STUDIA MIEJSKIE
tom 34 (2019)

Tymon DMOCHOWSKI*, Michał DZIĘCIELSKI**,
Maciej KAMIŃSKI***, Maciej SZAREJKO****, Jan ZIPSER*****

AN ATTEMPT TO INVESTIGATE THE IMPACT OF SELECTED INFRASTRUCTURE INVESTMENTS ON THE POTENTIAL DEVELOPMENT OF THE BIGGEST EUROPEAN CITIES. APPLICATION OF THE SHIFTING MODEL (INTERVENING OPPORTUNITIES MODEL TYPE)

PRÓBA BADANIA WPŁYWU WYBRANYCH INWESTYCJI INFRASTRUKTURALNYCH NA POTENCJALNY ROZWÓJ NAJWIĘKSZYCH MIAST EUROPEJSKICH. ZASTOSOWANIE MODELU PRZESUNIĘĆ (MODEL TYPU POŚREDNICH MOŻLIWOŚCI)

No. DOI: 10.25167/sm.1259

ABSTRACT: The core of this article is a simulation of economic growth diffusion, based on the well-established Intervening Opportunities Model. The algorithm allowed detection of spatial distribution patterns of leading groups of beneficiaries from development of the Central Communication Port. The simulation experiments were conducted in two series: for predicting the impact of the Central Communication Port and the impact of both the Central Communication Port and Via Carpatia (also known as the New Amber Road) that is currently in development. The goal of this article is to answer the question: Which regions of Europe will benefit most from the development of the Central Communication Port? The results of the simulations confirm that European settlement and economic systems are inert in forming and conditioning zones of higher economic growth.

KEY WORDS: Shifting Model, Intervening Opportunities (model), Central Communication Port, Via Carpathia

---

* Wrocław University of Science and Technology, e-mail: tymon.dmochowski.pwr.edu.pl, ORCID: http://orcid.org/0000-0002-9926-0333.

** Faculty of Geographical and Geological Sciences, Adam Mickiewicz University in Poznań, e-mail: michal.dziecielski@amu.edu.pl, ORCID: https://orcid.org/0000-0002-7056-5774.

*** Wrocław University of Science and Technology, e-mail: maciej.kaminski@pwr.edu.pl, ORCID: https://orcid.org/0000-0003-0678-5489.

**** Wrocław University of Science and Technology, e-mail: maciej.szarejko@pwr.edu.pl, ORCID: https://orcid.org/0000-0001-8234-4349.

***** Opole University, Faculty of Economics, Institute of Human Geography and Spatial Management, 45-058 Opole, Ozimska 46a, Poland, e-mail: jan.zipser@uni.opole.pl, ORCID: https://orcid.org/0000-0002-6772-7904.

ABSTRAKT: Przedmiotem niniejszego artykułu jest symulacyjne badanie dyfuzji wzrostów gospodarczych, oparte na ugruntowanym modelu pośrednich możliwości. Użyty algorytm umożliwił detekcję wzorców rozkładu przestrzennego grup wiodących beneficjentów wymiany handlowej, realizowanej przez Centralny Port Komunikacyjny. Eksperymenty symulacyjne wykonano w dwóch seriach – dla prognozy wpływu działania Centralnego Portu Komunikacyjnego oraz dla działania CPK łącznie z budowaną jednocześnie Via Carpatia (czyli tzw. „Nowym Szlakiem Bursztynowym"). Celem niniejszego artykułu jest odpowiedź na pytanie: Które rejony Europy najwięcej zyskają na działaniu Centralnego Portu Komunikacyjnego? Osiągnięte przez nas wyniki eksperymentów symulacyjnych potwierdziły znaczną bezwładność systemu osadniczo-gospodarczego Europy w zakresie formowania i kondycji stref (klastrów) o najwyższym potencjale rozwojowym.

SŁOWA KLUCZOWE: Model Przesunięć, (model) Pośrednich Możliwości, Centralny Port Komunikacyjny, Via Carpatia

Introduction

In the relevant literature, it is possible to find many publications describing the impact of an airport on a city and regional economy (ACI Europe 2004; Huderek-Glapska 2012, 2017), as well as on an entire country (Hujer and Kokot 2001). Examples of modeling such issues can be found in the works by Huderek-Glapska et al. (2016) and Montalvo (1998). The topic of incorporating airports into intermodal transport networks can be found discussed in EUROSIL (2000), Huderek-Glapska (2010) and Laplace et al. (2004).

The announcement of plans concerning construction of the Central Communication Port (CCP) roused a lot of interest from public opinion, which should not be surprising, since the CCP expects to service one hundred million passengers a year – the number that can only be attributed to the airports in Atlanta (107.4 million) and Beijing (101 million), but none of the European airports has managed to reach this number so far.

In the first place, at the starting stage of the CCP's construction, it is supposed to service 45 million passengers a year. This would immediately place it as the fifth largest airport in Europe, right after Heathrow and Charles de Gaulle, which service around 60 million passengers every year, then Frankfurt (around 57 million) and Schiphol (around 51 million). It would be close to equal with Madrid's Bajras Airport (around 45 million) but larger than Munich's Airport (around 38 million).

In the European scale, however, it would have a large advantage: a possibility to grow and double its passenger flow. This is what makes the CCP such an extraordinary investment: a potential to become one of the largest airports in the world.

A transportation hub of such a magnitude, in Europe, is raising a lot of questions regarding preservation of the economic balance between member states of the European Union, and rightfully so. There are some who see a great chance in this (mainly Poland), but also countries like Germany – that perceive it as a powerful competitor in their own effort to develop Berlin's Airport.

All of the above chances and concerns would be put to rest if the plans for constructing the CCP were unrealistic. After all, we are not talking about an evolutionary

growth of the local, functioning establishment – but about creating a transportation hub of intercontinental importance in a very short period of time. In order for them to be realistic, a few very specific circumstances have to occur. Astonishingly, some of these (unlikely or even extreme) circumstances have already mateiralized. The Central Communication Port is planned as the intersection of the following two great international routes: New Silk Road and New Amber Road. Both mean to bind Chinese and European economies closer together. It would be difficult to find any reality for the CCP investment in Poland or Central Europe in general; however, if we consider it to be a terminal for the fast Chinese train route to Europe – our speculations about spatial diffusion of growth that may suddenly appear, might come out as a real, important, urgent, and necessary subject.

Materials and methods

An outline of the concept of the Shifting Model by T. Zipser

The essence of this article is a study on diffusion of a change triggered by the impact of a large economic center like the CCP and on the creation of the New Amber Road infrastructure – currently being developed Via Carpathia motorway. If we approach the subject from this angle, the Shifting Model (S-Model), based on the "intervening opportunities" idea (De Grange et al. 2009; Stouffer 1940; CATS 1960; Zipser T. 1973, 1975, 1976; Zipser T. & Sławski 1988), becomes – in its Concentrating Diffusion Variant (Zipser T. 2009, 2012) – an accurate choice for the simulation model. It connects, in the simplest manner, three essential parameters of a settlement network, i.e.: development potential of the settlement nodes; distance estimated by travel difficulty; and a technological progress stage, reflecting the level of globalization (simplicity of economic contacts in contrast to the distance in space). Such a construct allows indicating the hierarchy of a certain economic center along with its respective nodes of even extensive settlement networks, with a relative ease. It must be mentioned, that the "intervening opportunities" approach was already used in research of an air transit (Long and Uris 1971).

While the "intervening opportunities" idea is currently almost a classic solution, the core of the Shifting Model – Concentrating Diffusion Variant (S-Model-CDV) does require some additional functional clarification.

In its initial iteration, a single node, regarded in the modeling procedure as a primary object of analysis, is assigned with the so-called "load of contacts". The other existing nodes are diversified by the amount of "load of contacts" they can receive (accept). The first iteration spreads the "load of contacts" upon the network (graph). This spread is being conducted according to the classic "intervening opportunities" procedure. The nodes receive different amounts of the "loads". In the following iterations, each portion of the "load" accumulated in each node, is distributed following the same principle (i.e. "intervening opportunities" approach).

A characteristic feature of the model's operation is that in the zero iteration the "load of contacts" is placed at one point (in our experiments it is the CCP). During the first few iterations the "load" is significantly dispersed. After the first major distribution-"diffusion", the modeling procedure spontaneously and very clearly endeavors to concentrate the "load of contacts" in a fewer and fewer number of nodes with each iteration. This means that the S-Model-CDV replicates the phenomenon of spontaneous production of clusters in the development process of the settlement network.

In economic studies, cluster is generally defined as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate" (Porter 2000: 16). However, this definition is sometimes criticized (Martin and Sunley 2003: 5-35). There are also many other definitions of clusters (Doeringer and Terkla 1995: 225-237; Rosenfeld 1997: 3-23; Dijk 2003: 183-206; Fromhold-Eisebith and Eisebith 2005: 1250-1268).

It is crucial to define the specific term of a "cluster". By using it, we simply mean a spontaneous appearance of concentrations of the settlement system development. Concentrations, in which internal group relations (interdependence of direction and growth pace) and differences between groups (i.e. competition between the clusters), exhibited stability in all experiments and variants presented here. In this case, spatial potential of the cluster formation, is an emergent of settlement system activity – revealing itself in simulations as groups reacting to external, global changes in a combined, joint and simultaneous manner. In general clusters theory, this phenomenon can be a subject of further research – because it can prove an additional, useful and essential basis in predicting development of socio-economic clusters of different types and different levels of specialization. It is due to the fact that it indicates specific regions in settlement systems, in which spontaneous development of socio-economic clusters can be greatly simplified.

Entry data – graph of European agglomerations network

Preparation of entry data served mainly to determine the capabilities of local economies (regions, agglomerations, cities) to absorb the economic growth from the CCP region and reoccurring growth (appearing in further iterations) from centers that grew due to the contact with the CCP.

In order to maintain model coherence in continental scale, a simplified version of data preparation has been used. Economic potential of regions was described as region's population multiplied by (national) GDP (in order to represent the ability of local economies to participate in supply chains) and (national) purchasing power (in order to represent local potential for consumption). Regional potential, determined in such a way, is assigned to main regional economic center, typically understood as Functional Urban Area of the regional capital. Transport connections have been treated as weighs of the graph's edges and selectivity parameter ("choosiness", mathematically

linked to probability of contact satisfaction in closer regions) was predetermined as even for the entire model (local differences were expressed by weighing the nodes by purchasing power parity).

One of the essential assumptions was to keep initial potential of nodes set on the constant level. This allows further iteration to spread the entirety of economic growth potential over the graph. The result is presented as growth in percentages, tracing its source to the researched origin point. Experiment prepared in such a way allows us to simultaneously predict long term effects of a specific node – indicating self-stabilizing diffusion dispersions along the selected graph.

Nodes: Functional Urban Area (FUA). As a graphic localization we took geographic position of the FUA over one million inhabitants. The potential of surrounding regions was added up to FUA as a population count. In order to indicate region's economic potential, the number of inhabitants was multiplied by (national) GDP and purchasing power parity (average value from countries).

Transportation network – with weighed lengths. A single edge of a graph is not directly understood as a single physical road – be it a railroad or a roadway. It reflects a sum of all known connections served by different transport modalities. A railroad is added to roadways as edge weight reduction. It is not considered a separate edge on the graph. On a single edge connecting two cities, it is possible (and frequent) to have different weights assigned to specific segments of the edge. It reflects more precise data, indicating that, for example, lower weights apply only to the fragments of the connections and note entire routes connecting regional capitals. Thanks to that it is possible to add information about finished freeways and other rapid transit routes.

During the simulation, the concise weight of the road segments connecting every two nodes reflects difficulty of transit on that specific road. It is not only a measure of distance in a spatial understanding, but also infrastructural and multimodal. The less weight is attributed to the edge, the greater the connection there is between two nodes.

Definition, diffusion, simulation role and picking criteria of the selectivity parameter

The main goal of the S-Model is to study spatial distribution of the civilization phenomena, including those of socio-economic origins. The level of economic growth is defined by the selectivity parameter value general preference (general for all parts of the model and referring to every individual experiment) and reflects the economy's character profile (development stage) in a highly aggregated manner.

So far the only type of economy, studied by means of the S-Model, has been an industrial economy (Szromnik 1992: 229; Zipser T. et al. 1990) – for different spatial variants and development phases. In the case of presented experiments, selectivity was assigned with a value based on industrial economies, more specifically for industrial economy dominated by low processed production, technologically advanced economy and industrial-services economy.

Experiments, presented here, served as an indicator of European economy's dynamics, including possibility of its growth in a quality dimension, meaning an increased influence of the service-information sector.

In the case of presented model, "development potential diffusion" is a derivative phenomenon. It is not a given parameter, but instead, a result of modeling. A connection of selectivity with simplicity of the goods spread seems to be unmistakably matched (the greater the selectivity, the further is the diffusion's spread).

In an alternative approach, such as the gravity model approach, similar phenomena are modeled using friction parameter as an analogue to the selectivity parameter and gravity attraction as an analogue to the possibility of finding destination on further, intervening nodes of the graph.

Experiment Variants

The experiment was conducted in two infrastructural variants, each for three types of economy, adding up to a total of six simulations.

Variant 1: The CCP. A study of growth diffusion brought about by the Central Communication Port

The goal of this experiment was to determine the diffusion of the CCP alone as a great transshipment port, a place of significant goods circulation and with a unique solitary nature that contrasts the linear nature of routes like Via Carpathia. The experiment was supposed to underline the significance of the difference between a fast construction of an airport and a great scale.

Variant 2: CCP + VC. A study of growth diffusion brought about by the Central Communication Port and distributed by Via Carpathia

The goal of this experiment was to study the influence of Via Carpathia construction on the distribution of results of growth diffusion brought about by the CCP. Choosing this route as the only correction to the previous modeling was influenced by the fact that it is directly connected with the plans of the CCP construction as a Central-European terminal, it is also the greatest road investment in this part of Europe and as a part of the New Amber Road, it is supported by the Chinese Government as an inter-European goods distribution canal, being a core of the Chinese European-bound trade.

Rules of interpreting the results

The simulation algorithm that was used, serves mainly to determine the settlement system's answer to the newly-appearing growth. It is not a prognosis indicating how the entire system will look like in the far future. The simulation solely indicates how

settlement system will divide the change among its nodes, a phenomenon whose effects we are trying to study.

The correct functioning of the S-Model-DCV requires some initial generalizations, such as: simplification of companies' conditions and social aspects of the economy (represented as a single node of the graph) and the local wealth level, consumer potential of the individual households and purchasing power of the different sectors of the economy – to name a few of the economic subsystems characterized by those with autonomic dynamics. Similarly, individual cities and industrial centers can exhibit significant sector specialization (such as cities and regions basing their economy on some natural resource – mining operations, specialized production – energy, petroleum, shipyard or military). Such places can exhibit significant autonomy as a reaction to simplified economic changes (such as growth/decline of GDP, demographic changes, currency rate); however, they can be influenced by conditions of internal, narrow sectors – such as governmental purchase orders, new technologies, etc. For this kind of special sectors, the model must treat them as a representation of transregional interaction, in which these specific technologies are absorbed by greater transregional systems – and in this larger system's dynamics, the influence of this specialization can be grasped as simplified condition of the economy, one that relies more now on joint dynamics.

In practice, it is crucial to assume that the simulation algorithm which we are using, allows us to detect macro-spatial templates, in which there exists a heightened potential for developing interdisciplinary economic clusters.

Level of trust in the results

The S-Model has a long implementation tradition. Pioneering attempts to use it in the form of a computer simulation application date back to 1965 (Zipser T. 1973, 1976) and it has been used and developed to this day by research teams of Wrocław University of Science and Technology (Zipser T. 2016). The model was also successfully introduced into the field of archaeology as a tool for settlement process reconstruction (Zipser J. 2014). The S-Model (regarded as an intervening opportunities model type) is one of the two properly tested simulation approaches for the settlement systems modeling (the second one represents the diverse gravity models).

The S-Model-DCV works best on the network (graph), in which modeled connections reflect existing network of transport routes and nodes (being always some kind of aggregation and generalisation of regional economies) – a real distribution of settlement accumulations. It works best in continental scale then; however, it does bring a lot of problems in simulating transit distribution inside large cities, where the distribution of buildings is nearly even and regional division (and secondary determination of centroids for this region) has an arbitrary character. Additionally, transport connections between arbitrary centroids have an arbitrary character as well.

Based on the experience from the previous attempts of using the S-Model-DCV, it is clear that we need to apply the following distrust of our results:

Firstly, the model does properly represent the functioning of most important networks – transregional and intercontinental. The presented scale of the simulation corresponds to the best area of efficiency of the model.

Secondly, the model does not precisely determine single points of settlement concentrations (and more precisely – can indicate "best localization" of a large city situatied 30 kilometers away from the actually existing one). It does, however, properly indicate "a sum of the potential" of the cities creating neighbouring economic clusters. For isolated economies (where, for example, the country's border was considered a barrier, it was possible for the model to make mistakes if the isolation power of such a border was not somehow implemented into simulated economic contacts).

The same characteristic (disruptive for predicting European economy in the times of iron curtain) – seems very useful for simulating the same area (Europe) after the Cold War period and fast economic integration of the European Union.

In view of the above statement, the experiment was designed in a way to use the S-Model in an exemplary manner – both in the selection of scale and distribution of nodes, as well as in the interpretation of results. We use this model to analyse the distribution of large-scale clusters, defined as spontaneously appearing groups of cities and regions linked to each other in such a way that global changes react in a convergent manner (at the same time they show increases or lack in increases). However, we draw attention to the limited confidence in the results obtained as development forecasts for individual cities.

Results

Variant 1 – the CCP as a single point node

The core of the experiment is to study the modelled influence of the singular goods distribution center. An influence understood as a spatial growth distribution. It answers the question: how growths originating from a single point will be absorbed by specific nodes of the network. Henceforth it does determine the growth proportion between the beneficiary.

Each variant should be treated as hypothetical, because the type of the modeled economy does not match with the type of goods transported via airplanes. However, the indirect workings (understood as, for example, technological modernization of resource economy) indicate here the change in economy's structure and is covered in Figure 2.

Despite its hypothetical character, the vivid central-European cluster in Leipzig and Hamburg deserves our attention. It stretches from there to the East, all the way up to Krakow (Figure 1).

The influence of the CCP as a single center, in conditions of industrial economy, is distributed completely asymmetrically – a single consumption point reaching furthest to the East is Warsaw – basically the CCP itself (Figure 2).

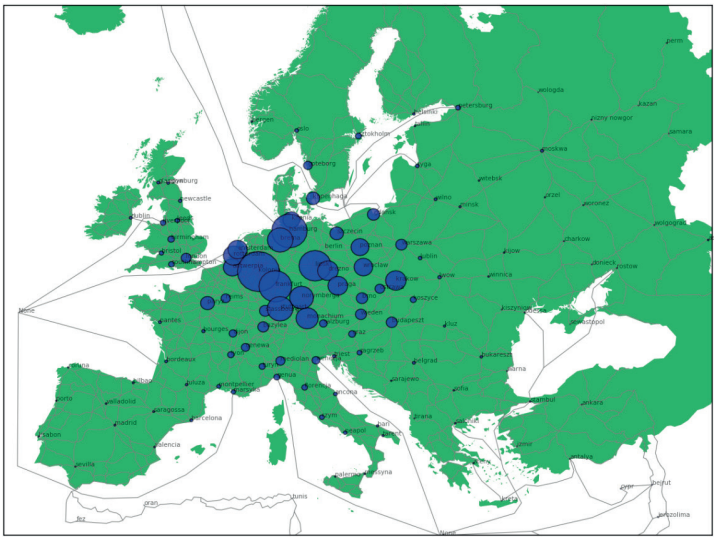

Fig. 1. The spatial distribution of growths spread from the CCP in conditions of the resource and industrial economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

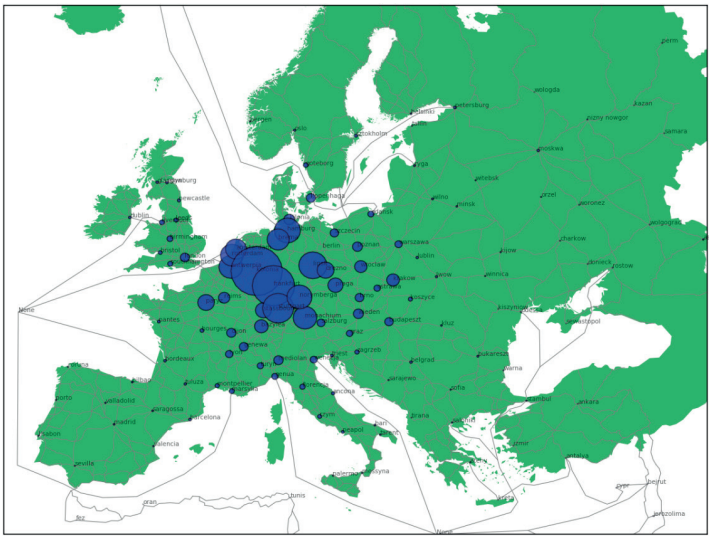

Fig. 2. The spatial distribution of growths spread from the CCP in conditions of the industrial economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

The central European cluster that we mentioned is much less potent compared to the "resource" economy variant. This cluster shows only Leipzig and Hamburg, still clinging to the possibility of growth – this positions them more in the western European cluster. In the area of central European cluster, the predicted growth is much closer to the ones predicted in the area of France – which can be surprising.

For a variant of the CCP as a singular point, for high tech economy, growth potentials generated by the Central Communication Port will mostly be consumed by the western European cluster.

The share of central European cluster, if we do not include the area of Germany, is nearly nonexistent (Figure 3).

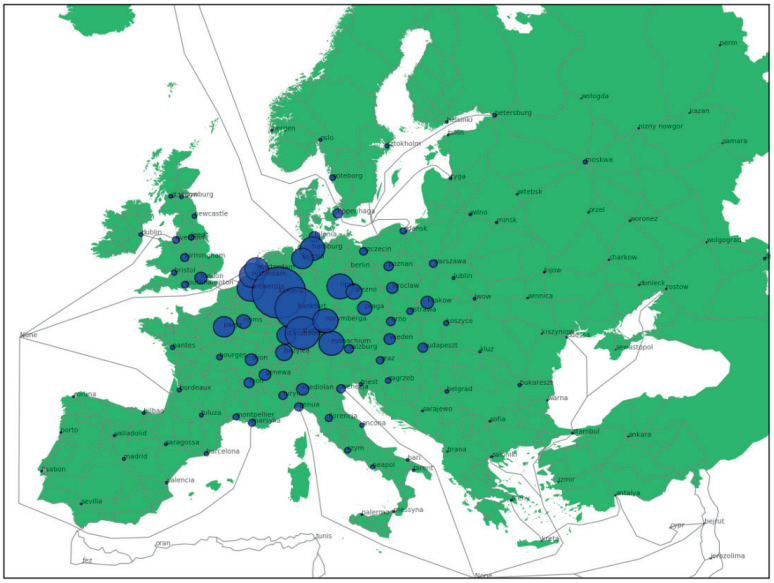

Figure 3. The spatial distribution of growths spread from the CCP in conditions of the industrial and service economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by the circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

Variant 2 – Joint endeavour of the CCP and Via Carpathia

Via Carpathia, the new European transport corridor (Helsinki – Tallinn – CCP – Thessaloniki), currently developed intensively as a highway. Some countries lying on the path of Via Carpathia (like, for example, Slovakia) have already completed the construction of their segments. It is then crucial to note that despite the grand scale of this investment – it is not a completely hypothetical plan, but the CCP functionality along Via Carpathia is the most probable outcome.

It is also possible to notice the attractive or even ground-breaking idea of plans to construct fast railway servicing the CCP; nevertheless, these plans are being greatly modified today, which makes the future course of new railways not possible to predict today.

The spatial distribution presented in Figure 4 is hypothetical (the type of key resource is different from the type provided via air traffic). It was meant to highlight the general thesis that the road development, even along the eastern border of the EU, supports not only these areas, but also (mainly) the central European cluster, leaving Berlin in the lead.

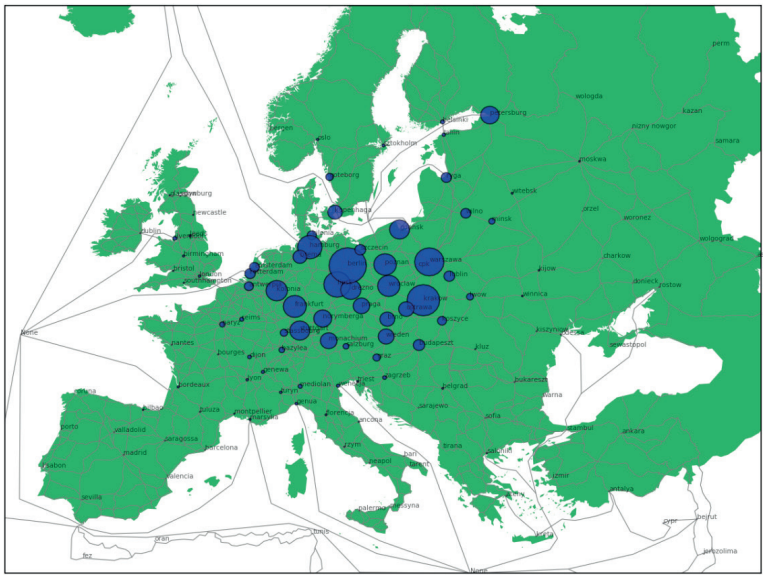

Fig. 4. The spatial distribution of growths spread from the CCP + VC in conditions of the resource and industrial economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

Figure 5 deserves special attention due to the fact that joint endeavour of the CCP and Via Carpathia allows maintaining a relative balance between European Clusters. A significant part of growth is located in eastern part of Germany (Berlin remains a central European leader). However, western European cluster appears to outweigh others.

In the modern economy model, by which we mean dominance of services and industry, the largest beneficiary of the CCP and Via Carpathia investments is western European cluster (Figure 6). It might be surprising that such important investments located so far east – lead only to the empowerment of Berlin's position within western European cluster – making it a more German cluster – with three dominating centers: west, north (Hamburg) and east (Berlin and Leipzig).

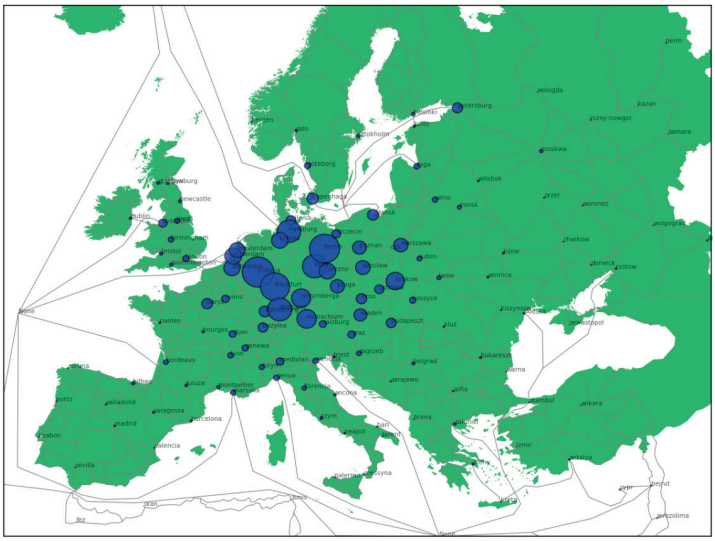

Fig. 5. The spatial distribution of growths spread from the CCP + VC in conditions of the industrial economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by the circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

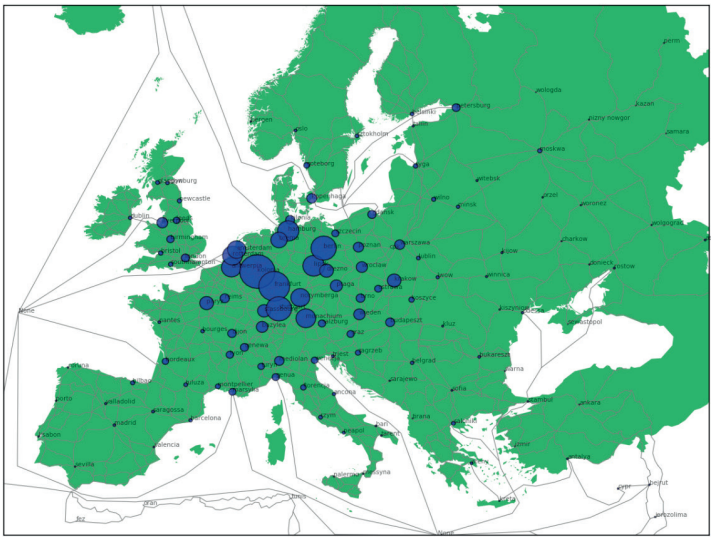

Fig. 6. The spatial distribution of growths spread from the CCP + VC in conditions of the industrial and service economy. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by the circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

Discussion

The presented variants of modeling the industrial economy are not forecasts or suggestions of forecasts. They were presented to highlight the processes of economy changes which are sensitive to the level of economic advancement. The singular goods distribution center and the East European cluster transport network variants are only a presentation of trends (in range of the selectivity parameter). The reason for their presentation is the reference to the prognostic stereotype, which assumes that the consumption of growth appears only in the immediate vicinity of the distribution node.

We presented the origin of this stereotype – modeling of types of low-processed economy, in which the high transportation cost is the dominant parameter limiting the distribution of goods, in fact confirms this phenomenon. This modeling also indicates that this type of goods is not distributed by air, so its distribution should not be modeled with selectivity corresponding to the dynamics of the distribution of low-processed materials. And this is what our modeling has shown: it overthrew the stereotype of the construction of the Central European hub as a support only for the development of Central Europe.

Another important phenomenon which our simulations have shown is the almost complete asymmetry of the final distribution. Despite the fact that the modeling area was the entire European continent (with, for example, Moscow, Kazan and Samara), the region of accumulation of growths is Western Europe. The agglomerations east of CCP accept a small amount of distribution.

Development of Via Carpathia transport corridor definitely strengthens the Central European cluster – the distribution of growths of both clusters is divided into approximately equal parts (Figure 7). The phenomenon of growth of non-junction points of

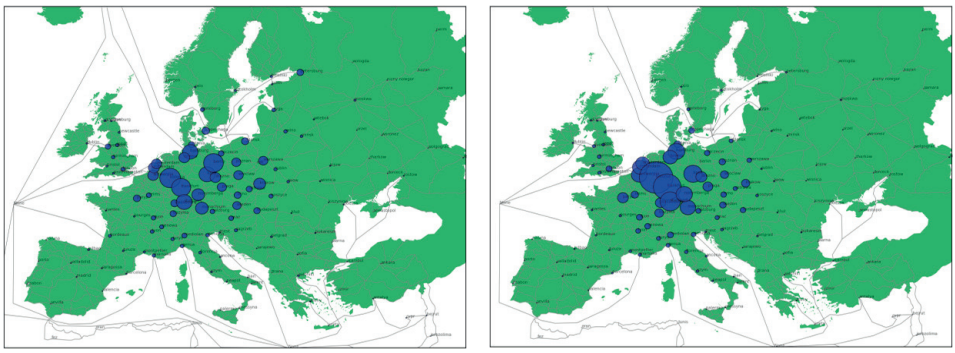

Fig. 7. The Impact of Via Carpathia (left) on reducing regional differences in the rate of economic growth of the intermediate economy. On the right, the distribution of diffusion of the CCP growth consumption operating pointwise (without expanding the transport network). Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by the circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

Via Carpathia itself, but the parallel route Gdańsk-Poznań-Wrocław-Brno-Vienna and (to a lesser extent) Warsaw-Kraków-Košice is also noteworthy. In this distribution, the growths in eastern Germany are almost the same as for the variant without Via Carpathia – this means that growths in central Europe are taking place at a cost of growths in western Europe (but not the former East Germany).

An additional aspect which can be traced is the stability of the transition of the European economy from the industrial-service to the service-information phase. In our experiment (in terms of confidence in the results) we can conclude that the proportions of the development distribution contributed by the CCP + VC look very similar to the industrial and service economy. This also means, that due to the creation of the CCP and VC, this region of Europe will develop more evenly, without excessive discrimination of the fringe and less developed economies. This natural European tendency to smoothly nurture maturing local economies to the requirements of the service-information economy is either preserved or boosted, but surely not disturbed, by the CCP and VC (Figure 8).

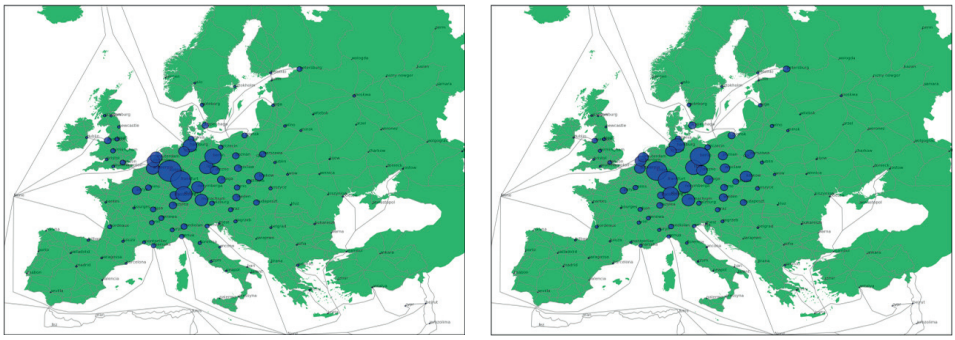

Fig. 8. The European service and information centers under the operating conditions of the CCP + Via Carpathia (on the left) are created from the even transformation of industrial and service centers (on the right). The spatial distribution of the European economy is preserved despite thorough transformations of the economic structure. Land areas are marked in green. Roadways, railroads and sea routes are marked in gray. Functional urban areas are represented by the circles marked in blue. The higher the growth absorbed by specific functional urban areas, the larger the size of the circle.

Source: own calculations.

Conclusions

In this article we were attempting to answer the question: which parts of Europe will benefit most from the influence of the Central Communication Port. The answer that we found was a little surprising: launching a new air traffic node in central Europe will contribute mostly to the development of western European cluster, which can lead to a rise in the disproportions in regional economic development levels. However, the details of our modeling, revealed a possibility to maintain balance between central and western Europe development pace – which would go in accordance with the EU cohe-

sion policy. Hence, such is our approach to the result interpretation: equal growth of both European clusters is in the best interest of the European Union, because excessive dominance of one cluster might turn into a cause of lasting discontent among European citizens – which could fuel movement of separatist nature, laying groundwork for dissolution of the EU. So the best answer to the question "who will gain the most from the construction of the CCP" is "Europe as a whole".

Results of our experiments suggest a great numbness of Europe's economic systems to the formation of centers and clusters. The results we provided fully confirmed the phenomenon of supporting the growth of the most developed clusters – even after creation of solitary distribution centers of the peripheral edges of the EU.

We also confirmed the thesis that construction of a very efficient transport corridor on the eastern border of the EU, can have a limited impact on the empowerment of the central European cluster in these sectors of economy that are highly advanced (knowledge based). Construction of Via Carpatia can lay the foundation for the growth of central European cluster, mostly in those sectors of the economy that are averagely advanced – so specifically the same type in which this region currently specializes. However, the experiments were able to show limitations in that regard as well – because in this variant we can only talk about equalizing the growth potentials of the western European and central European clusters (growths distribute themselves nearly equally and this is the most optimistic variant for central Europe).

The Central Communication Port can be understood as a chance for developing the region of central Europe – but keeping in mind that it is only a tool for potentially soothing rapidly intensifying growth potential disproportions between central and western Europe, without encroaching on balance systems which base on economic dominance of western Europe over eastern Europe. Such "soothing" is an element of the cohesion policy and can be treated as a chance for Europe as a whole. A final conclusion remains as a statement that in a long-term perspective, the greatest threat for western European economy is intensification of disproportions – leading to the conclusion that the lack of the CCP is a greater threat than its construction and development.

Acknowledgments

This research was founded by the Institute of Socio-Economic Geography and Spatial Management, Adam Mickiewicz University in Poznań from a grant for young researchers.

We also thank the two anonymous reviewers whose comments helped improve and clarify this paper.

References

ACI Europe. 2004. *The social and economic impact of airports in Europe*, York Aviation.
CATS. 1960. *Final Report II*, Chicago.

De Grange, Louis et al. 2009. Gravity model estimation with proxy variables and the impact of endogeneity on transportation planning. *Transportation Research: Part A*, 43 (2), 105-116.

Dijk, Meine P.V., Arni Sverrisson. 2003. Enterprise clusters in developing countries: mechanisms of transition and stagnation. *Entrepreneurship and Regional Development*, 15, 183-206.

Doeringer, Peter B., David G. Terkla. 1995. Business Strategy and Cross-Industry Clusters. *Economic Development Quarterly*, 9, 225-237.

EUROSIL. 2000. National Technical University of Athens, Contract SC-1113. Accessed 1.07.2019) https://trimis.ec.europa.eu/sites/default/files/project/documents/eurosil.pdf.

Fromhold-Eisebith, Martina. Gunter Eisebith. 2005. How to institutionalize innovative clusters? Comparing explicit top-down and implicit bottom-up approaches. *Research Policy*, 34, 1250-1268.

Huderek-Glapska, Sonia. 2010. Port lotniczy w systemie transportu intermodalnego (An airport in the system of intermodal transport), *LogForum*, 6 (1) (5), 47-54.

Huderek-Glapska, Sonia. 2012. Oddziaływanie portu lotniczego na gospodarkę regionu (The impact of an airport on the economy of a region). *Przegląd Komunikacyjny*, 2, 20-25.

Huderek-Glapska, Sonia. Federico Inchausti-Sintes. Eric T. Njoya. 2016. Modeling the impact of air transport on the economy – practices, problems and prospects. *LogForum*, 12, 47-61.

Huderek-Glapska, Sonia. 2017. Co oznacza sukces portu lotniczego i kiedy ma wpływ na gospodarkę miasta i regionu? (What does a success of an airport mean and when does it impact the economy of a city and a region?), *Przegląd Komunikacyjny*, 72 (11), 4-7.

Hujer, Reinhard. Stefan Kokot. 2001. Frankfurt Airport's impact on regional and national employment and income. In: *Regional Input-Output Analysis*, ed. Pfähler Wilhelm, 1-45. Baden-Baden: Nomos Verlagsgesellschaft.

Laplace, Isabelle et al. 2004. The airport of the future: Central link of intermodal transport? Accessed: 28.06.2019. https://www.eurocontrol.int/eec/gallery/content/public/documents/EEC_INO_documents/INO_workshop_2004/05_%20FuturAirport.pdf.

Long, Wesley H., Richard B. Uris. 1971. Distance, intervening opportunities, city hierarchy and air travel. *The Annals of Regional Science*, 5 (1), 152-161.

Martin, Ron. Peter Sunley. 2003. Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, 3, 5-35.

Montalvo, Jose. 1998. A methodological proposal to analyze the economic impact of airports. *International Journal of Transport Economics*, 25 (2), 181-203.

Porter, Michael. E. 2000. Location, Competition and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly*, 14, 15-34.

Rosenfeld, Stuart A. 1997. Bringing business clusters into the mainstream of economic development. *European Planning Studies*, 5, 3-23.

Stouffer, A. Samuel. 1940. Intervenning Opportunities: A Theory Relating Mobility and Distance. *American Sociological Review*, 5 (6), 845-867.

Szromnik, Andrzej. 1992. *Metody analizy interakcji przestrzennych* (Methods of spatial interactions analysis). In: Mynarski Stefan (ed.), Badania przestrzenne rynku i konsumpcji. Przewodnik metodyczny (Spatial studies of the market and consumption. A methodological guide), 203-244. Warszawa: PWN.

Zipser, Jan. 2014. Koncepcja teoretyczna modelu dyfuzji osadnictwa dla potrzeb analizy procesów osadniczych górnośląskiej grupy kultury lateńskiej (The theoretical conception of the model of settlement diffusion for the needs of analysis of settlement processes of Upper Silesian group of Laten culture). *Śląskie Sprawozdania Archeologiczne*, 56, 61-78.

Zipser, Tadeusz. 1973. A simulation model of urban growth based on the model of the opportunity selection process, *Geographia Polonica*, 27, 119-132.

Zipser, Tadeusz, 1975, *Raporty Instytutu Architektury i Urbanistyki PWr: Modele symulacyjne w rozwoju sieci osadniczej (Reports of the Institute of Architecture and Urban Planning: Simulation models in the development of the settlement network)*. Wrocław: Instytut Architektury i Urbanistyki Politechniki Wrocławskiej.

Zipser, Tadeusz. 1976. The territorial-production complex as a self-balancing network of spatial relations, In: *Economic models in regional development and planning*, eds. Jerczyński Marek, Bandman Mark, 149-164. Warszawa: PWN.

Zipser, Tadeusz et al. 1990. The model of intervening opportunities in theory and practice of territorial arrangement. Wrocław: Wydawnictwo Politechniki Wrocławskiej.

Zipser, Tadeusz. 2009. Globus i Tribus 1. Accessed: 15.11.2019 https://azon.e-science.pl/zasoby/globus-i-tribus,50469/.

Zipser, Tadeusz. 2012. Globus i Tribus 2. Accessed: 15.11.2019 https://azon.e-science.pl/zasoby/globus-i-tribus-ii,50471/.

Zipser, Tadeusz. 2016. Przewidywanie stanów, modelowanie procesów i budowanie decyzji (Foreseeing states, modeling processes and building decisions). *Architectus*, 3 (47), 3-13.

Zipser, Tadeusz. Jerzy Sławski. 1988. *Modele Procesów Urbanizacji. Teoria i jej wykorzystanie w praktyce planowania (Models of urbanization processes. Theory and its use in the planning practice)*. Wrocław: Państwowe Wydawnictwo Ekonomiczne.