \beta_3 \ln d_{ij}$$

where $\beta_0 = \ln(\alpha)$.

According to international literature (Biagi *et al.*, 2011; Piras, 2012; Wajdi *et al.*, 2017), we must include two other variables in the model to control for the socio-economic conditions of origin and destination provinces. We consider the unemployment rate (U_i and U_j) as a proxy of the economic situation[6] and the percentage of highly educated 25-64 adults (E_i and E_j) as a proxy of human capital. The first variable refers to one year before the year of analysis, the second to the nearest population census. There is empirical evidence that unemployment rates and human capital are the main determinants of migration flows across Italian regions (Piras, 2012; Fratesi and Percoco, 2014). The coefficient for the unem-

[5] A list of problems linked to the log-linearization of the gravity model can be found in Wajdi *et al.* (2017).

[6] This variable is used as a measure of the local development for origin and destination provinces. The gross domestic product (GDP) and other assimilated measures are not available at this geographical level for all the years considered.

ployment rate at the province of origin is expected to have a positive effect on out-flow and a negative effect on in-flow in the same province. The coefficient for the percentage of highly educated adults in the provinces of origin are expected to be positive, as is that of the destination provinces. There are various explanations in subject literature to support these assumptions; one of the most relevant is the following: highly educated potential migrants generally have a higher propensity to migrate from origin provinces. A high level of education is associated with a greater demand for educated persons and, consequently, for higher in-flows (Wajdi *et al.*, 2017).

The cross-sectional independence of observations is required by the PPML estimator and it can be achieved with the inclusion of dummy variables. The inclusion of dummies suffices to restore the cross-sectional independence of the residuals (Bertoli and Moraga, 2015). A way of extending the basic gravity model is thus to add dummy variables to control geographical condition (Lewer and Van de Berg, 2008). We added two dummy variables to each considered model. One such variable was contiguity among provinces ($cont_{ij}$) representing a common border between provinces ($cont_{ij}$=1 if there is contiguity and $cont_{ij}$=0 if not). The second variable is the same major region (sr_{ij}), which is a dummy variable equal to 1 for pairs of provinces belonging to the same macro geographical areas (North, Centre, and South) and 0 otherwise. We included the contiguity dummy in our model because people are likely to move to neighbouring provinces (Lewer and Van den Berg, 2008; van Lottum and Marks, 2012; Flores *et al.*, 2013). The provinces that share a border should record significantly higher flows than provinces without a common border, as clearly noted in many studies (e.g. Van Lottum and Marks, 2012; Flores *et al.*, 2013; Gómez-Herrera, 2013; Bertoli and Moraga, 2015). Thanks to the "historical" social economic gap among macro geographical areas, internal migration has principally been characterised by a pattern of South-North migration. Even if this pattern is changing, strong differences among macro geographical areas persist. We consider a dummy variable representing the same macro geographical area of origin and destination provinces to control the importance of flows among macro geographical areas. We expect the coefficient of this variable to be negative for provinces belonging to the same macro geographical areas, according to the importance of the inter-macro geographical area migration in Italy.

Therefore, the model becomes:

$$\ln F_{ij} = \beta_0 + \beta_1 \ln P_i + \beta_2 \ln P_j - \beta_3 \ln d_{ij} + \beta_4 \ln U_i + \beta_5 \ln U_j + \\ + \beta_6 \ln E_i + \beta_7 \ln E_j + \beta_8 \ln cont_{ij} + \beta_9 \ln sr_{ij} \qquad [1]$$

The model was then modified in order to consider the migratory flows of Italians and foreigners in a unique model by using a dummy variable (Italians/foreigners).

Towards this aim, we introduced a third dummy variable λ set at 0 when citizenship (z) is equal to Italian (I), and set at 1 when z is equal to foreigners (F).

Therefore the model is:

$$\begin{aligned}\ln F_{ij}^{z} &= \beta_0 + \beta_1 \ln P_i + \beta_2 \ln P_j - \beta_3 \ln d_{ij} + \beta_4 \ln U_i + \beta_5 \ln U_j + \\ &+\beta_6 \ln E_i + \beta_7 \ln E_j + \beta_8 \ln cont_{ij} + \beta_9 \ln sr_{ij} + \\ &+\lambda^{z}(\Delta\beta_0 + \Delta\beta_1 \ln P_i + \Delta\beta_2 \ln P_j - \Delta\beta_3 \ln d_{ij} + \Delta\beta_4 \ln U_i + \Delta\beta_5 \ln U_j + \\ &+\Delta\beta_6 \ln E_i + \Delta\beta_7 \ln E_j + \Delta\beta_8 \ln cont_{ij} + \Delta\beta_9 \ln sr_{ij})\end{aligned} \quad [2]$$

Consequently, when the flow relates to Italians (z=I), the model becomes:

$$\begin{aligned}\ln F_{ij}^{I} &= \beta_0 + \beta_1 \ln P_i + \beta_2 \ln P_j - \beta_3 \ln d_{ij} + \beta_4 \ln U_i + \beta_5 \ln U_j + \\ &+\beta_6 \ln E_i + \beta_7 \ln E_j + \beta_8 \ln cont_{ij} + \beta_9 \ln sr_{ij}\end{aligned} \quad [2a]$$

When the flow relates to foreigners (z=F), the dummy variable (λ) is equal to 1 and the model can be therefore expressed as:

$$\begin{aligned}\ln F_{ij}^{F} &= (\beta_0 + \Delta\beta_0^{F}) + (\beta_1 + \Delta\beta_1^{F}) \ln P_i + (\beta_2 + \Delta\beta_2^{F}) \ln P_j - (\beta_3 + \Delta\beta_3^{F}) \ln d_{ij} + \\ &+(\beta_4 + \Delta\beta_4^{F}) \ln U_i + (\beta_5 + \Delta\beta_5^{F}) \ln U_j + (\beta_6 + \Delta\beta_6^{F}) \ln E_i + (\beta_7 + \Delta\beta_7^{F}) \ln E_j + \\ &+(\beta_8 + \Delta\beta_8^{F}) \ln cont_{ij} + (\beta_9 + \Delta\beta_9^{F}) \ln sr_{ij}\end{aligned} \quad [2b]$$

With this modification, we obtained a simultaneous and comparable estimation of the effects of population size, distance, and dummy variables on the migratory flows of Italians and foreigners.

A different version of the model can be expressed by considering not only the total population in the place of origin and destination, but also the populations of both Italians and foreigners as explanatory variables. This model takes into account the cross effect of the foreign population on the migratory flows of Italians and, vice versa, by using a unique model. The idea is to include both Italian and foreign populations in the model as explanatory variables, hypothesising that the Italian population has a stronger effect on the migratory flows of Italians and the foreign population on the migratory flows of foreigners.

If we consider the four populations (Italian population P^{I}_{i} in the province of origin, foreign population in the province of origin P^{F}_{i}, Italian population in the province of destination P^{I}_{j}, and foreign population in the province of destination P^{F}_{j}), the model becomes:

$$\begin{aligned}\ln F_{ij}^{z} &= \beta_0 + \beta_1 \ln P_i^I + \beta_2 \ln P_j^I + \beta_3 \ln P_i^F + \beta_4 \ln P_j^F - \beta_5 \ln d_{ij} + \\ &+\beta_6 \ln U_i + \beta_7 \ln U_j + \beta_8 \ln E_i + \beta_9 \ln E_j + \beta_{10} \ln cont_{ij} + \beta_{11} \ln sr_{ij} + \\ &+\lambda^z (\Delta\beta_0 + \Delta\beta_1 \ln P_i^I + \Delta\beta_2 \ln P_j^I + \Delta\beta_3 \ln P_i^F + \Delta\beta_4 \ln P_j^F - \Delta\beta_5 \ln d_{ij} + \\ &+\Delta\beta_6 \ln U_i + \Delta\beta_7 \ln U_j + \Delta\beta_8 \ln E_i + \Delta\beta_9 \ln E_j + \Delta\beta_{10} \ln cont_{ij} + \Delta\beta_{11} \ln sr_{ij})\end{aligned} \quad [3]$$

Therefore, when the flow relates to Italians, the model becomes:

$$\begin{aligned}\ln F_{ij}^{I} &= \beta_0 + \beta_1 \ln P_i^I + \beta_2 \ln P_j^I + \beta_3 \ln P_i^F + \beta_4 \ln P_j^F - \beta_5 \ln d_{ij} + \\ &+\beta_6 \ln U_i + \beta_7 \ln U_j + \beta_8 \ln E_i + \beta_9 \ln E_j + \beta_{10} \ln cont_{ij} + \beta_{11} \ln sr_{ij}\end{aligned} \quad [3a]$$

When the flow relates to foreigners, the dummy (λ) is equal to one and the model can be expressed as:

$$\begin{aligned}\ln F_{ij}^{F} &= (\beta_0 + \Delta\beta_0^F) + (\beta_1 + \Delta\beta_1^F) \ln P_i^I + (\beta_2 + \Delta\beta_2^F) \ln P_j^I + \\ &+(\beta_3 + \Delta\beta_3^F) \ln P_i^F + (\beta_4 + \Delta\beta_4^F) \ln P_j^F - (\beta_5 + \Delta\beta_5^F) \ln d_{ij} + \\ &+(\beta_6 + \Delta\beta_6^F) \ln U_i + (\beta_7 + \Delta\beta_7^F) \ln U_j + (\beta_8 + \Delta\beta_8^F) \ln E_i + \\ &+(\beta_9 + \Delta\beta_9^F) \ln E_j + (\beta_{10} + \Delta\beta_{10}^F) \ln cont_{ij} + (\beta_{11} + \Delta\beta_{11}^F) \ln sr_{ij}\end{aligned} \quad [3b]$$

The Akaike Information Criterion (AIC) (Flores *et al.*, 2013) and the residual deviance (Flowerdew and Aitkin, 1982) are reported for evaluating the fitness of regression models for each estimated model.

4. INTERNAL MIGRATION: APPLICATION OF THE GRAVITY MODEL

4.1 Descriptive results

In the 1990s, after a phase of stagnation, internal migration in Italy recorded an upturn. In absolute values, the internal flows shifted from 1.11 million in 1995 to 1.56 in 2012[7] with a total increase of 456,000 units (Table 1). This increase was mainly due to the foreign population: there were 41,000 changes in residence of foreign citizens in 1995 and 279,000 in 2012. The role of foreigners in internal

[7] The peak recorded for 2012 was due to a modification in the mechanism used for the registration of changes in residency between municipalities.

migration became more relevant over these years (from 4% in 1995 to 18% in 2012), as it did in Spain over the same period (Recaño-Valverde and de Miguel Luken, 2012). Afterwards, the changes of residence decreased to 1.28 million in 2015. The contribution of foreigners remained relevant at the same level (18%). Only in 2015 did this contribution decrease slightly (Table 1).

Table 1. Changes of residence by citizenship and type of migration. Absolute values (thousands) and percentages over total number of changes, Italy, 1995–2015

	Italian (a)			Foreign (b)			All citizenships: (a)+(b)		
Year	Total	Between provinces		Total	Between provinces		Total	Between provinces	
		a.v.	%		a.v.	%		a.v.	%
1995	1,069	422	39.5	41	19	45.7	1,110	441	39.7
1996	1,052	424	40.3	44	20	45.5	1,096	444	40.5
1997	1,099	436	39.7	54	25	45.5	1,153	461	40.0
1998	1,131	451	39.8	69	33	47.2	1,200	484	40.3
1999	1,145	461	40.3	74	33	45.2	1,219	494	40.5
2000	1,184	484	40.9	88	40	45.8	1,272	524	41.2
2001	1,040	426	40.9	93	43	45.9	1,133	469	41.4
2002	1,115	452	40.5	109	47	43.3	1,224	499	40.8
2003	1,101	439	39.8	115	48	41.8	1,216	487	40.0
2004	1,149	448	39.0	162	63	39.1	1,311	511	39.0
2005	1,136	442	38.8	185	69	37.3	1,321	511	38.6
2006	1,164	452	38.8	204	78	38.4	1,368	530	38.7
2007	1,176	451	38.4	204	76	37.3	1,380	527	38.2
2008	1,176	453	38.6	213	79	37.0	1,389	532	38.3
2009	1,098	425	38.8	215	81	37.5	1,313	506	38.5
2010	1,120	442	39.5	225	87	38.6	1,345	529	39.3
2011	1,120	438	39.1	238	94	39.6	1,358	533	39.2
2012	1,277	505	39.5	279	113	40.6	1,556	618	39.7
2013	1,113	443	39.8	249	101	40.4	1,362	544	39.9
2014	1,074	424	39.5	239	97	40.4	1,313	521	39.7
2015	1,082	424	39.2	202	85	42.1	1,284	509	39.7

Source: based on Istat data.

Our analysis excluded movements within the province, although they represent the majority of the changes in residence (about 60%). From now on, we

will consider only the migration between Italian provinces (inter-provincial migration). Focusing on the internal migration of Italians only, the number of the changes in residence among provinces accounted for 39% of the total number of the changes in residence (Table 1). There was a constant increase in the number of the changes in residence for foreigners between Italian provinces, but the share of the total changes in residence dropped from 46% in 1995 to less than 39% in the period 2005–2011. The absolute number of the changes in residence among provinces has decreased since 2013 (Table 1).

Between 1995 and 2015, interprovincial in-migration and out-migration rates were always (with only one exception) under 10 per a thousand residents for Italians, and between 15 and 50 per a thousand for foreigners. This is consistent with the results reported in literature, in which the internal migration rates of foreigners were higher than the rates of Italians. The interprovincial in-migration and out-migration rates of both populations registered a constant increase in the period between 1995 and 2000, and a sharp drop in the period between 2000 and 2015 (Fig. 1).

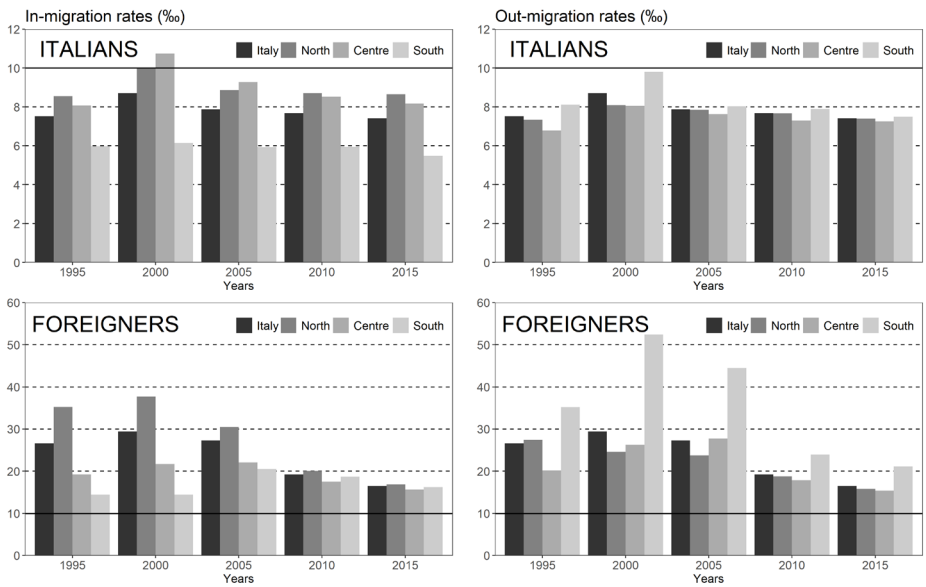

Fig. 1. Inter-provincial in-migration and out-migration rates (per a thousand of resident population) by citizenship and geographical division, Italy, 1995, 2000, 2005, 2010, and 2015

Source: based on Istat data.

Focusing only on the internal migration of Italians, Figure 1 shows a clear dichotomy between the Centre-North and the South of Italy for all the years considered: the North and Centre of Italy reported the highest level of in-migra-

tion, while the South had the highest rates of out-migration. In general, foreigners followed the same migration patterns but with a different level of intensity (Fig. 1).

4.2. Model with the total populations

The aim of our analysis is to explain the different internal migration behaviour of the resident population according to citizenship. To this end, we chose to analyse the internal migration of foreigners and Italians using a unique model so the coefficients can be compared. As discussed in Section 3, the model hypothesises that the origin and destination populations have a positive effect on the sizes of migratory flows. The model also hypothesises that the distance between provinces has a negative effect on the sizes of migratory flows. An intuitive assumption is that the negative effect of distance is smaller for foreigners, since they are less tied to the territory of origin and are more likely to travel longer distances as they have already experienced international migration. Foreigners should record a lower value for the coefficients of geographical variables than Italians, for the same reasons as just mentioned. The expected coefficients for the two socio-economic variables (the unemployment rate and the percentage of highly educated adults) should have the sign found in literature and presented in Section 3. This is positive for the unemployment rate in the province of origin and negative for that in the province of destination; the coefficients concerning the percentage of highly educated adults are positive for both origin and destination provinces.

The results of the model confirmed our hypothesis about the role of explanatory variables: the total populations have a positive coefficient and, therefore, a direct effect, while the negative coefficient of distance reveals the inverse effect between the number of migrants and the distance. The coefficient of unemployment rates in the province of origin is, as expected, always positive for Italians; for foreigners, this has not been true for the last two years (2010 and 2015). This could be explained by the situation in the labour market during the economic crisis, since foreigners are probably employed in the irregular economy more than they have been in the past. The coefficient of the unemployment rate in the province of destination is always negative but it was not significant for Italians in 2010 due to the economic crisis and consequently the generalised increase in unemployment. Human capital has the hypothesised effects over time for both Italians and foreigners. The pull effect of this variable is more important than the push one, above all for Italians. The coefficients of geographical dummy variables show the expected sign even if their effects are smaller in the case of foreign migration within the same major region (Table 2).

Table 2. Parameter estimates of Poisson pseudo-maximum likelihood (PPML): equation [2]. Coefficient of independent variables on the inter-provincial migratory flows of Italians and foreigners, Italy, 1995, 2000, 2005, 2010, and 2015

Parameters (variable) / Year	1995	2000	2005	2010	2015
β_0 (constant)	-22.59***	-25.20***	-24.71***	-24.83***	-25.49***
β_1 (size of the total population in origin P_i)	0.93***	0.98***	0.97***	0.94***	0.90***
β_2 (size of the total population in destination P_j)	0.78***	0.84***	0.82***	0.88***	0.90***
β_3 (Distance d_{ij})	-0.37***	-0.34***	-0.42***	-0.45***	-0.49***
β_4 (unemployment rate in origin U_i)	0.50***	0.40***	0.37***	0.45***	0.52***
β_5 (unemployment rate in destination U_j)	-0.14***	-0.21***	-0.15***	-0.01 n.s.	-0.11***
β_6 (percentage of highly educated adults in origin E_i)	0.55***	0.15***	0.50***	0.19***	0.49***
β_7 (percentage of highly educated adults in destination E_j)	0.86***	1.49***	1.21***	1.27***	1.21***
β_8 (Contiguity $cont_{ij}$)	1.82***	1.77***	1.75***	1.72***	1.66***
β_9 (same major region sr_{ij})	-0.07***	-0.12***	-0.14***	-0.15***	-0.12***
Differential effect of foreigners					
$\Delta\beta^F_0$ (constant)	-0.92***	2.02***	5.41***	1.69***	2.82***
$\Delta\beta^F_1$ (size of the total population in origin P_i)	-0.05***	-0.07***	-0.05***	-0.11***	-0.05***
$\Delta\beta^F_2$ (size of the total population in destination P_j)	0.12***	-0.05***	-0.08***	-0.08***	-0.03***
$\Delta\beta^F_3$ (Distance d_{ij})	-0.26***	-0.24***	-0.27***	-0.34***	-0.30***
$\Delta\beta^F_4$ (unemployment rate in origin U_i)	-0.41***	-0.04***	-0.27***	-0.66***	-0.57***
$\Delta\beta^F_5$ (unemployment rate in destination U_j)	-0.88***	-0.86***	-0.86***	-0.45***	-0.33***
$\Delta\beta^F_6$ (percentage of highly educated adults in origin E_i)	0.12*	0.58***	0.28***	0.64***	0.13**
$\Delta\beta^F_7$ (percentage of highly educated adults in destination E_j)	0.21***	-0.53***	-0.84***	0.17***	-0.01 n.s.
$\Delta\beta^F_8$ (Contiguity $cont_{ij}$)	-0.72***	-0.52***	-0.41***	-0.47***	-0.50***
$\Delta\beta^F_9$ (same major region sr_{ij})	0.04*	0.03*	0.04***	0.07***	0.004 n.s.
Number of observation	440,938	524,434	510,604	529,162	509,339
Residual deviance of null model (21,011 degree of freedom)	1,730,597	1,941,526	1,814,960	1,784,543	1,695,411
Residual deviation of model (21,000 degree of freedom)	251,147	305,595	289,381	277,134	234,908
AIC of null model	1,785,617	2,003,236	1,881,236	1,853,494	1,764,196
AIC of model	306,205	367,344	355,696	346,124	303,372

Significant codes: * at 0.1 level, ** at 0.01 level, *** at 0.001, n.s. not significant.

Source: our work based on Istat data.

It is interesting to note that, for the migratory flows of Italians, the effect of the total origin population (β_1) has droped off over time from 2000, while the effect of the total destination population (β_2) has increased (except in 2005), probably due to the introduction of more complex patterns of relationships and migration.

The most interesting result is that the populations of origin and destination have a similar effect on the migratory flows of Italians and foreigners, given that the parameters $\Delta\beta^F_1$ and $\Delta\beta^F_2$ are close to zero but significant. We also noted that, in time, the population masses (in the provinces of origin and destination) for foreigners have a smaller effect than those for Italians (except in 1995 in the province of destination). For example, in 2015, the coefficient of the total population in the province of origin was equal to 0.90 for Italians and 0.85 (which is 0.90-0.05) for foreigners, while the coefficient of total population in the province of destination was equal to 0.90 for Italians and 0.87 (which is 0.90-0.03) for foreigners (Table 2).

Then, the parameter $\Delta\beta^F_3$ (which expresses the differential effect that should be added to β_3 to quantify the effects of the distance on the migratory flows of foreigners) is negative and highly significant (Table 2). This suggests that the negative effect of distance is stronger for foreigners, in contrast to the hypothesis that the distance counts more for Italians since foreigners are less tied to the place of origin. The contiguity has a significant positive effect for migratory flow as pointed out in literature, in particular for Italians. The same area has a negative effect on Italian flows, demonstrating that, *ceteris paribus*, the migratory flows between two geographical areas are more numerous than those within the same major region. That is not true for those of foreigners.

4.3. Model with different populations

A debatable point in the last model is that the overall resident population is considered an explanatory variable. In reality, the Italian and foreign resident populations, and not just the total population, might have different effects on Italian and foreign internal migrations. It is thus possible to hypothesise that the populations with the greatest influence on the flow of foreigners are the foreign populations themselves. The size of the foreign population could also be a proxy of the economic situation of the provinces. In this case, a large number of foreigners (which we hypothesised is greater in the wealthier and most dynamic provinces in the country) should have a negative effect on Italian emigration and a positive effect on Italian immigration. The model with different populations provides a more accurate explanation of the role played by the masses, having distinguished between the populations in Italians and foreigners.

With regard to the migratory flows of Italians, the Italian population in the province of origin always plays the strongest migratory role, even though its effect decreased in the previous year (Table 3). It is interesting to note that the

foreign population in the province of destination has a direct and statistically significant impact on the size of the Italian flows. Then again, the foreign population in the province of origin has a slight negative effect on the Italian internal migration: in the period analysed (except 2000), the larger the foreign population in the province of origin was, the lower the impetus for Italians to out-migrate appeared. That was probably due to the higher presence of foreigners in areas with better economic conditions and job opportunities, since foreigners tend to settle in the most dynamic areas of the country (Cangiano and Strozza, 2005; Bonifazi and Marini, 2010). In other words, the large foreign population appears to be an indirect sign of the economic dynamism of a territory. The effects of socioeconomic variables are similar to those of the previous model (see Table 2), even if the effects of the unemployment rate in the province of destination are very small. The percentage of highly educated adults has a less important pull effect than estimated in the previous model. Conversely, the coefficient related to a high level of education in the province of origin is higher in the latter model for the last two years (2010 and 2015). The effects of geographical variables between the provinces of origin and destination were confirmed as in the previous model.

Table 3. Parameter estimates of Poisson pseudo-maximum likelihood (PPML): equation [3]. Coefficient of independent variables on the inter-provincial migratory flows of Italians and foreigners, Italy, 1995, 2000, 2005, 2010 and 2015

Parameters (variable)	Years				
	1995	2000	2005	2010	2015
β_0 (constant)	-20.68***	-21.69***	-23.69***	-24.48***	-24.58***
β_1 (size of the Italian population in origin P^I_i)	0.94***	0.99***	1.01***	1.06***	0.96***
β_2 (size of the Italian population in destination P^I_j)	0.57***	0.46***	0.61***	0.68***	0.66***
β_3 (size of the foreign population in origin P^F_i)	-0.01*	0.01*	-0.03***	-0.12***	-0.05***
β_4 (size of the foreign population in destination P^F_j)	0.19***	0.32***	0.19***	0.19***	0.23***
β_5 (Distance d_{ij})	-0.38***	-0.34***	-0.41***	-0.46***	-0.49***
β_6 (unemployment rate in origin U_i)	0.50***	0.40***	0.32***	0.30***	0.43***
β_7 (unemployment rate in destination U_j)	-0.04***	-0.02***	-0.02***	-0.12***	-0.02***
β_8 (percentage of highly educated adults in origin E_i)	0.57***	0.14***	0.52***	0.45***	0.60***
β_9 (percentage of highly educated adults in destination E_j)	0.53***	0.99***	1.05***	1.03***	1.00***
β_{10} (contiguity $cont_{ij}$)	1.82***	1.78***	1.76***	1.72***	1.67***
β_{11} (same major region sr_{ij})	-0.06***	-0.08***	-0.13***	-0.14***	-0.12***

Parameters (variable)	Years				
	1995	2000	2005	2010	2015
Differential effect of foreigners					
$\Delta\beta^F_0$ (constant)	9.01***	12.33***	11.26***	9.31***	8.61***
$\Delta\beta^F_1$ (size of the Italian population in origin P^I_i)	-0.57***	-0.82***	-0.66***	-0.81***	-0.67***
$\Delta\beta^F_2$ (size of the Italian population in destination P^I_j)	-0.40***	-0.49***	-0.76***	-0.49***	-0.49***
$\Delta\beta^F_3$ (size of the foreign population in origin P^F_i)	0.46***	0.64***	0.56***	0.66***	0.59***
$\Delta\beta^F_4$ (size of the foreign population in destination P^F_j)	0.44***	0.37***	0.61***	0.38***	0.44***
$\Delta\beta^F_5$ (Distance d_{ij})	-0.27***	-0.21***	-0.22***	-0.26***	-0.22***
$\Delta\beta^F_6$ (unemployment rate in origin U_i)	-0.12***	0.33***	0.33***	-0.02 n.s.	-0.07***
$\Delta\beta^F_7$ (unemployment rate in destination U_j)	-0.64***	-0.68***	-0.34***	-0.08***	0.04**
$\Delta\beta^F_8$ (percentage of highly educated adults in origin E_i)	-0.75***	-0.48***	-0.19***	-0.41***	-0.61***
$\Delta\beta^F_9$ (percentage of highly educated adults in destination E_j)	-0.48***	-0.92***	-1.15***	-0.37***	-0.53***
$\Delta\beta^F_{10}$ (Contiguity $cont_{ij}$)	-0.73***	-0.48***	-0.36***	-0.39***	-0.42***
$\Delta\beta^F_{11}$ (same major region sr_{ij})	0.06**	0.07***	0.10***	0.11***	0.06***
Number of observation	440,938	524,434	510,604	529,162	509,339
Residual deviance of null model (21.011 degree of freedom)	1,730,597	1,941,526	1,814,960	1,784,543	1,695,411
Residual deviance of model (21.000 degree of freedom)	247,961	296,698	282,699	269,704	229,658
AIC of null model	1,785,617	2,003,236	1,881,236	1,853,494	1,764,196
AIC of model	303,026	358,454	349,021	338,701	298,490

Significant codes: * at 0.1 level ** at 0.01 level *** at 0.001 level

Source: our work based on Istat data.

With regard to foreign internal migration, the size of the Italian population in the destination provinces had a negative impact in 2000 and 2005, revealing a preference for provinces with a smaller Italian population. In fact, foreigners move from provinces with a larger demographic size (attractive for international immigrants), to smaller provinces, probably because of the more accessible housing market. We can note that this coefficient became positive in 2010 (0.68–0.49=0.19) and in 2015 (0.66-0.49=0.17), probably due to the stronger effects of the economic crisis in those provinces. This appears to be in line with the fact that

the internal migration of foreigners is more flexible and more affected by changes in job opportunities and economic conditions. Conversely, the effect of the Italian population in the province of origin on the internal migration of foreigners is always positive, while the differential effect for foreigners is negative; for example, in 2015, the coefficient of the Italian population in the province of origin was equal to 0.96 for Italians and 0.29 (which is 0.96-0.67) for foreigners. The effect of the Italian population in the province of origin on the internal migration of foreigners is thus significantly lower than the same effect on the internal migration of Italians.

The estimated parameters of the foreign population, in both origin and destination provinces, are always positive and crucial to explain the inter-provincial migratory flows of foreigners. The effect of the foreign population in the province of destination is stronger than that in the province of origin. That reminded us of the possible roles played by social capital and migratory networks in directing internal transfers among the members of an immigrant community (Kritz and Nogle, 1994; Gurak and Kritz, 2000). This seems to be more significant than socio-economic conditions, because the effects of this kind of variable are less important in this model than their effects in the previous model (compare the results in Table 2 and Table 3).

Lastly, this model confirms that the negative effect of the distance is stronger among foreigners than among Italians. In fact, the coefficients of the differential effect of the distance for foreigners are negative and they add to the already negative effect of the Italian coefficients: for example, in 2015 this was -0.49 for Italians and -0.71 for foreigners (which was -0.49-0.22). While the effects of two geographical dummy variables for foreigners were lower than for Italians, confirming that they had weak ties to territory.

In conclusion, the Italian populations in both the origin and destination provinces and the contiguity show the main associations for the internal migration of Italians. With regard to foreigners, the foreign population in the province of destination, the Italian population in the province of origin, the distance, and the contiguity between origin and destination provinces have the main associations.

5. CONCLUSION

Using a modified extended version of the gravity model, we aimed to evaluate the importance of demographic and geographic variables for the inter-provincial migration of Italians and foreigners. The article focuses on two distinct research questions: first, we wanted to evaluate whether the inter-provincial migration of foreigners follows a process of spatial assimilation or whether it is driven by the

attractiveness of the migration networks; secondly, we wanted to examine whether or not the inter-provincial migration of Italians is affected by the foreign population.

The analysis of the inter-provincial migratory flows by citizenship has confirmed significant differences in the push and pull variables affecting the intensity of Italian and foreign internal migrations. As expected, the greater the size of the Italian resident population in the provinces of origin, the higher the dimension of migratory outflow, for both Italians and foreigners. The differences between the effects of this explanatory variable between Italians and foreigners do not change significantly over time. The attractive force of the Italian resident population in the provinces of destination has a direct effect on the internal migration of Italians and it is more relevant for the flows of Italian citizenship. Conversely, the size of the Italian population in the province of destination had a negative effect on the migration of foreigners in 2000 and 2005. The latter effect on the migration of foreigners could be read against the theory of spatial assimilation. In other words, if one takes into account the fact that foreigners have always been concentrated in the provinces with the highest demographic dimension, the negative value of the effect could be interpreted as an indicator of an ongoing process of geographical redistribution. However, this is not in opposition to the hypothesis of the importance of the migration network. In fact, the internal migration of foreigners is mainly affected by the number of foreigners in destination areas. This result appears to be congruent with the ethnic concentration hypothesis and in line with the following considerations. This effect changed in the last two years considered, when it assumed a similar level to that observed in the first year considered (1995). With regard to foreign flows, the attractiveness of the foreign population in the destination province is even stronger than the push effect of the Italian population in the origin province, suggesting the probable importance of migratory networks as among the attractive factors. One possible explanation is the role played by ethnic networks, however, our data did not allow us to test that.

Finally, the size of the foreign population in the place of origin has a different effect on internal migration by citizenship. As expected, it has a positive association with the migratory flows of foreigners: the greater the foreign population, the higher the outflow. On the other hand, it has the opposite effect on Italian internal migration. In fact, Italian citizens are reluctant to leave provinces with a high presence of foreigners. In other words, according to the inter-provincial migratory flows, the results of the quantitative analysis do not show any evidence of white-flight theory (WFT) in Italy. It should, however, be stressed that migration between provinces, excluding aspects such as the dichotomy between city central areas and suburban neighbourhoods, might not be completely appropriate for testing this hypothesis. The inclusion of some socio-economic explanatory variables into the model does not affect the results. Therefore, the presence of foreigners cannot be seen as a proxy variable for the economic conditions and job opportunities of an area. That result is in contrast with what has been shown in

other countries (e.g. the Netherlands), where, on the contrary, a direct relationship between the presence of foreigners in the place of origin and the out-migration of nationals has been found (Van Ham and Fejiten, 2008).

The impact of the distance on migratory flows is negative for both Italians and foreigners, but its importance differs between the two groups. Foreigners are far more affected by the distance between the place of origin and the place of destination.

Essentially, the results foster a wider use of the gravity model to describe the migration of sub-groups. The proposed model allows us to obtain an initial understanding of the mechanisms behind internal migration by citizenship.

The results of the proposed analyses also have political implications. The level of attractive capacities of some typologies of geographical areas (for example, those of greater or smaller demographic dimensions) could push policymakers to adopt public policies aimed at increasing the attractiveness, or at least attempt to retain the population of disadvantaged areas, through the adoption, for example, of specific incentives. In essence, the results of these applications could provide planners and policymakers with useful information for introducing a planned policy aimed at favouring the redistribution of the population in a given direction. It is also possible to include policy variables in gravity models to evaluate the impact of governmental subsidies, local taxes, defence spending, educational offers, urban area plans, or direct measures such as migration incentives and policies (Van der Gaag *et al.*, 2003; Ramos, 2016), but this last specific aspect does not fall within the objectives of this article.

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WHY DO SKILLED PEOPLE MIGRATE TO CITIES? A SPATIAL ECONOMETRIC ANALYSIS FOR UNDERSTANDING THE IMPACT OF THE SOCIAL ENVIRONMENT ON THE ATTRACTION OF HUMAN CAPITAL TO CITIES IN TURKEY

Abstract. The main focus of this study is on understanding the importance of social dynamics of cities for attracting human capital to urban regions. The principal research question of the article is "if there is a spatial dependency on neighbouring provinces' social environmental qualities in human capital attraction for Turkey." It is believed that developmental disparities among regions can be overcome with a balanced distribution of human capital. In this article, first the concept and importance of human capital and its evolution throughout economic history are explained in order to emphasize the relationship between development and human capital for urban regions. The literature review consists of migration models developed and used in previous studies and recent literature that together consider human capital and its flow with spatial analysis. A review of migration models helps structure the quantitative models' building blocks, or the concepts to be quantified. Literature that discusses human capital and spatial analysis, at the same time, guides the study in implementing the most appropriate analysis technique. The literature discussed in the paper is focused on human capital migration and urban attractiveness. Its similarity with the current study work is the focus on the relationship between urban environment components and human capital. However, the cited studies lack the "spatial/relational" approach to urban regions which means that the effects of developments in settlements neighbouring the region were ignored. The contribution which we intend to make with the current study is to adapt the spatial econometric analysis to the problem of human capital attraction. Literature review is followed by data used in the empirical part of the study, and brief information on spatial econometric analysis. Next, findings of the empirical spatial econometric analysis of Turkey's 81 urban regions are provided. Overall, the analysis indicated that undergraduate and post-graduate migrants care about the social prosperity of the neighbouring environment of destination province. The last part concludes with an interpretation of empirical study findings and discusses relevant urban and regional policy instruments.

Key words: Human capital, human capital attraction, relational approach, spatial econometrics, Turkey, regional development, spillover Effects.

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1. INTRODUCTION

The success of a regional economy is a chaotic story. Many regional economists and researchers consider dynamism as the word that best describes regional economic success (Arvantidis, Petrakos and Pauleas, 2007). The essential factors that define the dynamism of today's regions are known to be high quality human capital, innovation based on research and development (R&D) (Lucas, 1988; Romer, 1990; Barro, 1991; Becker, 1993; Benhabib and Spiegel, 1994; Hanushek and Kimko, 2000), a stable political environment (Lipset, 1959; Brunetti, 1997), powerful, modern and networked institutions, and improved inter-regional relations (Morgan, 1996, 1997; Evans and Harding, 1997; Jessop, 1998). With human capital defined as one of the building blocks of regional economic dynamism, the analysis of human capital flows between regions should guide policy makers in developing some policies to improve the creative capacities and knowledge assets of regions. However, in the first place, there is the need to conceptualise "region". In human geography, until the middle of the 20th century, geographers tended to define a region as the interaction of human beings and the natural environment in a delimited area. However, the definition of a region began changing in the 1960s and has turned into the concept of "heterogeneous relations" (Murdoch, 2006). In Turkey, investigating the relationship between space and human capital flows is a difficult issue. This is because data production on migration uses a territorial methodology. In other words, in data collection processes administrative and territorial boundaries are taken as data production sets. Data details may disappear among these artificial boundaries. Besides, the artificial boundaries only help produce local or global-scale knowledge. It is not possible to produce knowledge in between those scales. We can determine different geographies by analysing spatial relations grounded in human activity. The methodology of spatial econometric analysis helps us gather some clues on relations beyond artificial provincial boundaries. With the help of this methodology, it is possible to measure the effect of social activity on neighbouring provinces. Again, this perspective allows us to evaluate a region with multiple relations and environments. The empirical findings of the article indicate that neighbouring provinces' social environmental characteristics influence the human capital attraction of a province in Turkey. This means that if we just explore or analyse provinces in their own limited territories, we fail to notice the organic relationships among these provincial boundaries. As planners we have to keep this "multiple relational" approach in mind while conducting an analysis of an urban issue. Therefore, when producing future urban policies, the issue under question should be evaluated using a combined filter of different environments such as the social, economic, natural, etc. Hence, this study is a part of wider research in which different environments are considered in detail. This article discusses only the social environment dimension of this whole.

As a result, this study is built on the interrelation between social environments of urban regions in Turkey and the attraction of human capital to those regions.

In order to emphasise "human capital flows and its attraction to certain places", which is the main consideration of this study, it is necessary to understand the historical evolution of influential thinking on human capital. Since the 13th through to the 20th century, the concept of "human capital" almost reached its most mature form. In the 21st century, the evolutionary economic geography approach has centred this mature conception of "human capital" at the crux of the theory. According to this approach, skilled, educated and creative human power is a requirement for competitiveness. Thus, over the social, economic and technological changes of each historical period the concept of "human capital" was slowly filled in with notions of experience, knowledge, talent, and creativity. In economic formulations, "human capital" moved away from numerical magnitude to something the quality of which formulations began to focus on (Hunt, 2002). According to this study's initial assumption, human capital is the main engine for regional development. Intellectual power is needed in order to create an economically dynamic environment with people possessing entrepreneurial abilities and an environment that is seen as housing innovative industries from various sources (Karlsson *et al.*, 2001). Regions with dense information, unique ideas and competences can be called creative environments (Egan, 1992; Andersson, Quigley and Wilhelmsson, 2005; Faggian and McCann, 2006). These creative environments host academic and cultural activities of various kinds which constitute the most important part of knowledge production, they create opportunities for high levels of communication both within the region and out of the region, and they are in continuous development with the help of cooperative relations inside the regions (Andersson, 1985). People living in an urban environment share their feelings, experiences and the above mentioned kind of explicit knowledge while doing their jobs, working as a group for certain shared objectives, or in undertaking or observing creative artistic events. The fact of being part of such an environment accelerates the diffusion of knowledge, and this relocation and transformation of knowledge multiplies the number of people who learn, teach and produce new ideas. Literature tells us that the prosperity of the social environment in urban regions is highly related with the attraction of human capital to these regions and its accumulation there.

To sum up, for creative environments, the mobility of people who have the capacity to transform tacit knowledge into explicit knowledge is the main issue for regional development. The accumulation of human capital in a region both by being raised in the same region and by attracting them from other regions is a pivotal action to be taken by central, regional, and local authorities. That is why this study's leading question is: "Which properties of the social environment influence the attraction of human capital to urban regions in Turkey?" As stated earlier, this study defines regions from a relational perspective. In this context, answering

the research question is attempted using spatial econometrics which gives hints about the effects of an occasion in an urban area on neighbouring urban areas. Previous studies conducted on human capital have mostly focused on variables that are effective for human capital attraction. However, without spatial spillover effects, this approach is insufficient. Human capital attraction cannot be analysed just by considering the destination region's conditions, as it is a variable which has a propensity to be influenced by the development of neighbouring environments. Therefore, the spatial econometric analysis technique used in this study makes it possible to investigate the ramifications of the developments in neighbouring regions on human capital mobility in destination regions.

2. LITERATURE REVIEW

Attractiveness and human capital migration are the two main modules of the conceptual framework for this study. The motive for the dual structure of the study comes from the human capital perspective that many authorities consider as the principle element of regional development. If a regional environment is to be enriched in terms of human capital structure, quality of life instruments should be dealt with. Many studies in literature suggest that regions should concentrate on the enrichment of their environment's quality of life conditions in order to be more powerful academic and cultural bases. Thus, it would be easier to attract human capital – educated and creative people – who are the main agents of development. There is a large literature on modelling human migration. Main categories of migration models in literature are classical labour migration models, human capital models, job search models, and gravity models. Our study is mostly inspired by human capital models of migration, and independent variables used in the study were chosen based on this theory and previous human capital migration studies. Therefore, brief information on the human capital model and related studies developed using this model is given in this section.

The human capital approach in migration theory differs from the classical theory with its ability to take into consideration the migrant's remaining working life while assuming that the migrant will respond to higher incomes. One of the main assumptions in this theory is that the group of both mobile and well-educated graduates is also the group that contributes the highest share to knowledge formation and accumulation (Faggian and McCann, 2009). Put more clearly, when talented and well-educated people move into a region, production capacity increases, competitivity in the labour market rises, and information and innovation begin to be transferred more effectively (Simon, 1998). It is, therefore, crucial to identify the influential factors in the process of migrants'

decision making on destination choices. It has been shown by many studies that cities as living spaces are mostly preferred by well-educated people (Ritsila and Ovaskainen, 2001). Higher pay and improved chances in cities are the major factors stimulating this tendency. Additional factors are listed as opportunities for education and family life (Glaeser, 1998). Sjaastad (1962) was the pioneer of this argument. According to him, when somebody moves to a region, he/she makes an investment. Glaeser (1998) introduced another factor of human capital accumulation in regions. He suggested that the reason for migrating to cities is the chance for migrants to improve knowledge and talents by getting together with other professionals and thus rise in their careers. This leads to a further increase in income (Glaeser, 1998). Additionally, all costs and benefits are included in the human capital approach, many of which were incomplete in the classical approach. The last strength of the human capital approach in migration modelling is its sensitivity to the selective nature of the action which draws attention to the tendency of young, highly educated and skilled people to migrate (Ritsila and Ovekairen, 2001).

The human capital approach has been very inspiring for many migration and urban studies, starting with the work of Jane Jacobs in 1984 and continuing until the present.

Jane Jacobs (1984) used the term "creative people" as a synonym for "human capital" and noted that regional economic development depends on the qualifications of cities to attract creative people. Lucas (1988), inspired by Jane Jacobs, stressed that most knowledge is spilled over in interactions between people accumulated in cities. The importance of human capital has increased with the development of industry specialising in high technology products and services.

Florida (2003) as a contemporary supporter of creative economies argued that the mobile-talented human capital pool is the most important factor for companies to cluster in certain regions and this source of human capital makes them more competitive and creative. In his studies Florida emphasized the importance of the social environment besides economic opportunities. According to Florida (2003), economic reasons are not the only reasons for highly qualified and talented people to move from one place to another. He argued that the diversity of destinations is one of the most important driving forces behind the talented population's movements across borders. For this reason, he defined culturally diverse places as creative centres where creative human capital, innovation and high-tech industry are concentrated. Those places become the centres of growth because of creative people's preference for living there. Florida's methodology was to compare the correlation statistics of cities using different index values representing mostly the social environment. Another important effect of cultural diversity is known in literature as the migrant stock effect which refers to a generation of people who migrated before and are able to provide information to those who follow (Armstrong and Taylor, 2000, pp. 141–165).

Faggian and McCann (2006) studied the influence of the knowledge capacity of regions on their ability to attract young graduates. In their research, they analysed data which showed them the migration patterns of British students with the help of GIS (Geographical Information Systems). Knowledge capacity indicators used in the study were regional labour market indicators, industry structure indicators (employment demand and innovation indices), quality of life indicators, and geographical indicators. One of the results drawn from the study was the positive correlation between attractiveness of a region for the young human capital and some of the characteristics of the regions such as innovative potential, crime rate, the proportion of knowledge workers, and geographical peripherality. Another outcome of the study was the negative correlation between the weakness of the local job market, and the ability of the region to attract the young talented population. In addition, the study proved that having a research institute or a university raises the chance of the region to benefit from young graduates as a talented human resource. However, there is no direct evidence of the relationship between universities and their contributions to innovative activities in regions. They used an econometric analysis methodology in order to understand the effective specialties of regions on human capital flows and they mapped those results. However, "relational aspect of space" is missing in their study, as in others.

There is also a policy dimension for attracting human capital. Coniglio (2008), in his study, assessed the effects of a regional policy to create a well-educated and talented population and then make them contribute to the regional economy by keeping them within the same region. The manner of migration of this talented population at the micro-level forms the core of their study. To define migrants' personal characteristics, the main causes of migration and the distinguishing features of the destinations for the young and educated migrants were the leading questions they posed in the study. One of the main findings of the study was that giving financial support to young graduates who want to attend a post-graduate course or an internship in the region proved useful for retaining a large portion of the population in the same region. Additionally, developing the ties between local economic agents and higher education courses to provide internships for graduates has a positive effect on retaining graduates in the region. According to the results of the analysis, physical distance, availability of direct information of probable destinations and improved quality of life conditions are the most important features for regions to attract young talented population. Another regional characteristic they analysed in the model was the quality of life and the measures used for it were expenditure on fine arts and musical performances, crime statistics, and population density. Results of the survey showed that human capital flows are most influenced by the increase in income per unit of labour relative to national average among these regional characteristics, and higher unemployment rates have discouraging effects on the flows. The analysis also proved that regions

growing faster receive more young talented migrants compared to the national average. In terms of quality of life indicators, crime has a stronger effect on decisions to move out of that region. However, population density has an adverse yet a weaker effect which means that young talented individuals prefer to move into more populated and diverse places. The methodology used in this study was econometric equations, like in the previous ones. Nevertheless, only one region is studied and therefore the relational approach to understand different regions' effects on one another is missing.

Van der Gaagand and Van Wissen (2008), in their study, aimed to contrast and assess the demographic and explanatory ways of estimating internal migration in some European countries. Three groups of indicators were used, labelled demographic, economic and other. Demographic indicators include population, density, migration, and accessibility. Economic indicators consisted of GDP per inhabitant, unemployment rate, employment and housing stock. Distance and contiguity belong to the "other" group.

One of the conclusions of the study was that the demographic model is a suitable option for estimations covering a short period. Then again, explanatory migration models are useful for scenario making. Demographic models are suitable for regions following a more steady development process. However, for regions evolving quickly in terms of their economy and urban characteristics, demographic models do not give satisfying outcomes. This is also true for regions witnessing rapid falls in economic and urban conditions. Explanatory models are also ideal for long-term predictions of migration patterns. This study is quantified with regression models for a cross-country analysis.

Those models and determinants developed in earlier years paved the way for contemporary academic studies on human capital migration. For instance, Faggian and McCann (2009) in their study intended to analyse the relationship between graduate migration for employment and the innovation performances of British regions. They included the regions' characteristics in the analysis, so as to see if the knowledge infrastructure of a region had an effect on the graduates' decisions to move.

According to migration literature, non-material costs of moving are environmental features for economically developed regions. Environmental features include very wide-ranging elements related to the physical, economic, social, and political sides of the general quality of life. Thus, these features cover neglected and idle property, size of new housing developments, population density, degree of urbanisation, crime and other social anomalies affecting public peace, average temperatures, general weather conditions and air quality, recreation, sports and educational opportunities, and infrastructure besides the above stated indicators.

Glaeser and Saiz (2004), in their research, claimed that there is a strong relationship between urban growth and the educated population with evidence from

both Great Britain and the United States. They drew that conclusion by comparing the percentage of college graduate residents and population growth rates in different cities of the two countries. Glaeser and Saiz (2004) also checked for the relationship between other urban amenities and population growth, and found out that some of the features associated with weather conditions and occupational agglomerations in certain sectors are more strongly correlated with growth. After measuring the correlations between the listed independent variables with population growth and human capital, they concluded that human capital is a factor in raising cities' and regions' productivity levels. According to their findings, if qualified people agglomerate in a province, it causes wages and living costs to go up. Additionally, the structure of occupations in a province supports its growth.

The literature discussed above focused on human capital migration and urban attractiveness. Their similarity with the current study is the focus on the relationship between urban environment components and human capital. However, the cited studies lack the spatial/relational approach to urban regions which means that the effects of developments in settlements neighbouring the region were ignored. The contribution we intend to make with the current study is adapting spatial econometric analysis to the problem of human capital attraction.

This is not to suggest that spatial econometric techniques have never been used in urban issues in literature. There are, of course, many studies combining the two, such as Baudino, 2016; LeSage and Pace, 2010; Chen and Zhou, 2017; Liu *et al.*, 2017, etc. Nevertheless, their main focus is not on human capital but some other urban environmental component.

Having summarised the relevant literature and the contribution of the current project, we now turn to the specific literature on Turkey. When we explore Turkish literature based on human capital, migration and spatial analysis, there are two studies on internal migration patterns of Turkey for 20th century. One of them is by Munro (1974) who worked on influential factors of internal migration and tried to understand the relationship between urbanisation and migration using data from the 1960s. He focused on push models of migration in the methodology. The other piece of research conducted in the late 20th century was by Tunalı (1996). He also investigated the same period as Munro, i.e. 1960–70. His main target was "causes of stepwise-remigration" patterns in the period. He found some evidence that young and better educated and skilled people show a higher propensity to re-migrate than the rest of the population which also supports findings in global literature. He the adopted job search and human capital approaches to migration in his study. However, that was a period of urbanisation and flows from rural to urban areas. Therefore, the migration problem area was quite different from the present century's context. One of the more recent studies on Turkey was conducted by Kırdar and Saraçoğlu (2007) in which they analysed the connection between the conver-

gence of income per capita and internal migration for the period 1975–2000. They found a negative impact of migration on convergence among regions that is contrary to the neoclassical approach. That contrasting result was explained by the authors by the volume and qualifications of migrants. Rural-to-urban migration, i.e. low skilled migration, was still dominant in internal flows at the beginning of the 2000s. Thus, the main motivation for migration between regions was economic. Previously, Gezici and Hewings (2004) analysed the same relation and found no significant effect of migration on convergence for the years 1987–1997. After the 2000s, the migration motivations of individuals in Turkey began to diversify (Kırdar and Saraçoğlu, 2007). Two years after their work, Karahasan and Uyar (2009) studied the relationship between educational disparities and income inequalities within Turkey. Their focus was not directly on human capital and development, but on education as the central component of human capital. A similarity of their work with the current study is the spatial dependency perspective introduced with the help of Moran's I values that they calculated in their research. Their data s applied to the years 1997–2006. They analysed Turkey's regional differences in education levels by using three different education categories (primary, secondary, and university). Their variable was the ratio of students to instructors for each category. Additionally, they highlighted the lack of research on social determinants of economic inequalities of regions. Their results for that period showed that there was a spatial dependency for primary and secondary level ratios. However, there was no significant dependency for university level ratios. They also looked for the spatial patterns for the income level of the regions. Nevertheless, they did not examine the direct effects of income levels and education ratios on each other. One of the most recent studies on human capital in Turkey was conducted by Erdem (2016). He used district level data from 2008 and 2012, and measured human capital disparities, their spatial dependency levels, and their change between 2008 and 2012. Maps produced as part of his analysis showed east and west dualism for primary and secondary education degrees of the population. However, the dualism was not clearly visible for tertiary education level. Then again, for the tertiary level of education, there were aggregation centres. His findings showed spatial dependency and aggregation in certain nodes in terms of human capital. He showed that there was a disproportionate allocation of human capital in Turkey, that it is especially accumulated in the western part of the country, around leading metropolitan cities like Istanbul, Ankara, Izmir, Eskişehir, Muğla, etc. His findings also supported the claim that the accumulation of human capital in regions has positive spillover effects. Another human capital oriented study was carried out by Yüceşahin and KC in 2015. They conducted population projections focusing on the changes in the quality of human capital according to three different political progressive future scenarios for Turkey. In their concluding remarks,

they underlined that general development policies should be considered hand in hand with urban and regional development policy and plans. Lastly, there is a study that measures spatial spillover effects of knowledge using R&D firm level data (Çetin *et al.*, 2016).

As it is obvious from the literature discussed above, there are many studies combining human capital flows and econometric analysis, and also a considerable number of studies that combined urban issues and spatial econometric analysis. However, there is not much literature that combines human capital migration and spatial econometric analysis.

3. DATA AND METHODOLOGY

In our empirical study, econometric spatial regression analysis was applied to social environment indicators in order to observe the effects of social environment indicators on the human capital attractiveness of cities in Turkey.

3.1. Data

In order to understand the effects of social environmental variables on human capital attractiveness, eight different indicators (all province based) were used. These are the socio-economic development index[1] (SEGE2011); the proportion of the population staying at their place of birth, which is used as an indication of cultural diversity and migrant stock effect (MIG_S_EFF); cities' rank order changes from 1990 to 2015 (RANKORDER) which indicates each province's population growth among all 81 cities in Turkey; the number of visitors to museums and archaeological sites per 1,000 people which is used as an indication of the involvement of inhabitants with social and cultural performances (VISITORS); the number of exhibitions at galleries by province per 1,000 people which indicates involvement of inhabitants to art performances (EXH_GAL); the number of theatre performances in the 2012–13 season per 1,000 people which is an additional indicator of involvement of inhabitants to social and cultural performances (PERFORM); the number of films shown per 1,000 people in each 81 province which again gives us a clue about citizens' involvement in social and cultural events (PIC_SHOW); and the number of visitors to fairs and conventions per 1,000 people in each 81 province that is the last variable representing the involvement level of citizens in social and cultural events (PART_FAIR) (see Table 1).

[1] Index developed periodically by the Ministry of Development.

Table 1. Variables used in the empirical model

Variables Used in the Empirical Model						
Relevance of the Variable for the Model	**Variable**	**Indicator**	**Date of the indicator**	**Abbreviation in the model**	**Institution that produced raw data**	**Source of the data**
Dependent	Human capital migration	proportion of migrants who hold undergraduate degrees or higher	2015	TRFACULTY	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	General socio economic development level of the provinces	socio economic development index value	2011	SEGE2011	Strategy and Budget Presidency	https://www.ab.gov.tr/files/ardb/evt/2_turkiye_ab_iliskileri/2_2_adaylik_sureci/2_2_8_diger/tckb_sege_2013.pdf
Independent	Cultural diversity	proportion of population staying at their place of birth	2015	MIG_S_EFF	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	Population growth	provinces' rank order changes	1990-2015	RANKORDER	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	Involvement of inhabitants with social and cultural performances	number of visitors to museums and archeological sites per 1000 people	2015	VISITORS	General Directorate of Cultural Heritage and Museums	http://www.turkstat.gov.tr/Start.do
Independent	involvement of inhabitants to art performances	number of exhibitions at galleries by province per 1000 people	2015	EXH_GAL	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	involvement of inhabitants to social and cultural performances	number of theater performances 1000 people	2013	PERFORM	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	involvement of inhabitants to social and cultural performances	number of films shown per 1000 people	2015	PIC_SHOW	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do
Independent	involvement of inhabitants to social and cultural performances	number of participants to fairs and conventions per 1000 people	2015	PART_FAIR	Turkish Statistical Institute	http://www.turkstat.gov.tr/Start.do

Source: own work.

The above-mentioned independent variables are all suggested by the literature which was reviewed in the previous section. In the relevant literature, a large variety of independent variables were used to represent different environmental specialties of cities such as pay, educational opportunities, family life opportunities, population diversity, knowledge capacity, industry structure, innovative potential, geographical position, expenditure for creational and art performances, job market conditions, presence of research institutions, weather conditions, etc. In the present empirical study – guided by the relevant literature – we concentrated on the quality of social environments using a group of indicators. Furthermore, in literature focused on Turkey, there are useful studies on migration, human capital, and economic inequalities. However, not a single study has been carried out that specifically tried to measure the effects of the social urban environment on human

capital attraction using a relational approach. That is why, for our empirical analysis, we selected variables representing the wealth of the social environment such as a general socio-economic index giving information about the regions' overall development levels (in short SEGE2011 in the empirical part), cultural diversity (MIG_S_EFF), pace of population growth (RANKORDER), involvement levels of inhabitants in social, cultural, and art performances (VISITORS, EXH_GAL, PERFORM, PIC_SHOW, and PART_FAIR) for 81 different provinces in Turkey.

Spatial regression analysis was implemented using those social environment indicators as dependent variables and the regression model was constructed for the independent variable of proportion of migrants who hold undergraduate degrees or higher (TRFACLTY). The proxy for human capital is a difficult issue in this kind of analysis. The concept is expected to include the talent, experience and academic levels of people. However, data restrictions in Turkey do not allow for using such a comprehensive proxy. Migrants to urban areas can be categorised according to their education levels. Another question that should be considered when deciding the proxy for human capital is "which education level represents the most valuable human capital." The answer to it changes according to the developmental rank of the whole economy, educational contents of different levels (which abilities they provide their graduates with), their contributions to the economic conditions of the country, and, of course, to the time period used in the analysis. For the current study, three different levels of education were considered; high school, undergraduate and graduate, and Ph.D.-level educated people. Each of these categories can be meaningful as a proxy for human capital in accordance with the main objective of interest. In this study, each category was tested as dependent variable, the highest values and the most meaningful spatial dependency results were obtained for undergraduate and higher educated migrants. Therefore, regressions were structured upon that proxy of human capital. The following results were, therefore, presented considering the same eight independent variables belonging to social environment effects on the dependent variable as explained above.

All the data except SEGE (which is the latest available index produced by the Ministry of Development periodically) was collected by the Turkish Statistical Institute (TURKSTAT) and these indicators were established on following an examination of human capital migration models and related studies mentioned in the literature review part (see Table 1).

3.2. Methodology

The methodology used in order to assess the relationship between human capital attractiveness and social environmental indicators was to construct a spatial econometric model, and this section provides technical information about the main statistical figures used in the spatial econometric analysis.

A note on what we mean by the word *spatial* here. In spatial models, space is the most important component. Spatial models are built on the idea that "an occurrence in a particular territory has connection with another occurrence in a bordering territory". This is also compatible with Tobler's First Law of Geography that states: "Although there is a total relationship between each existent, adjacent existents have tighter relationships." Spatial econometric models are based on these main ideas and if we use a spatial econometric model in a study, we are not only interested in variables' effects on dependent variables but also their effects on neighbouring locations. In other words the geographical positioning of a place is an important factor in this methodology. Why is it critical or convenient to use a spatial econometric regression in understanding the urban environment's role in attracting human capital for Turkey? First of all, debates on the definition of a region or an urban entity have a long history. How should we imagine and conceptualise a region? Is it a territory somehow limited by boundaries and shall we take it as if every occurrence is happening inside this closed system? Or is it a relational spatial existence in interaction with any other existence near or far? Especially when talking about the mobility of human beings, we cannot approach a region from the former perspective. That is because humans do not just move their corporeal body to a place, but they also bring their living thoughts, experiences, knowledge, culture, and a way of life with them. The destination is also a living environment with social human beings and their attributes. To put it differently, a relational approach (Amin, 2004 and 2007; Jones, 2009; McCann and Ward, 2010; Ward, 2010) is requisite for a mobility study. In Turkey and in many countries, urban statistics are produced from a territorial perspective. For that reason, one of the ways to approach urban issues is to add a viewpoint to urban research by which one can look at an issue from a broader perspective than that of bounded provinces. Here, spatial econometric analysis helps broaden our perspective from province boundaries and gives us the opportunity to comment on their interrelations with neighbours.

The most important figure representing variables' effects on neighbouring locations is spatial autocorrelation, which is also the most prominent part of our analysis. Therefore, spatial autocorrelation will be explained first. The feature to quantify the intensity of the connection between adjacent and remote elements is called spatial autocorrelation. Anselin and Bera (1998) defined spatial autocorrelation as the probability for two close geographical positions having similar distinctive specialties. In other words, it is a mathematical analysis of the likeness of areas and characteristics. This value can be equal to zero or can be negative or positive. A value of zero means there is no relationship, a negative value determines a negative relation, and a positive value means there is a positive relationship between the variables (Viton, 2010).

The second component of the analysis are the spatial weight matrices. Before constructing a spatial model, it is important to determine which territory is the

neighbour of another. This step contains an R R matrix that is rectangular and symmetric in form, including 1s and 0s. Assuming territory A is a neighbour of B, then the value in the matrix for A and B is 1, and if not, the value is 0. There are four main methods for creating this matrix, i.e. rook, distance based, k-nearest, and queen. For our study, each of the results of the four matrices was tested and the highest significant value was obtained from the queen matrix. Therefore, the preferred matrix for this study is the queen relation which means that two territories are determined as neighbours if they have a shared boundary at any direction and of any length (Viton, 2010). The other options for the matrix have additional restrictions. In a queen matrix, spatial interrelation in any direction is admissible. We are studying a country's urban regions internally and we do not have any presumed evidence of a relation between urban regions in terms of human capital attraction. Therefore, the most suitable matrix option for this research is queen, which gives us enough space to control for all the neighbours in each direction without any distance limitation.

The third component is Moran's I value. Moran's I value is used for both analysis for clustering (global Moran's I) and analysis for clusters (local Moran's I), and it is an element of spatial autocorrelation tests. Global spatial autocorrelation is determined by the assessment of a null hypothesis of an arbitrary territory. If this null hypothesis is rejected, then we can claim that there is a spatial clustering of variables and thus we can get more knowledge about the allocation of values than we could from other statistical instruments such as box plots, quintile maps, etc. The main role of spatial autocorrelation's main is to calculate the magnitude of every variable's relation in a territory with a spatially weighted average of variables in bordering territories.

Below is the formulation of Moran's I value:

$$I_t = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(k)x_{it}x_{jt}}{\sum_{i=1}^{n}\sum_{j=1}^{n} x_{it}x_{jt}}$$

Here w_{ij} refers to the extent that territory i is associated with territory j, and x_{tt} is the difference between variable i and the mean of the variable i at the year t. Finding a value of I bigger than the expected I value means that there is a positive autocorrelation and if it is smaller than the expected I value, then it shows a negative spatial autocorrelation (Çelebioğlu, 2017). Various methods can be used to define autocorrelations. Here, the calculation of permutations is preferred. 999 re-sampled datasets are generated and then I figures are calculated. The result of these calculations is contrasted with current real dataset (Altay and Çelebioğlu, 2015).

The Moran scatter plot is the image of the global Moran's I analysis and in this image, the regression line's slope matches the Moran's I value. An enhanced ver-

sion of the Moran scatter plot is also able to describe the interrelation of a variable at a territory and another variable at a nearby territory which is called the bivariate spatial autocorrelation. Local Moran's Is images are cluster and significance maps.

A spatial autocorrelation analysis is completed by means of composing spatial weights. The evaluation of spatial autocorrelation is applied to ordinary least-squares regression. The maximum likelihood analysis is used to measure spatial error and lag models. (Anselin, Syabri and Kho, 2006; Altay and Çelebioğlu, 2015) are the two main types of spatial regression models.

According to the spatial lag model, the degree of dependent variable "a" at a region "X" is affected by the degree of that same dependent variable at the bordering region "Y". That is a statistical expression of "spatial spillover". For instance, the rate of unemployment in a region may be affected by the rate of unemployment at a bordering region. Here is the formulation:

$$y = \lambda Wy + X\beta + u$$

Where W_y represents spatially lagged dependent variable for weights matrix W, X is explanatory variables's matrix, represents error terms, is for the spatial coefficient. In case there is no spatial interrelation, then equals zero (Çelebioğlu, 2017).

The second kind of spatial model is called the "spatial error model". Here, the calculations of the spatial impact are done by the help of error terms and the formulation is:

$$y = X\beta + u$$
$$u = \rho Wu + \nu$$

Where u represents error terms, ρ is the spatial error coefficient, and ν represents uncorrelated error terms. If there is no correlation, ρ equals zero (Çelebioğlu, 2017).

The model then changes to:

$$y = X\beta + (I - \rho W)^{-1} \nu$$

While using spatial regression models, the procedure starts with the calculation of standard Lagrange multiplier error and Lagrange multiplier lag numbers. If neither of the two tests rejects the null hypothesis, the next step is to proceed with outcomes of the ordinary least squares method. Conversely, if any of them rejects the null hypothesis, then it shows the researcher the direction to continue using a spatial error model or a spatial lag model. As a third outcome, the null hypothesis may be rejected by both of the Lagrange Multiplier tests. In this case, the robustness of statistics should be checked. One will be more meaningful than the other (Anselin, 2005).

4. FINDINGS

The first step for spatial econometric analysis is to put the dependent variable TRFACULTY with eight independent variables listed above through an ordinary least squares (OLS) test. Faggian and McCann (2009) and many of the previous researchers proved that a mobile and educated population affects knowledge production and innovation capacities of provinces positively. Therefore, our analysis dependent variable was chosen to be faculty and higher educated migrants. In addition to that, internal migration studies taking Turkey as the case were mostly concentrated on mass migration numbers (Kırdar and Saraçoğlu, 2007; Gezici and Hewings, 2004) rather than focusing on some specific groups of migrants like we normally do. Therefore, the construction of our model based on the human capital dependent variable makes a distinction for Turkish internal migration studies. The value of R^2 is found to be 0.75. In this model, the multi-collinearity condition number is less than 30 (8.68) (see Table 2).

The results of the OLS test for migrants of undergraduates and higher to the socio-economic development index and participation to fairs in cities are significant at the 1% level, but the number of art performances and changes in rank orders through the years 1990 to 2015 are significant at the 5% level (see Table 2). Yet, although the changes in rank order through the years are significant, the effect of this independent variable on attractiveness is negative and the socio-economic development index and participation in fairs in cities affect the attractiveness of undergraduates and higher to cities positively. This result indicated parallel findings with Glaeser (1998) and Florida (2003) who found that both economic and social environmental factors were effective on the attraction of people to the cities. Glaeser (1998), Faggian and McCann (2006) also emphasized the positive effect of human capital accumulation in regions on attracting additional human capital. In our analysis we found out that participation in fairs was an effective variable in human capital attraction. That resembled Glaeser's findings. That was because fair participants cover a population who has special interest and specialisation in certain business activities coming from different parts of Turkey and sometimes outside Turkey. They were big business events that gathered the professionals and the related consumer society, those events led to information based interactions and new knowledge formations. Faggian and McCann's (2006), identified in their study some additional factors differing from the economic factors like crime rates which represent the social environment of cities. That also supported our findings of social environmental factors on human capital migration. In our OLS model, independent variables like the migration stock effect, the number of visitors to museums and archeological sites, the number of exhibitions at art galleries, the number of films shown in cinemas were all insignificant. Florida's (2003) findings especially showed positive correlation with cultural diversity in human capital attraction. However, in our analysis the variable we used for representing migrant stock effect was found to be insignificant for the human capital attraction potential of Turkish provinces.

Table 2. Results of spatial econometric analysis

Dependent Variable: TRFACULTY	**Coefficients**		
	OLS	**Weighted-OLS**	**Spatial ERROR**
Constant	0.248398 (0.00844)	0.248398 (0.00844)	0.283626 (0.01072)
SEGE2011	0.196918 (0.00009)	0.196918 (0.00009)	0.404693 (0.00000)
MIG_S_EFF	-0.00355239 (0.18780)	-0.00355239 (0.18780)	-0.00274778 (0.22073)
RANKORDER	-0.0083396 (0.03039)	-0.0083396 (0.03039)	-0.00586401 (0.05095)
VISITORS	-2.29698 (0.39000)	-2.29698 (0.39000)	-2.43748 (0.25349)
EXH_GAL	-1.2088 (0.63184)	-2.29698 (0.39000)	-1.5448 (0.42465)
PERFORM	0.32081 (0.03309)	0.32081 (0.03309)	-0.0518068 (0.67838)
PIC_SHOW	-0.025015 (0.76052)	-0.025015 (0.76052)	0.0900463 (0.15771)
PART_FAIR	0.652583 (0.00000)	0652583 (0.00000)	0.50565 (0.00000)
Lambda	-	-	0.728623 (0.00000)
R^2	0.756118	0.756118	0.820674
Adjusted R^2	0.729020	0.729020	-
Jarque-Bera	124.4639 (0.00000)	124.4639 (0.00000)	-
Breusch-Pagan	208.6814 (0.00000)	208.6814 (0.00000)	101.1206 (0.00000)
Moran's I (error)	-	2.1342 (0.03283)	-
Lagrange Multiplier (lag)	-	0.2344 (0.62826)	-
Robust LM (lag)	-	5.1914 (0.02270)	-
Lagrange Multiplier (error)	-	2.7604 (0.09663)	-
Robust LM (error)	-	7.7174 (0.00547)	-
Note: P-values are in brackets.			

Source: own work.

The step following the OLS analysis was the construction of the regression model that measured the volume of spatial effects of the same 8 independent variables belonging to the social environment of cities. Spatial effects were tested once again with the help of the "queen weight matrix".

After the exploration of "Diagnostics for Spatial Dependence" parts in the model results, in the light of Lagrange Multiplier and Robust LM values which were 0.09663 and 0.00547 respectively, the Spatial Error Model was chosen for the next procedure. Those two values showed very high levels of significance. Thus, the spatial error model was applied using the queen weight matrix (see Table 2).

As can be seen in Table 1, spatial dependency was significant for province preferences of undergraduate and above migrants, which was proved by the result of the likelihood ratio situated in diagnostics for the spatial structure part. That test result was significant at 1% level. The lambda value was also significant at 1% level and its coefficient was 0.72, which means there is a high spatial dependency in the model (see Table 2). A coefficient of 0.72 tells us that one unit of change in error terms in a neighbouring province will cause a change of 72% in that province's probability to be preferred by undergraduate and higher graduates. Erdem (2016) also found a spatial dependency for the human capital accumulation for Turkey in his study.

Thus the outcomes of the model constructed to understand the effects of the social environment on human capital attraction in Turkey showed us that spatial dependency is effective for undergraduate and postgraduate degree holders. In other words, undergraduate and higher degree holder migrants care about the social prosperity of the neighbouring environment of the destination province which is also supported by the findings of global literature seeking the relationship between skilled people's agglomeration in cities and urban amenities.

5. CONCLUSION AND POLICY SUGGESTIONS

This research has been motivated by the driving force of urban environments which is human capital. Mobility of human capital is known to increase the potential of producing new knowledge and avoiding the community stuck in social, economic, and environmental bottlenecks. Despite many of the data restrictions both on scale and content, the empirical analysis was conducted using spatial econometric analysis techniques in the interpretation of the model results. That approach to urban issues gave us the strength to see and analyse the relations ongoing among the administrative boundaries. The analyses based on only the provincial level data is somehow restricting the interpretation of the geographies

of cultural, commercial, social, institutional or environmental relatedness. Therefore, the relational approach and spatial analysis techniques as its instrumental assistant may open new windows in producing urban and regional policies.

In the introductory and theoretical sections of the study;

– Region conception of relational approach of the geography,
– a brief review of historical evolution of human capital conception,
– recent literature on human capital, spatial attractiveness, and some relevant spatial econometric models were discussed.

The details of our empirical model and findings were given in the following parts of the study. In summary, according to the structured model in this study, there are three significant independent variables, namely the level of social development index, participation in fairs and conventions, and the rank order changes of the cities from 1990 to 2015. The most effective independent variable on attracting undergraduates and higher to provinces is the level of participation in fairs and conventions in cities. Fairs and conventions are big events that gather people and the cutting edge knowledge and technology in specialised sectors. Therefore, we can comment that as huge platforms of knowledge sharing and spillover, networked and mobile society are the most influential factors for attracting educated and talented human capital in Turkey. Consequently, urban and regional planning policies for provinces in need of human capital should give priority to organising and constructing those kinds of events and infrastructure for sectors that cultivate those kinds of organisations. When we examine the distribution of the rate of participation in fairs and conventions per province, it is clear that cities getting high rates of participation are accumulated mostly in the western part of Turkey and that it follows a similar pattern with overall developmental disparities among the provinces. This shows that big organisations for technology and knowledge accumulation and sharing are carried out mostly in the western part of the country and the benefits arising from such organisations do not spillover to the eastern parts of the country.

Participation in fairs and conventions gives clues about a community's mobility, eagerness to interact with colleagues, willingness to learn more about some specific issues, and openness to new information.

The lambda value in the model for the social environment is very high, which means that province choices of human capital are affected by the level of social environment variables in the neighbouring locations.

In the light of the study findings, social environments of neighbouring provinces in Turkey influence the human capital attraction capacity of one another, in other words, there is a significant spillover effect among the provinces. This finding shows us that development strategies of provinces should not be developed by considering them independently, as if each province is a closed entity with no relation to the rest of the world, but there should be a regional and relational approach in producing urban strategies which also takes into consideration the neighbour-

ing provinces. Although there are institutional organisations like regional development agencies that have been active since 2009, which can coordinate the implementation of this relational approach, they are not effectively operating on such issues. The implementation of regional plans and regional development strategies that are prepared by regional development agencies should be supported.

Such institutional structures that operate above the provincial boundaries should coordinate central, provincial, and local authorities in advancing common strategies, policies, and plans focused on developing social environment factors for urban areas with the help of scientific knowledge. Decision makers should cooperate especially with the sociology, economics, and urban and regional planning departments at universities for developing the social environment of urban areas.

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GEOGRAPHICAL, HISTORICAL AND POLITICAL CONDITIONS OF ONGOING AND POTENTIAL ETHNIC CONFLICTS IN CENTRAL AND EASTERN EUROPE

Abstract. For centuries Central and Eastern Europe has been the scene of frequent changes of borders and numerous ethnic conflicts. Contemporary ethnic diversity of this region is much smaller, however, the growing nationalisms of the various societies, mutual mistrust, and the temptation of politicians to use ethnic issues in the regional geopolitical competition pose a real threat to the stability and peace in Central and Eastern Europe. The dynamic political, legal, social and economic changes which have been taking place in this part of Europe for three decades now, which overlay its clear civilization division into the Latin and the Byzantine parts and are intensified by historical animosities, must have had an impact on the situation and the perception of minorities. In contrast to Western Europe, the contemporary ethnic diversity of Central and Eastern Europe is primary the consequence of various, often centuries-old historical processes (settlement actions, voluntary and forced migrations, border changes, the political and economic expansion of particular countries), and in the ethnic structure especially dominate the indigenous groups, migrants, particularly from the outside of the European cultural circle, are of marginal importance. Moreover, national minorities are usually concentrated in the border regions of countries, often in close proximity to their home countries, becoming – often against their will – element of the internal and foreign policies of neighbouring countries.

The main aims of the article are to explain the threats to peace arising from the attempts to use minorities in inter-state relations and regional geopolitics as well as engaging minority groups into ethnic and political conflicts (autonomy of regions, secession attempts) and still the very large role of history (especially negative, tragic events) in the shaping of contemporary interethnic relations in Central and Eastern Europe.

However, the varied ethnic structure typical for this region does not have to be a conflict factor, on the contrary – it can become a permanent element of the identity and cultural heritage of each country.

Key words: national minority, ethnic minority, border region, separatism, ethnic conflicts, international relations.

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1. INTRODUCTION

In the early 1990s, significant political and geopolitical transformations occurred in Central and Eastern Europe: the fall of Communist rule, the reunification of Germany, the dissolution of the Soviet Union, the disintegration of Yugoslavia, and the division of Czechoslovakia. The emergence in quick succession of several independent national states rippled through various ethnic minorities, especially those living in border regions. Political and economic relationships completely changed between the new sovereign states, as well as, to a large extent, between nations separated by borders. A process of expanding European integration was started, which led after several years to the inclusion of some countries in Central and Eastern Europe into the NATO and EU structures, while leaving other outside the zone of political, economic and military integration, thus leading to new lines of division in these new political and legal circumstances.

There are regions in the world with relatively higher political and territorial instability, and the resulting more frequent variations in borders, identified as the *shatter belt* by S. Cohen, an American geographer and geopolitician. The main reasons for the border volatility in such regions are the lack of natural geographic barriers, ideological contradictions, and the incompatibility of political and ethnic borders (Cohen, 1973).

In the area of Central and Eastern Europe, where we could observe numerous border changes over the last 100 years, especially following the First and Second World Wars and the fall of Communism in the 1980s and 1990s, all of the causes listed by S. Cohen could be found. However, the most important determinants of the instability of political borders in the region, especially in the first half of the 20th century, was the direct impact of German and Soviet imperialism, the existence of multinational states, the clear disparity between political and ethnic borders, and the lack of geographical barriers. Then, after 1990, the main elements included ideological (the fall of Communist system) and ethnic issues (the desire to create nation states). All European border changes in the late-20th century were related to systemic transformations, as well as centrifugal and separatist tendencies leading to the dissolution of multinational states (the Soviet Union, Yugoslavia, Czechoslovakia) or, less frequently, integration tendencies leading to the unification of two German states. They resulted in the total overhaul of the political map of Central and Eastern Europe, both by the emergence of several new sovereign states, as well as numerous ephemeral creations (like interim political territories). All of those states have been created by improving their former federal statuses from federal units to independent countries, Apart from many conflicts, the last three decades brought about the peaceful resolution of a couple of border disputes, while some still remain unresolved (Sobczyński, 2013; Bufon, Minghi and Paasi, 2014).

However, these minor border disputes are now much less dangerous for the European peace than the internal separatist conflicts. Just as in the early 1990s, cur-

rent attempts at territorial disintegration and border changes in Ukraine (Crimea, Donetsk, Lugansk), Georgia (Abkhazia, South Ossetia) or Moldova (Transnistria, Gagauzia) have a very strong ethnic context, "enriched" by political and military interventions from the neighbouring country (Russia).

2. THE SPATIAL SCOPE

Controversy regarding the spatial extent of Central, Central-Eastern and Eastern Europe have been discussed at length in numerous historical, geographical, political, and geopolitical studies (Eberhardt, 2003, 2004; Rykiel, 2006; Bański, 2008; Komornicki and Miszczuk, 2010; Sobczyński, 2010, 2013). There is no consensus concerning the clear delimitation of the regions, with differences in political and cultural, as well as geographical, historical or civilisational criteria.

The most popular, dating back to antiquity and the Middle Ages, concepts of the division of the European continent, were the divisions into Western and Eastern Europe, representing the division into Latin and Greek, Germanic and Slavic as well as Catholic (later also Protestant) and Orthodox. In all of these concepts, the dominant criterion was the cultural criterion (linguistic, religious, ethnic), and the boundaries were not linear but zonal and altering in time. Politically, the most visible division of Europe was the period of "cold war" in the second half of the 20th century and the division into capitalist democratic countries in the West and communist countries in the East (Eberhardt, 2003, 2004; Rykiel, 2006; Bański, 2008).

A huge diversity, especially political and cultural, extending from Germany and Italy to the Ural, part of which is referred to as Eastern Europe, caused in the 19th, and especially in the 20th century, the emergence of new ideas separating from Eastern Europe a transition zone with features and influences of both the West and the East, referred to as Central Europe or Central-Eastern Europe.

Originally, the concept of Central Europe (*Mitteleuropa*) was introduced by Germany at the end of the 19th century and covered the real and potential political, cultural, and economic domination of the German State. Usuaully, that applied to the area from the Rhine to the Vistula and from the Baltic to the Balkans. This term was a consequence of the geopolitical and imperial aspirations of Germany at that time. The contemporary definition of Central Europe is clearly political and it was coined after Second World War, when it embraced the communist states in Europe, outside the USSR. After the collapse of the communist bloc in 1989, significant differences were noticed between these countries and the definition of Central Europe was limited to Poland, the Czech Republic, Slovakia and Hungary, as a more homogeneous and distinctive group from the Balkan states, and integrating with the structures of Western Europe within NATO and EU more

quickly. Currently, this area can be treated, in political, cultural, and civilizational terms, as the eastern borderland of Western Europe (Rykiel, 2006; Bański, 2008).

The definition of Central-Eastern Europe is both cultural (traditional) and political (contemporary). In the traditional cultural approach, Central-Eastern Europe was identified in the 19th century with a vast area between Germany, Turkey and Russia, that is, it covered the Slavic territories (without Russia), Hungary and the northern and central parts of the Balkans. In contemporary, political terms, Central-Eastern Europe, initially identified with former communist countries outside the USSR, and then as a result of the growing conflict in the Balkans and increasingly important political and cultural differences, this definition was limited to Central European countries (Poland, the Czech Republic, Slovakia, Hungary), and with the expansion of NATO and the EU, adding Baltic states to this group (Lithuania, Latvia, and Estonia). This currently leads to blurring the differences between the concepts of Central Europe and Central-Eastern Europe (Rykiel, 2006).

However, one cannot equate the terms of Central-Eastern Europe and Central and Eastern Europe. The definition of the latter is much broader, including Belarus, Ukraine and western Russia, whose states, because of their different political, economic, and cultural characteristics, cannot be associated with Central-Eastern Europe (Bański, 2008).

This paper attempts to discuss the current and potential ethnic conflicts using the example of three Central European states (Poland, Czech Republic, Slovakia), as well as six others that became independent after the dissolution of the USSR (Estonia, Latvia, Lithuania, Belarus, Ukraine, Moldova). The most precise, common term of regional affiliation of these nine countries is Central and Eastern Europe.

3. MULTI-ETHNIC BORDER REGIONS IN CENTRAL AND EASTERN EUROPE

Border regions, especially those highly diversified in terms of ethnicity, religion, language, and culture, are often associated with unstable, conflict-prone areas where antagonisms between nations living there occurred and continue to occur. This belief has intensified over the last decades when many regions in Central and Eastern Europe experienced the rise of nationalisms, separatist tendencies, reactivation of historical disputes, and the use of ethnic minorities in interstate political and geopolitical struggles (Rumley and Minghi, 1991; Batt, 2001; Appadurai, 2006).

Multi-ethnic areas, typical for the interstate borderlands in Central and Eastern Europe, are usually located at the verge of two or more ethnic areas. They represent a mixture of indigenous and immigrant populations of different origins (settlers, colonisers, refugees, displaced populations), sometimes from distant countries, but mostly from neighbouring ones. Immigrant populations have gener-

ally inhabited such regions for generations, with recent immigrants being a rarity. These regions are very diverse internally. They may consist of representatives of several nations, ethnic or cultural groups of different origins, level of social and economic development, as well as political status. These groups may occupy their own little territories or live in dispersion. Their mutual interactions may be peaceful or hostile. All multi-ethnic regions are dynamic. Their ethnic structures and cultural characteristics vary depending on a number of factors and demographic, social, economic, and political processes (Koter, 2003).

It is clear that both historically shaped regions of mutual "mixing" of several neighbouring nations or ethnic groups, and areas of modern mass economic and political immigration have to become multi-ethnic. However, there is a clear difference between them, one that may be dubbed *autochthonous multi-ethnicity* and *guest multi-ethnicity* (Barwiński, 2016).

There is a type of multi-ethnicity specificity to Central and Eastern Europe, namely regions where different, often long-lasting historical processes (such as settlement actions, migration, border changes, political, and economic expansions of certain states) shaped an ethnically diverse multicultural society. Immigrant populations have shaped the ethno-religious, cultural, economic, and political landscapes of such regions for so long and so clearly, being "incorporated" into its history, geography, and economy so deeply, that we may talk about *autochthonous multi-ethnicity*, where all ethnicities, both local and immigrant, are now "at home".

In such regions, of course, the social, cultural, and economic diversity of immigrant and local populations was initially very clear. Social differences were exacerbated by the nature of a settlement, as indigenous (mostly rural) population vastly differed from the immigrants (usually urban), in professional, economic, and educational terms. Social relations in such regions were rarely partnerships. As a rule, the group dominant in economic and cultural, though not always population, terms imposed its culture on the indigenous people, e.g. Germans in Poland and the Czech Republic, Hungarians in Slovakia and Romania, Poles in Ukraine, Belarus, Lithuania, Italians and Turks in the Balkans, Russians in the former Soviet republics (Koter, 1995, 2003; Kolossov, 1999; Eberhardt, 2003; Kowalski and Solon, 2008). At the same time it had a huge impact on the social and economic development of those areas, and over time there has been a far-reaching socio-cultural integration, both between the nationalities, as well as integration with the country of residence. That was further strengthened by the settlement of nations living in the diaspora for centuries, but exerting vast influence on the social, economic, political, and cultural lives on the regions they inhabited, mostly Jews and Armenians, somewhat also Roma, Tatars and Karaites. This type of multi-ethnic regions is nowadays common in Central and Eastern Europe, including Poland, Romania, Slovakia, Ukraine, Belarus, Lithuania, Latvia, and Estonia, where a number of national and ethnic minorities feel the co-owners and co-hosts of the area they inhabit. Hence the terms *autochthonous multi-ethnicity*.

In contrast, a completely different type of multi-ethnicity may be seen in regions of concentration of economic immigrants, typical for modern highly-developed countries, mostly in Western and Northern Europe. These are highly atomised areas, often limited to "ethnic neighbourhoods" in big cities. This may be described as *guest multi-ethnicity*, as the immigrant population, usually from culturally different backgrounds, maintains far-reaching autonomy and unwillingness to integrate in their country of residence, often after several generations. It also engages with the social and political life of the region to a limited extent. Such communities are treated as external guests by both themselves and "natives".

Currently, we can distinguish over 20 multi-ethnic regions inhabited by at least three different nationalities in the part of Central and Eastern Europe under discussion. This list is certainly not complete (Table 1). Unfortunately, there is no possibility of referring to reliable, objective and comparable statistical data concerning the contemporary national structure of the inhabitants in concerned countries and border regions. This is mainly due to the different methods of population censuses and the calculation of national diversity in Central and Eastern Europe, thus there is a lack of comparability of ethnic statistical data. In addition, large temporal differences (sometimes exceeding 10 years) in carrying out the last censuses in the countries of the region or even a lack of data, e.g. in the case of Ukraine, where due to political and military crises, the last census was carried out in 2001 and now its results of the nationality structure are completely outdated.

Table 1. List of multi-ethnic border regions in Central and Eastern Europe

No.	Border region	National/ethnic groups
1	Eastern Estonia	Estonians, Russians, Ukrainians, Belarusians
2	Latgale (Eastern Latvia)	Latvians, Russians, Poles, Belarusians, Ukrainians
3	Eastern Lithuania	Lithuanians, Poles, Russians, Belarusians, Karaites
4	North-western Belarus	Belarusians, Russians, Poles
5	Grodno Region	Belarusians, Poles, Russians
6	Polesia	Poles, Belarusians, Ukrainians, Lithuanians, Tatars
7	Warmia and Masuria (former East Prussia)	Poles, Ukrainians, Lemkos (Ruthenians), Germans, Masurians
8	Gdańsk Pomerania	Poles, Kashubians, Germans, Ukrainians
9	Northern Carpathians	Poles, Ukrainians, Lemkos (Ruthenians), Gypsies
10	Polish Silesia	Poles, Silesians, Germans, Gypsies, Ukrainians
11	Czech Silesia	Czechs, Slovaks, Poles, Silesians, Moravians, Germans
12	Moravia	Czechs, Moravians, Slovaks
13	Spiš	Slovaks, Poles, Germans, Gorals
14	Southern Slovakia	Slovaks, Hungarians, Gypsies

No.	Border region	National/ethnic groups
15	Eastern Slovakia	Slovaks, Gypsies, Ukrainians, Ruthenians, Hungarians
16	Eastern Galicia	Ukrainians, Poles, Russians, Armenians
17	Transcarpathian Ruthenia	Ukrainians, Ruthenians, Hungarian, Romanians, Russians, Slovaks
18	Bukovina	Ukrainians, Romanians, Moldovans, Russians, Poles, Germans
19	Crimea	Russians, Ukrainians, Tatars
20	Donbas	Ukrainians, Russians, Belarussians
21	Transnistria	Moldovans, Russians, Ukrainians, Romanians
22	Southern Moldovia	Moldovans, Romanians, Gagauz, Ukrainians, Russians, Bulgarians

Source: own work (extended and updated) based on Koter, 2003, p. 15.

Fig. 1. Multi-ethnic border regions in Central and Eastern Europe

Source: own work based on Eberhardt, 2003 and Koter, 2003.

A massive resettlement of people after the Second World War, later migration, and the emergence of a number of nation states in the 1990s significantly reduced, but not levelled altogether, the ethnic diversity in various countries of Central and Eastern Europe. The current political borderland zones (Fig. 1) are still highly ethnically diverse, and most ethnic minorities living in them come from dominant nations in neighbouring countries and have been present in the region for centuries.

The political and cultural diversity in Central and Eastern Europe coincides today not only with national or ethnic borders, but also with religious divisions, clearly deepened by the borderland location of a region, at the border longitudinally dividing Europe – between the western (Latin) and eastern (Byzantine) Christianity. This confirms the social and cultural transformations occurring in the world. The processes of globalisation, and the political and economic unification of Europe and the world are accompanied by the growing awareness of civilisational differences, especially in terms of religion (Huntington, 1996; Bański, 2008).

Running roughly along the eastern borders of Estonia, Latvia, Lithuania, Poland, Slovakia and Hungary with Russia, Belarus and Ukraine, the division line based on the tradition of western Christianity and the influences of Orthodox culture is the most persistent division line in the European continent. Since 2004 it has been further reinforced physically (by technical means of border protection) and legally (visa regulations), now serving as the external border of the EU, which means that the Baltic states and the Central European states may now be treated, in both cultural and political senses, as the eastern march of Western Europe, while the eastern border of the EU becomes the main division line in Europe. It is currently a barrier between completely different political, economic, legal, and social realities. It differentiates not only formally, but also in culturally, mentally, and economically. It may certainly be considered one of the strongest civilisation barriers in modern Europe.

In Central and Eastern Europe, we are now dealing with the overlapping and mutual strengthening of political, civilisational, religious, and ethnic differences, occurring most intensively in the borderlands of individual countries. The situation is similar to the processes in the Balkans. It occurs also in Western Europe (for example: Spain, Belgium, Scotland, Northern Ireland) and the processes might be the same, but the way of solving it is completely different.

4. ETHNIC MINORITIES AND THE RELATIONSHIP WITH THEIR MOTHERLANDS AND FOREIGN HOMELANDS

Because of political, ethnic, and historical circumstances, the relationships between individual ethnic minorities living in Central and Eastern European countries and their countries of residence and the so-called foreign homelands dif-

fer widely and have varied consequences. One characteristic of this relationship is that they mostly settle in close vicinity to state borders. This is undoubtedly relevant when analysing the interstate relations, though calling ethnic minorities *bridges* in interstate relations has become diplomatic canon and a rhetorical figure of political correctness. In political practice, due to the historical events and the needs of current internal politics and geopolitical interests, the role of a given nationality in the mutual relations between the country of residence of a minority and its foreign homeland may be vastly different, and do not have to involve bridging (Barwiński, 2013).

R. Brubaker (1996) pointed this out by using the concept of *triple relational dependency* to analyse the ethnic structure of Central and Eastern European countries. According to the theory, ethnic relations are rarely limited to just the relationship between the majority and the minority, but very often foreign homelands play a role in their shaping, which makes them tripartite in character. The importance of minorities' cross-border contacts for ethnic relations in a given country depends on their character, intensity and the attitude of the dominant group towards them. Close relations within the ethnic community strengthen minority identity, while their weakness or lack thereof fosters assimilation processes. In turn, the lack of acceptance from the majority for the relationship between the minority and its foreign homeland may spark conflicts.

Support provided to ethnic minorities by their foreign homelands may include political and legal, social and cultural, economic, as well as military activities, which was clearly visible in the Russian involvement in Ukraine. Their scale depends on the strength of the ties with their compatriots abroad and the real possibility of influencing their situation, resulting both from their own political and economic, as well as military potential, and the kind of relation with the state the minority currently lives in. The motivations for such activities may vary from symbolic support of maintaining communication with the homeland to inciting ethnic conflicts, separatist movements, and border changes. For ethnic minorities, support received from their foreign homeland is an important factor in maintaining national identity in psychological, as well as organisational and material senses. Yet a lack of such support may weaken the ties with the homeland (Hastings, 1997; Mandelbaum, 2000; Budyta-Budzyńska, 2010).

Other factors that complicate the trilateral relations between the ethnic minority, its motherland and its foreign homeland in Central and Eastern Europe include the diverse political status of certain states, membership in various economic and military organisations, disproportions in population, economic, and military potential, frequent tragic historical experiences in mutual relations, as well as different processes of systemic transformation, which may result, among others, in different political relations between neighbours.

5. ONGOING ETHNIC CONFLICTS

In the area of Central and Eastern Europe under discussion, we can currently identify at least three regions affected by conflicts which may be described as ethnic, i.e. one in which the ethnic structure of an area is one of the reasons for the emergence and escalation of the conflict, while the nations inhabiting such a region are active parts in it. In addition, they are characterised by the use of violence, armed forces, political, and military interferences from a neighbouring country, state authorities losing control over a region, the desire to change state borders, and, thus, the annexation of a territory or secession. They may all be described as separatist regions, with their separatism inspired by Russian or, wider, Russian-speaking population. These regions are Donbas (Donetsk and Luhansk provinces) and Crimea in Ukraine, and Transnistria in Moldova.

Contemporary Ukraine is very clearly divided into – generally speaking – the eastern and western parts. This division is historically and culturally conditioned, it is a consequence of the centuries-old affiliation of Western Ukraine to Poland and Austria-Hungary, and eastern part to Russia, and related with that national, religious, cultural and social, and economic processes. Currently, it appears as a diverse sense of Ukrainian national and linguistic identity of the inhabitants of the eastern and western parts of the country, a different national structure, other political and electoral preferences, domination of pro or anti-Russian attitudes. In addition, there are clear economic differences (industry and natural resources are located mainly in the eastern part of the country) and a very high strategic and geopolitical importance of Ukraine, both for Russia and the EU.

As long as Ukraine under president Yanukovych maintained a pro-Russian policy, authorities in Moscow did not decide to take radical steps against their neighbour. However, a political turn in a large portion of the society, and then in the new authorities of Ukraine, towards the EU, as well as the postponing of the Russian-Ukrainian cooperation becoming closer, encouraged Russia to strengthen their zones of influence in the regions of Ukraine where it was still possible. The political vision of integrating Ukraine with the EU and of limiting the influence of Russia in the Black Sea region forced Moscow into very risky operations. The fears of the Russian minority and Russian-speaking Ukrainians concerning the patriotic turn in Ukraine, including the position of the Russian language and culture, as well as the traditionally strong pro-Russian sympathies of the majority of Crimeans and millions of inhabitants of eastern Ukraine, were the driving factors of such intentions (Bachmann and Lyubashenko, 2014; Slyvka, 2017).

The annexation of Crimea and the attempted detachment of Donetsk and Luhansk provinces, followed by their federalisation with Russia or takeover by Russia in other, less formal way, may lead to the total and permanent loss of control by the authorities in Kiev over the eastern part of their country. Paradoxically, this sit-

uation may in the future be beneficial to the geopolitical situation of Ukraine. The regions being broken off from the country are mostly inhabited by Russian-speaking population (not only Russians) with clear pro-Russian political leanings, as opposed to the national Ukrainian authorities in Kiev, and decidedly reluctant towards the EU and NATO. In the longer term, this may increase the political and national unity of the country, as well as facilitate its integration with the political, economic, and military structures of western Europe. But we should be aware that eastern regions of Ukraine, at present being under the conflict, were one of the most developed and industrialized parts of Ukraine.

It may, however, be assumed that Russian politics will aim at further destabilising the situation, fuelling armed conflict and the lack of regulation in the political and administrative status of separatist regions, which may effectively inhibit the European aspirations of Ukraine. Russia is not seeking to formally annex Donbas, as it did with Crimea, but will continue to fuel the conflict in order to pressure the Ukrainian authorities to abandon their pro-western aspirations and decide to integrate Ukraine with Russia within a Moscow-controlled organisation, such as the Eurasian Union. The refusal to do so will result in a permanent loss of control over the eastern, industrialised and resource-rich part of the country, as well as the progressing political and economic destabilisation of Ukraine (Mitrokhin, 2015; Katchanovski, 2016; Besier and Stokłosa, 2017; Slyvka, 2017; Vitale, 2017).

Moldova is another post-Soviet country torn by local separatisms. It is a historical part of Romania, annexed by Stalin, who also changed its borders to add, among others, a strip of ethnically Ukrainian land in the left bank of the former border river of Dniester. Moldova's break-away from the USSR, its declaration of independence and, above all, its closer ties with Romania in the early 1990s, pushed the Russians and Ukrainians in the left bank of the Dniester (Moldavans only amounted to approx. 40% of the population), to proclaim the Republic of Transnistria, independent of the authorities in Chișinău. The separatism of Moldavan Russians has been effectively politically supported by their foreign homeland, with a military support coming from the Russian 14th Army stationing there. The Republic has an unusual shape, since it extends over approx. 200 km along the river, forming a strip of land no wider than 25 km, but narrowing several times to under 5 km, with no sea access, and borders with Moldova and Ukraine. It is not officially recognised by any state, and its system, though constitutionally republican and democratic, is a *de facto* continuation of communism with some attempts at introducing elements of market economy. Despite these limitations, it has been functioning as a separate geopolitical entity for over 25 years, though it is politically and economically dependent on Russia. Transnistria is a classic example of successful secession and a state existing *de facto*, but not *de iure* (O'Loughlin, Kolossov and Tchepalyga, 1998; Sobczyński, 2010, 2013; Devyatkov, 2012).

6. POTENTIAL ETHNIC CONFLICTS

In addition to these three examples of ethnic conflicts, characterised by the use of military force, separatism, the desire to change the borders, and the interference of neighbouring countries, the area of Central and Eastern Europe under discussion also includes many regions, usually in the borderlands between countries, that may soon become core areas for further ethnic conflicts. This does not mean armed conflicts, although that cannot be excluded. Scenarios may vary – from declarations by political leaders and growing antagonism between the dominant nation and the minorities, through demands for autonomy, the emergence of separatist tendencies, to the formation of ephemeral geopolitical entities, and attempts at changing state borders. Ethnic conflicts may also be limited to psychological operations (creating the atmosphere of threat and fear) or involve symbolic violence (e.g. the devastation of relics, cemeteries, monuments, as well as the destruction of spiritual culture, customs, traditions).

This article attempts to identify regions in which ethnic conflicts of various types and intensity may occur (Fig. 2). When identifying them, the following criteria were adopted:

– location and geographical features in border regions;
– clear national diversity of residents, and, in particular, the residence of a national minority that is part of a dominant nation in a neighbouring country;
– a sense of discrimination among a national or ethnic minority caused by the actions of state and local authorities (including limiting political, linguistic, educational, and cultural rights);
– the reluctant or hostile attitude of the dominant nation towards minorities what results in a sense of danger among the minority group;
– negative, often tragic, historical experiences of mutual ethnic and political relations of the dominant nation and the minority group;
– destabilising influence of the authorities of a neighbouring state (among others: using the national minority in current foreign and internal policy, fuelling local and regional conflicts, and supporting separatist movements and organizations).

Not all of these factors must occur simultaneously. Internal ethnic conflicts (within one state) most often arise from the sense of discrimination and threat of the minority group by the dominant nation or the country of residence, and are the result of historical resentment, prejudice, and cultural stereotypes, as well as an element of the current political competition between the country of residence and the foreign homelands of individual nationalities (Budyta-Budzyńska, 2010). The location of multi-ethnic conflict areas in border regions, often inhabited by ethnic minorities being part of the dominant nation in the neighbouring country, may very easily transform such disputes into external and multinational conflicts (Moraczewska and Janicki, 2014).

One state very susceptible to such a threat is Ukraine (Fig. 2). This is mainly due to the weakening of state structures caused by the entanglement in a conflict with

Russia, as well as the wide ethnic, religious, economic, cultural, social, and mental differences between regions due to historical and geographical circumstances (Korostelina, 2008; Sobczyński and Barwiński, 2013; Besier and Stokłosa, 2017).

Fig. 2. Ongoing and potential ethnic conflicts in border regions of Central and Eastern Europe
Source: own work.

6.1. Eastern Galicia

Owned by Poland from the mid-14th to the late-18th century, then by Austria and again Poland in the interwar period, it is inhabited by the part of the Ukrainian nation most aware of its identity and distinctiveness, with the greatest tradition

of fighting for independence, and strong nationalist tendencies. It is currently the most pro-European and the least pro-Russian part of Ukraine, with multigenerational tradition of *opposition to Polishness*, serving as the cradle for anti-Polish organisations. This region, in every respect (national, cultural, mental, social, historical, economic) differs significantly from eastern Ukraine. It is mostly inhabited by Polish minority, as well as Armenians and Russians. It is a community with a rich sense of Polish identity, with clear national and religious separateness, brutally affected by the terror of Ukrainian nationalists in the 1940s. The current Ukrainian-Russian conflict understandably intensifies nationalist attitudes in the Ukrainian society, especially in western Ukraine. The glorification of the Ukrainian Insurgent Army (also by the authorities), and the emphasis of nationalist symbols in the public space is common in Eastern Galicia, even though in the current political situation directed against Russia and Russians, not Poland and Poles, it is very negatively perceived by the Polish minority, increases the sense of threat, and the growing distrust in the Ukrainian society and state. Poles in Eastern Galicia are demographically and politically too weak to oppose Ukrainian nationalism. Polish government is also not eager to actively support and defend the Polish minority in Ukraine since it supports Ukraine in its conflict with Russia. Some activities, however, mostly from local authorities in Eastern Galicia, are increasingly annoying for Warsaw. As a consequence, and paradoxically, the most pro-European and anti-Russian region of Ukraine, directly bordering Poland, is also the most anti-Polish, as far as the attitudes of part of its population and local authorities are concerned, and the Poles living there are feeling more and more threatened and undesirable.

6.2. Transcarpathia

It stands out from the modern Ukraine with its completely different political history – several centuries of affiliation with Hungary (till the end of the First World War, in the frame of Austro-Hungarian Empire), then Czechoslovakia (during the interwar period, to 1940), Hungary again during the Second World War and, starting in 1945, with the USSR, and after 1991 to Ukraine. Its cultural and ethnic distinctiveness (with numerous Hungarian, Romanian and Ruthenian minorities), as well as its shortest, along with Crimea, political and legal affiliation with Ukraine, are clearly visible. During the last 25 years, Transcarpathia experienced several appearances of autonomy movements from the Ruthenians (or, more specifically, the activists of Ruthenian organisations), though with no foreign support and little activity from the Ruthenians themselves, their operations did not bring any permanent effects. Yet such effects may potentially come from the operations of Hungarian authorities. The Hungarian minority is the most active and well-organised ethnic group in Transcarpathia, with a strong sense of national and linguistic

autonomy, repeatedly making demands for the autonomy of the region (Kocsis and Kocsis-Hodosi, 1998).

Hungary can give, according to the national law, Hungarians living abroad a second (Hungarian) citizenship to anyone who apply for it and whose ethnic roots might be proven as Hungarian. In 2014, during the political and military conflict between Ukraine and Russia, president Viktor Orban demanded dual citizenship for Hungarians in Transcarpathia, as well as autonomy for the region. Based on historical territorial claims and further activation of local Hungarian minority, the government in Budapest may use the current weakening and the engagement of Ukraine in its conflict with Russia in the eastern provinces to attempt to destabilise this small, extremely western (geographically speaking) region of Ukraine, isolated by the arch of the Carpathians. Active support for the Hungarian minorities in Slovakia, Ukraine and Romania, frequent use of nationalist Hungarian rhetoric and, above all, numerous pro-Russian speeches and gestures of Viktor Orban make such a scenario more likely, albeit difficult to imagine in the current geopolitical circumstances.

6.3. The Baltic states (Lithuania, Latvia, Estonia)

The independence of the Baltic states, despite their complicated ethnic structures, was proclaimed, unlike the Balkans or the Caucasus, without ethnic wars. Apart from a good economic situation, one of the reasons for that could be the relatively short residence and immigrant nature of the most numerous minority, namely Russians. Therefore, in the 1990s, in the societies of the Baltic states, there were still no historically motivated animosities, myths or symbols that so effectively divide the multi-ethnic, indigenous communities of Balkans, Ukraine, Caucasus and other places. The fear of ethnic minorities of the dominant majority is also significantly smaller than in other regions of Central and Eastern Europe (Kaufman, 2001; Kowalski and Solon, 2008; Janicki, 2009; Mole, 2012; Vitale, 2015).

This does not change the fact that the majority of Russians living in the Baltic states was opposed to their independence. Despite the 25 years that have elapsed since, a large portion of the Russian minority are still stateless, as they boycotted the legal way towards citizenship, which involved, among others, passing an exam in Estonian, Latvian or Lithuanian language, which they know very poorly, if at all, and which significantly limits their ability to integrate (Duvold and Berglund, 2014). In addition, the contemporary political events, and especially the attitude towards the Russian intervention in Georgia and Ukraine, clearly deepened the divisions between Russians and Balts, significantly contributing to the increase in mutual distrust and a sense of threat.

The Baltic states are an example of the occurrence of an ethnic conflict, which is mainly the result of instrumental use of a minority in politics by the

country of residence, as well as the country of origin (foreign homeland). Russia systematically, since the early 1990s, has interfered with the internal affairs of Lithuania, Latvia and Estonia under the pretence of protecting the rights of the Russian minority. In turn, the authorities of Baltic states often blamed the representatives of the Russian minority of disloyalty, hostility, as well as autonomy or separatist pursuits, due to the influence from Moscow among the minority. Such accusations were often valid. Russia still considers these states as their zone of influence, a part of the post-Soviet space, proving multiple times that it can effectively interfere with the internal affairs of sovereign states by sparking and strengthening ethnic conflicts (Zvidrins, 1998; Levinsson, 2008; Gaponenko, 2013; Duvold and Berglund, 2014; Vitale, 2015). In the case of potential further deterioration of the situation in Ukraine, this may lead to strong reactions from the governments of the Baltic states, which may consider the Russian minority agents of a hostile country and deport them or limit their rights. This will certainly be met with a strong counter from Russia.

The situation in Lithuania is slightly different, as the Russian minority is small, with Polish minority, concentrated in Vilnius and the rural regions of eastern Lithuania, playing the same role that Russians do in Estonia and Latvia. It was opposed to Lithuanian independence and, in the face of its proclamation, tried to establish an autonomous region. Despite 25 years have passed, it remains the minority most conflicted with the Lithuanian state. Many problems experienced by the Poles in Lithuania are exaggerated by Polish organisations, as well as Lithuanian media and authorities, then used by both sides in their political propaganda. However, some problems exist objectively. Before the Russian aggression in Ukraine, negative relations between Poles and Lithuanians were one of the main Lithuanian conflict topics, but now Russian foreign policy became a far more pressing issue. For Polish organisations, the maintenance of the atmosphere of conflict and threat, the escalation of demands and requests, is still one of the main methods of increasing their influence and support among Poles living in Lithuania, in order to effectively persuade them that Polish organisations are the only institutions that care for their interests and protect them against Lithuanisation (Kowalski, 2008; Leśniewska, 2013; Leśniewska-Napierała, 2015; Norkunaite, 2016).

The behaviour of the Polish community in Lithuania in the early 1990s was, among others, the result of the wrong policy of local Polish leaders, which in turn stemmed from their incorrect assessment of the geopolitical situation in Central and Eastern Europe. Decisions made back then continue to reverberate in the Lithuanians' distrust in the Polish community. Sadly, the political mistakes of the early 1990s may now be repeated in completely different geopolitical circumstances.

For several years now, the leaders of the biggest Polish organisations in Lithuania have been leading a clear and consistent pro-Russian policy, which involves,

among others, close coalitions with Russian minority's political parties, criticism of Vilnius' and Kiev's policies concerning the conflict in Ukraine, while supporting Putin. Such operations are calculated, among others, to increase support from Russian electorate for Polish political parties in local and parliamentary elections. This current election strategy may in the long term be extremely costly in political terms (Barwiński and Leśniewska, 2014; Leśniewska-Napierała, 2015; Janusauskiene, 2016).

In the context of the conflict in Ukraine, which is perceived in Lithuania as a direct threat of Russian aggression, pro-Russian political activities of the leader of Polish minority are met with extremely negative reactions from Lithuanian authorities and the society, thus increasing mutual antagonisms and distrust, and causing new divisions to appear. There is also a risk of Russia using the Polish minority in Lithuania, especially Polish political and local government activists, to conduct operations against Lithuania, in order to destabilise its internal situation.

Along with the belief of disloyalty of the largest ethnic minorities (Russian and Polish), the fear of an external threat to state sovereignty does not bode well for the resolution of ethnic problems accumulating for the last 25 years in Lithuania, Latvia and Estonia.

Further developments in the Baltic states will mostly depend on the character of ethnic policies of the authorities of these states, as well as the foreign policy in Russia. If the authorities limit the formal and legal activities perceived as discriminatory by ethnic minorities (especially those concerning language), and decide not to escalate the hostilities between state nations, Russians and other minorities, and Russia concentrates on their operations in Ukraine, there should not be any intensification in this conflict, especially not military in nature. The fact that the Baltic states (unlike Ukraine or Moldova) belong to NATO is of paramount importance, as any potential military operations on their territories might cause unforeseen repercussions (Janicki, 2009).

6.4. Silesians in Poland

Ethnic conflicts may also occur when a group heretofore considered regional begins gaining awareness of their own distinctiveness and voice national ambitions. The recognition of a regional group as a nation, or at least an ethnic minority, has some very serious legal, social, and political consequences since, among others, national and ethnic minorities enjoy wider political, administrative, financial, linguistic, and cultural rights than regional groups (Budyta-Budzyńska, 2010).

This type of situation exists in many regions of Europe, including Poland, where the political and national aspirations of regional groups, mainly Silesians and Kashubs, correlated with the dynamic growth of their populations and diver-

sity, has been intensively growing since the beginning of the 21st century. This tendency is met with opposition from political and administrative authorities, as well as a portion of the Polish society, who negate the national distinctiveness of regional groups, especially the most numerous one, i.e. Silesians.

During the last census in 2011, Silesians dominated the structure of minority communities in Poland in terms of population. More people declared Silesian nationality than any other non-Polish ethnic and national identifications (almost 850 thousand Silesians, of the total of under 1.5 million people declaring non-Polish nationality). That confirmed their dominant position from the previous census in 2002, but the growth in numbers was largely caused by the politicisation and promotion of Silesian nationality, as well as increased activity of Silesian organisations. As a result of the effort by Silesian activists and multiple court appeals in 2012, an Association of People of Silesian Nationality was registered, which still did not resolve the formal and official recognition of Silesian nationality, if only because at the end of 2013, the Supreme Court found that Silesians cannot be considered a separate nation (Barwiński, 2014).

Silesians are a typical example of a borderland community, in this case between Poland, the Czech Republic and Germany. The sense of Silesian national autonomy was shaped as a result of geographical, political, and economic references to the historical big and the small (regional) homeland of Silesia, marked by changing national affiliations and the resulting cultural influences of three main nations – Poles, Germans and Czechs. The influence of these cultures intersected most often in the area of Upper Silesia, where the population identifying as Silesians is now concentrated. The choice of their own national option by Silesians is also influenced by the attitudes of their Polish surrounding (both authorities and the society), which exhibit a lack of trust and understanding, thus increasing the mobilisation in the community (Heffner, 1998; Szajnowska-Wysocka, 2003; Rykała and Sobczyński, 2016).

That increased sense of distinctiveness and national identity, as well as the increasing declarations of Silesian nationality among Upper Silesians, has not changed its legal status. Despite the fact that Silesians meet all the conditions prescribed by the Polish law for a community to be recognised as an ethnic minority, and, according to the latest censuses, are the most populous minority group in Poland, they are still not an officially recognised ethnic minority and the Silesian language (used by over 530,000 people according to the census) still does not have a regional language status, unlike Kashubian (approx. 108,000 people). This is solely dictated by political reasons, the ignorance of the authorities and their reluctance to perceive regional groups in national categories, despite clear auto-identification of Silesians. Such a situation causes growing frustrations, a sense of marginalisation, and rejection, which result, among others, in increasing demands of national autonomy of Upper Silesia. This may lead in the future to some radicalisation of Silesian attitudes and, furthermore, to the emergence of isolation-

ist and separatist movements in this most populated and industrialised borderland region of Poland. As we have seen numerous times in history, in this case the politicians' actions may have the opposite effect.

6.5. Hungarians in Slovakia

There are some 0.5 million Hungarians living Slovakia, constituting the largest national minority, concentrated geographically in the south of the country, along the Slovak-Hungarian border, where many administrative units dominated by Hungarians are located. Such a distribution is a consequence of the centuries-old affiliation of this region with Hungary, as well as border arrangements following the First World War. Therefore, the Hungarians in Slovakia are a typical example of a national minority constituting a fragment of a neighbouring nation, which had previously conquered and dominated the nation, among which it today resides. In such a situation the relations between the majority and minority are usually not good. Mutual animosity is prevalent, as are recollections of past harms, numerous negative stereotypes, and the fear in the dominant nation that the minority lacks loyalty for their country of residence and is being used by their foreign homeland (Koter, 1993, 1995). Such fears are to a large extent justified in the case of Slovak authorities and the society. The Hungarian minority is numerous, territorially concentrated, has a very strong sense of national identity and autonomy (especially linguistic), is well organised, with a high social position and awareness that there is a real foreign power that is able to take care of their interests (Gyurcsik and Satterwhite, 1996; Kocsis and Kocsis-Hodosi, 1998; Istok, 2003). Therefore, since the early 1990s, it has been active numerous times with demands of autonomy, as well as others, while Budapest was persistent in their support for such claims. The situation of the Hungarian minority in Slovakia has been continually the main reason for diplomatic disputes between Bratislava and Budapest for years. The mutual perception of reality by the Slovaks and Hungarians has not been significantly changed by the political integration of the borderland as part of the European Union and the Schengen Agreement (Malova and Vilagi, 2006). The main causes are the progressive growth of nationalist and populist sentiments in these countries, reflected in the radicalisation of attitudes in both and among their authorities. For both Hungarian and Slovak nationalists, the Hungarian minority living in the borderlands is a convenient element in their political games (Lugosi, 2011).

The Slovak-Hungarian conflict concerning the Hungarian minority proves that historical events may significantly shape contemporary politics as well. Although no one in Budapest speaks out about the possible annexation of southern Slovakia by Hungary, just as no one in Bratislava claims that Slovakia is afraid of such an event, both governments act as if these were the motives behind their actions.

7. CONCLUSIONS

Ethnically motivated separatist tendencies, along with the prevalent growth of nationalist sentiments, are currently the main reason for conflicts (including military ones) in Europe, as well as formal and informal border changes, both the latest ones (the Balkans, Transnistria, Kosovo, Crimea, eastern Ukraine), and potential ones, such as Bosnia and Herzegovina (Republika Srpska), United Kingdom (Scotland), Belgium (Flanders), or Spain (Catalonia). It can be assumed that many European regions that are highly ethnically diverse are bound to play an increasingly destructive political role in the following decades. However, the crucial conflict factor is not the simple distribution of ethnic minorities or the fact of the sheer existence of an ethnically diverse region, but how the minorities are treated by politicians, both in their country of residence and of origin, as a bargaining chip in interstate relations, as well as the political ambitions of minority leaders.

In the 1990s, one of the main factors that destabilised the situation in the Balkans was the distribution of Serbian population in former Yugoslavian states, by then aspiring to independence, as well as the political and military support from Serbia. In the first decades of the 21st century, a similar role, albeit in clearly different geopolitical and military circumstances, is played by the Russian population living in large numbers in former Soviet republics and being used by the authorities in Moscow for Russian political, geopolitical, and economic purposes. The Russian minority in Ukraine, in the Baltic states and Moldova is a convenient pretext for Russia to interfere in the internal affairs of these states, and to exert pressures on international public opinion.

Ethnically motivated separatist movements and the changes in European borders in the 1990s were happening within the territories of individual countries and were in fact transformations of their internal structures. The annexation of Crimea by Russia in 2014 was the first case of a border change in Europe at the expense of a neighbouring country after the post-Second World War delineation of borders. In addition, it was the first post-WWII forced annexation of a territory of a European state. This is an extremely dangerous tendency, which is also totally contrary to international law.

Equally dangerous is the new method of conducting ethnic conflict, successfully applied by Russia in Crimea and Donbas, the so-called *hybrid war*. It involves pro-Russian separatists starting an armed conflict with the participation of Russian special forces as "green men" (well-armed and trained soldiers without any distinctions, concealing their state affiliation), followed by hidden military involvement of Russian land and air forces. Apart from Ukraine, Russia may also use such tactics in the Baltic states, Belarus, Moldova or Kazakhstan.

The events in Ukraine, earlier in Georgia, clearly show the huge role that the area of the former USSR plays in Russian foreign policy, as well as Russia's de-

termination to protect their interests in the region, even at the cost of significant deterioration of political and economic relations with the West. One of the geopolitical objectives in modern Russia is the restoration of the influence in the former USSR republics, and one of the ways to achieve that is to use the Russian minority living there. A large portion of Russians, as well as Russian authorities, believe that one of the most important tasks should be to defend the rights of Russian speakers against the hostile, at least in their opinion, operation of institutions and administrations in the countries they live in. Russians are getting more and more convinced that the majority of the world, Europe especially, is hostile, aggressive and determined to destroy Russia. Such a message dominated Russian-speaking TV channels, but also in Russian social media, also popular in Ukraine or the Baltic states. The vulnerability of the Russian minority, as well as other minority groups, to Russian propaganda, with its resulting radicalisation, poses a real threat of destabilisation of the socio-political situation, especially in countries bordering Russia.

The temptation to use the representatives of one's own minority living outside of the motherland is obviously not limited to Russian politicians. This may also be seen in Hungary, as well as in Polish-Lithuanian or Polish-Ukrainian relations over the last 30 years. The use of ethnic minorities in borderland regions by politicians is extremely dangerous and conflict-prone. Often such activities are designed to distract their own people from internal problems. Searching for enemies and problems abroad, and fuelling nationalist sentiments serves to consolidate the society and boost support for the authorities. National minorities have remained for many years one of the favourite subjects for populist politicians in times of political or economic crisis.

We can only hope that politicians realise that creating ethnic conflicts usually does not serve the representatives of ethnic minorities. But do the politicians even care for ethnic minorities? They most often simply use their situation for their own gains.

Then again, ethnic conflicts, usually undesirable and destabilising, especially from the point of view of state authorities and the dominant nationality, may from the minority's perspective play a positive role of uniting, integrating and mobilising a group, according to the rule that "nothing unites like a common enemy". By becoming, over time, part of the national mythology and common heritage, crises and conflicts reinforce and activate the sense of autonomy, identity, and internal integration. Moreover, ethnic conflicts are often not the result of discrimination against ethnic minorities, rather the contrary: the awareness of their influence and opportunities. A threat of conflict is maintained on purpose, as it is a form of pressure on the dominant group, or the authorities in a given country or region. The threat of destabilisation of the existing political, social or economic order is a way to achieve additional rights and privileges by a minority community. The result is not about the conflict itself, but rather the creation of a permanent threat of one.

The threat of rebellion is a tactic of struggle for privileges (Budyta-Budzyńska, 2010). We should also remember that minorities have a natural tendency to escalate their demands and exaggerate their problems, a kind of hypersensitivity, functioning in the so-called "besieged fortress" syndrome.

One solution for many real and potential conflicts is to move away from any form of discrimination, guarantee full right for all minorities (including linguistic and political ones) and, in some cases, granting autonomy, not only cultural, but also administrative and territorial. However, territorial autonomy is associated with legitimate concerns in some governments and dominant nations of federalisation, which would lead to more intense separatisms and territorial disintegration. The recent history of Central and Eastern Europe provides a great number of proofs to support such a thesis. Therefore, full loyalty of ethnic minorities towards their countries of residence is another prerequisite for stabilisation. In the part of Europe where history still divides rather than unites nationalities, these are truly difficult to achieve at the same time.

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IDENTITIES WITH HISTORICAL REGIONS – ARE THEY ADAPTING TO MODERN ADMINISTRATIVE DIVISION? THE CASE OF UKRAINE

Abstract. Historical regions remain the most common basis for the formation or promotion of regional identities in Europe. However, regions and regional identities are in the process of constant formation and can change significantly in line with new conditions. In this paper we focused on the changes of the spatial spread of identities with historical regions in Ukraine in comparison to the initial boundaries of those. The results show that identities with historical regions are markedly adapting to modern administrative boundaries. At the same time, the symbolic value of historical regions constitutes an essential element of identity building in contemporary administrative regions.

Key words: regional identity, historical regions, administrative regions, ergonyms, identity transformation.

1. INTRODUCTION

Europe has always been the continent of regional identities (Applegate, 1999). During the last three decades, Europe experienced a particularly dramatic increase in the role of regions as economic, cultural, and administrative units, growth of their material and symbolic capital. Regions receive more and more resources and powers transmitted from the state level; they increasingly become subjects of international relations and a competitive struggle (Keating, 1998; Boisen *et al.*, 2011; Terlow, 2012). In some cases (Catalonia, Scotland, Flanders, etc.), developed political regionalism leads to separatism, threatening the integrity of the existing states. That is why the question of regional identity,

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its essence, sustainability, and the role in the formation and reproduction of the regions remains at the top on the agenda.

Researchers in European regionalism started to pay more attention to ethnic and socio-psychological aspects rather than to political centres and regimes (Rokkan and Urvin, 1982). Schmitt-Egner (2002) outlined the understanding of a region as a historical landscape with collective historical memories. Historical regions, i.e. areas characterised by socio-cultural (including ethnic, ethnographic or linguistic) unity and/or limited to political or administrative boundaries in the past, remain the most common basis for the formation or promotion of regional identities in Europe. The European decentralization experience allows us to consider identity as an instrument of regional integration. At the same time, there are several options for the correlation of the grid of such historical regions and the modern administrative system: the boundaries of historical regions can be fixed by the existing administrative division (e.g. federal lands in Germany, autonomous regions in Spain), partly taken into account (voivodeships in Poland) or ignored (Czechia, Ukraine). In the last example, such regions may exist informally without officially recognised names, boundaries, institutions, and symbols.

Ukraine is one of the few major European countries where the administrative division, inherited from the Soviet era and, as in most post-socialist states, aimed at the development of a centralised state (Yoder, 2003), ignores the boundaries of large historical regions. Most researches dealing with the regionalisation issue in Ukraine applied to the political differentiation and electoral patterns, focusing on explaining regional differences using cultural and/or socioeconomic factors (Birch, 2000; O´Loughlin, 2001; Barrington and Herron, 2004; Yakymenko and Lytvynenko, 2006; Clem and Craumer, 2008; Barrington and Faranda, 2009; Melnykovska, Schweickert and Kostiuchenko, 2011; Liashenko and Putrenko, 2011; Osipian and Osipian, 2012; Katchanovski, 2014). Then, the influence of historical regions and borders remains definitely underestimated. However, in recent years, some works were published explaining the effect of "phantom borders" on the current social structure and political regionalisation. The analysis performed by Jelen and Dostál (2017) partially confirmed the existence of phantom boundaries in Ukraine's political and cultural-demographic aspects. Peisakhin (2013) shows differences in political views and other life attitudes along the historical border of the Austrian and Russian empires, dividing historical regions of Galicia, Bukovina, Volhynia, and Podolia. Gentile (2017) also studied the influence of former political borders on political and ideological division in Ukraine; however, he revealed local peculiarities of geopolitical orientations among citizens of Luhansk and Stakhanov criticizing the total homogenisation of Ukrainian regions (Gentile, 2015). By studying the symbols and monuments in two villages on opposite sides of a historical border in Western Ukraine, Löwis (2017) questioned traditional statistical correlations between electoral and linguistic or historical maps and shed light on the ambivalence of spaces of identification and the ties that those village communities entertain with history.

Since Ukraine's declaration of independence in 1991, there were repeated calls for a change of the existing administrative division by consolidating existing first-level administrative units (oblast) or creating additional macro-regional level of governance (Popovkin, 1993; Zastavnyi, 1994; Dorohuntsov and Fedoryscheva, 1996; Dolishniy *et al.*, 1997; Palamarchuk and Palamarchuk, 1998; Dolishniy, Kravtsiv and Symonenko, 2002; Symonenko, 2002; Dotsenko, 2003; Pistun and Melnychuk, 2010; Oliynyk *et al.*, 2015). It is worth noting that the network of historical regions was taken into account, to a greater or lesser extent, in determining the names and boundaries of the new macro-regions proposed. Some researchers associate the success of the decentralisation reform in Ukraine with the success of the formation of new local identities (Kotenko and Tkachuk, 2016).

Significantly, the Ukrainian national administrative-territorial system could be compared to the EU NUTS system in this way. At present, the first-level units (oblasts) are comparable to NUTS 2; the second-level units (raions) are significantly smaller in terms of population than standard NUTS 3 units, but the consolidation of raions, which brought them into line with the NUTS 3 standard, has already begun in the framework of the on-going decentralisation reform. However, there are currently no NUTS 1 regions (with a population of 3 to 7 million) in Ukraine. This gap could be filled just by creating a macro-regional level, including on the basis of historical regions.

Leaving the economic and political feasibility of such regional consolidation out of the framework of this paper, we may, however, pose a question: how justified and adequate is equating of the proposed macro-regions with the historical ones? Are historic regions a real basis for creating a network of new macro-regions, or are they just phantoms that may not be taken into account? And if they really exist, then what their essence is, including the actual limits. After all, the facts suggest that regions and corresponding identities are in the process of constant formation and cannot be tightly bound to one "correct" identity or to a specific historical period (Paasi, 1986a, 2002; Gilbert, 1988; Murphy, 1991). The "old" identities with historic regions can change significantly in line with new social, political, and economic conditions, increasingly combining both traditional and new elements that determine their dynamic and network character, temporariness of configuration, orientation rather on the needs for future development than on the historical tradition (Terlow, 2009, 2012; Terlow and van Gorp, 2014). Paasi (2001) expressed the opinion that the European regions are more likely to be the result of actual regionalisation processes than historical and cultural entities. Thus, the real perception of historical regions by their inhabitants is in question (Vaishar and Zapletalová, 2016). Moreover, while local identities formed on the basis of personal experience and individual contacts, regional identities require indirect communication between people by means of the media, political parties or other social institutions (Anderson, 1983), and, therefore, are strongly related to these institutions.

Chromy *et al.* (2004), investigating regional identity in Czechia, came to the conclusion that the traditional historical regions are quite stable in the collective memory, but this statement does not apply to certain parts of their borders: the cores of historical regions are clearly defined, while their external boundaries are unclear. In fact, the outer boundary of the identity with a historical region is often coinciding with modern administrative boundaries. Šerý and Šimáček (2012), as well as Vaishar and Zapletalová (2016), came to a similar conclusion. Studying historical regions of Małopolska (Lesser Poland) and Śląsk (Silesia) and similarly-named present-day voivodeships, Nowak (2018) concluded that old cultural and historical divisions are still important for the people, but the possible economic advantages seem to prevail. A recent study in Ukraine showed that the majority of the population of the three administrative oblasts retains self-identification with historic regions (Melnychuk and Gnatiuk, 2018). Simultaneously, in some areas, due to an alignment of a certain administrative region with a certain historical region in the public discourse, the spread of identity with another historical region (which had nothing in common with the area) takes place. The authors named such identities as hybrid because they combine both traditional and new elements of identification. A similar phenomenon on a smaller spatial scale was also noted in Czechia (Vaishar and Zapletalová, 2016). Turning back to Ukraine: Gomaniuk (2016) found that the historical region of Tavria/Taurida is nowadays publicly linked predominantly to only one modern administrative region (Kherson oblast).

How universal is this phenomenon? The answer requires testing considering more historical regions and in a wider spatial context. Therefore, the purpose of this paper was to determine the changes of the spatial spread of identities with historical regions in Ukraine in comparison to the initial boundaries of these regions, as well as to clarify the role of the current administrative division in this transformation.

2. DATA AND METHODS

Ukraine is one of the largest countries in Europe, located within several natural regions and relief macrostructures. For a long time, the territory of Ukraine was divided between neighbouring states, being cut by interstate borders. Each of these states had its own administrative system, often stable for several centuries. Due to differences in geographical locations, conditions, and availability of resources, different parts of the country have different economic specialisations. All these factors (landscape diversity, political fragmentation, persistent historical administrative division, and the differences in economic specialisations) created the prerequisites for the formation of large historical regions of different origins.

For the analysis, we selected 7 historical regions of Ukraine: Galicia, Podolia, Volhynia, Bukovina, Slobozhanschyna, Polesia, and Donbas. The first five regions from this list are political ones, that is, they existed in the past as the relevant administrative units or were separated from the rest of the country by state borders. Polesia is primarily a landscape region, represented by the zone of mixed forests, and never existed as a separate administrative or political unit. Donbas is an economic (industrial) region shaped on the basis of the Donetsk coal basin. However, political and industrial regions have certain cultural (ethnographic, in particular) specificity of the local population, as well as landscape features, which are often expressed in macro-relief toponymy (Podolian and Volhynian Uplands, Donets Ridge, etc.). Thus, there are many criteria for delineating the borders of a region, and all of them are important for the formation of regional identity (Keating, 2004; Zuefle, 2004). As a rule, regional boundaries, drawn according to different criteria (political, ethnographic, natural, economic), do not coincide. Thus, a historical region does not have unambiguously defined borders; instead, one may identify the core of the region where most of the criteria are fulfilled, and the peripheral part, where only some of them are true.

Therefore, in order to define the boundaries of historical regions for this research, we proceeded from the basic genesis of a region (political, landscape, or economic). In the case of political regions, we tried to outline relatively the most stable boundaries of an area once included into the respective administrative units.

Thus, we used the following boundaries of historical regions:

1. Galicia: stable boundaries of the Kingdom of Galicia and Lodomeria as part of the Habsburg Monarchy, the Austrian and Austro-Hungarian Empires (1772–1918).
2. Podolia: maximum limits of Podolian (1434–1793) and Bratslavian (1566–1793) voivodeships of the Polish-Lithuanian Commonwealth and Podolian Governorate of the Russian Empire (1797–1925).
3. Volhynia: maximum limits of the Volhynian voivodeships of the Polish-Lithuanian Commonwealth (1566–1795), the Volhynian Governorate of the Russian Empire (1795–1925) and the Volhynian voivodeship of Poland (1921–1939).
4. Bukovina: borders of the Duchy of Bukovina within the Habsburg Monarchy (1849–1918).
5. Slobozhanschyna: borders of 5 Sloboda Cossack regiments (1651–1765).
6. Polesia: limits of the landscape zone of mixed forests.
7. Donbas: boundaries of the Donetsk Coal Basin (roughly coinciding with the limits of the Donetsk industrial region).

The boundaries and names of modern first-level administrative units (oblasts and cities with special status) are shown in Fig. 1. The modern administrative system practically does not take into account the boundaries of historical regions, although it reflects some historical boundaries of the 20th century (e.g. the state borders between the USSR, Poland, Czechoslovakia, and Romania in 1920–1939)

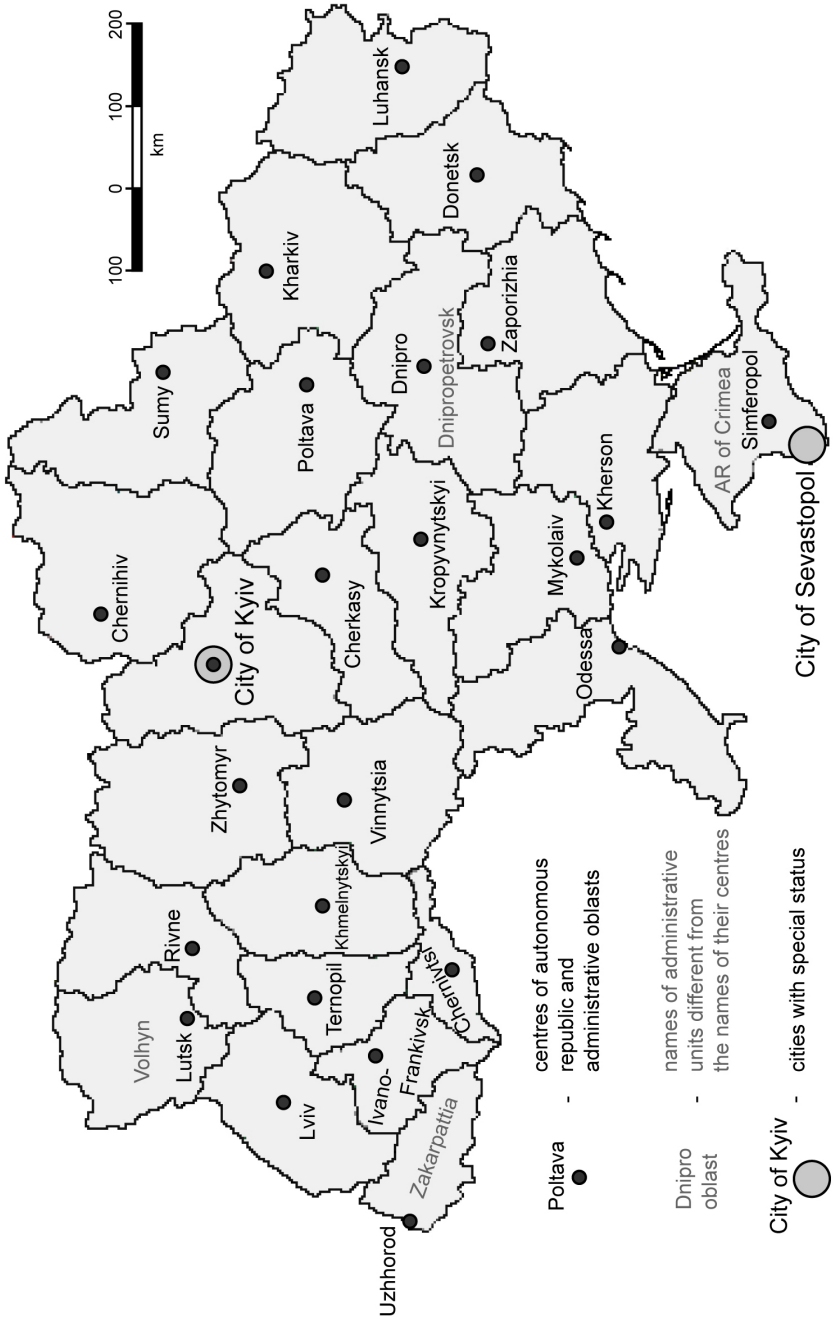

Fig. 1. Borders and names of modern administrative regions (oblasts) of Ukraine

Source: own work.

Unquestionably, a direct population survey could provide the most exact and precise data on actual regional identity. However, the labour and time-consuming nature of this method pushed us to use the so-called regional identity markers – artifacts, sociofacts, and mentifacts, indirectly indicating how people identify with a place or region, enabling one to study the present state, and (if several time sections available) the dynamics of identity, including its spatial patterns. In literature, identity markers are often defined as characteristics or attributes used by people to distinguish one area from another (Simon *et al.*, 2010). These markers could be different kinds of place names, names of private enterprises and institutions, local media, trademarks and brands, commemorative signs dedicated to famous local personalities or important historical events, spatial behaviour of people, including movement of goods and information across the territory (mainly various non-governmental services), residential patterns of local sports teams' fans, electoral behaviour patterns, etc. In particular, the role of toponymy as a regional identity marker was clarified in numerous theoretical and empirical contributions (e.g. Guyot and Seethal, 2007; Pavliuk, 2007; Botolv, 2009; Jordan, 2010, 2012; Bucher *et al.*, 2013; Woodman, 2014; Weaver and Holtkamp, 2016; Gnatiuk, 2018; etc.).

Thus, in this study the current limits of the spatial spread of identities with historical regions were defined using such identity marker as ergonyms – the names of private enterprises and institutions. This category of place names constitutes a dynamic subsystem of toponymy, representing a strong link to the present state of regional identity and allowing tracing its temporal changes. The feasibility of ergonyms in regional identity studies was tested by Melnychuk *et al.* (2014). A comparison of those results with the results of a direct sociological survey in three Ukrainian oblasts (Melnychuk and Gnatiuk, 2018) proved a high reliability of this marker: the areas where respondents identified with a certain historical region, in general, coincided with the areas of continuous distribution of the corresponding ergonyms.

The on-line directory of Ukrainian enterprises and organizations UA-REGION (https://www.ua-region.com.ua/) was used to create the database of ergonyms. The database included ergonyms derived from the names of selected historical regions: actual names of regions, basic adjective forms and regional identifications of the inhabitants. Only names given by free choice of the owner or the management were selected for the analysis. In particular, we eliminated official names of executive authorities, local self-governments and communal (municipal) enterprises, as their origin is explained by administrative factor only. Such restrictions were extremely important in cases when the name of a historical or landscape region corresponded to the name of a contemporary administrative unit (e.g. historical Volhynia and modern Volhyn oblast; region of Polesia and Poliskyi raion in Kyiv oblast, etc.)

The database was checked and cleared of any repeating and doubtful items. Then each ergonym was linked to respective administrative units (oblasts and raions). The following indicators were calculated on the basis of the database:

1. Representation (R) – the percentage of ergonyms associated with the historical regions, from the total number of ergonyms in the area (by raions).

2. Coefficient of territorial coverage (K_{Cov}) – the proportion of administrative raions with ergonyms associated with this historical region (by oblasts).

3. Coefficient of concentration (K_{Con}) – the percentage of ergonyms associated with the given historical region, concentrated in given oblasts (by oblasts).

The assumption was that the presence of ergonyms, semantically related to a certain historical region, pointed to the identity of the local inhabitants with a region. Mind you, those who identify with a historical region (as well as the corresponding ergonyms) may concentrate also in the basic destinations of migrants from the region concerned, first of all in large cities (Melnychuk *et al.*, 2014).

3. RESULTS AND DISCUSSION

Comparison of the territories of historical regions with the spatial pattern of the corresponding ergonyms (Fig. 2), as well as the calculated coefficients K_{Cov} and K_{Con}, (Fig. 3), indicated certain changes in the territorial distribution of identitification with historical regions. In particular:

1. The vast majority (91.3%) of Podolia-related ergonyms are concentrated in two oblasts – Khmelnytskyi and Vinnytsia, and are almost uniformly distributed throughout their territories, including those parts that never belonged to Podolia: the northern part of the Khmelnytskyi oblast, which historically always belonged to Volhynia, and the north-eastern part of the Vinnytsia oblast, which pertained to the Kyiv (Middle Dnieper) region. Podolia-related ergonyms are also evenly distributed throughout the territory of the Ternopil oblast, except for its northern Volhynian part, but their representation is rather low, with the exception of the extreme south-east, formerly a part of the Podolian voivodeship. However, Podolia-related ergonyms are virtually non-existent in other oblasts partially covered by the historical Podolia, namely north of the Odessa oblast, west of the Cherkasy and Kirovohrad oblasts, and southwest of the Kyiv oblast.

2. More than 90% of all Volhynia-related ergonyms are concentrated within one modern region – the Volhyn oblast, and are roughly uniformly distributed throughout its territory. Also, such ergonyms are present in the southern part of the Rivne oblast and the northern part of the Ternopil oblast. All those territories were part of the historical Volhynia. However, these ergonyms are practically absent in other Ukrainian areas covered by the historical Volhynia, including in the Zhytomyr oblast, as well as in the northern part of the Khmelnytskyi oblast.

3. Galicia-related ergonyms are concentrated (90.8%) in three oblasts: Lviv, Ivano-Frankivsk and Ternopil, and are evenly distributed across their territories, with the exception of the northern part of the Ternopil region, which historically belonged to Volhynia.

4. Almost all Bukovina-related ergonyms (80.2%) are located within the boundaries of the Chernivtsi region and are evenly represented in both its historical parts, belonging to Bukovina and Bessarabia respectively.

5. The main area of Slobozhanschyna-related ergonyms roughly coincides with the historical limits of the five Sloboda Cossack regiments, namely in the north and the centre of the Kharkiv oblast, the south of the Sumy oblast and the north of the Luhansk oblast. However, they also exist in the rest of the territories of the first two oblasts, which historically did not belong to Slobozhanschyna. Together, Kharkiv, Sumy, and Luhansk oblasts gather more than 90% of Slobozhanschyna-related ergonyms.

6. The distribution of Polesia-related ergonyms, in general, coincides with the limits of the mixed forest zone, but there are certain deviations. Corresponding ergonyms are evenly distributed throughout the Zhytomyr and the Chernihiv oblasts, including their southern forest-steppe parts. However, in the Kyiv and the Sumy oblasts, the southern boundary of their distribution almost coincides with the boundaries of natural zones, and in the Rivne oblast the majority of ergonyms is concentrated in its northern part with a lack of Volhynia-related ergonyms.

7. Donbas-related ergonyms are generally confined to the territory of the Donetsk Coal Basin. However, they are also present in adjacent areas, in particular scattered throughout the whole Donetsk oblast and the northern part of the Luhansk oblast.

Based on these findings, three types of areas can be distinguished for each historical region:

1. Status Quo areas: territories belonging to given historical region in the past and retaining a sufficiently strong identity with it.

2. Lost areas: territories that belonged to a historical region in the past, but lost (or have been losing) the corresponding identity, including cases when people began to identify with other historical region.

3. Gained areas: territories that did not belong to a historical region, but developed (and gradually strengthen) the identity with it.

Fig. 4 represents the status quo areas, lost areas, and gained areas for each of the historical regions analysed. Those are rather generalised synthetic schemes not based on accurate calculations at the level of raions and neglecting local trends, which sometimes differ significantly from the general picture. However, these schemes clearly show the last century's tendencies of changing the boundaries of areas where identities with historical regions are observed. They demonstrate that identities associated with different historical regions existed in different circumstances due to the pattern of modern administrative divisions. Historical regions

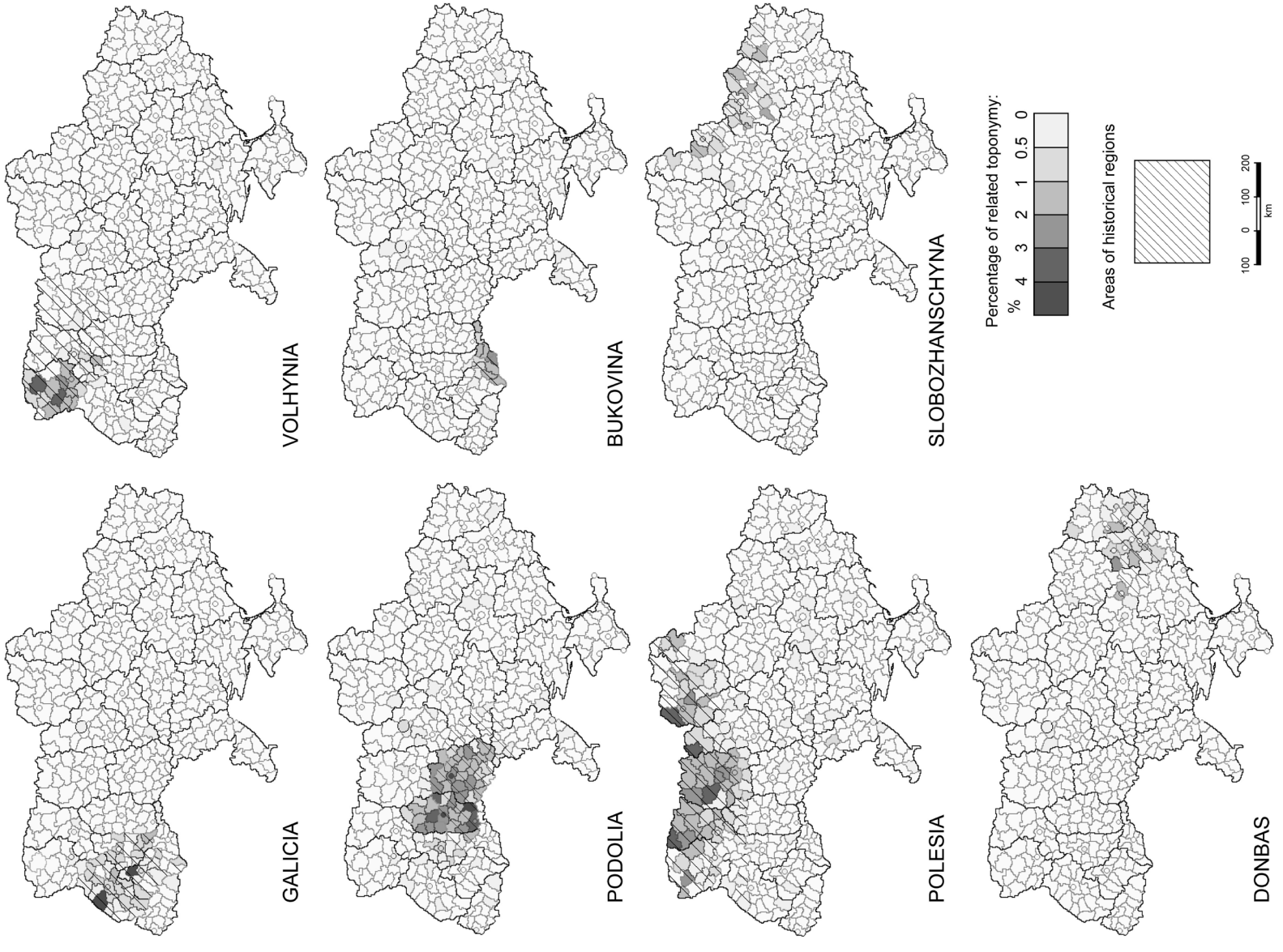

Fig. 2. Comparison of the territory of historical regions with the distribution areas of the corresponding ergonyms

Source: own work.

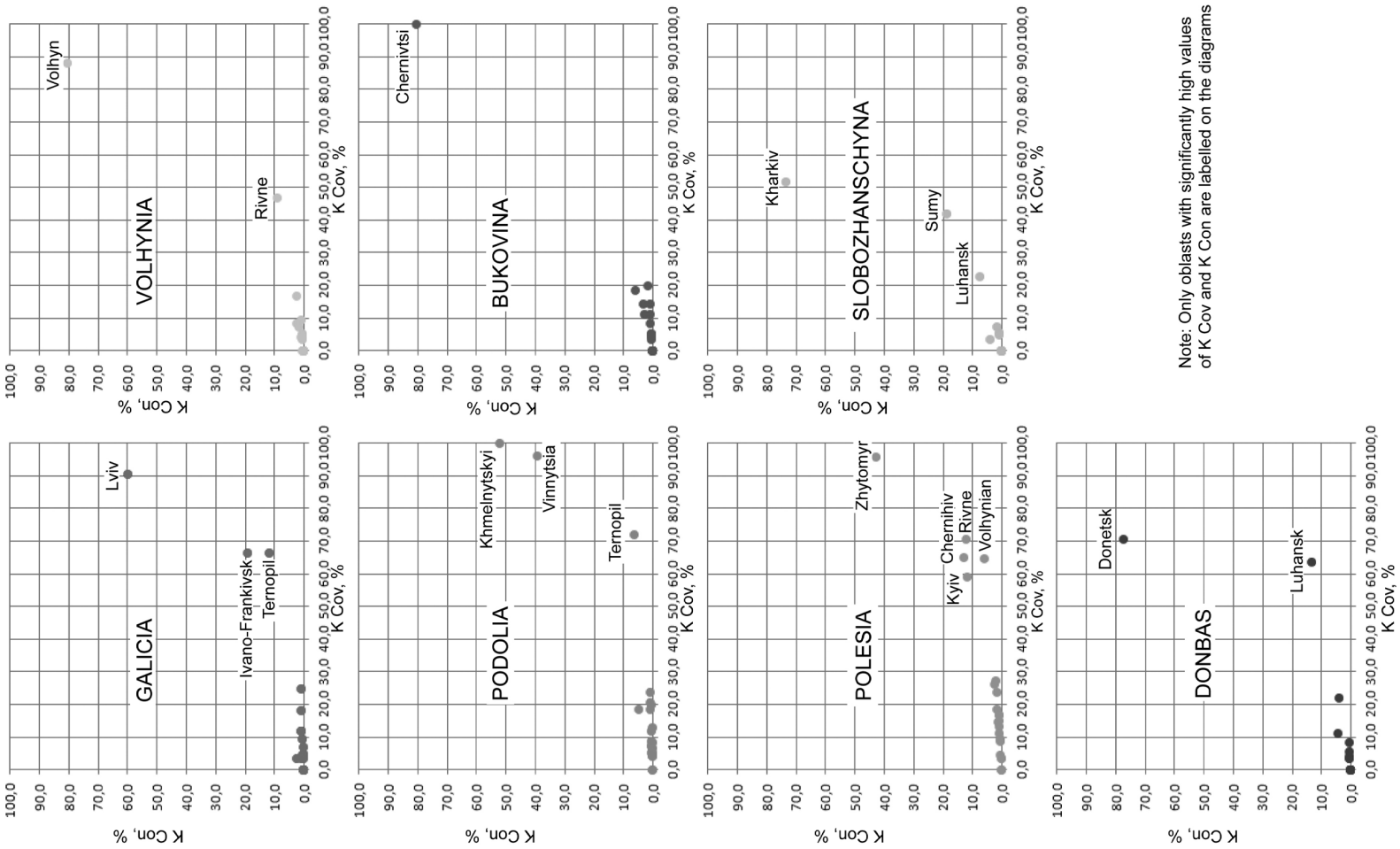

Fig. 3. Calculated coefficients K_{Cov} and K_{Con}, for historical regions by oblasts

Source: own work.

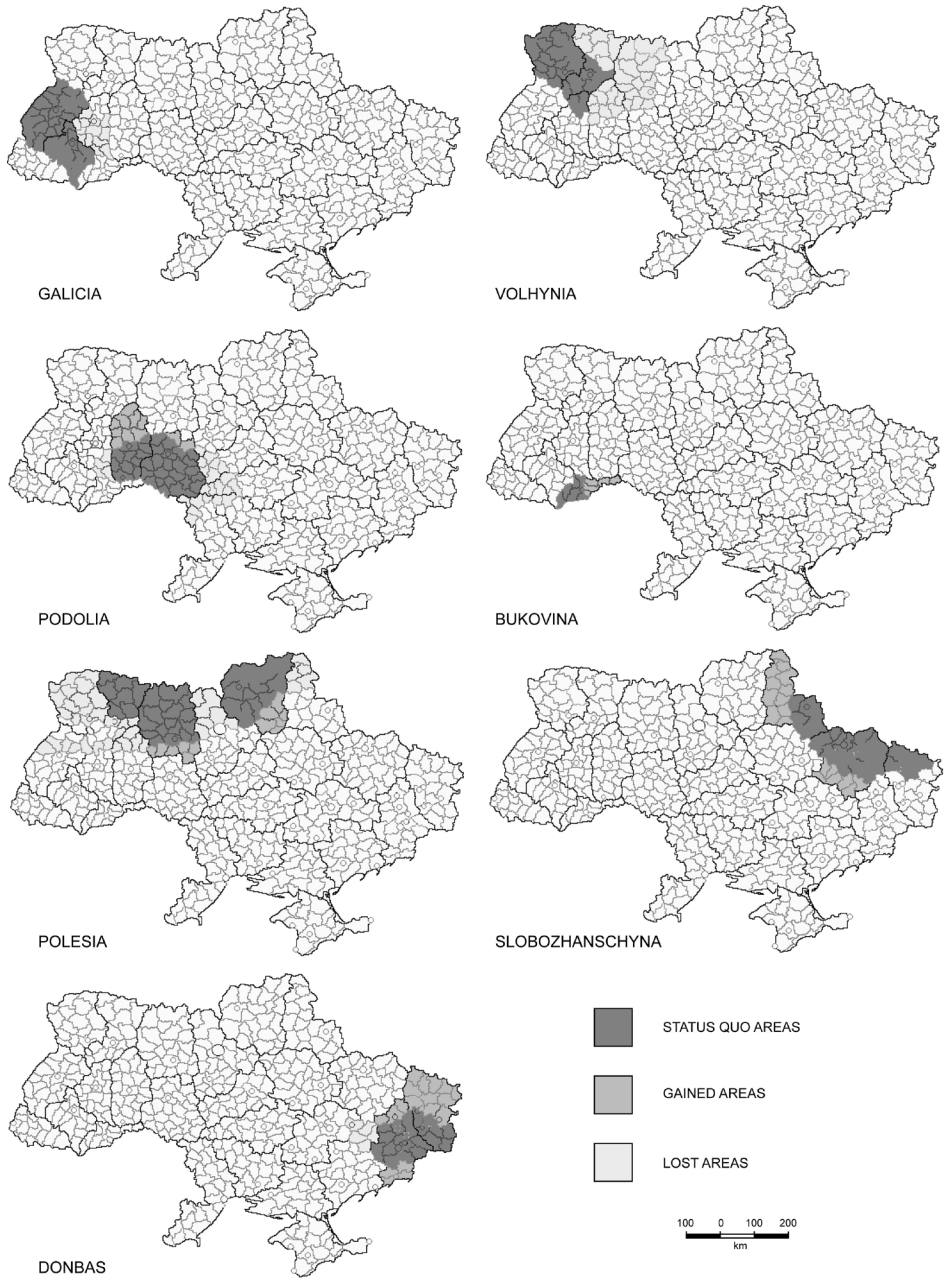

Fig. 4. Changing spatial patterns of the identities with historical regions
Source: own work.

may experience a) a significant spatial gain (Slobozhanschyna, Bukovina), b) an increase with some areas while simultaneously losing the others (Podolia, Donbas, Polesia), and, c) a significant spatial reduction (Volhynia, Galicia).

The revealed tendencies indicate that certain oblasts, under certain favourable conditions, are experiencing a process of unification, or homogenisation, i.e. the spread of identity with a certain historical region over an entire oblast. In other words, there is a matching between the identification with a given oblast and the identification with a historical region. For example, identification with Podolia has spread throughout the Vinnytsia and the Khmelnytskyi oblasts; identification with Bukovina covers the entire Chernivtsi oblast; identification with Polesia is more or less typical for the entire Zhytomyr and Chernihiv oblasts, etc.

Thus, all oblasts of Ukraine can be divided into 2 groups:

1. Anchor regions, which grasp the identity with a particular historical region, while identities with other historical regions, if any, disappeared or have been in the process of disappearing.

2. Swing oblasts, where identities with several historic regions continue to coexist.

After redrawing the administrative system in the first half of the 20th century, virtually all regions had a diversified structure of identity with historic regions. However, with time, some of them experienced a process of unification (modern anchor oblasts), while others retained the initial diversity (modern swing oblasts). The likelihood of a unification scenario was stimulated by the following factors:

Factor 1: Initial predominance of identity with one historical region within an oblast. This means that one, and only one, historical region covered the vast majority of the oblast territory.

Factor 2: An oblast centre is located within the limits of initially dominating historic region, covering the most part of the oblast.

Factor 3: Semantic link of the name of an oblast and/or oblast centre with the name of a certain historical region.

Based on Table 1, all anchor regions were influenced by at least 2 of these factors, while the effect of only one factor is insufficient to induce a unification scenario.

Table 1. Types of oblasts* and their factor conditionality

Oblast	Identity with historical region	Type	Factor 1	Factor 2	Factor 3
Chernivtsi	Bukovina	Anchor	+	+	-
Volhyn	Volhynia	Anchor	-	+	+
Khmelnytskyi	Podolia	Anchor	+	+	+ / - **
Vinnytsia	Podolia	Anchor	+	+	-
Lviv	Galicia	Anchor	+	+	-
Ivano-Frankivsk	Galicia	Anchor	+	+	-

Oblast	Identity with historical region	Type	Factor 1	Factor 2	Factor 3
Kharkiv	Slobozhanschyna	Anchor	+	+	-
Donetsk	Donbas	Anchor	+	+	+
Zhytomyr	Polesia	Anchor	+	+	-
Chernihiv	Polesia	Anchor	+	+	-
Rivne	Volhynia / Polesia	Swing	-	+	-
Sumy	Slobozhanschyna / Polesia	Swing	-	+	-
Luhansk	Donbas / Slobozhanschyna	Swing	-	+	-
Ternopil	Galicia / Podolia / Volhynia	Swing	-	+	-
Kyiv	Polesia / possibly Middle Dnieper	Swing	-	-	+

* Only those oblasts that can be confidently classified as anchor or swing according to available data are specified.

** Until 1954, the city of Kamianets-Podilskyi (i.e. "Podolian Kamianets") was the oblast centre.

Source: authors' analysis.

What will happen to swing oblasts in the future? There are two possible answers: either their current state is metastable, or there is a process of unification, drifting into one of the historical identities, although much slower than in anchor oblasts. The answer to this question may vary in each particular case, since it depends on the complexity of various factors. However, we are likely to suppose a slow unification process in most of the swing regions. It happens because one of the identities has an advantage over the other due to one of the factors. Most often this is the location of the regional centre in the area of one of the dominant historical identities. Proceeding from this, it is possible to foresee the strengthening of the identity with Volhynia in the Rivne oblast and the identity with Slobozhanschyna in the Sumy oblast. Also, we could expect the enhancement of the identity with Donbas in the Luhansk oblast, but after its division into the Russian-occupied south (including the oblast centre) and the Ukrainian north, the drift of the northern part to identify with Slobozhanschyna is more likely. As for the Kyiv oblast, its status of a metropolitan region and the semantics of the regional centre name contribute to the strengthening of identity rather with Kyivschyna/Middle Dnieper than with Polesia. The most difficult situation took shape in the Ternopil oblast due to the competition between the three identities, none of which has obvious advantages; although the area of the identity with Volhynia in the northern part appears to be the weakest side in this "confrontation", it does not disappear (like in the neighbouring Khmelnytskyi oblast) since neither of the other two identities haa a monopolistic symbolic domination in the rest of the territory, including the oblast centre.

However, the case of the Rivne oblast is more complicated than it seems. The fact is that the neighbouring Volhyn oblast, by its very name, exclusively binds the

"brand" of Volhynia, making other oblasts "not entirely Volhynian", which forces it to seek an alternative identity. The toponymic factor may work also in other cases. For example, Donetsk, as a regional centre, ties the Donbas "brand" to the respective oblast (Donbas = Donetsk Basin), worsening the prospects of this identity in the Luhansk oblast. If the Kamianets-Podilskyi oblast, after changing the regional centre in 1954, was not renamed into the Khmelnytskyi oblast, the same factor could weaken the identity with Podolia in the neighbouring Vinnytsia oblast.

Thus, in some cases, the process of unification can acquire the extreme form "one historical region = one administrative region". In that case, if some oblasts monopolise brands of historical regions, others are forced to seek a fundamentally new regional identity. This identity can hypothetically be based on historic regions of a smaller scale, but also local economic specialisation, geographical situation, landscape features, etc. In fact, current rethinking of Polesia takes place according to exactly such a model.

What acts as the engine of unification in certain, specified above, favourable conditions? The authors believe that two factors are important: 1. a socio-psychological inclination to perceive objects like integral and unambiguous phenomena; 2. the influence of a socialisation process by means of institutions, primarily the media and education.

Speaking of the socio-psychological aspect, we assume two things. First, it seems that Gestalt psychology (see, e.g. Lehar, 2003) has a point here and people tend to consider spatial units (regions) as integral categories. According to Odehnal and Šerý (2012), regional boundaries play an important role in shaping regional identity: helping to define the limits of a region, they help people perceive it. Historical regions in Ukraine are informal, and not only the average citizen, but even an expert may have a problem with defining them clearly. Simultaneously, the boundaries of modern administrative regions are clearly defined landmarks convenient for the mental approximation of other spatial structures. Secondly, it is a universal psychological inclination of human beings to formulate the unequivocal hierarchical correspondence between spatial taxa. People are prone to unequivocal correlations such as "oblast k belongs to region A", or "region B includes oblasts m and n" (ideally – "region C = oblast p"). The situation whre the statement "oblast p *partially* belongs to region A" and "oblast p *partially* belongs to region B" are valid at the same time, makes a dissonance to this harmonious hierarchy; therefore, people begin to prefer one of these statements in favour of which more arguments are found.

Meanwhile, the quality of this argumentation depends on the second factor, namely, the socialisation process. Paasi (2009) admitted that the fact of belonging to a region is not obvious for the majority of the population. The most objective and unbiased information about the boundaries of historical regions comes almost exclusively from the elites, including geography and history experts. This information is disseminated mainly in academic literature, it is rarely voiced in the media, and therefore, it is not widely known to the general public. In addition, it is ambiguous, difficult to comprehend, and therefore uncomfortable for everyday

use. Instead, the mass media present a simplified, unambiguous look at things, representing the position of regional authorities, using identity with one or another historical region as a brand of the administrative unit. Since uniqueness and awareness are important for every brand, in the case of several alternative identification options, officials, knowingly or unknowingly, are more likely to choose one with more arguments to account for. The three above-mentioned factors of unification typically play a role of such arguments.

National geographical and historical education, in particular, schemes of economic and socio-geographical regionalisation set out in school and university textbooks, also should be considered. The importance of bilateral relationships between identity and education policies at different levels and in various contexts were depicted, e.g. in contributions by Hega (2001), Brown (2005), Măduţa (2014), Li (2016), etc. The study of the politics of school textbooks in the Kharkiv, Sumy, and Luhansk oblasts in Ukraine (Rodgers, 2006) revealed how education can frame political views in those regions. Even fiction is important: the representations of four Ukrainian cities in fictional narratives by contemporary authors show a stressed sense of belonging to the local territory, which is conveyed to the readers (Rewakowicz, 2010). In our case, since administrative oblasts are considered as regionalisation units, the historical differences within the oblasts are neglected, so that whole oblasts are included into a particular unit. As a result, such schemes stimulate the equation of administrative oblasts with a specific region. For example, a very popular scheme of economic regionalisation, presented in school geography textbooks, contains the Northwest region enclosing the Volhyn and the Rivne oblasts. In that mode, the Rivne oblast is linked to the Volhyn oblast (and hence to the historical Volhynia) and separated from the Zhytomyr oblast (i.e. from Polesia). We assume that regionalisation schemes may promote the formation of fundamentally new regional identities in the absence of historically grounded alternatives, for example, the formation of Prydniprovya based on the homonymous economic region enclosing the Dnipropetrovsk and the Zaporizhia oblasts.

Electoral and geopolitical regionalisation is also a significant factor for Ukraine, a country located at a geopolitical fault-line and undergoing permanent political crisis. Relevant newsbreaks constitute an integral part of the everyday practices of ordinary Ukrainians and may influence the shaping of regional identities. For example, the Ternopil oblast is traditionally treated as a part of the Western Ukraine electoral region, and Galicia is traditionally considered the core region of Western Ukraine. Accordingly, the Ternopil oblast is considered by the mass media mainly as a part of Galicia. Simultaneously, according to the peculiarities of natural conditions and economic development, the Ternopil oblast is included in the Podolian economic region. This dichotomy produces two co-existing contradictory messages ("the Ternopil oblast is Galicia" and "the Ternopil oblast is Podolia"), which leads to the spread of both identities throughout the oblast and, at the same time, does not allow them to increase substantially as a result of mutual competition.

Proceeding from the universal psychological base for unification, this phenomenon should not be limited to Ukraine. Why, then, Ukraine appears to be such a good example? In our opinion, the optimal (for the revealed effect) ratio of the size of historical regions and modern administrative units (oblasts) is quite important. After all, if modern administrative regions are very small compared to the historical ones, one historical identity will sharply dominate among the new regions. Accordingly, the change of identity as the result of a unification will occur only in limited areas, so the overall transformation of the spatial pattern of historical identities will be negligible. If, however, new regions are too large (comparable in size to the historical ones), the existing differences in historical identity within the new regions could be a major obstacle of unification. Nevertheless, this is an assumption requiring further verifications.

Moreover, the process of unification is facilitated by the absence of other identities (linguistic, religious, ethnic, racial, etc.), which, being clearly assigned to specific regions, may significantly strengthen regional identification. Ukraine, by European standards, is a diversified country in terms of regional cultural traits. But in the continental part of the country, such differences are rather gradual changes with small gradients. Among the historical regions considered in this paper, Galicia is the only exception: its inhabitants in the overwhelming majority are Greek Catholics, while the inhabitants of the adjacent Ukrainian lands (Volhynia and Podolia) are predominantly Orthodox. Therefore, it is indicative that the area of identity with Galicia practically did not change its limits; it is noteworthy how the Orthodox north of the Ternopil oblast retains its identity with Volhynia.

A situation similar to that of Ukraine is observed in Czechia, where modern administrative units since 1949 have not been consistent with the boundaries of the historical regions (Bohemia, Moravia, and Czech Silesia), new and historical regions are close to the optimal size ratio, and the identity with the historic regions has an exceptionally cultural and ethnographic character (Vaishar and Zapletalová, 2016). In view of that, it is significant that our results are viewed with the results of the Czech authors cited at the beginning of the article. In our opinion, interesting results can also be obtained in France, where the modern administrative division into departments and regions is not always consistent with the boundaries of historical provinces.

4. CONCLUSIONS

The example of Ukraine proves that the historical regions and the associated identities are not something consistent, determined once and for all. Instead, they are dynamic structures transforming over time, changing their boundaries and adapting to new (geo)political, economic, social, and cultural realities, in-

cluding to the current administrative division. In fact, the names of historical regions function as labels, which may hide a substance significantly different from the original meaning when the corresponding historical region was first shaped. Regional identity can be relatively freely chosen, since in modern conditions it is no longer firmly attached to cultural peculiarities, as well as to historical political and administrative boundaries. Of course, some of these boundaries are fairly stable, as their influence has been tracked for many centuries. But there are no fundamental obstacles for the formation of quasi-historical regions on fundamentally new grounds (modern territorial organisation of public administration, political and economic processes, including their network forms). The task for a researcher is to establish which attributes of the regions are more persistent, and which are more dynamic, and under what conditions that persistence/ dynamism is more likely to be manifested.

However, it is important that historical identities, in particular their symbolic attributes like name, coats of arms, and natural and cultural monuments, are widely used by modern administrative regions in own building their own identities. Modern administrative units, as formal structures with defined boundaries and functioning institutions, are becoming more and more important identification objects, but they do so largely due to their interaction with and integration into the network of historic regions. The factors and mechanism for assigning the brands of historical regions by the modern administrative units, as well as the formation of fundamentally new regions on the basis of geographic, economic or political criteria, is more or less understandable. However, a question remains, why for the authorities and the population it is so important to identify with something more than modern administrative units. Probably it is a desire to pull away from the modern administrative division as having no deep historical roots, being temporary, and Soviet-rooted, and to identify instead with something more rooted, long-lasting, and with a gust of historical romance and symbolism. As Paasi and Zimmerbauer (2011) accurately pointed out, regional symbols often make it possible to combine the past, the present and future of a region, fill it with real content, and ensure legitimacy.

The dynamic and hybrid nature of identity with the historical regions provides additional arguments for both supporters and opponents of the administrative division reform at the macro-level. If the network of modern administrative units reflects the real identity more clearly than academically grounded regionalisation, the task of supporters is substantially simplified: it is only necessary to integrate existing administrative units correctly, not cutting them into parts (here it remains an open question what to do with the swing regions. Possibly lower level identities, their spatial cores and peripheries should be taken into account). However, opponents of the reform also receive a serious argument: why redesign the administrative map again if historical identities are successfully developed on the basis of existing administrative regions?

In any case, it must be acknowledged that positioning modern administrative units in the context of a certain macro-region in a public discourse at a national, regional or local level is a powerful instrument of regional policy that can accelerate or slow down the development of a new regionalism and direct this process in desired direction. Indeed, although regions cannot be considered as self-sufficient fixed formations and constantly change their configurations, the importance of the sense of place and identification with relatively stable and symbolically capacious territorial units remains and presumably will not disappear.

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DYNAMIC SPATIAL PANEL DATA MODELS IN IDENTIFYING SOCIO-ECONOMIC FACTORS AFFECTING THE LEVEL OF HEALTH IN SELECTED EUROPEAN COUNTRIES

Abstract. The aim of the paper is to investigate the relationship between socio-economic factors and the level of health of citizens of selected European countries. Disability-adjusted life years (DALYs) were used as the measure of health. The author applied dynamic spatial panel data models with fixed effects and spatial autocorrelation of the error term. The models were estimated using a novel, modified quasi maximum likelihood method based on M-estimators. The approach is resistant to deviations from the assumptions on the distribution of initial observations. The estimation of initial observations is a severe weakness of standard methods based on the maximization of the quasi-likelihood function in the case of short panels. M-estimators are consistent and asymptotically normally distributed. The empirical analysis covers the specification, estimation, and verification of the models.

Key words: dynamic spatial panel data models, M-estimation, fixed effects, short panels, DALYs – disability-adjusted life years, the level of health, socio-economic factors.

1. INTRODUCTION

Public health affects the productivity of labour and human capital as well as public spending. Investing in health is one of the priorities of the "Global Europe 2050" strategy, which aims at securing sustainable economic growth in Europe (Eurostat's Report for the European Commission, 2017). The implementation of programs promoting a healthy lifestyle and an efficient allocation of funds for balanced healthcare systems at national and international levels should be supported

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by the identification of factors affecting the health of a population. Statistical modelling of the relationship between socio-economic factors and the levels of health in time and space also facilitates designing an adequate public policy in this area.

The aim of the paper is to investigate the relationship between socio-economic factors and the level of health of citizens of selected European countries. The level of health can be assessed using either summary health measures or disease burden indicators (Murray *et al.*, 2002; Wróblewska, 2008; Robine, 2006). Healthy life years (HLY) (Trzpiot, Orwat-Acedańska, 2016) is one of the most popular measures from the former group. The paper uses a disease burden measure, i.e. disability-adjusted life years – DALYs. The DALY is a measure that expresses the total life years lost due to premature death or damage to health caused by a disease. Series of DALYs are characterized by significant autocorrelations in both time and space.

At the level of individual countries, these dependencies can be investigated using spatial panel data (SPD) econometric models. Spatial panel data has the cross-sectional and time dimensions and, additionally, the time dimension includes the spatial context. In other words, spatial models account for spatial interaction effects and dependencies between neighbouring objects, which allows for more informative and precise analysis of various phenomena.

The paper proposes spatial dynamic panel data (SDPD) models with fixed effects and spatial autocorrelation of the error term. These models extend the spatial panel framework with time dynamics that represents a trend in a dependent variable. In particular, the paper focuses on Dynamic Spatial Autoregressive Fixed Effects Models (DSAR-FEM).

In contrast to static models, most of the estimators of dynamic spatial panel models are biased and inefficient. This problem is particularly severe in the case of a short panel (with a small number of periods). The shortcomings of the standard estimation methods led to the development of several sublime alternative techniques. Elhorst (Elhorst, 2010c) and Su, Yang (Su, Yang, 2015) proposed the quasi-ML (QML) estimation of the SDPD model with short panels. The main difficulty in using the ML or QML method to estimate SDPS models with short panels is the modelling of initial observations (the data generating process for the pre-sample period)[1] because statistical properties of the ML estimators largely depend on the assumptions of initial observations (Dańska-Borsiak, 2011). The model for initial differences involves an unknown process starting time. Moreover, its predictability typically requires that time-varying regressors be trend or first-difference stationary. When there are many time-varying regressors in the model, the modelling of the initial difference may introduce too many additional parameters, causing an efficiency decline (Yang, 2018). It is highly desirable to have a method that is free from the specification of initial observations and pos-

[1] Alternative estimation methods, such as the IV-GMM approach, despite being free from the assumption on initial observations, deliver inefficient estimates (Dańska-Borsiak, 2011).

sesses good statistical properties, especially in the case of short panels. It should be noted that ML and QML estimators are considered more efficient than GMM estimators for dynamic panel data models (Hsiao *et al.*, 2002; Binder *et al.*, 2005; Bum, Carce, 2005; Gourieroux *et al.*, 2010; Kruiniger, 2013).

In the paper, the models are estimated using a novel, modified quasi maximum likelihood (QML) method with M-estimators proposed recently by Yang (Yang, 2018). The approach is free from assumptions on the distribution of initial observations. Moreover, M-estimators are consistent and asymptotically normally distributed. The empirical analysis covers the specification, estimation, and verification of the models.

The paper is organized as follows. First, the concept of the DALY is presented in the context of the brief review of literature related to the subject. The evolution of how the DALY measure has been applied in the European countries since 1990 is discussed, and the rationale behind the choice of a model class and the criteria for the selection of countries is presented. The third section consists of three subsections. First, based on literature, the general idea of spatial models and their estimation methods are discussed. The second subsection is concerned with the analytical form of the models used in the study, while the third one describes the M-estimation procedure. The fourth section contains an empirical analysis. It consists of two subsections. First, endogenous and explanatory variables are presented together with the main assumptions used in the empirical study, which is followed by the discussion of the results. The last section concludes the paper.

2. DISABILITY-ADJUSTED LIFE YEARS (DALYS)

2.1. The essence of measurement and literature review

Disability-adjusted life years (DALYs) represent an increasingly popular population health metric. DALYs belong to a family of population health summary indicators and measure the Global Burden of Disease (GBD). The indicator was introduced by Murray and Lopez (Murray, 1994; Murray, 1996; Murray, Lopez, 1996a, 1996b), who conducted a GBD study (World Bank, 1993) for the World Bank and the World Health Organization. DALYs are based on measuring health gaps, as opposed to measuring health expectancies (Murray, Lopez, 1994), and as such the indicators measure the difference between current conditions and a selected target, for example an ideal health state.

The DALYs are the sum of the Years Lived with Disability (YLD) and the Years of Life Lost to premature death (YLL). One DALY is thus one lost year of healthy life. DALYs are calculated as follows (Murray, Lopez, 1994):

$$DALYs = YLD + YLL \quad (1)$$

where: YLD – the adjusted number of years lived with disability; YLL – the number of years of life lost due to premature mortality.

Years lived with disability (YLD) refer to years lived in health worse than ideal. To estimate the YLD at the level of a population, the number of disability cases is multiplied by an average duration of a disease and the weight factor that reflects the severity of a disease on a scale from 0 (perfect health) to 1 (dead). The basic formula for one disabling event is:

$$YLD = I \times DW \times L \quad (2)$$

where: I – the number of incidents; DW – a disability weight; L – an average duration of a disability (years). Disability weights for 22 diseases are calculated using a person trade-off method. The weights are also used to define 7 classes of disability and a distribution of severity of a few hundreds of treated and untreated diseases (Murray, Lopez, 1994). The weights also account for a person's age. The paper proposes higher weights to the same diseases and disabilities in the case of young and middle-aged people and lower ones for infants and elderly people. Moreover, the use of discounting related to the level of health and health benefits results in higher weights for the current levels of health and lower for the expected ones.

The YLL metric essentially corresponds to the number of deaths multiplied by the standard life expectancy at the age at which death occurs, and it can be rated according to social preferences (see below). The basic formula for calculating the YLL for a given cause, age or sex is: (Murray, 1996)

$$YLL = N \times L \quad (3)$$

where: N – the number of deaths; L – standard life expectancy at the age of death (in years). To estimate the YLL at the level of a population, age-specific mortality rates must be combined with life expectancy for fatal cases, had they not developed into the disease. If mortality affects the population in a random fashion, life expectancy can be derived from standard life tables. Murray (Murray, 1996) proposed a table based on the highest observed national life expectancy (for Japanese women), taking into account differences in life expectancy between men and women. If mortality affects a susceptible sub-population, the use of standard life expectancy would lead to a gross overestimation of the YLL. In this case, disease-specific information is necessary to estimate the additional loss of life years by the disease under consideration. For estimating the YLL for more than 100 causes of death, the following information sources are used: the death registration

system based on International Classification of Diseases (ICD-9), sample data, epidemiological estimates, and mortality models for selected causes of death.

The philosophical and methodological aspects of the DALY calculation were examined in detail in Murray, 1994; Murray, Acharya, 1997. The measure is also widely discussed in literature (Anand, Hanson, 1997; Anand, Hanson, 1998; Laurell, Arellano, 1996; Barker, Green, 1996; Berman, 1995; Desjarlais *et al.*, 1995; Lozano *et al.*, 1995; Martens *et al.*, 1995). The steps preceding the actual calculation, however, are still under-researched. Devleesschauwer (Devleesschauwer, 2014) attempted to address this gap by presenting a stepwise approach towards the DALY calculation (Devleesschauwer, 2014).

The paper identified the socio-economic factors that are related to DALYs in selected European countries. To the author's knowledge, this issue has not been studied with the use of the spatial statistical models. Furthermore, the paper posited that it is of crucial importance to go beyond standard statistical and econometric procedures based on dynamic spatial panel data models analysis. Instead, the application of M-estimation of fixed effects spatial dynamic models with short panels was proposed for investigating the relationships between selected socio-economic factors and the DALY measure in Europe in space and time, which can also constitute an important contribution to literature. The identification of the factors affecting a population's health should contribute to the creation of reliable and effective policies within national and internationals public health management strategies.

2.2. DALYs in European countries in the last 25 years

Currently, the estimated years of life lost due to premature mortality, YLL, and the years of life lived with disability, YLD, account for almost 300 diseases belonging to three major groups and twenty subgroups of causes. The values of DALYs for almost every country of the world are published by the Institute for Health Metrics and Evaluation (IHME), an independent population health centre at the University of Washington.

European countries are heterogeneous in terms of the DALY measure (observed in the last 25 years). This is primarily because of differences in the geopolitical conditions that affect the distributions of life expectancy, epidemiological estimates, and mortality models.

Figure 1 depicts mean values of DALYs for selected 26 European countries divided into three groups in the years 1990–2015:

a) **Group A**: Lithuania, Latvia, Estonia, Hungary;

b) **Group B**: Austria, Belgium, Switzerland, the Czech Republic, Germany, Denmark, Spain, Finland, France, the United Kingdom, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Sweden;

c) **Group C**: Iceland.

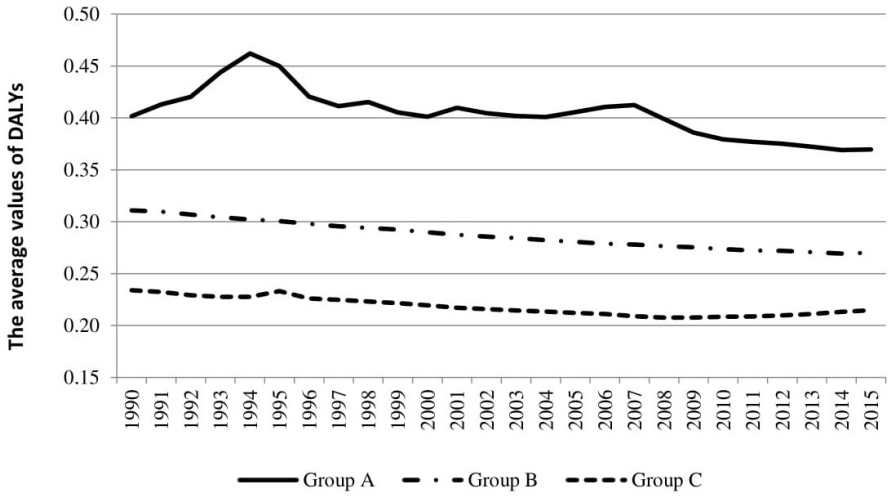

Fig 1. Average values of DALYs for countries for the three groups (A, B, and C) in the period 1990–2015
Source: Own work based on the Institute for Health Metrics and Evaluation (IHME) data.

The DALY time series are characterised by a downward trend, which is related to a global increase in life expectancy and changes in the burden of diseases.[2] Moreover, spatial heterogeneity among European countries can also be observed. The countries classified in Group A – Lithuania, Latvia, Estonia, and Hungary – are characterised with the highest values of DALYs. The countries from Group B are characterised by lower DALYs compared to the previous group. Clearly, the lowest values of the studied measure are observed in Iceland and, therefore, the country forms a separate group in the figure. The differences reflect the geopolitical locations of the countries, which are correlated with the burden of diseases.

The spatial heterogeneity of the DALY measure is shown in Figure 2. The DALY values for the countries shown there are average values for the years 1990–2015. Apart from the four countries in Group A, high values of DALYs are observed in other Central and Eastern Europe countries, such as Poland or the Czech Republic. Then, the measure takes considerably lower values in the original EU Member States.

The DALY measure is calculated taking into account the entire population of a country. It is also possible to estimate the measure for selected subpopulations defined by age, e.g. people more than x years old. The study also examines the DALYs_70+ measure, which is calculated for people over 70 years of age. This subpopulation is important from the point of view of public health management

[2] In 1990s, major diseases comprised respiratory system diseases and perinatal diseases, whereas in the last decade the considerable increase in civilizational diseases such as cardiovascular diseases and neoplasms has been observed. In the future, a growing role of car accidents and mental diseases (mainly depression) is expected.

and social security spending. Similarly to DALYs, the downward trend can be observed for DALYs_70+. Fig. 3 depicts these values for the years 1990–2015.

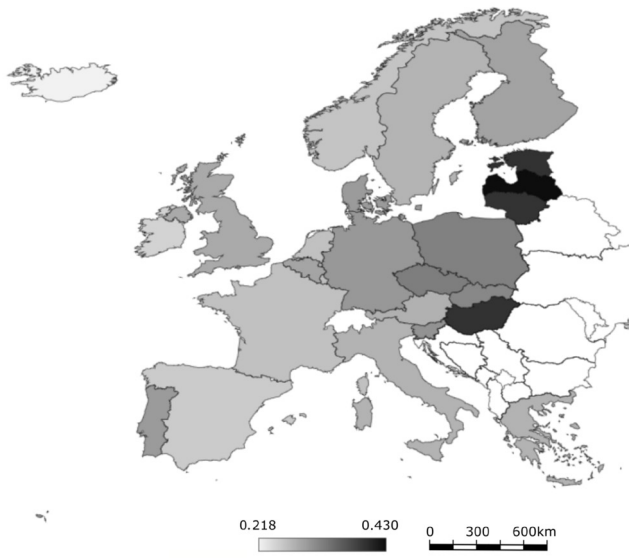

Fig. 2. Average values of DALYs in the European countries in the years 1990–2015.
Source: own work based on the Institute for Health Metrics and Evaluation (IHME) data.

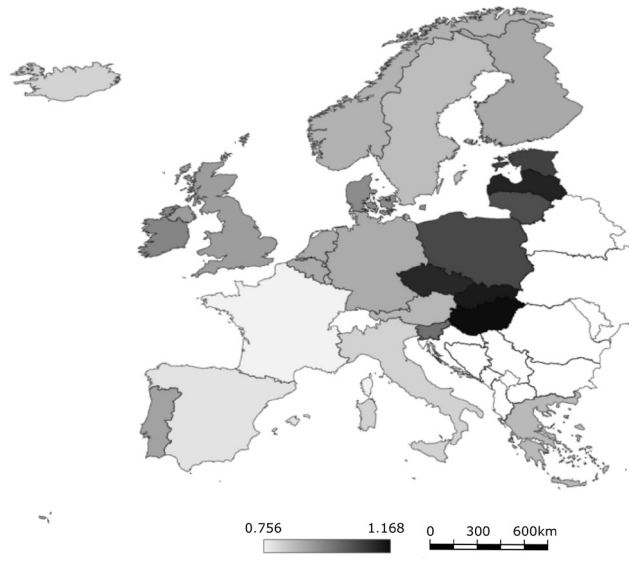

Fig. 3. Average values of DALYs_70+ s for countries in groups A, B and C in the years 1990–2015
Source: own work based on the Institute for Health Metrics and Evaluation (IHME) data.

3. THE THEORETICAL BASIS OF SDPD MODELS

In the standard panel data (SPD) methods, two additional effects can be taken into account in addition to the usual effect of explanatory variables. One is an unobserved object-specific effect, independent of time, also referred to as a group effect. The other is also an unobserved, time-specific effect, constant across objects, which sometimes is shortened as a time effect. Among the models with object or time-specific effects, one can identify varying-parameter models (e.g. Random Coefficient Models (RCM), Seemingly Unrelated Regressions (SUR)), and error decomposition models (e.g. Fixed Effects Models (FEM), Random Effects Models (REM)).

The plethora of the model types is accompanied by a variety of estimation procedures, such as the Maximum Likelihood (ML) method, the Generalized Method of Moments (GMM), and the Method of Instrumental Variables (IVM). Literature on spatial panel data was hugely inspired by the seminal paper of (Anselin, 1988), where the ML estimation techniques were studied. The typology of the spatial panel data models and modifications of the ML estimators suitable for certain model types are presented in Elhorst 2005. The effective estimation techniques of various types of the spatial panel models are discussed in Elhorst (2010a, pp. 377–407; 2010b, pp. 9–28) and Lee, Yu (2010a, pp. 165–185; 2010b; 2010c, pp. 255–271). Spatial interaction in panel models can be modelled as the processes of: spatial autoregression for a dependent variable (Spatial Autoregressive – SAR), spatial autocorrelation of the error term (Spatial Error – SEM), moving average spatial autocorrelation of the error term (Spatial Moving Average – SMA), and the spatial lags of regressors (Spatial Crossregressive – SCM).

Additional difficulties related to spatial panel data modelling occur if one wants to include the time dynamics of a dependent variable. The dynamics in a linear model can be accounted for in many ways. One is to add the time lags of a dependent variable.[3]

Extensive literature, summarized by Anselin, 2001; Anselin *et al.*, 2008, exists on spatial dynamic panel data (SDPD) models. Spatial effects in dynamic panel data models may appear in the form of the spatial lags of a response variable (Yu *et al.*, 2008; Yu, Lee, 2010; Lee, Yu, 2010d; Korniotis, 2010; Elhorst, 2010c), spatial errors (Elhorst, 2010c; Yang *et al.*, 2006; Su, Yang, 2015) or space-time lag.

3.1. Dynamic Spatial Error Fixed Effects Model (DSE_FEM)

As already mentioned, in order to investigate the relationship between socio-economic factors and the DALYs in EU Member States, the study used dynamic spatial panel data models with fixed effects and spatial autocorrelation of the error

[3] Alternative approaches include: 1) adding a time variable to a set of regressors; 2) using a two-way model; 3) using a time-varying parameters model.

term. The dependent variable and k regressors were observed for N spatial units and T periods. Dynamic Spatial Error Fixed Effects Model (DSE_FEM) has the following form:

$$y_{it} = \rho y_{it-1} + \sum_{j=1}^{k} \beta_j x_{ijt} + \mu_i + \varepsilon_{it} \tag{4}$$

$$\varepsilon_{it} = \lambda \sum_{l=1}^{N} w_{il} \varepsilon_{lt} + v_{it} \tag{5}$$

$$i = 1, ..., N; \; t = 1, ..., T; \; l = 1, ..., k,$$

where: y_{it} – a dependent variable; – an element of the spatial weight matrix; ρ – a time autoregression parameter; – a fixed effects parameter; x_{ijt} – a regressor; β_j – a parameter representing an impact of regressors on a dependent variable; $\boldsymbol{\varepsilon}_{it,}$ v_{it} – the error term; λ – a spatial autoregression parameter. Random variables v_{it} are normally, independently and identically distributed with the expected value equal to 0.

3.2. The idea of unified M-estimation of the Dynamic Spatial Error Fixed Effects Model (DSE_FEM)

The main difficulty in using the ML or QML method to estimate SDPS models with short panels is the modelling of initial observations (the data generating process for the pre-sample period). The model for initial differences involves an unknown process starting time. Moreover, its predictability typically requires that the time-varying regressors be trend or first-difference stationary. When there are many time-varying regressors in the model, the modelling of an initial difference may introduce too many additional parameters, causing an efficiency decline (Yang, 2018).

Yang (2018) proposed a unified initial-condition free approach to estimate the SDPD models with fixed effects. The method generates estimators that are consistent and asymptotically normal. Corrections on the conditional quasi-scores are totally free from the specification of the distribution of initial differences. The proposed estimator is simply referred to in this paper as the *M*-estimator in view of Huber (1981) or van der Vaart (1998). The method proposed by Yang (2018) for the covariance matrix estimation is valid only when T is small, but when T is large, a standard alternative (plug-in method) based on the conditional variance of the adjusted quasi-scores, treating initial differences as exogenous, can be used. The exact steps leading to the calculation of estimates are complicated and, therefore, they are not presented here. The details can be found in Yang (2018).

4. EMPIRICAL ANALYSIS

4.1. Data, variables and empirical procedure

In empirical analysis, two groups of DSPD models were used. One consisted of models (4-5), in which DALYs were an endogenous variable, and the other consisted of models (4-5), in which DALYs_70+ were an endogenous variable. Both indicators are expressed in per capita terms. The selection of potential exogenous variables focused on health and lifestyle determinants as well as socio-economic factors. Eight exogenous variables were examined for each country under study (Table 1).

Table 1. Exogenous variables used in the first stage of the estimation procedure for models (4–5) in the specification procedure

Variable	Symbol	Description of the variable
X_1	GDP	GDP per capita in constant US dollars
X_2	ΔGDP	Real GDP growth rate
X_3	ALCOH	Yearly alcohol consumption per capita in litres
X_4	AIR_POL	Yearly nitric oxide emissions per capita in kilograms
X_5	EDUC	Average education years
X_6	H_CARE	Healthcare spending as a percentage of GDP
X_7	N_BEDS	Number of hospital beds per 1,000 inhabitants
X_8	SOCIAL	Social spending as a percentage of GDP

Source: own work.

The final set of analysed countries (objects in models) was determined using two criteria. First, the countries that are relatively homogeneous in terms of the measure were selected out of the 26 countries for which the average DALY measure is depicted in Fig. 1. It was assumed that it would be incorrect to include all the 26 countries mentioned in Section 2.2 in one model because of significant differences in DALY values. Second, the analysis only included those countries for which the complete set of data relating to the eight exogenous variables was available.

As a result, the sample consisted of 17 countries, mostly of the "original EU"[4] (without Luxemburg, yet including Iceland, Norway and the Czech Republic):

[4] The term refers to the countries that constituted the European Union prior to the accession of the new members in 2004.

Portugal, Spain, France, Belgium, the Netherlands, the Czech Republic, Italy, Greece, Austria, Germany, Denmark, the United Kingdom, Ireland, Iceland, Norway, Sweden, and Finland.

The final investigation period of 2003–2013 was a compromise between the criteria for the selection of countries and availability of exogenous variables for each country.

Exogenous variables were obtained from the OECD database. Endogenous variables (DALYs, DALYs_70+) came from the database of the Institute for Health Metrics and Evaluation. The spatial matrix **W** was created using the common border criterion. All the computations were carried out in Matlab using the procedures written by Yang.

4.2. Results

Table 2 presents the estimates of models (4-5) and their statistical significance for the DALY measure. Five out of eight exogenous variables are statistically significant at the level of significance equal to 0.1. These are: **ΔGDP** (GDP growth rate), **ALCOH** (alcohol consumption), **EDUC** (years of education), **H_CARE** (healthcare spending), **SOCIAL** (social spending). Dynamic and spatial autocorrelations are also significant, which corroborates the choice of the modelling tool.

Table 2. Estimation results for the models (4–5) with DALYs as endogenous variable

Exogenous variables	β_j	$s(\beta_j)$	*t* statistic	p-value*
GDP	-0.010	0.000	-1.169	0.243
ΔGDP	-0.697	0.161	-4.328	**0**
ALCOH	-0.052	0.020	-2.622	**0.009**
AIR_POL	-0.005	0.004	-1.183	0.237
EDUC	0.017	0.009	2.027	**0.043**
H_CARE	0.051	0.025	1.999	**0.046**
N_BEDS	0.010	0.040	0.246	0.806
SOCIAL	-0.040	0.012	-3.347	**0.001**
Parameter				
ρ	0.972	0.035	28.047	**0**
λ	0.241	0.109	2.222	**0.026**

* The estimates in bold are statistically significant ($\alpha = 0.1$)

Source: own calculation.

As some variables were discovered to be insignificant, the model was subsequently re-estimated with the significant variables only. The estimates obtained during this step are shown in Table 3.

Table 3. The estimation results of the respective models (4-5) for DALYs

Exogenous variables	β_j	$s(\beta_j)$	*t* statistic	p-value*
ΔGDP	-0.790	0.194	-4.072	**0**
ALCOH	-0.058	0.021	-2.761	0.006
EDUC	0.018	0.006	2.782	**0.005**
H_CARE	0.042	0.024	1.781	**0.075**
SOCIAL	-0.032	0.013	-2.552	**0.011**
Parameter				
ρ	0.991	0.027	36.530	**0**
λ	0.239	0.114	2.109	**0.035**

* The estimates in bold are statistically significant (α = 0.1)

Source: own calculation.

As a result of the respecification, all the exogenous variables are statistically significant. The DALY measure for the entire population is correlated with both economic factors (GDP growth rate, social and healthcare spending in relation to GDP) and social factors (years of education, lifestyle, i.e. alcohol consumption). Although the p-value for these factors is below 0.1, which means they are all statistically significant, DALYs are characterized by near-unit-root behaviour and the error terms are also significantly spatially correlated, although the correlation is rather weak (value of lambda). In consequence, the time autocorrelation parameter ρ is close to one, so a slower decrease in the DALYs measure (its higher growth rates) is negatively correlated with GDP dynamics, alcohol consumption, and social spending, and positively related to the level of education and healthcare spending. The manifestations of some relationships can be explained by considering the dependence of the components of the DALY measure – YLL and YLD. The estimated model takes the following form:

$$\begin{aligned} DALYs_{it} &= 0.99 DALYs_{it-1} - 0.79\ \Delta GDP_{it} - 0.06\ ALCOH_{it} + \\ &+0.02\ EDUC_{it} + 0.04\ H\_CARE_{it} - 0.03\ SOCIAL_{it} \end{aligned} \tag{6}$$

$$\hat{\varepsilon}_{it} = 0.23 \sum_{l=1}^{N} w_{il} \varepsilon_{jt} \tag{7}$$

The second stage of the study involved the estimation of the model (4-5) and the testing of the significance of parameters for the DALYs_70+ series. Initially, all the regressors were included. The results are presented in Table 4.

Table 4. Estimation results for model (4-5) for the DALYs_70+ measure

Exogenous variables	β_j	$s(\beta_j)$	*t* statistic	p-value*
GDP	-0.003	0.000	-0.013	0.989
ΔGDP	-2.778	1.222	-2.274	**0.023**
ALCOH	-0.091	0.062	-1.452	0.146
AIR_POL	-0.031	0.013	-2.285	**0.022**
EDUC	0.100	0.040	2.483	**0.013**
H_CARE	0.057	0.076	0.754	0.451
N_BEDS	0.036	0.087	0.413	0.680
SOCIAL	-0.022	0.024	-0.907	0.364
Parameter				
ρ	0.957	0.047	20.564	**0**
λ	0.282	0.069	4.107	**0**

* The estimates in bold are statistically significant (α = 0,1)

Source: own calculation.

In this case, only three out of eight exogenous variables are statistically significant at the level of significance equal to 01. These are: Δ**GDP** (GDP growth rate), **AIR_POL** (air pollution), and **EDUC (**average years of education). Dynamic and spatial autocorrelations are also statistically significant. Subsequently, the model is respecified to eliminate the insignificant variables. The results are presented in Table 5.

Table 5. The estimation results of the respecified model for DALYs_70+

Exogenous variables	β_j	$s(\beta_j)$	*t*- statistic	p-value*
ΔGDP	-2.254	1.214	-1.858	**0.063**
AIR_POL	-0.023	0.011	-2.026	**0.043**
EDUC	0.098	0.037	2.661	**0.008**
Parameter				
ρ	0.958	0.027	35.001	**0**
λ	0.279	0.053	5.248	**0**

* The estimates in bold are statistically significant (α = 0,1)

Source: own calculation.

Disability-adjusted life years for people over 70 years of age in the investigated countries are affected by a GDP growth rate (economic factor) as well as social factors such as the years of education and air pollution. These relationships are accompanied by very strong dynamics and weak spatial autocorrelation of DALYs_70+. The estimated model has the following form:

$$DALYs\_70^{+}{}_{it} = 0.96\ DALYs\_70^{+}{}_{it-1} - 2.25\ \Delta GDP_{it} - 0.02\ AIR\_POL_{it} + \\ +0.10\ EDUC_{it} \tag{8}$$

$$\hat{\varepsilon}_{it} = 0.28 \sum_{l=1}^{N} w_{il} \varepsilon_{jt} \tag{9}$$

Compared to the model in which the DALY was an endogenous variable, differences in the set of variables statistically significant for the model with the endogenous variable DALY_70+ indicate that the selection of population (based on age) is an important aspect in the identification of socio-economic factors determining disease burden.

5. CONCLUSION

The paper identified the factors affecting disability-adjusted life years based on the sample that consisted of 17 European countries and span the years 2003–2013. Spatial dynamic panel models were used to analyse the persistence and spatial autocorrelation of the variables under study. The novel estimation method introduced recently by Yang (2018) was applied. The DALY measure was found to be significantly related to several economic, social, and environmental factors such as healthcare spending, alcohol consumption or air pollution, but also a GDP growth rate, and years of education. Apart from the former, rather obvious, factors identified by several other studies, the latter two carry interesting policy implications. Significant correlation with a GDP growth rate implies that the DALY indicator was affected by business cycle fluctuations and, in particular, the recent financial crisis. It means that not only does preventing severe economic crises have an indirect impact on public health through healthcare or social spending, but it also affects public health directly. Finally, the correlation of DALYs with years of education confirms an important role of education in improving the level of health in the society.

Due to fundamental differences between the countries in Group A and Group B (defined in section 2.2), the countries from Region A could not be included in

the sample. Moreover, the countries from Group A cannot form a separate sample since their number did not allow for the generation of the amount of data sufficient for the development of spatial models.

The factors affecting DALYs can still be identified irrespective of spatial dependence and using standard panel data models, which, however, is beyond the scope of this paper.

The investigation of the spatial-temporal relationship (accounting for a dynamic effect) between the DALY measure for European countries and socio-economic factors requires several important choices relating to such issues as the period of a study, a population in terms of age, and the geopolitical location of countries.

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BOOK REVIEW

Carlo GIANELLE, Dimitris KIRIAKOU, Caroline COHEN, Marek PRZEOR (eds.) (2016), *Implementing Smart Specialisation Strategies. A Handbook*, Brussels: European Commission

Smart specialisation is a modern approach to regional development. *Implementing Smart Specialisation Strategies. A Handbook* is an ambitious effort to compile a comprehensive guide to smart specialisation strategies in the European Union. The handbook clarifies many concepts that are crucial for the smart specialisation approach based on integration between research and regional policy, specifically the effective utilisation of a Quadruple Helix.

As a general conclusion, we consider that this handbook is very valuable, both to funding officers and all stakeholders, because it clearly states the ambition of the EU and the Commission. However, the handbook's scientific foundation appears to be quite weak and, consequently, it may be too arbitrary from a researcher's point of view, and based on popular beliefs and ad hoc political thinking.

Discussion on Chapter I: The Entrepreneurial Discovery Process (EDP) cycle: from priority selection to strategy implementation

In smart specialisation strategy, the EDP is a key issue in regional planning. Chapter I provides examples from France, Poland, Spain, Greece, and Belgium. It would be interesting to know how the regional case examples were selected for various chapters of the handbook. One problematic question in the S3 handbook is how EDP prioritisation is executed in practice. The division of labour between venture capital and public funding is quite a problematic issue in this respect. Are we able to prioritise the best and the most innovative business models on the basis of the EDP?

The handbook defines participatory models as working or focus groups: partnerships and public-private committees, websites tailored for citizen participation, consultation, and methodologies based on action research approaches. Table 1.1 and Fig. 1.1 are very informative in their definitions about what EDPs are/are not.

The context of instability in politics should be discussed because of the so-called populist trends, and the crisis in the inadequate exploitation of knowledge-based management. 'Entrepreneurial readiness of the actors' may require more up-to-date thought. The entrepreneurial spirit should be elaborated more clearly, because it is a dynamic force in some, but not all regions of Europe.

There is a need for more detailed instructions showing how the potential planning arsenal would be used in the EDP, because the handbook is meant to provide guidance for regional agents and stakeholders. Typically, many agencies take advantage of SWOT analyses based on the current situation, but future-oriented scenarios are not integrated into the analyses. The selection of 'promising sectors' requires some understanding of comparative advantages and resilience structures in European regions. How to find them? This issue is not an easy one for the stakeholders.

Discussion on Chapter II: Good governance: principles and challenges

It is quite easy to agree with the view that establishing good governance in conjunction with smart specialisation requires the application of general principles in local/regional contexts. From this perspective, the creation of transparency and common cohesion, for instance, have different meanings in different countries and regions.

To enable the application of general principles locally, it should especially be possible to identify the factors that produce differences between the local and national levels of smart specialisation. This receives too little attention in this work. Specifying cultural factors and their impact would have significantly increased the applicability value. Also, it would have been possible to utilise perspectives from contingency or institutional theories. Power relations, the economic environment and its nature, as well as the social environment with its interactive relations are among the factors that affect the implementation of good governance nationally and locally.

The work gives the general impression that implementing good governance runs along the same lines in smart specialisation as in other activities involving cooperation between different actors. However, if we wish to understand the nature of smart specialisation, it is particularly important to examine the matter more systemically. Smart policy-making and its governance are based on open systemic thinking. This kind of smart specialisation is able to take in influences from outside the system – say, from customer relations – and to renew and create new added value through specialisation differently than earlier. It is clear that the published work underlines the importance of dynamics in the governance of smart specialisation. Thus smart specialisation calls for the ability of good governance to support continuous development and dexterity. This places emphasis on trust-based management, for instance.

Platforms constitute a central element in the governance of smart specialisation. Ideally, platforms are able to combine different kinds of expertise and lead

various actors to jointly work on a subject. What should be noticed, however, is that the challenge of good governance in regions, or at the local level, is not the governance of just one platform, but rather the promotion of interaction and interfacing between the platforms of different actors – companies in particular – so that smart specialisation is generated. This requires constant identification and highlighting of joint advantages, such as outlining why companies benefit from implementing smart specialisation jointly and not by themselves through their own platforms. At the same time, good governance should also be used to fairly distribute the benefits of smart specialisation.

Discussion on Chapter III: From priorities to projects: selection criteria and selection process

Chapter III deals with the operationalisation of the smart specialisation theory. Smart specialisation practitioners acknowledge that leading and lagging regions may need different interpretations of the basic theory. Affluent regions that have an abundance of knowledge institutions may subsidise basic research, develop General Purpose Technologies or follow the path-dependent trajectories of their clusters. Rural and other regions mostly apply research and existing technologies in their core activities, or fill gaps in their policy mixes.

In the smart specialisation method recommended in the handbook, project selection is done by evaluators. Giving such power to a group of experts changes the local power relations radically so reaction from the old regional elites is to be expected. We also find this problematic as, in practice, the Entrepreneurial Discovery Process is usually led by firms. Who has the final word when a participatory EDP and the evaluator panel disagree? It would be good to see more advice on this question, because this issue is not handled in the handbook at all. The authors of the handbook do not recognise that there is a need for a regional authority, the project selector, to maintain continuous RIS3 collaboration in regions, and also to foster regionally and locally-based development efforts with strong regional leadership.

At the end of chapter III there is a mention of the assessment of the projects' economic impact on regions and countries. This is an appropriate starting point, but there is still a huge dilemma linked to the assessment of the effect of single projects on regional development. It is very demanding to analyse and separate the impact of a certain project's contribution to macro-level variables, such as economic growth, jobs, and innovativeness. One way could be to assess a single project's quality factors, such as the skill level and experience of the project workers, extent of networks, created patents, and scientific and practical publications. These are at least linked to the success of a region.

Historically, in many developing countries, participatory local development processes have been seized by the local elites. Is this the most urgent problem that we should also concern ourselves about in Europe with regard to smart special-

isation processes? Regional authorities that gain their legitimisation from representative democracy are at the same time facing pressures from experts (technocratic decision criteria), and from local interest groups and participatory processes (EDP). Possibly, regional authorities should be given official entitlement by the EU to co-ordinate and balance the various interests of various stakeholders for the advantage of a given region.

Discussion on Chapter IV: Transnational cooperation and value chains

The internationalisation of the value chain associated with a future regional economic growth is above all the result of the operations of multinational companies. The EU's transnational S3 strategy concerning GVC (Global Value Chain) should, first of all, draw attention to the attractiveness of a region's globally competitive companies and how to retain them there.

The handbook does not justify the absolute or relative importance of transnational cooperation or GVCs among the factors that create regional or European-wide competitiveness. Consequently, we remain quite unsure about the ultimate benefits and costs of investing in the specific forms of transnational cooperation and GVCs.

The chapter lists the factors that affect economic growth and regional development. The list includes a supportive environment, infrastructure, regulatory framework, research & technology & education, and human capital. There has been a lot of socio-economic research on these, and their importance has been recognised as fundamental. However, one must wonder how strongly the learning of intra-regional industry GVCs, provided platforms, matchmaking and other recommended activities contribute to regional development.

It is argued that smart specialisation and transnational cooperation are close companions. Transnational learning is crucial to achieving growth. All we need is more of the same and some new tricks to raise the efficiency of an internationalisation endeavour. Even so, the task is not an easy one, as competitive advantages and other excellence domains cannot be viewed as fixed. Rapid change means that regions must commit all their actors to constant information gathering regarding market opportunities. This search for information will cost time and resources, so it would be good to have foreign partners who have already gathered the information.

Innovation occurs in both upstream (R&D) and downstream (GVCs, FDI, outsourcing, subcontracting) activities. In fact, there is a dual innovation system in the EU. The FDI innovation system is production-oriented and led by multinational enterprises (MNEs) who invest in tangible production structures. However, the system of domestic R&D&I activities is not directly related to MNEs, as the former invests in intangible capacities, which enables the creation of new technology firms. To conclude, many theoretical and practical issues are still open and obscure.

Discussion on Chapter V: Monitoring

Monitoring is needed to reassure the citizens of EU Member States that smart specialisation is giving value for the taxpayers' money. The handbook is very clear in its message. You need to have a performance measurement system, which shows how activities in projects change into outputs.

It seems that the handbook is biased to serve the immediate needs of European agencies that control regional funds and operational programs. This is understandable, but also a very limited viewpoint for regional development strategies. Furthermore, there is a real threat of increasing the bureaucratic costs that are connected with the gathering and processing of large amounts of data which are irrelevant to regional development.

Indicators work well when the processes are stable, i.e. when we know what kind of processes are generating the data. The problem, especially with the Entrepreneurial Discovery Process, is that it should be an experimental exercise. If we want every region to find its own strengths, we must allow variation. Bottom-up processes are difficult to measure meaningfully with indicators.

Monitoring indicators and their functions are described in Table V.1 of the handbook. The first three types of indicators are purely meant for funding agents. The fourth type of indicators are meant to obtain data about structural change and specialisation. The construction and maintenance of regional and local, up-to-date databases are crucial for the knowledge creation that may advance the objectives of S3. The examples do not include investments, employment and income indicators that are fundamental socio-economic variables in this context. Also, the indicators for human capital and R&D&I are missing.

From the point of view of socio-economic growth and development research, one factor is worth paying attention to: the role of universities and research institutions is secondary in the handbook. However, they are fundamental in transforming scientific knowledge into regional success. Whatever the other stakeholders might be, universities can ensure the quality and systemic consistency of development programs.

The purpose of the fifth set of indicators is to measure the context of a regional economy. This begs the question of why context indicators are separated from structural change and specialisation indicators. They should be unified because both sets of indicators are connected to the general problems of socio-economic growth and development. Gauging the monitoring system can also be a problem if some stakeholders believe that some measures may benefit their private interests at the expense of others. This can be a potential problem in the bottom-up approaches.

Chapter V gives regional and national examples of *good practices* that have been implemented in individual regions of Italy, Wales, Spain, and France. The common feature is that they have been executed well according to Commission guidelines. Undoubtedly, these major efforts may serve official goals and require-

ments, but the coherent, theory-based organisation of knowledge and the learning processes for the socio-economic progress in regions is missing. To put it in the form of a metaphor: "You can get lots of information about individual trees, but how does this help you to manage forestry successfully as an ecosystem?"

Concluding remarks

The handbook can be expected to be valuable to both regional authorities who are involved in the selection and financing of suitable projects, and to those actors who are seeking financing for their regional development projects. From an academic standpoint, there are some more or less serious omissions that require further processing. For the factual socio-economic development of European regions, balancing the functions of "resilient systems" and the "comparative advantage" are fundamental questions in S3, but the handbook almost totally ignores this research.

For example, these concepts could bring some new points of view to the discussion on GVCs. It is, of course, beneficial to a region to become involved in GVCs. However, the resilience and comparative analyses of regions could reveal how vulnerable a region might be if it constructs its S3 too much in GVCs. It is a good strategy to provide suitable conditions for entrepreneurship and GVCs, but a region should not become dependent on one GVC, because GVCs represent global high finance that can transfer its production activities elsewhere overnight. The region should have enough resilience to survive such socio-economic shocks, which is an evident challenge for smart specialisation strategies.

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