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Exploring the position of cities in global corporate research and development: A bibliometric analysis by two different geographical approaches

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ABSTRACT

Global cities are defined, on the one hand, as the major command and control centres of the world economy and, on the other hand, as the most significant sites of the production of innovation. As command and control centres, they are home to the headquarters of the most powerful MNCs of the global economy, while as sites for the production of innovation they are supposed to be the most important sites of corporate research and development (R&D) activities. In this paper, we conduct a bibliometric analysis of the data located in the Scopus and Forbes 2000 databases to reveal the correlation between the characteristics of the above global city definitions. We explore which cities are the major control points of the global corporate R&D (home city approach), and which cities are the most important sites of corporate R&D activities (host city approach). According to the home city approach we assign articles produced by companies to cities where the decision-making headquarters are located (i.e. to cities that control the companies' R&D activities), while according to the host city approach we assign articles to cities where the R&D activities are actually conducted. Given Sassen's global city concept, we expect global cities to be both the leading home cities and host cities.

The results show that, in accordance with the global city concept, Tokyo, New York, London and Paris surpass other cities as command points of global corporate R&D (having 42 percent of companies' scientific articles). However, as sites of corporate R&D activities to be conducted, New York and Tokyo form a unique category (having 28 percent of the articles). The gap between San Jose and Boston, and the global cities has consistently narrowed because the formers are the leading centres of the fastest growing innovative industries (e.g. information technology and biotechnology) in the world economy, and important sites of international R&D activities within these industries. The emerging economies are singularly represented by Beijing; however, the position of Chinese capital (i.e. the number of its companies' scientific articles), has been strengthening rapidly.

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1. Introduction

Globalization and the spatial restructuring of the world economy have increased since the 1970s and can primarily be characterized by the expansion of trade, the growing volume of foreign direct investments (FDI), and the emergence of the new international division of labour (Cohen, 1981; Fröbel, Heinrichs, & Kreye, 1980). These developments have dramatically enhanced the developing countries' participation in the world economy. In the process of economic globalization, multinational companies (MNCs) have become the central orchestrators of a global reallocation of manufacturing away from core industrial countries towards the developing countries (Dicken, 2007; Schoenberger, 1988). MNCs interconnect nation-states, regions, and cities, and they exercise significant control over nation-states (Bonanno & Constance, 2008). In this new world-system, cities have gradually become more important while the significance of nation-states has lessened (see, for example, Knox, 1995; Sassen, 2001, 2006; Scott, Agnew, Soja, & Storper, 2001). 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*'. In her seminal work entitled, *The Global City*, Saskia Sassen (1991) specified New York, London, Tokyo, Frankfurt, and Paris as the leading examples of global cities. Furthermore, she defined the most important characteristics of global cities (Sassen, 2001: 4):

> *Beyond their long history as centers for international trade and banking, these cities 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 for specialized service firms, which have replaced manufacturing as the leading economic sector; third, as sites of production, including the production of innovation, in these leading industries; and fourth, as markets for the products and innovations produced.*

We highlight two important points concerning this definition: On the one hand, global cities are the outstanding command and control centres of the world economy, and on the other, they are the most significant sites for the production of innovation (Sassen, 2001). The correlation between these two characteristics is the starting-point of this paper, and our main aim is to examine whether our theory is correct or not. Based on the characteristics of the global cities, we proposed a hypothesis, which needs to be confirmed by conducting a bibliometric analysis.

Hypothesis: Global cities are the major command and control centres of the world economy, and they are the most significant sites of the production of innovation.[1] As command and control centres, they are home to the headquarters of the most powerful MNCs of the global economy (Alderson & Beckfield, 2004; Csomós & Tóth, 2016; Csomós, 2013; Godfrey & Zhou, 1999; Taylor & Csomós, 2012; Taylor et al., 2009). MNCs are often considered to be the most visible symbols of globalisation (Gavin, 2001), because, for example, they have worldwide networks of subsidiaries, branch offices, customer service offices, and corporate research centres. To ensure the global competitiveness of firms, MNCs need to be highly involved in research and development (R&D) (Crespo, Griffith, & Lages, 2014; Kogut & Zander, 1993; Malecki, 1997; Roth, Jayachandran, Dakhli, & Colton, 2009). MNCs, wherever they are headquartered, tend to locate their R&D-oriented subsidiaries and corporate research centres into the most innovative environments in the world. Thus, if global cities are the major command and control centres and the most significant sites of the production of innovation in the world, they are home to not only the headquarters of the leading MNCs, but also host their R&D-oriented subsidiaries and corporate research centres. This means that, on the one hand, global cities are the major control points of corporate R&D (home city approach) and, on the other hand, the sites of international R&D activities (host city approach).

In this paper we put the above hypothesis to the test by conducting a bibliometric analysis. The intensity of corporate R&D activities can be measured through the number of patents and/or the number of patent citations (Ács, 2011; Chang, Chen, & Huang, 2012; Liu, Cheng, & Yang, 2006; Ribeiro, Ruiz, Bernardes, & Albuquerque, 2010; Ribeiro, Kruss, Britto, Bernardes, & da Motta e Albuquerque, 2014; Santangelo, 2002; Wang, Zhao, Gu, & Chen, 2011, Wang, Zhang, & Xu, 2011; Wong & Wang, 2015); the amount of R&D expenditures (Granstrand, 1999; Kumar, 2001; Piergiovanni & Santarelli, 2013; Yoo & Moon, 2006); the quantity and quality of research cooperation between companies and universities (Feng, Zhang, Du, & Wang, 2015; Gao, Guan, & Rousseau, 2011; Kneller, Mongeon, Cope, Garner, & Ternouth, 2014; Leydesdorff, Park, & Lengyel, 2014; Ramos-Vielba, Fernández-Esquinas, & Espinosa-de-los-Monteros, 2010), and it can be quantified by the number of scientific articles authored or co-authored by researchers from the companies (Chang, 2014; Furukawa & Goto, 2006; Hicks, Ishizuka, Keen, & Sweet, 1994; Hicks, 1995; Hullmann & Meyer, 2003; Tijssen, 2004). Several MNCs, especially those that operate in high-technology industries, are exceedingly involved in R&D activities; likewise, their researchers produce many scientific articles (Chang, 2014; Godin, 1996). Depending on the complexity of the MNC's organization and the geographical location of its R&D-oriented subsidiaries and corporate research centres, scientific articles can come from a number of domestic and

[1] Sassen (1991) argues that global cities have become the most significant sites of the production of innovation. Of course, it is possible to achieve innovation without conducting R&D activities. This means that companies can be innovative without conducting R&D activities but by purchasing technology in the market through R&D contracting, licensing of technology and know-how, contracting technical and engineering services, and acquisition of machinery and equipment related to innovation (Veugelers, 1997; Veugelers and Cassiman, 1999). However, the phenomenon of "production of innovation", as to be mentioned by Sassen, is not equivalent to the phenomenon of "purchasing of innovation", because the former requires conducting advanced R&D activities, while the latter primarily requires money to buy innovation. Therefore, there is a close connection between R&D activities conducted by companies and the innovation produced by them.