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Spatial hierarchy and emerging typologies inside world city network

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Abstract. The first part of the paper provides a new approach to measuring a spatial structure of world city network (WCN). Based upon the results of media-popular 'global city rankings' produced by several international think tanks, our calculation allowed to reveal global urban hierarchy and identify several sub-networks inside of world cities. The second part of the paper devotes to recent discussions on nature of globalization and urban macrosystems, bearing in mind ranking results. It is shown that a typological approach can provide more insights to a role of city as part of WCN from functional and relationships prospective.

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1. Introduction

City system is an essential part of modern global economy, which can hardly be understood without considering its spatial aspects (Jones, 2010). Urban approach in global studies made it possible to reveal, to some extent, a networking spatial organization of world economy, and to identify its essential nodes, namely "world cities" (Hall, 1966; Friedmann, 1986), or "global cities" (Sassen, 1991). Utilizing data

on a subsidiaries network of advanced producer service companies, Globalization and World Cities international research group (GaWC) separated all cities in the dozen of ranks, or hierarchical levels (GaWC, 2000, 2004, 2008, 2010, 2012). This specific calculation method and its obtained results since then became someway "classical" among others. The first decade of the new century has been marked by a significant increase in the number of theoretical and research studies (Derudder, 2006). For now, one can clearly separate what could be labeled "narrow" and "broad" directions in identifying the world city network (WCN). The first usually uses statistical data on (a) branch network of advances producer service firms (GaWC: Taylor et al., 2010) or (b) divisions of leading multinational corporations (MNC) (Alderson et al., 2010) or (c) international flows, such as passenger air transportation (arguably the most popular approach among others), telecommunication networks, etc. (Ma, Timberlake, 2008; Mahutga et al., 2010). In general, analytical approach and calculation method, suggested by GaWC, became quite popular in a field of global city analysis (GCA) and now to be widely used by other researchers. This allowed productively identify several specific networks of world cities, such as global "maritime" (Verhetsel, Sel, 2009) or "science" (Matthiessen et al., 2010) world cities. Opposite to this, the "broad" approach, influenced by the concept of world-system by Wallerstein, suggests that WCN need to be analyzed in several areas, which are crucial to urban transformation under globalization (Chubarov, Sluka, 2012). What is maybe even more important, most recently GCA and related studies started to pay more attention to cities outside of an Anglo-American bias (Gugler, 2004; Timberlake et al., 2014).

Despite bustling development of GCA in recent years, a lot of research questions still remained to be revealed. The mainstream of research in the field of global cities has been widely criticized for the narrow econometric look at the phenomenon. At the study of global cities there is clear "imbalance in which most authors focus on the economic dimension of world cities/global cities" (Cook, 2006: 78). GCA is over-focused on the economic side of globalization, which led to the creation of a "uniform" understanding of the world city based on generalizations from cities in North America and Western Europe (Olds, Yeung, 2004). Among these, we would like to stress two following aspects need to be enhanced in GCA: detailed spatial structure of WCN, and creating of typology of world cities. This paper mainly addresses to academic discussion on these two topics.

2. Research method

Regarding the spatial structure of WCN, it is widely acknowledged that it has a certain hierarchy (Timberlake et al., 2014), but specific horizontal "flows" inside this hierarchy are still largely unclear. In order to understand in details the composition of this network of cities, several of scheduled rank studies had been produced recently at the intersection of academic and expert/consulting communities. Such rankings, clearly related to the "broad" approach in GCA, now regularly presented by several major international think tanks like The Economist, A.T. Kearney, PWC, Knight Frank, and Mori Foundation (see Table 1). All rankings were made by a similar procedure and cover such fields of urban development as demography, economics, culture, and environment.

Table 1. Summary of global cities rankings

Name of study	Institution	Years of publishing	Cities in ranking	Number of used indicators	Top-5 cities in the study
Global Cities Index and Emerging Cities Outlook	A.T. Kearney	2008, 2010, 2012	66	24	New-York, London, Paris, Tokyo, Hong Kong
Global Power City Index	Mori Foundation	2008-2013	40	70	London, New York, Paris, Tokyo, Singapore
Global Cities Index	Knight Frank	2008-2013	40	~25	New York, London, Paris, Tokyo, Brussels
Global City Competitiveness Index	The Economist Intelligence Unit	2012	120	31	New York, London, Singapore, Hong Kong, Paris
Cities of Opportunities	PWC	2011, 2012	27	60	New York, London, Toronto, Paris, Stockholm

Data sources: A.T. Kearny, Mori Memorial Foundation ion, Knight Frank, The Economist Intelligent Unit, and PWC

The number and similarity of these ratings are the interesting phenomenon itself, reflecting the current demand inside the business and administrative elite for clearer articulation of the horizontal and vertical relationships between the world's most important cities. Also, top-five cities in different rankings are almost similar (this is quite noteworthy too), but the middle and bottom parts of the hierarchies are quite different. An attempt to summarize the results of the most detailed and informative of ratings has been made in this study, based on data from Global Cities Index and Emerging Cities Outlook (2012), Global Power City Index (2013), Cities of Opportunities (2012), and Global City Competitiveness Index (2012). The score of each participant (city) was calculated using the following formula:

$$M_i = \rho^j \times \frac{R_i^j}{\sum_{i=1}^{N_j} R_i^j}; \rho^j = \frac{N_j}{\sum_{j=1}^{T} N_j}$$

where R_i^j – rank of participant i from ranking j, N_j – total number of participants in ranking j, ρ^j – adjustment ration of ranking j, T – total number of rankings.

3. Results

The methodology applied allowed to uniform all differences between the scores, gained by the cities in rankings (unequal number of participants, different assessment rules, and discrepancy in used statistical data), and assign a new score to each city in the range from 0 to 100. In the final list were included all cities with the score not lower of the first 27 members of each rating (according to number of cities in the shortest of used rankings). As the result, 56 cities stand out (Table 2). These cities were logically separated to 5 groups according to their score from highest to lowest (score intervals from 100 to 95, 95 to 75, 75 to 55, 55 to 35 and 35 to 0). These 5 resulting categories consist of 2, 4, 11, 21, and 18 cities, respectively (see Table 2).

Table 2. Aggregated 'global city ranking', 2012

Level	Rank	City	Score
1	1	New York	100
	2	London	97.7
2	3	Paris	92.2
	4	Tokyo	86.9
	5	Hong Kong	80.7
	6	Singapore	74.9
3	7	Los Angeles	72.3
	8	Chicago	71.5
	9	Seoul	71.2
	10	Toronto	69.3
	11	Sydney	68.8
	12	San Francisco	67.1
	13	Berlin	66.1
	14	Stockholm	65.1
	15	Madrid	64.1
	16	Beijing	63.0
	17	Shanghai	60.3
4	18	Moscow	54.7
	19	Milan	54.5
	20	Vienna	52.4
	21	Washington	52.3
	22	Brussels	51.3
	23	Frankfurt	50.7
	24	Zurich	50.1
	25	Boston	49.8
	26	Amsterdam	49.8
	27	Kuala-Lumpur	49.5
	28	Mexico	49.3
	29	Istanbul	49.1
	30	Sao Paulo	47.1
	31	Barcelona	46.6
	32	Genève	45.1
	33	Copenhagen	44.0
	34	Mumbai	43.1
	35	Buenos Aires	41.1
	36	Taipei	40.9
	37	Bangkok	38.8
	38	Osaka	38.7
5	39	Melbourne	32.1
	40	Montreal	31.9
	41	Johannesburg	31.7
	42	Vancouver	31.5
	43	Dubai	30.6
	44	Houston	30.3
	45	Rome	29.8
	46	Atlanta	29.7
	47	Miami	29.2
	48	Dublin	28.5
	49	Abu Dhabi	27.0
	50	Fukuoka	25.2
	51	Tel-Aviv	24.8
	52	Delhi	23.2
	53	Rio de Janeiro	21.1
	54	Guangzhou	18.8
	55	Shenzhen	18.7
	56	Dallas	17.3

Source: Author's calculations

There are six cities altogether in two highest categories (average score above 75 out of 100), including "super-leaders" New York and London (more than 95). These two are widely acknowledged comprehensive and long-term dominating global cities of the modern world. Their leadership is closely historically connected with prominent positions of home-countries within the modern capitalist global economy and, especially, within the sphere of finance and business consulting. Four cities with score 95 to 75 are Paris, Tokyo, Hong Kong, and Singapore. Their formation is the unique case too, and each is a strong and multifunctional player on the global arena and undoubtedly a regional leader. Paris here reflects the second-most center inside the EU and most outstanding continental counterpart of London, while 3 other cities represent East Asia as the largest emerging region and new financial and economic platform for global players. Most prominent cities inside lower categories are Los Angeles, Chicago, and Seoul.

Using the regional approach, our findings confirm hypothesis that the WCN is clearly organized in three main territorial subnetworks (WCSN, see Note 1) - the European, the North-American, and the Asian-Pacific (see Fig. 1). Each of three WCSN has its own specifics, such as hierarchical and spatial configurations, overall dynamics and the dynamics of the individual centers, nature of the relationships between the composing elements, etc. To estimate these features of each WCSN we used several following parameters: (a) *size*, i.e. the number of cities composing the subnetwork; (b) *hierarchical formula*, i.e. the sequence of 5 numbers, each number represents the number of cities in the subnetwork on each hierarchical level from upper to lower; (c) *power*, i.e. the sum of scores of all cities composing the subnetwork; (d) *share,* i.e. the share of power of the subnetwork in total score of all cities in the ranking; and (e) *average share,* i.e. the arithmetic mean of shares of all cities composing the subnetwork in the total score of all cities in the ranking.

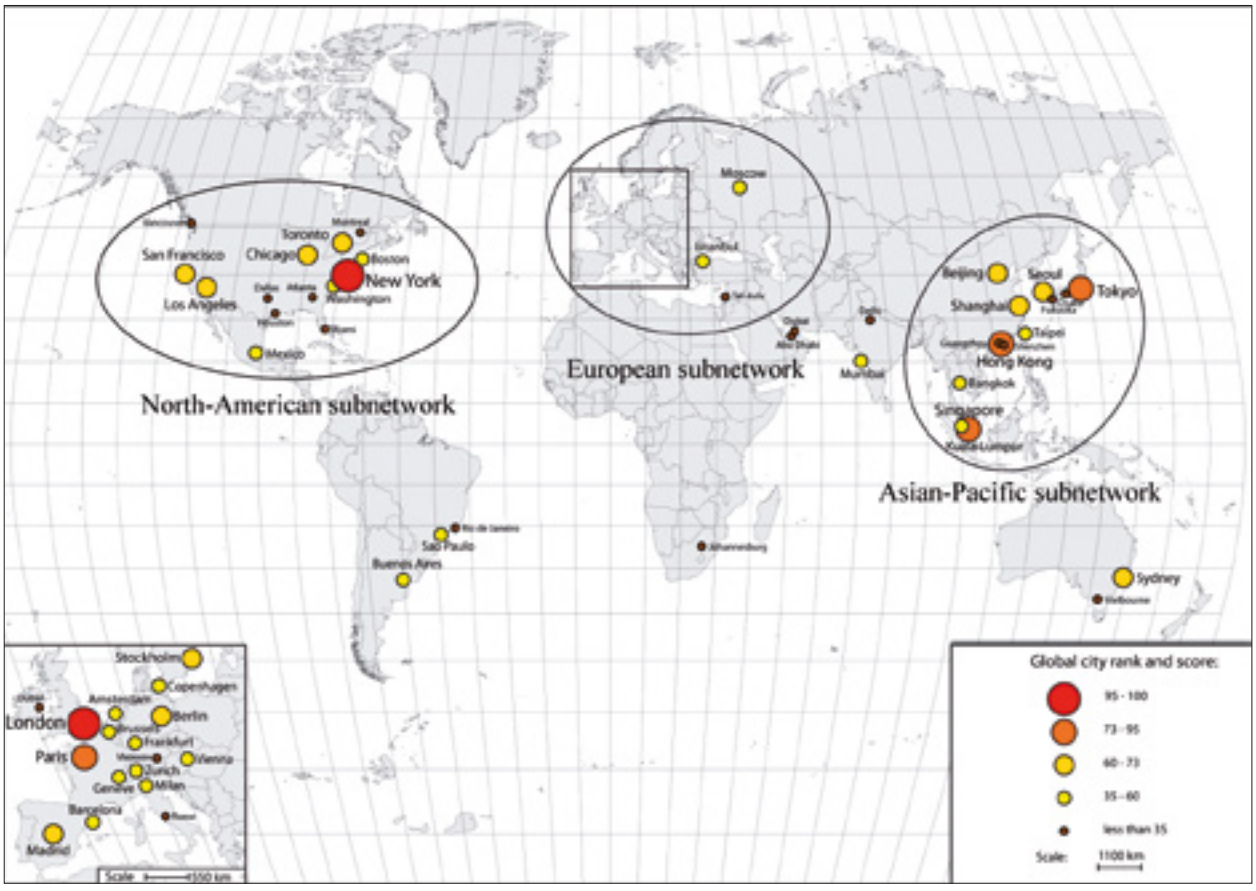

Fig. 1. Subnetworks of World City Network

Source: Author's calculations

According to the our calculation results (see Table 3), North-American and European subnetworks are two leading inside WCN at the present time. Both of them have the clearly standing out leading city, which has huge global influence and representing this subnetwork on world stage. Noteworthy, that performance and influence on world affairs of two highest-rated global cities in the modern world are to high degree equal (New York is just a little bit ahead of London).In terms of *size,* the European WCSN is the largest of all. It includes 19 cities and *hierarchical formula* looks like 1-1-3-11-3, where "average" cities dominate. *Share* (37%) and *average share* (1.94%) are also ahead of two others subnetworks.

Table 3. Characteristics of main subnetworks of world cities system, 2012

Subnetwork	Size	Hierarchical formula	Power	Share, %	Average share, %
European	19	1-1-3-11-3	1016.8	36.9	1.94
North-American	14	1-0-4-3-5	701.4	25.5	1.82
Asian-Pacific	13	0-3-3-3-4	667.8	24.3	1.87
Outside	10	0-0-1-3-6	366.0	13.3	1.33
Total	56	2-4-11-21-18	2751.8	100	1.79

Source: Author's calculations

Key characteristics of North-American and Asian-Pacific subnetworks are quite close in terms of *size* (14 and 13 cities), *share* (both around 25%) and *average share*(1.8-1.9%).Th main difference between them is that the Asian subnetwork lacks one clear leading city on the level of New York or London. The distance between the traditional leader Tokyo and two rapidly growing competitors Hong Kong and Singapore is quickly shortening. *Hierarchical formula* in region is 0-3-3-3-4, what seems to be the most balanced of all three subnetworks. At the same time, this is the most dynamic part of the world, driven by fierce competition between several well-balanced metropolises. The global influence of Tokyo, Hong Kong, and Singapore is close to each outher, but still lower than that of their European counterpart Paris. The North American WCSN is much less balanced (*hierarchical formula* 1-0-4-3-6): over-dominance of the New York leads to the loss of one hierarchical level, which is not the case in Europe and Asia.

There are only 10 world cities left outside of any subsystems (which is less than one-fifth of the total). All of them represent the largest major countries outside the most developed regions of the world, namely Brazil, Argentina, India, Australia, South Africa, and UAE. The highest positioned among others is Sydney, the rest are in the bottom of the list. *Share* and *average share* of these cities are much lower than that of the cities inside any of the three WCSN.

Analyzing the country affiliation of global cities, the first place, somehow expected, is held by the United States (10 cities), followed then by China (5), and Japan (3). 9 countries possess 2 global cities: Canada, Brazil, Spain, Switzerland, Germany, Italy, India, UAE, and Australia.

4. Discussion

Obtained results were used to visualize spatial patterns of the hierarchical system of global cities in the modern world (see Fig. 1 earlier in text). This is not to represent any kind of "final version" of the system of world cities, but more an aggregated data from the few different, but reliable sources, each of them itself is the data-aggregators from the relevant and quite broad fields. Findings can reveal mainly the spatial structure of the modern WCN, but the nature of the relations between global cities and the key features of interactions between each other are still largely unclear under such approach.

Other factors, rarely considered in GCA before, such as global value chains, in fact "… open up a perspective on the *variable* positioning of cities in a globalizing economy" (Kratke, 2014: 145). In gener-

al, "unequal extent and different form of the cities' integration in global economic networks" (Kratke: 2014: 145) can include differences in socioeconomic, political, cultural, and other pathways to globalization. For example, cities of fast-growing successful developmentalist East-Asian countries, such as Tokyo, Seoul, and Taipei in their nature quite different from those from "old" free market states (Hill, Kim, 2000; Wang, 2003). 12 parameters have been identified where situation in Asia is much different from the situation in the "model" cities of London and New York. For example, it was shown that situation in these cities do not fit famous thesis about the growing social and spatial polarization as the result of the large influx of foreigners, the domination of business and financial-speculative TNCs working hand-in-hand with government structures, etc.

Deterritorialisation is another concept, widely used in global cities literature. Our findings on 3 main WCSNs show that this thesis is also not working exactly in the way Sassen was predicting it (Sassen, 1991): hierarchy of global cities show the close correspondence with the location of their country in world system (see also Alderson et al., 2010; Mahutga et al., 2010). Pro-globalist approach states that the cities from different parts of the world are exactly the same, "constructed" from repeating "blocks" (developed financial sector, skyscrapers of business districts, MNC, wealthy areas inhabited by foreigners, etc.), less and less linked with parent countries. The extreme expression of this view is T. Friedman's "flat world" thesis (Friedman, 2007). By doing this modern GCA often ignores the fact that the 'model' world cities of New York and London each were formed under the unique conditions that only allowed them to climb to the top of the world capitalist system. This experience is hard to duplicate, even with the massive influx of governmental funding, considering fierce competition from existing global leaders. Recent calculations on the branch networks of TNCs and passenger traffic between the cities further questions the deterritorialisation thesis (Ma, Timberlake, 2013).

Realizing the above problems, we join those researchers who are trying to alter methodological principles and fix this imbalance in current theoretical approaches. In general, we believe that different categories of world centers behave differently depending on the nature of parent state governing model and established relationships at various levels of the urban hierarchy inside the local urban system. One of the most promising in this field is the study on the typology of global cities. Even the possibility of creating typologies of global cities is currently one of the most controversial in the field. Some authors directly point at the impossibility of creating a typology of global cities because of the difficulty, complexity, and rapid variability of the object of research (Wu, Ma, 2006). But in fact, different kinds of classifications (though not the very rigorous) of world's leading centers are well represented in expert and public sphere. Two-fold typology were created by dividing all of world cities in the market-oriented bourgeois and the state-oriented political-bureaucratic (Kim, Hill, 2000). Another typology identifies three categories of global cities: "hyperglobal", "emerging", and "global city-states", each with different features of interaction between urban, national, and global levels (Olds, Jung, 2003). Another study, within the framework of so called "functional-status-genetic typology" divided all global cities in Europe into 4 groups of cities according to their administrative status and specificity of hierarchical relations in the home country (Kurasov, 2009). The functional analysis of global cities in modern China shows three "pathways" of global cities clearly different from each other (Chubarov, Brooker, 2013). "Global capital city" Beijing has administrative, management, scientific, educational, cultural, and creative specialization inside the WCN. Other Chinese global cities include "industrial and trade" global cities of Shanghai, Guangzhou, and Shenzhen, as well as the complex "global gateway" city of Hong Kong. S. Kratke in his recent study also articulates different pathways, or "sectoral trajectories" of cities in globalization (Kratke, 2014). In another research, the division of roles within the triad Shanghai-Beijing-Hong Kong based on the following scheme. The first is the fastest growing financial center (this is to be called "New York" model), the second is the political center ("Washington" model), and the third is the "global platform" outside the direct jurisdiction ("London" model), thanks to the concept of "one country - two systems" (Kearney, 2012: 4). By another opinion, San Paulo and Shanghai have chosen the path of London and New York, while Beijing and Deli closer to

Paris and Tokyo. Moscow, Istanbul and Mumbai haven't made their choice yet (Clark, 2012).

Thus, the similarity between global cities objectively exists; however, the essential differences between them are also undeniable. For example, most articulated of all types is the "global gateway" city, characterized by the high connectivity within the urban network with specialization on interaction and mediation of business services. Another clearly standing out class of global cities are medium-sized centers of Western Europe, which possess the relatively small population (comparing to their counterparts in Asia and Americas), but large importance at political and cultural areas (Kurasov, 2009). The results of our calculation could also be interpreted as the dominance of three major types of cities: global gateway cities, global capital cities, and global specialized cities, still further research are to be done. It seems that at this stage it is the functional and typological approach that can be effectively use to make the next significant step forward in the analysis of the global urban network.

5. Conclusion

The composed "average" ranking of global cities, based on several existing ones, is a novel way to understand most general features of the spatial structure of WCN. Using calculation results, we estimated several important characteristics of existing WCN, such as the number of cities, their distribution between the countries and continents, average size, importance, and the level of dominance inside each of subnetwork. Three subnetworks clearly stand out, each with its own characteristics and specialties. Bearing in mind these results, this paper makes the theoretical and empirical attempt to contribute to the discussion on spatial hierarchy and composing a typology of global cities. Our finding shows clear differences between the three geographical subnetworks, both in qualitative and quantitative terms. Regarding the typology, we followed some previous researches at this field and the identified some of the possible lines of future research, which could help to overcome failures and limits of the modern GCA.

Note

(1) Despite 'subsystem' seems to fit better in this case, we still decided to use 'subnetwork' following 'world cities network' introduced by GaWC.

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