Cities as command and control centres of the world economy: An empirical analysis, 2006-2015

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Abstract

As a result of their rapid economic growth, several powerful corporate giants have emerged in developing countries, especially in China, operating not only in the traditional manufacturing sector, but also in high-tech industries and finance. Major cities in developing countries have gradually become important command and control centres of the global economy, and have also become powerful enough to be in the same tier as major cities of developed countries around the world. In this paper, I examine the position of cities as command and control centres on the basis of the power of their headquartered corporations. The result shows that until 2012, New York, London, Tokyo, and Paris; i.e., the global cities, were the leading command and control centres. However, the gap between these global cities and Beijing gradually closed, and by 2015, the Chinese capital outranked all the global cities. The outstanding performance of Beijing-based corporations that operate in financial, energy, and construction services sectors is the driving force behind Beijing's increasing global power. In addition, the leading position of the global cities as command and control centres has been threatened by the San Francisco-San Jose metropolitan region, a newly emerging economic hub in the United States.

Keywords: world cities, developing countries, command and control, transnational corporations, Beijing

1. Introduction

Within the framework of the post-industrial economy of our era, the role of traditional manufacturing firms has depreciated, however, they have a significant effect on the global economy. This is, for example, demonstrated by the recent diesel scandal of the Volkswagen, which could potentially push the global automotive industry into a crisis. Furthermore, those countries that are most significantly affected by the company's foreign direct investments (e.g., Hungary, the Czech Republic, and Poland) stand to lose 0.5-1.5% points from their GDP

growth. Although Volkswagen operates 119 production plants in 20 European countries and an additional 11 countries in the Americas, Asia and Africa[1], all high-level decisions that basically influence the firm's global strategy are made in the company's headquarters in Wolfsburg, Germany[2]. Therefore, regardless of the fact that this city is home to only one large transnational corporation (TNC), Wolfsburg can be considered as one of the major command and control centres of the world economy, and also one of the most significant ones in the international automotive industry. However, there are several cities worldwide that host the headquarters of not only one, but dozens, of large TNCs. Because of the aggregate significance of the high-level decisions made in these corporate headquarters, such cities have an even more powerful impact on the world economy (Feagin and Smith, 1998). These cities are not necessarily characterized as "world cities" as defined by Friedmann (1986), nor "global cities" as defined by Sassen (1991; 2001), but as the home to the headquarters of powerful TNCs, they can be considered as major command and control centres of the world economy (Knox, 1995; Godfrey and Zhou, 1999; Alderson and Beckfield, 2004; Sassen, 2006; Csomós 2013).

Since the mid-1960s, momentous political and economic developments have affected the global economy (e.g., the emergence of the new international division of labour, the 1973 and 1979 oil crises, the collapse of the socialist system, and the global financial crisis of 2007-2008). These events, in part, have led to the massive growth of some developing countries (e.g., Brazil, China, India, Mexico, Russia, and the Arab States of the Gulf) (Kose, 2010). In line with these developments, the number of TNCs has increased rapidly (Ietto-Gillies, 2002). Until the mid-1990s, the United States, Western Europe, and Japan had been considered as the homelands of the major TNCs (Vernon, 1992). Since that time, several giant corporations have emerged in developing countries, especially in China (Goldstein, 2007; Dunning et al., 2008; The Economist 2008; PwC, 2010). By now, TNCs in developing countries have become powerful enough to be able to compete with their western rivals, not only in domestic markets (Huber and Ennis, 2014), but also in other emerging markets; even markets of the developed countries (Tang, 2010). In recent years, through the acquisition of North American and Western European firms (Deng, 2007; Rui and Yip, 2008), several large Chinese and Indian companies have managed to gain new markets in the developed world. Moreover, by reversing the usual direction of foreign direct investments (i.e., from the developed countries to the developing countries), they have been able to increase the power of their companies (Deng, 2007; Li, 2010; Pradhan and Sauvant, 2010). As a result, the traditional command and control centres of the developed world have, relatively speaking, been losing power, while some cities in the developing world have been gradually emerging as major control points of the global economy.

My main goal is to give a comprehensive literature overview, how the term "command and control" has changed over time, and to present which cities were the leading command and control centres of the world economy in 2006 and a decade later. Furthermore, through the example of Beijing, I highlight why Chinese cities have become significant command and control centres, but have not become leading world cities.

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[1] http://www.volkswagenag.com/content/vwcorp/content/en/the_group/production_plants.html
[2] There is disagreement as to whether the high-level decision making process in TNCs is centralised in global headquarters, or whether a more diffuse structure exists (see, for example, Jones, 2002). As for Volkswagen's diesel scandal, it has become clear that most strategic decisions (even the technical design of the software) were made in Wolfsburg with the knowledge of the CEO (Smith and Parloff, 2016).

The structure of this paper is as follows: First, I examine the command and control function of cities in the world city literature. Second, I rank cities on the basis of the power of their command and control function, and then I present the shifting global position of cities as command and control centres in the past decade (2006-2015)[3]. Third, I focus on Beijing, the city in which global power has recently grown to the largest extent, and attempt to inspect the prospects for further growth.

2. The command and control function of cities in the mainstream world city literature

Globalization is one of the most important processes of today's world. Since the second half of the 20th century, the restructuring of the world economy has intensified and can be characterized by, among other things, the increasing expansion of international trade and the rapid growth of foreign investments. However, the most spectacular phenomenon of economic globalization is generally considered as the emergence of the new international division of labour (NIDL) (Fröbel et al., 1980); that is, in this case, the gradually growing involvement of developing countries in the world economy, primarily as sites of low-cost production (Munck, 2002). As the orchestrator of the global reallocation of manufacturing away from core industrial countries towards developing countries, TNCs are generally regarded as the central actors in economic globalization (Cohen, 1981; Clarke, 1985; Schoenberger, 1988; Dicken, 2007). The organizations that make up TNCs encompass the world economy, connect national and regional economies, and exercise significant control over nation states (Bonanno and Constance, 2008). In the new world system, in parallel with the declining importance of nation states, the role of cities has become more significant (see, for example, Knox, 1995; Scott et al., 2001; Sassen, 2001; Sassen, 2006). Alderson and Beckfield (2004: 812) argue that "developments of the past few decades are seen as producing a new global hierarchy of cities, at the apex of which are located what have variously been referred to as 'world cities' or 'global cities'. Such cities constitute the key nodes or command points that exercise power over other cities in a system of cities and, thus, the world economy." World cities/global cities are generally characterized as extremely complex entities by each fundamental theory in the field (Friedmann, 1986; 1995; Sassen, 1991; 2001; Beaverstock et al., 1999; Hall, 2001; Taylor, 2004); therefore, they are described on the basis of very different principles. However, regardless of the substantial differences, there are some overlapping elements in these theories. One of the most important elements is that world cities/global cities concentrate the headquarters of the most powerful TNCs worldwide, and this element makes them the major command and control centres of the world economy (Friedmann and Wolff, 1982; Konx, 1995; Smith and Timberlake, 1995; Godfrey and Zhou 1999; Alderson and Beckfield 2004; Sassen, 2006; Carroll, 2007; Taylor and Csomós, 2012).

Thereinafter, I examine how the notion of command and control appears in mainstream world city literature, and how ongoing economic globalization has influenced researchers' opinions about the command and control function of cities.

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[3] The reason for choosing the period from 2006 to 2015 are that following: on the one hand, this period covers the financial crisis of 2007-2008 and the following global economic crisis of 2008-2012, and on the other hand, when preparing the analysis the Forbes "The Global 2,000" for 2015 was the most up-to-date dataset available.

In his pioneer work, entitled *The World Cities*, Peter Hall (1966) identified seven major cities (conurbations) as world cities (London, Paris, the Randstad Holland, the Rhine-Ruhr, Moscow, New York, and Tokyo). According to Brenner and Keil (2006: 20), "Hall conceived world cities primarily as national centres that channeled international forces and interests towards national interests. Hall's conception of a 'world city' is thus arguably a product of a period in which cities operated primarily as nodes within national urban systems." It should be mentioned that Hall examined world cities rather as individual units from the perspective of urban planning, than as key actors in the world system. However, he initiated a wide range of criteria to define world cities, and according to two of those criteria, world cities were "the headquarters of major industrial concerns" and "the headquarters of the trading banks" (Hall, 1966: 7).

Brenner and Keil (2006: 9) argue that the emergence of the NIDL since the late 1960s resulted, in large measure, from the massive expansion in the role of TNCs in the production and exchange of commodities on a world scale. One very important process of this period was the deindustrialization of the core economies (Linklater, 1990); that is, the relocation of the traditional low-cost manufacturing from the core economies towards the semi-peripheral and peripheral countries. In line with these developments, the corporate structure of manufacturing TNCs has undergone important changes. TNCs, as the main driving forces behind the spatial restructuring of the world economy, have tended to separate the geographical location of their high-level activities (i.e., high-level decision-making, financial activity, and the control of the global commodity chain) from the manufacturing activities, relocating the latter into developing countries (Cohen, 1981; Pacione, 2009). One of the most remarkable scholars of this period was Stephen Hymer, who suggested a "correspondence principle", which attempted to identify and relate the centralization of control within corporations to the concentration of economic activity within the international economy (Dunning and Pitelis, 2010). Hymer (1972: 114) predicted that TNCs would tend to produce a hierarchical division of labour between geographical regions, and it would tend to centralize high-level decision-making occupations in a few key cities (i.e., the world cities/global cities) in the advanced countries, surrounded by a number of regional sub-capitals, and confine the rest of the world to lower levels of activity and income. According to Smith (2014: 101), it was Hymer who first outlined a global hierarchy of cities, and in that, he envisioned centralized control of the international economy as lying in some cities rather than others. Furthermore, Hymer (1972: 124) argued that eventually New York, London, Paris, Bonn, Tokyo, Moscow, and Beijing would be the major global cities because they would be the home to the core headquarter functions and high-level strategic planning of the world's leading TNCs.

In the following two decades, as a legacy to Hymer's outstanding work, several scholars considered the spatial concentration of corporate headquarters and high-level decision-making occupations as the most important characteristics to define world cities, e.g., Heenan (1977); Cohen (1981); Friedmann and Wolff (1982); Glickman (1987); Feagin and Smith (1987). However, John Friedmann's (1986) article entitled *The World City Hypothesis* can be considered as the most significant contribution of this approach. It "consists of a series of generalizations regarding urbanization in the context of globalization" (Alderson and Beckfield, 2004). The remarkable innovation of Friedmann's work resulted in the introduction of a clear taxonomy for world cities, according to which, world cities had to fulfil several major criteria

(e.g., a major financial centre; headquarters for TNCs; international institutions; rapid growth of business services sector; important manufacturing centre; major transportation node; population size). Moreover, their home countries had to be classified by The World Bank as core countries. Friedmann identified New York, Los Angeles, Tokyo, London, Paris, and Chicago as primary world cities in core countries. In his hypothesis, Friedmann attributed special importance to the spatial concentration of corporate headquarters; however, the criteria he established can be considered even more complex than that proposed by Hymer. According to Alderson and Beckfield (2004: 817-818), Hymer saw globalization generating a fairly static urban hierarchy dominated by traditional powers, while Friedmann (1995) characterized the world city system as a dynamic hierarchy with ranks and entrance criteria that are open. A decade later, Friedmann (1995: 23-24) revised his former theory by classifying New York, London, and Tokyo as major command and control centres exclusively.

Since the beginning of the 1990s, several studies have emerged that consider the spatial concentration of corporate headquarters, or the power of TNCs, as the key feature when defining world cities (see, for example Knox, 1995; Lyons and Salmon, 1995; Godfrey and Zhou, 1999; Alderson and Beckfield, 2004; Taylor and Csomós, 2012; Csomós, 2013; Csomós and Derudder, 2014a); however, in the following decades, the significance of this kind of research approach has started to fade away. In 1991, Saskia Sassen's pioneering work, *The Global City*, was published, and since her introduction of the global city concept, researchers' conceptualization on the functional centrality of cities in the global economy has radically changed (Derudder, 2006). According to Sassen (2001: 4), beyond their long history as centres for international trade and banking, global cities (New York, London, Tokyo, Frankfurt, and Paris) now function in four new ways: first, as highly concentrated command points in the organization of the world economy; second, as key locations for finance and specialized service firms that have replaced manufacturing as the leading economic sector; third, as sites of production, including the production of innovations, in these leading industries; and fourth, as markets for the products and innovations produced. In her concept, Sassen's (2001:6) focus is not on power, but on production: the production of those inputs that constitute the capability for global control. Sassen (1991; 1995; 2001) argues that the awesome power of large corporations is insufficient to explain the capability for global control. According to Taylor (2004: 25), on the basis of Sassen's global city concept, it can be stated that global cities are more than merely command and control centres; they are the first global service centres in urban history.

Since the introduction of Sassen's global city concept, it has become widely recognized that advanced producer service (APS) organizations are the distinctive feature of contemporary world city formation (Beaverstock et al., 1999). Furthermore, Peter J. Taylor (2001) introduced his interlocking network model (INM) in which "globalised producer services firms are the key 'network makers' connecting cities in a 'world city network' (WCN)" (Derudder and Parnreiter, 2014). As a consequence of these major concepts (Sassen's global city theory and Taylor's interlocking network model), APS firms and banks have become the key agents of the world city formation (see, for example, Beaverstock et al. 1999; Taylor, 2002; Derudder et al., 2003; Taylor, 2004; Derudder and Taylor, 2005; Hanssens et al., 2013; Neal, 2014; Taylor, 2014), and they have significantly contributed to the diminishment of the importance of TNCs as symbols of world cities.

In this paper, I examine the command and control function of cities as originally defined by Hymer (1972) and Friedmann (1986); that is, I attribute the command and control function of cities to the power of the TNCs they host. The reason for this is that in developing countries, a growing number of giant manufacturing corporations and banks have been established (for example, the leading four company of the Forbes "The Global 2,000" for 2015 are all headquartered in China), and they can significantly affect the world economy (Sauvant, 2008). In developing countries, the high-level decision-making activities of large corporations tend to be geographically more concentrated in some dominant cities, and primarily in the capitals; therefore, some of these cities have become globally important headquarter cities (see, for example, Lai, 2012; Ma et al., 2013; Pan and Xia, 2014; Pan et al., 2015). However, despite the rapid growth of their economies, the financial systems of developing countries can generally be considered as fairly undeveloped (Elliot and Yan, 2013), and cannot be compared with those of developed countries (The World Bank, 2012). Thus, although they may possess giant banks in terms of assets, large stock exchanges in terms of market capitalization, and impressive goals for the future development of international financial centres (see, for example, Cheung, 2010; Lai, 2012; Pethe et al., 2014; Yildirim and Mullineux, 2015), the major financial centres of developing countries (e.g., Beijing, Shanghai, Shenzhen, Bangkok, Sao Paulo, Mumbai) still cannot be considered competitive with those of the major financial centres in developed countries (e.g., New York, London, Paris, Frankfurt) (Du et al., 2014; Chen and Chen, 2015; Z/Yen Group, 2015). However, as homes to powerful corporations in terms of their size, leading headquarter cities in developing countries have emerged as major command and control centres of the world economy and as real rivals for the command and control centres of developed countries. While the financial side of the world economy has relative stability and is dominated by the financial centres of the United States, Western Europe, and Japan; in the real economy, radical changes have occurred, primarily thanks to the massive growth of the Chinese economy.

3. Data and methods

After explaining how the command and control function of cities is defined in this paper, it is necessary to clarify two more critical issues of the empirical analysis: first, how the command and control function of cities can be measured; and second, what the territorial demarcation of cities is.

3.1. Measuring the command and control function of cities on the basis of the power of the TNCs they host

Researchers use several methods to measure the command and control function of cities; however, most of them are largely influenced by subjective impressions. In general, it is very common to count the number of headquarters of leading TNCs and banks (perhaps the regional headquarters of subsidiaries) that are concentrated in given cities; and then, on the basis of this sum or by some sort of weighted scoring, define the position of these cities in the national/world city system (see, for example, Borchert, 1978; Cohen 1981; Wheeler, 1985; Holloway and Wheeler, 1991; Meijer, 1993; Lyons and Salmon, 1995; Abbott, 1997; Godfrey and Zhou, 1999; Alderson and Beckfield, 2004; Taylor et al., 2009). Counting the number of TNC headquarters

located in given cities has key importance in several studies and can definitely be measured on some level in regard to the command and control function; however, this alone cannot adequately reflect the real power of cities as they pertain to the economy. The difference between these approaches (i.e., the concentration of headquarters vs. the power of cities) is presented through an example: According to studies that focus on the spatial concentration of headquarters of leading TNCs, only Tokyo, New York, London, and Paris can be considered as major command and control centres of the world economy (Godfrey and Zhou, 1999; Alderson and Beckfield, 2004, Taylor et al., 2009; MGI, 2011), while these studies give minor consideration to some important second-tier cities, e.g., Beijing, Osaka, and Zurich. As a matter of fact, the headquarters of several globally influential TNCs can be found in the major cities. For example, in 2015, a combined total of 365 out of 2,000 Forbes companies were headquartered in Tokyo, New York, London, and Paris; that is, 18% of the leading TNCs were concentrated in these four cities. None of the studies consider Bentonville, Arkansas, with a population of 40,000, as a command and control centre of the world economy. Since the city is home to only one single large TNC, this is not surprising. In 2015, the Forbes 2,000 companies were headquartered in 390 cities worldwide, but of these cities, 202 hosted only a single TNC. Bentonville falls into this latter category, and therefore, obviously cannot be compared with the major world cities that are home to 30 or more corporate headquarters. However, if one considers the power of a TNC as the basic determinant of the command and control function of cities, it should be mentioned that Bentonville is home to Walmart, the world's largest retail company with more than 11,000 stores in 27 countries. Walmart is the largest non-governmental employer in the world, with 2.2 million employees worldwide, as well as the largest non-governmental employer in the United States, with 1.4 million employees nationwide; that is, Walmart employs 1% of the United States' work force. In 2015, Walmart generated revenues of $485.7 billion, which was more than that of any other company in the world, and, in fact, more than the combined revenues of Osaka's 35 Forbes companies. By exercising enormous market power, Walmart is capable of influencing local and national wages, even retail prices (Basker, 2005; Bonanno and Lopez, 2012), and with its large assets, the company is capable of entering foreign markets (Iacovone et al., 2015). All the strategic decisions made in the Bentonville headquarters of Walmart can significantly affect the retailing, the economy of the United States (Economy in Crisis, 2012), and indirectly the world economy. Therefore, regardless of the obvious fact that Bentonville is not a world city, it can be considered as one of the most important command and control centre of the world economy.

In this analysis, I do not merely calculate the number of headquarters concentrated in any given city, but I also determine the command and control function of cities on the basis of the power of the TNCs they host. For this reason, several cities appear in my rankings that are generally not mentioned as world cities. In this analysis, I use data from the Forbes "The Global 2,000" database from the years 2006 and 2015. These data correspond to the main financial data (revenues, market value, assets, and profits) of the 2,000 largest public companies of the world. I integrate information on the key indicators of firm size and performance. The level of command and control (i.e., the power of cities) is expressed by the Command and Control Index (CCI). $CCI_{x,y}$ of a given city x in a given year y is calculated as follows (Csomós, 2013; Csomós and Derudder, 2014b):

$$CCI_{x,y} = \sum_{i=1}^{n_{x,y}} \frac{R_{i,x,y} + A_{i,x,y} + P_{i,x,y} + MV_{i,x,y}}{4}$$

Where:

$R_{i,x,y}$ = the proportion of revenues in the total dataset;

$A_{i,x,y}$ = the proportion of assets in the total dataset;

$P_{i,x,y}$ = the proportion of profit in the total dataset;

$MV_{i,x,y}$ = the proportion of market value in the total dataset;

i = the number of the company headquartered in city in given year ($i = 1,…,n_{x,y}$);

n = the total number of companies headquartered in city x in year y;

In conclusion, the CCI is a measure without unit and reflects to the power of cities as command and control centres.

3.2. Territorial demarcation of "cities"

Another fundamental issue of this analysis is the territorial demarcation of cities. Derudder (2006) argues that in Sassen's global city concept, a global city corresponds to those units that have linkage to the world economy and where business activities are conducted (i.e., the city that hosts the traditional central business district), while in Friedmann's world city concept, a world city corresponds to a much larger territorial unit; such as a metropolitan region, in which corporate headquarters are spread out over a larger area. In this paper, I consider Friedmann's world city definition as the basis for the territorial demarcation of the empirical analysis; therefore, I integrate individual headquarters' cities and towns into large urban zones. Florida and Jonas (1991), Lyons and Salmon (1995), and even Sassen (2006) all stress that in the United States, and then in Europe, the relocation of headquarters from large cities to suburban areas has become quite common since the 1970s. This phenomenon is what Florida and Jonas (1991) refer to as the "decentralization of corporate organizations". According to Garreau (1991), Brenner (2002), and Ross and Levine (2012), this development has resulted in a significant change in the suburban network of metropolitan areas: suburbs have begun to play an active role in the economy. Because of the general trend of the suburbanization of corporate headquarters since the 1970s, suburbs, regarding their economic functions, cannot adequately be separated from the central cities of their metropolitan regions (Muller, 1978).

When defining "cities" as territorial units, I relied on the territorial demarcation of respective national statistical offices, the ESPON EGTC in the European Union (www.espon.eu), and the Office of Management and Budget in the United States (www.whitehouse.gov/omb). For example, in my framework, "New York" corresponds to the New York-Newark-Jersey City, NY-NJ-PA Metropolitan Statistical Area, which is home to the headquarters of 87 Forbes 2,000 companies. However, of these 87 companies, 55 are headquartered in New York City, and 32 are located in 27 smaller or larger cities (Armonk, Paramus, Roseland, etc.) within the New York metropolitan area. In Japan, for example, Osaka corresponds to the large Keihanshin metropolitan region that encompasses the metropolitan areas of Kyoto, Osaka, and Kobe. Paris corresponds roughly to the entire Ile-de-France region,

which includes 1,800 cities and towns. In line with this method of the territorial demarcation of cities as command and control centres, I define cities in the same way in all countries.[4]

In 2006 the Forbes 2,000 companies were headquartered in 687 cities, which could be integrated into 353 metropolitan regions; and in 2015, they were located in 683 cities and could be integrated into 390 metropolitan regions.

4. Changing position of cities as command and control centres between 2006 and 2015

Reed (1981); Meyer (1986); Glickman (1987); Thrift (1989); Sassen (1994); Budd (1995); Short et al. (1996); Godfrey and Zhou (1999); Sassen (2001); Taylor et al. (2009); Lee et al. (2012) stress the outstanding roles of New York, London, Tokyo, and Paris in the global economy as major world cities, global cities, financial centres, etc. The ranking, on the basis of the value of the CCI[5], also shows that until 2006, New York, Tokyo, London, and Paris had been the leading command and control centres (Table 1), with more than 30% of the combined value of the CCI. However, in more recent years, radical changes have occurred, primarily due to the massive growth of Beijing's command and control function. On the basis of its CCI value, the Chinese capital arrived right behind the major cities in 2007, then, between 2012 and 2014, Beijing outranked Paris (2012), London (2013), and Tokyo (2014), and finally it managed to surpass New York in 2015, becoming the leading command and control centre of the world economy.

Table 1. Ranking the leading command and control centres in 2006 and 2015 on the basis of their CCI value

Rank	City/Metro	Country	Number of HQs	CCI 2006	City/Metro	Country	Number of HQs	CCI 2015
1	New York	United States	97	8.897	Beijing	China	59	7.610
2	Tokyo	Japan	199	8.088	New York	United States	87	6.588
3	London	United Kingdom	94	6.547	Tokyo	Japan	142	6.279
4	Paris	France	66	5.695	London	United Kingdom	79	5.139
5	Dallas	United States	28	2.201	Paris	France	57	4.502
6	Zurich	Switzerland	13	1.843	San Jose	United States	28	2.374
7	San Francisco	United States	25	1.670	San Francisco	United States	21	2.321
8	Seoul	South Korea	44	1.659	Seoul	South Korea	59	2.241
9	Amsterdam	Netherlands	14	1.607	Hong Kong	China/Hong Kong	55	2.228
10	Chicago	United States	38	1.583	Washington	United States	18	1.746
11	Houston	United States	34	1.527	Toronto	Canada	17	1.512
12	San Jose	United States	29	1.505	Dallas	United States	22	1.510
13	Washington	United States	21	1.437	Chicago	United States	35	1.474
14	Toronto	Canada	20	1.405	Zurich	Switzerland	23	1.472
15	Charlotte	United States	8	1.356	Moscow	Russia	20	1.280
16	Munich	Germany	9	1.345	Houston	United States	25	1.212

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[4] In the case of the United States "cities" correspond to Metropolitan Statistical Areas (as defined by the Office of Management and Budget), but not to Combined Statistical Areas. In the case of the European Union "cities" correspond to Functional Urban Areas (as defined by the ESPON), but not to polynuclear metropolitan areas.

[5] In this paper I examined the command and control function of cities in a closed system, and in this system cities' CCI values are relative values. This means that the total value of the CCI never grows over time, and always remains the same. It necessarily follows from the way the CCI values are calculated in this system that the CCI values of some cities will decrease, whereas those of some cities will increase. These cities, of course, not winners and losers, the change of cities' CCI value expresses the change of their relative positions. As a matter of fact, the world economy is expanding, and cities' command and control function also grows (in the case of some cities slower, and in other cases faster).

17	Madrid	Spain	19	1.324	Shanghai	China	20	1.114
18	Osaka	Japan	47	1.296	Stockholm	Sweden	21	1.034
19	Beijing	China	15	1.294	Munich	Germany	8	0.989
20	Atlanta	United States	19	1.177	Minneapolis	United States	15	0.975
21	Minneapolis	United States	20	1.160	Shenzhen	China	15	0.971
22	The Hague	Netherlands	3	1.145	Seattle	United States	11	0.937
23	Bridgeport	United States	12	1.104	Sydney	Australia	20	0.934
24	Stockholm	Sweden	23	1.064	Madrid	Spain	16	0.910
25	Edinburgh	United Kingdom	3	1.029	Mumbai	India	24	0.897
26	Nagoya	Japan	23	1.027	Nagoya	Japan	14	0.876
27	Hong Kong	China/Hong Kong	35	1.019	Atlanta	United States	17	0.865
28	Seattle	United States	12	1.012	Osaka	Japan	35	0.864
29	Detroit	United States	14	0.914	Taipei City	Taiwan	31	0.809
30	Frankfurt	Germany	7	0.858	Melbourne	Australia	9	0.776
31	Rome	Italy	8	0.852	Newbury	United Kingdom	1	0.753
32	Los Angeles	United States	27	0.821	Bridgeport	United States	13	0.725
33	Melbourne	Australia	12	0.760	The Hague	Netherlands	4	0.717
34	Cincinnati	United States	12	0.747	Omaha	United States	4	0.714
35	Moscow	Russia	8	0.723	Los Angeles	United States	21	0.699
36	Fayetteville*	United States	3	0.715	Sao Paulo	Brazil	12	0.673
37	Milan	Italy	15	0.702	Fayetteville*	United States	3	0.671
38	Sydney	Australia	20	0.693	Frankfurt	Germany	5	0.652
39	Philadelphia	United States	19	0.675	Philadelphia	United States	15	0.649
40	Brussels	Belgium	11	0.609	Charlotte	United States	4	0.635
41	Richmond	United States	9	0.578	Singapore	Singapore	20	0.630
42	Calgary	Canada	17	0.561	Basel	Switzerland	6	0.627
43	Taipei City	Taiwan	26	0.555	Dublin	Ireland	18	0.622
44	Basel	Switzerland	8	0.532	Boston	United States	16	0.593
45	Riyadh	Saudi Arabia	5	0.530	Amsterdam	Netherlands	10	0.561
46	Düsseldorf	Germany	5	0.508	Detroit	United States	10	0.558
47	Boston	United States	17	0.492	Cincinnati	United States	8	0.524
48	Hartford	United States	6	0.477	Calgary	Canada	13	0.473
49	Helsinki	Finland	15	0.466	Montreal	Canada	13	0.459
50	Stuttgart	Germany	4	0.454	Riyadh	Saudi Arabia	15	0.459

*The Fayetteville metropolitan area includes Bentonville, Arkansas; the headquarters city of Walmart.

Similarly to that of Beijing, the CCI value of other major Chinese cities grew rapidly; therefore, Hong Kong (ranked 27th in 2006, 9th in 2015), Shanghai (ranked 111th in 2006, 17th in 2015), and Shenzhen (ranked 129th in 2006, 21st in 2015) also appeared among the leading command and control centres in 2015. Furthermore, the latter two cities showed the most significant increase in terms of their CCI values in the past decade: the CCI value of Shenzhen increased by almost 1,000%, Shanghai's increased by almost 800%, whereas Beijing's showed the third-largest increase (Table 2).

In 2006, New York, Tokyo, London, and Paris were primarily followed by North American cities. In fact, six out of the next ten cities (5th-14th in the ranking) were located in the United States, and one of them was located in Canada. Two European cities, Zurich and Amsterdam, also belonged to this group, as well as Seoul in East Asia. By 2015, the CCI value of Amsterdam decreased by 65%, and its position significantly weakened (ranked 9th in 2006, 45th in 2015), while Zurich showed a much smaller decrease in its position (ranked 6th in 2006, 14th in 2015). The CCI value of Seoul increased by 35%; however, its position did not change (ranked 8th in both years). Furthermore, during this decade, Hong Kong showed a creditable growth and by 2015, occupied a much better position. In 2015, a number of North American cities could be found among the leading command and control centres; however, their positions in the ranking changed significantly. The positions of Dallas (ranked 5th in 2006, 12th in 2015),

Chicago (ranked 10th in 2006, 13th in 2015), and Houston (ranked 11th in 2006, 16th in 2015) weakened, while the position of San Jose improved, and by 2015, that city arrived right behind the major command and control centres (ranked 6th in 2015). Washington and Toronto also showed a smaller increase in their positions, while San Francisco remained the same (ranked 7th in both years); however, its CCI value grew by 39%.

As can be seen in Table 1, in 2006, the major command and control centres (New York, Tokyo, London, and Paris) were followed mostly by cities of developed countries: 20 out of the leading 50 cities were located in the United Sates, and 17 were located in Europe. The developing countries[6] were singularly represented by Beijing (ranked 19th), Moscow (ranked 35th), and Riyadh (ranked 45th). By 2015, the number of cities in developing countries among the leading command and control centres grew, but not significantly. In fact, aside from Beijing, Moscow, and Riyadh, only Shanghai, Shenzhen, Mumbai, and Sao Paulo entered into this group of leading cities. However, it is worth noting that the CCI value of these cities increased dynamically in this period: the CCI value of Mumbai increased by 152%, while that of Sao Paulo increased by 189%, not mentioning the extreme growth of the major Chinese cities (Shenzhen, Shanghai, and Beijing) (Table 2).

Table 2. TOP 25 command and control centres with the largest positive and negative CCI change

Rank	City/Metro*	Country	Positive CCI Change, 2006/2015 (%)	City/Metro	Country*	Negative CCI Change, 2006/2015 (%)
1	Shenzhen	China	999.06	Austin, Texas	United States	-83.67
2	Shanghai	China	796.39	Kansas City	United States	-77.80
3	Beijing	China	488.04	Amsterdam	Netherlands	-65.07
4	Leuven	Belgium	327.50	Hamilton	Bermuda	-65.06
5	Newbury	United Kingdom	226.66	Edinburgh	United Kingdom	-62.24
6	Sao Paulo	Brazil	189.10	Richmond	United States	-61.04
7	Mumbai	India	152.32	Cleveland	United States	-58.03
8	Hong Kong	China/Hong Kong	118.65	Charlotte	United States	-53.19
9	Wolfsburg	Germany	106.31	Rome	Italy	-51.25
10	Barcelona	Spain	104.18	Brussels	Belgium	-47.97
11	Providence	United States	103.44	Essen	Germany	-46.33
12	Lisbon	Portugal	95.03	Athens	Greece	-45.98
13	Santiago	Chile	94.61	Düsseldorf	Germany	-44.53
14	Jakarta	Indonesia	86.09	Oklahoma City	United States	-42.34
15	Moscow	Russia	76.96	Bonn	Germany	-42.08
16	Bangkok	Thailand	74.77	Phoenix	United States	-41.35
17	Kuala Lumpur	Malaysia	72.32	Milan	Italy	-41.06
18	Brasília	Brazil	68.86	Helsinki	Finland	-39.84
19	Portland, Oregon	United States	66.91	Detroit	United States	-38.95
20	Singapore	Singapore	66.60	The Hague	Netherlands	-37.36
21	Omaha	United States	58.68	Columbus, Ohio	United States	-36.60
22	San Jose	United States	57.76	Rio de Janeiro	Brazil	-35.29
23	San Diego	United States	53.98	Bridgeport	United States	-34.36
24	Dublin	Ireland	48.53	Osaka	Japan	-33.34
25	Taipei City	Taiwan	45.74	Dallas	United States	-31.41

*Requirement: the combined value of CCI 2006 and CCI 2015 of a given city should exceed 0.2.

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[6] Definition of developing countries is based on the classification of the International Monetary Fund's World Economic Outlook, April 2015.

The geographical shift of the world's command and control function shows a typical pattern. On the one hand, along with the significant growth of the CCI value of the Chinese cities, the CCI value of cities located in the Arab states of the Persian Gulf and those of Indian cities also increased by more than 100% (Figure 1). On the other hand, the CCI value of the traditional command and control centres located in North America (particularly in the United States), Western Europe, and Japan decreased significantly. These shifts correspond to the opinion of Castells et al. (2012: 12): the financial crisis of 2007-2008 and the following global economic crisis of 2008-2012 can rather be considered as two examples of "non-global global crisis of capitalism"; because, for example, this crisis only slightly affected the economies of Latin America and China.

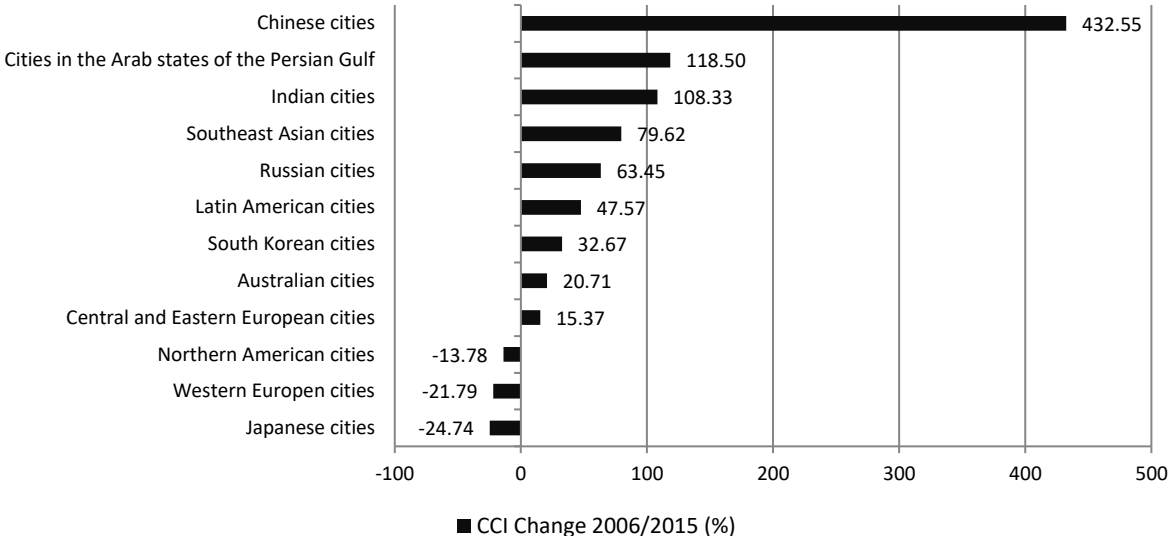|	CCI Change 2006/2015 (%)
Chinese cities	432.55
Cities in the Arab states of the Persian Gulf	118.50
Indian cities	108.33
Southeast Asian cities	79.62
Russian cities	63.45
Latin American cities	47.57
South Korean cities	32.67
Australian cities	20.71
Central and Eastern European cities	15.37
Northern American cities	-13.78
Western Europen cities	-21.79
Japanese cities	-24.74

Figure 1. Change of the value of the CCI by geographical subgroups

There are some cities among the leading command and control centres in which CCI value has been influenced by only one large TNC. The best examples are Leuven (Anheuser-Busch InBev), Newbury (Vodafone Group), and Wolfsburg (Volkswagen AG). Of course, the position of these cities is very unstable. The outstanding financial performance of Vodafone in financial year 2014/2015 was largely due to the fact that the company sold its 45% stake in Verizon Wireless to Verizon Communications for $130 billion. It is assumed that in the future, the CCI value of Leuven will also grow, since Anheuser-Busch InBev announced the acquisition of its largest competitor, SABMiller (headquartered in London) for $104 billion. Conversely, after the diesel scandal of Volkswagen, the CCI value of Wolfsburg will predictably decrease.

Most cities with the largest negative CCI change are typically home to more than one TNC, but they are generally facing deep structural crisis in their economy. To illustrate, since the financial crisis of 2007-2008, the financial sectors of Amsterdam and Edinburgh have significantly weakened; Hamilton, Bermuda has been continuously losing the headquarters of TNCs (which generally have been moving to Dublin or Zurich) since the Obama administration promised to act against tax havens; and Detroit's automotive industry has recovered slowly.

In conclusion, it can be stated that in the past decade, but primarily since the financial crisis of 2007-2008, the relative power of the traditional command and control centres; i.e., that of New York, Tokyo, London, and Paris, has significantly weakened. Beijing has become the major control point of China, the newly emerged powerhouse of the world economy, and now the largest command and control centre in the world (see also Csomós and Tóth, 2016). In addition, the pressure on New York, Tokyo, London, and Paris has intensified due to the fact that the combined CCI value (4.695 in 2015) of the San Jose-San Francisco metropolitan region has radically increased, and outranked that of Paris in 2015.

5. The rise of Beijing and the sources of its power

By 2015, on the basis of the power of headquartered companies, Beijing has become the largest command and control centre of the world economy. This means, first, that Beijing has managed to surpass its most powerful regional rivals, Tokyo and Seoul, in less than a decade; and second, the Chinese capital is the only city that has ever managed to outrank the four major command and control centres, New York, London, Tokyo, and Paris.

This rapid growth of the Chinese capital's command and control function can primarily be attributed to the fact that Beijing-based state-owned banks and energy companies have become extremely powerful (Figure 2).
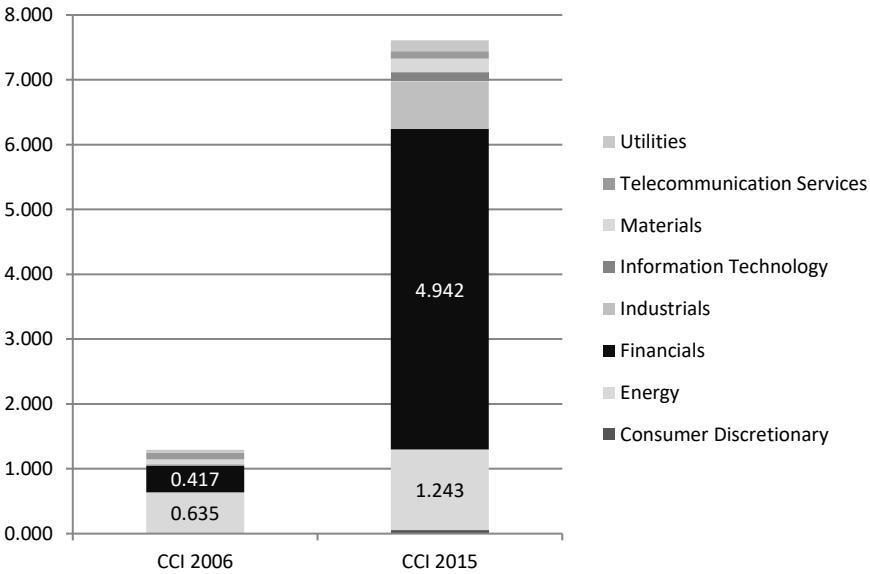

Figure 2. Industry-specific distribution of the command and control function of Beijing

Due to China's enormous energy demand, generated by the large transportation sector (Dargay and Gately 2010; Lin and Xie 2013), and the rapidly growing number of private cars (MGI, 2006; 2013), oil and gas consumption has been continuously increasing in this country. Since 1993, China has become a net oil importer, and by 2012, its dependency on imported oil exceeded 60% (Zhang, 2014). The Chinese oil companies are among the largest foreign investors in the global oil and gas industry. They invest and operate worldwide, including in

Africa and Latin America, where they are the most important actors. According to projections by the International Energy Agency (IEA), it is foreseeable that Chinese oil and gas consumption will dramatically increase in the future, and China's national oil companies (NOCs) are expected to be the instruments to satisfy the growing demand (IEA, 2011). The headquarters of all three state-owned oil giants, PetroChina, Sinopec, and CNOOC, are located in Beijing; therefore, the dominant role of the Chinese capital in the energy sector is not surprising (Pegg, 2012; Pan et al., 2015).

The extreme power of Beijing in terms of the value of the CCI does not straightforwardly show its role in the global financial sector. With respect to its CCI value, it could be easily stated that Beijing has become the world's major financial centre. In 2015, the CCI value of Beijing's financial sector (4.942) was greater than that of Paris (4.502), and was in fact greater than the combined CCI value of Germany (4.108). However, the reality is more complicated than what the numbers show, because Beijing is neither considered as a globally important financial centre, nor even as the leading financial centre within China (Lai, 2012; Chen and Chen, 2014). The future role of the Chinese capital in the global financial sector is unpredictable. On the one hand, in contrast to the international financial centres, Beijing does not have a stock exchange; therefore, Beijing-headquartered companies are listed in the Shanghai Stock Exchange and the Hong Kong Stock Exchange, but more frequently in the stock exchanges of New York, London, and Frankfurt (Gillis, 2014). Chen and Chen (2014: 18) claim that Beijing's bid to become an international financial centre is hampered by its lack of a stock market. According to Taylor et al. (2014: 868), Beijing is better connected to political world cities such as Washington and Brussels, and to other Pacific Asian cities, than to Shanghai, while the latter is better connected to the international financial centres such as New York, London, and Frankfurt. Although all giant state-owned banks (e.g., Bank of China, China Construction Bank, and Industrial and Commercial Bank of China) are headquartered in Beijing, the bulk of the domestic and offshore financial activities are carried out in the triad of Hong Kong, Shanghai, and Shenzhen (Zhao, 2003; Zhao et al., 2004; KPMG, 2011; Lai 2012). On the other hand, Beijing-based banks control large amount of assets: in 2015, the combined assets of nine of Beijing's major and regional banks ranked by Forbes exceeded $13,343 billion, more than that of any other financial centres in the world, even three times more than Japan's GDP[7]. As a result, Beijing-based banks are becoming more aggressive about expanding outside of China (Forbes, 2012), which eventually could contribute to the positioning of Beijing as a major international financial centre.

It is worth noting that this exposure to the financial sector can now be regarded as the main source of Beijing's increasing power, adding the Chinese capital to the ranks as a global leader command and control centre, but this exposure can pose a threat as well. In accordance with Sassen's (2001) definition of global cities as key locations for finance, New York, Tokyo, London, and Paris were ranked top in the CCI ranking for 2015, and their positions were largely influenced by the performance of their financial sectors. However, the contribution of the financial sector to the total CCI value of Beijing is even larger than that of the global cities (Figure 3). While the contribution of the financial sector to the CCI value of Tokyo, Paris, and

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[7] The World Bank, 2016: GDP at market prices (current US$)

London remains under 50% respectively, and New York slightly exceeds 50%, the ratio of the financial sector in the total CCI value of Beijing is 65%, which means that Beijing's command and control function significantly depends on the performance of its financial sector.
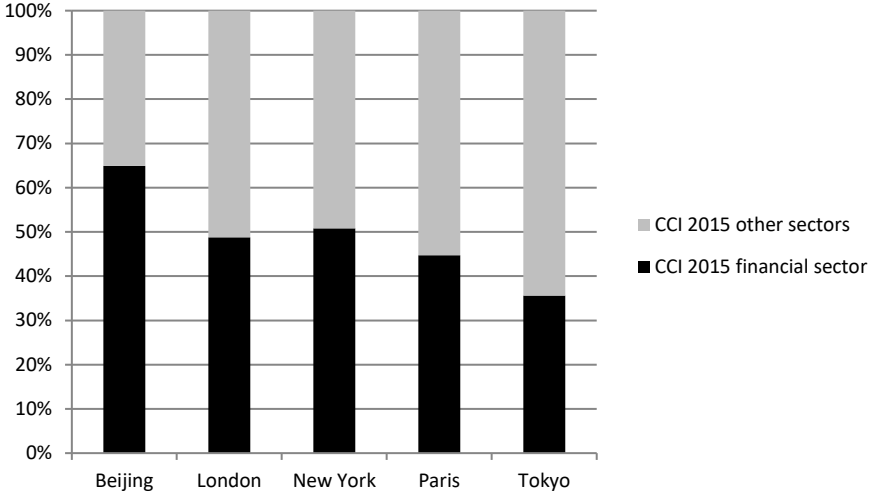

Figure 3. Contribution of the financial sector to the CCI value of the major command and control centres

A third dimension of Beijing's command and control function has recently emerged. In 2015, a China-led international financial institution, Asian Infrastructure Investment Bank (AIIB), was launched with the goal of providing financing for infrastructure projects of developing countries in the Asia-Pacific region. It is now expected that Chinese construction services companies will be the main actors of large infrastructure development projects abroad. Since 80% of the major construction services companies are headquartered in the Chinese capital, it can be predicted that the power of Beijing's command and control function will gradually increase.

6. Conclusion

Over the past half-century, but primarily since the publication of Friedmann's world city hypothesis paper in 1986, it has become common to rank cities on the basis of the concentration and/or the economic performance of the TNCs they host. However, in the 1980s, both the United States and the United Kingdom introduced neoliberal economic policies that have resulted in the growing significance of finance and services and the diminishing significance of the traditional manufacturing sector in these leading economies. Since the beginning of the 1990s, especially as a result of Sassen's book *The Global City*, researchers have begun to study economic globalization from a different perspective; according to which, the significance of the concentration of manufacturing firms as features of world cities has constantly depreciated (see, for example, Sassen 1991; Castells 1996; Taylor 2004). This development has led to some varying perspectives. For example, in the ranking of the Globalization and World Cities Research Network, in terms of their advanced producer services, Dubai, which is not a

particularly important command and control centre, occupies a more distinguished position (Alfa+) than Seoul (Alfa–), one of the largest economic hubs in the world[8]. However, on the basis of Friedmann's world city approach, these two cities are considered in a different way. Seoul, as home to 59 powerful TNCs with combined revenues of $1,337 billion, is one of the major command and control centres in the world (ranked 8th in the CCI ranking for 2015), whereas, only six companies of regional importance with combined revenues of $15 billion are headquartered in Dubai (ranked 125th in the CCI ranking for 2015). Therefore, with respect to the power of large companies, regardless of their sectors, an alternative urban hierarchy can be created.

In this paper, I have examined the position of cities as command and control centres on the basis of the power of their headquartered corporations. The result shows that until 2012, New York, London, Tokyo, and Paris; i.e. the global cities, were the leading command and control centres. However, due to the massive growth of the Chinese economy, the gap between the global cities and Beijing gradually closed, and by 2015, the Chinese capital outranked all the global cities. The outstanding performance of corporations operating in financial, energy, and construction services sectors is the driving force behind Beijing's increasing global power. In addition, the leading position of the global cities as command and control centres has been threatened by the San Francisco-San Jose metropolitan region, a newly emerging economic hub in the United States.

Acknowledgement

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[8] The World According to GaWC 2012 is available at http://www.lboro.ac.uk/gawc/world2012t.html

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