

Revisiting city connectivity

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Abstract

This article introduces a new perspective on city connectivity in order to analyze non-hub cities and their position in the world economy. The author revisits the different approaches discussed in the Global Commodity Chains (GCC), Global Production Networks (GPN) and World City Network (WCN) discourses and argues that synergies can be found if the WCN's firm-level argument is merged with the GCC and GPN's call for geographic embeddedness. This article lays out that a new bottom-up approach in the field of city network analysis can help investigating non-hub cities, taking a city's local economy and its ego-network as a starting point. Sudan's capital Khartoum serves as a test case and confirms that this approach leads to interesting findings. While Khartoum would score one of the lowest rankings in 'classic' connectivity audits, using a city's ego-network offers an alternative assessment that provides a better understanding Khartoum's status in the global petroleum industry.

Keywords: World city network, city connectivity, global production networks, global commodity chains, Khartoum, petroleum industry

JEL classification: R12

Date submitted: 22 March 2011 **Date accepted:** 8 November 2012

1. Introduction

The current debate about global networks focuses on economic indicators that originated at a time when the G8 had the sole authority over the world economy. Although for most people, London and New York still feature as the key nodes of the global economy, metropolitan centers such as Mexico City, Johannesburg or Sao Paolo are not yet recognized as global hubs. In times of rapid growth in most parts of the developing world, and with the G20 gaining political weight vis-à-vis the G8, it is time to redress this imbalance. With the onset of the financial crisis and the rapid emergence of transition economies like Brazil, India and China, a more adequate analysis of the position of cities in today's global economy calls for alternative methods, which allow for an interpretation of the dynamic, multi-polar environment that marks the beginning of the 21st century.

In economic geography, three particular strands of research dominate the scholarly debate about the role of firms and cities in the global economy: the Global Commodity Chains (GCC), the World City Network (WCN) and the Global Production Networks (GPN) discourse. Each of these research perspectives has its added value for specific research interests. Although GCC provides a valuable research perspective on the

spatial articulation of a specific production process, WCN offers a more quantitative assessment of economic flows through the office networks established by multi-national (service) companies. In turn, the GPN approach emphasizes the need to take account of the local factors that are at play when global connections across cities are being shaped. A number of recent publications have made a timely attempt to identify the synergies between the discourses on the WCN on the one hand and on GCC on the other, while also discussing the added value of assessment tools based on the GPN approach (Brown et al., 2010; Coe et al., 2010; Sassen, 2010).

This article takes this wish for finding synergies as a starting point, and develops an alternative conceptual argument on how to assess the position of more peripheral cities (particular those in developing countries and emerging markets) within a global city network. The original thought behind this argument stems from a more fundamental critique towards the WCN and its emphasis on those cities that have long been considered the most important metropolitan centers. To shift attention towards those cities that are not considered economic hubs, it is useful to draw from the insights offered by the GCC, WCN and GPN perspective, respectively.

The aim of this article is to explore new ways for assessing city networks at the outer end of the global economy. I start with exploring the possible fields of synergy between the three approaches to assess ‘the complexity of contemporary economic globalization and its impacts on territorial development’ (Coe et al., 2008, 4). I argue that this can be done by looking at a city’s ego-network and by deriving from this a city’s relevant connections beyond national borders.

In the first part, I develop an alternative view on how firm networks can be used to assess a city’s position in a global economy. I briefly discuss the differences between the GCC, WCN and GPN discourses and then suggest how the GCC and GPN approaches can be incorporated into an alternative framework for non-hub cities, by using the interlocking model developed by WCN scholars. The second part puts the argument to an empirical test, looking at Sudan’s capital Khartoum and its linkages with the global petroleum sector.

2. Juxtaposing GCC, WCN and GPN positions on city connections

Research about GCC emphasizes the specific production steps needed across different geographies from upstream (raw materials) to downstream (consumption) activities. In contrast, studies on the WCN maintain a focus on the role of urban centers in serving as a node in a corporate network, which facilitates the working flows across a global network of firm agents. Different to both GCC and WCN, scholarly work on GPN underscores the need to understand the many complexities—be it social, cultural, political or economic—that determine how firms create city networks across various geographic scales. The following sections introduce how GCC, WCN and GPN relate to city connectivity, and elaborate on where to find possible synergies.

2.1. GCC: the ultimate firm-level argument

The GCC approach has a strong ‘material’ element as it shows a particular interest in specific commodities and how (i.e. where) these are produced. It therefore represents ‘an analytical political economy tool, where the attention is focused on the systems of value creation employed by firms and other agents’ (Brown et al., 2010, 18). Its origins lead us

back to Hopkins and Wallerstein, who developed the research interest for production processes within an international economy. They define GCC as '[a] network of labour and production processes whose end result is a finished commodity' (Hopkins and Wallerstein, 1986, 159). In other words, the firm is at the center of enquiry, and this makes GCC scholars the advocates of the importance of certain geographies (city locations) for particular products or product groups. However, much of this research has been driven by the wish to understand the role of the nation state in these commodity chains. The debate focuses much less on the sub-national articulations of production networks (Smith et al., 2002, 49). As Gereffi argues, GCC studies aim to highlight the dynamics behind 'the changing spatial organization of production and consumption in the contemporary world-economy' (Gereffi, 1994, 2) and therefore keep a more macro-oriented focus. As Brown et al. summarize: 'despite the theoretical insight that a Global Commodity Chain connects inputs from different parts of the world, pulls them together in specific sites and provides output to different locations, the study of the actual geographies of these commodity chains has remained relatively underdeveloped' (Brown et al., 2010, 19). The GCC therefore says little about the local context in which these production chains are embedded. In addition, the GCC approach has done little to discuss the role of the service sector in facilitating (if not shaping) the way other industrial sectors do business around the globe. The latter is perceived as an important omission particularly by those scholars involved in the WCN discourse, which is built on the idea that global service companies hold the key to understanding what can be done where, and through whom.

2.2. The WCN: a service-centered discourse for the usual suspects

Despite a gradual move away from the triad cities, New York, London and Tokyo (e.g. Taylor et al., 2009), WCN studies still put great emphasis on the largest cities as the most important drivers behind globalization. In the early days of WCN research, Friedmann's concept of world city hierarchy in 1986 asserted that for a city to become a 'world city', it has to follow certain patterns of 'cityness', as defined in his seven interrelated theses (Friedmann, 1986, 69). Sassen's term 'global city' in 1991 led the research agenda to consolidate around the dual idea of dominant centers on the one hand and the periphery on the other (Alderson and Beckfield, 2004, 828). As Sassen argued back in 1991: 'the more globalized the economy becomes, the higher the agglomeration of central functions in a relatively few cities, that is, the global city' (Sassen, 1991, 8). According to this view, some key cities fulfil a control function in a global hierarchy of urban centers, whereas others have no other option than to catch up with their larger, more powerful counterparts (Sassen, 2002). In other words, cities of the first rank are those that serve as the 'command and control centers of the global economy' (Reszat, 2002). This interpretation has evolved further, and today Sassen highlights the need to recognize 'new types of geographies of centrality [, which] cut across the North-South divide' (Sassen, 2010, 159).

Since the introduction of the notion of centrality, however, various WCN scholars have been contributing to the search for adequate measures of power and possible ways to establish city hierarchies within this 'city-centered geography' (Taylor et al., 2007). An initial consensus was reached on the importance of international firm networks. The underlying assumption is that a city's role in international business networks—whether expressed through office locations, service providers or airline passenger flows (Witlox

et al., 2004)—can be considered a valid indicator for a city's status in the world city hierarchy.

The advance of city rankings based on firm data created a strong interest in academic as well as policy-making and business circles (Wall, 2009, 18, also see Gritsai, 1997; Krätke, 2001), as it allowed for cities to be assessed on the basis of quantitative scores, and a city could be compared with other urban centers. At the same time, it was criticized for what many regard as Western-biased data (Bassens et al., 2008; van der Merwe, 2004, 36); a city with a non-typical economic set-up (i.e. a city with a disproportionately high GDP share stemming from the local tourism industry) would inevitably receive lower scores in this type of ranking. As Neal argues: 'cities may play the role of a gateway city in some domains, while playing the role of a hub world city in others' (Neal, 2010). Robinson states that cities should be considered to be global in their own ways, and that they in fact 'place themselves in multiple circuits of globalisation, and choose to create networked relationships to neighbouring and distant places which are not central in terms of western economies' (Robinson, 2005, 759). According to Robinson, this problem is a central shortcoming of the WCN debate. In her view, the focus on the world's dominant business networks leads to 'a view of the world of cities [...] where millions of people and hundreds of cities are dropped off the map of much research in urban studies [...]' (Robinson, 2002, 219). Another argument against the use of city rankings sees them as too simplistic, because they focus on only a small part of such a network and tend to emphasize the apex of such a hierarchy (Gugler, 2004, 22; Carroll, 2007, 2298; Derudder, 2008a, 572; 2008b, 277). Despite these critiques, city rankings have become a major force in the field of economic geography.

As a result, the world cities at the core of the economic system and their global networks have long been subject to perspicuous study, whereas the lower ranks at the outer end of these networks have received much less interest within the WCN discourse. Coe et al. argue that there is a need to move beyond these existing hierarchies, to open up the debate for lesser connected cities, and to make the debate more inclusive: 'the language of core and periphery seems ever less pertinent to global realities' (Coe et al., 2010, 138). Sassen confirms this stance, arguing that centrality cannot be 'grafted onto the core/semiperiphery/periphery geometry' (Sassen, 2010, 159).

With a gradual shift from industrialized to emerging market economies, this argument has gained momentum. As Brown et al. argue: 'all cities experience contemporary global processes, and globalization can therefore not be construed as affecting just a few privileged cities' (Brown et al., 2010, 16). Using an analogy, this is as if the WCN approach attempts to understand the passenger flows through the London metro system by looking at the Victoria and London Bridge stations only, without considering the factors that make passengers board a train at London's remote Wimbledon station.

2.3. GPN: beyond firm networks?

The GPN research agenda can be seen as a counterweight to WCN's interest in the apex of the global economy. The GPN approach emphasizes the need to assess city connectivity not solely on the concepts of 'domination' and 'control', but on the notion of embeddedness (Figure 4). In other words, for a greater appreciation of these multiple circuits of globalization, research efforts should take account of the local context in which international firm networks evolve, and must assess the inter-relationships between firm and non-firm actors in this process: 'In particular, actors such as the firm

are theorized in the GPN framework not as individual agents per se, but as a constitutive part of the wider network through which emergent power and effects are realized over space' (Hess and Yeung, 2006, 1196). A key objective for GPN scholars is to investigate the relationship between firms and other actors and 'to analyse the consequences of global interdependencies and their relation to processes of local concentration and specialization' (Bathelt and Glückler, 2011, 4). In other words, this approach appreciates the specific context in which firms establish their production networks, and it emphasizes the relational element (as does the WCN discourse).

The GPN dilemma is that it aims to be comprehensive in its analytical scope while it finds itself confronted with the fact that the economic system dictates a significant share of what firms are able and willing to do. GPN advocates focus on 'soft' contextual interpretations of economic development; but companies still rely on 'hard' economic data when deciding where to invest. In doing so, GPN runs the 'danger of overemphasizing social relations stretched across space at the expense of economic transactions that constitute the very foundation of GPNs. [...] The challenge to future GPN research rests with our continual commitment to the analysis of the spatial creation, enhancement, and capture of value defined as surplus value and economic rent in different configurations of GPNs' (Hess and Yeung, 2006, 1200).

It is these spatial configurations of GPNs, which provide the starting point for the remainder of this article. To arrive at a meaningful interpretation of a non-hub city's position in a 21st century global economy, it is useful to combine the GCC firm-level focus and the WCN's model for intra-firm assessments with the GPN priority on the local context. This can be done by starting with a city's local, individual network and to derive from this a city's linkages. Such a move on the one hand reflects the critical stance towards WCN for being too essentialist, and on the other hand builds on the wish to contribute to the current search for synergies between the GCC, GPN and WCN approaches (Coe et al., 2010, 138).

3. Bridging the divide: using the WCN approach with a GCC and GPN lens

Brown et al. state that the WCN approach is only of limited value when looking beyond the macro (global) level, because the resulting analyses 'are the end result of ever larger data sets that depart from the logic of considering only the nodes at the global scale, but they are weak at revealing how urban networks at national and regional scales are connected to the wider WCN' (Brown et al., 2010, 16). To bring firm-specific and local context into a city network assessment, it is helpful to reflect on some of the aspects underpinning the WCN's interlocking model, and to determine how such an alternative assessment could be done so that it suits academic enquiries about those cities that have thus far 'fallen off the map'. Below I discuss why this is needed, and then present how Taylor's interlocking model can provide a starting point for such an analysis.

3.1. Why look at non-hub cities: the periphery matters

As globalization continues apace, today's world cities face increasingly tough competition from middleweight cities that are still positioned at the margins of the WCN. The current trends in demography and economic growth patterns are expected to lead to a new group

of medium-size cities (1–5 million inhabitants) in emerging—but also in marginal and niche—markets. These cities already constitute 23% of the world’s population, and this is expected to remain unchanged for the coming decades. According to UN data on urban population prospects, the global count of these type cities stood at 388 in 2011; in 2025 it is expected to reach 513 (UNESA 2011). China alone hosts 80 of such cities at the time of writing. According to McKinsey, medium-size cities are also set to become the most important drivers for the global economy:

[t]oday’s 23 megacities—with populations of ten million or more—will contribute about 10 percent of global growth to 2025, below their 14 percent share of global GDP. In contrast, 577 middleweights—cities with populations of between 150,000 and 10 million—are seen contributing more than half of global growth to 2025, gaining share from today’s megacities. (McKinsey, 2011, website summary)

Adding the effects of new communication technology, enhanced mobility across borders and the exponential growth in trade volumes, this could be called a ‘bottom-up’ trend of urbanization, whereby each reasonably large city has its peculiar global linkages, even more than it is the case already today. Bahrain’s capital Manama hosts the headquarters of Bahrain Air, a low-cost airline for the Gulf region; and Qatar’s capital Doha has become an important international media hub since the inception of Al Jazeera. Even cities in conflict regions are far from isolated. In 2001, Rwanda’s Kigali airport handled numerous flights with Coltan for European advanced ceramics producers (required for cell phones); and Kabul created a multi-million dollar business for civilian contractors during NATO’s ISAF stabilization mission (ranging from Ukrainian pilots to Dutch Safran Entrepreneurs). Because the revolution chased away Libya’s Muḥammad Ghadaḥfī, business people from all over the world are keen to establish ties with the new power holders. Tripoli is the entry point for a market of 1.6 million barrels per day of oil production, worth 2% of the world’s total in 2011. These developments are all related to, but not dependent on the presence of advanced producer services in the main hubs of the global city network. When looking beyond world cities, it is therefore important to move away from the idea that global service companies are the sole determinant for a city’s position in the global economy. Instead, it is necessary to acknowledge other, non-service-oriented economic developments that connect firms and territories on the national, regional and global scale to understand how locational strategies of corporate actors reach far beyond major business center, and how these processes shape a different type of city network. This is not to say that advanced producer services should be neglected. Even in non-hub cities, the service industry can play an important role and has to be considered if it determines the local economy. The argument is rather, that advanced producer services have created a worldwide network which reflects the realities of a 20th century geopolitical landscape; and that economic geography has thus far done little to highlight the opportunities that globalization presents for those cities that are not part of this network.

3.2. Moving beyond advanced service producers: building on the WCN interlocking model

The Globalization and World City (GaWC) group at Loughborough University has done authoritative work in WCN research, by looking at inter-city connections with a

network analysis tool. One of the group's models, developed by Taylor and his colleagues, allows for a quantitative assessment of a given city's connectivity based on international companies that specialise in servicing global capital, such as accountancy, advertising, banking, insurance, law and management consultancy (Beaverstock et al., 1999, 447; Taylor, 2004, 79–81). The model uses the size of the company locations across the globe as the main indicator for 'connectivity', thereby creating an 'interlock' between firms on the one hand and cities on the other. The underlying argument is based on an interesting interpretation of how offices create connections throughout the globe: the greater the service value of a company office (in this model defined as ranging from zero to five), the greater the working flows these offices maintain through other cities, and the higher a city's connectivity within the global city network as a consequence. In other words, Taylor's model uses the assumed working flows created by intra-company connections through cities as a proxy for city connectivity.

Although this model makes an interesting case for applying standard indicators across cities to arrive at a quantitative judgement on city networks, it follows the pitfalls of the WCN, as it excludes large sections of the world economy (Figure 1). In fact, it could be argued that by using service company networks as the main indicator, such an analysis reconfirms the picture of large metropolitan areas competing for the top positions within a 20th century world order. In line with this critique, Coe et al. warn that there are 'potential dangers of essentializing the global system as one that is primarily shaped by certain kinds of connections—namely the intra-firm relationships of advanced producer service firms—between certain kinds of cities—namely the leading tiers of global cities' (Coe et al., 2010, 138). Even though the more recent GaWC studies discuss in much more detail the position of regional and national city hubs outside the main globalization arena, such as Caracas or Manila (Taylor et al., 2011, 171 and 71), the resulting city network remains limited to the largest cities. The findings therefore do not provide answers to a globalizing economic system, in which every city is increasingly connected to numerous other cities around the globe: '[t]he rapid advance of globalisation means that every country, every city and every region, rich or poor, must compete with every other for its share of the world's consumers, tourists, investors, students, entrepreneurs, international sporting and cultural events; and for the attention and respect of the international media, of other governments, and the people of other countries' (Anholt, 2007, 72). As a result, there is a need for a research perspective that allows for a more dynamic analysis, so that it gives scholars the opportunity to address today's and future city network connections in developing country and emerging market cities—those that are not as easy to spot as the ones oriented towards the usual suspects New York, Tokyo or London.

4. From city connectivity to end-nodes

There are many methodologies to describe how cities connect to the global economy. At the core of the enquiry discussed here lies the WCN-inspired network-centric approach, which puts emphasis on the relationships between individual cities rather than merely looking at the composition of a city's economic profile. Taylor et al. emphasize that one of the key differences to 'classic' network analysis can be found in the additional layer that is needed to make sense of inter-city relations. Instead of the two standard network layers (the net and its nodes), city networks are defined by three layers (net, nodes and

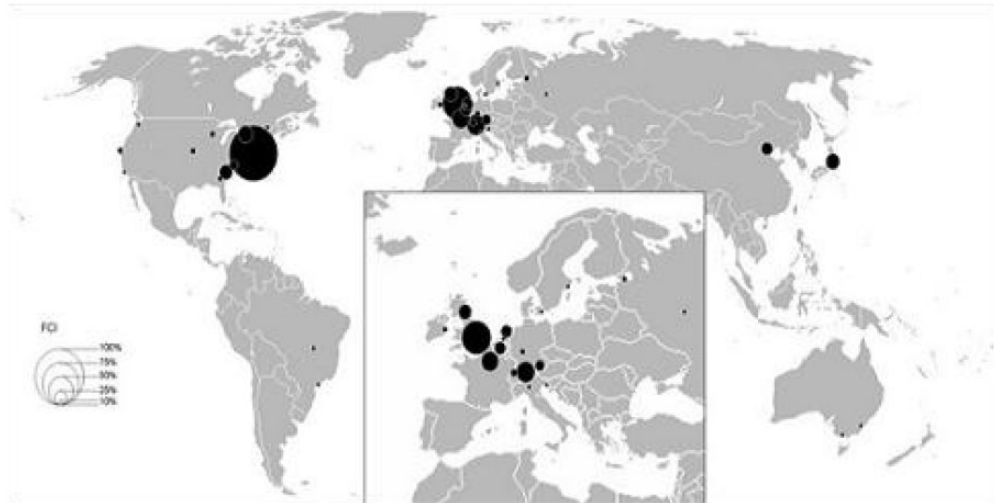


Figure 1. The imbalance in current global city network analysis (Taylor, 2009a).

sub-nodes). The global economy constitutes the net level, cities form the nodes and firms with their office locations are so-called ‘sub-nodes’ (Taylor, 2007, 61).

Before discussing how to assess non-hub city networks, it is useful to go back to Taylor and to clarify his concept of connectivity, and what it means for such an analytical exercise. His model focuses on advanced producer services and works with an indirect measure to establish connectivity. It looks at how the various office locations (sub-nodes level) create an interlocking network across the different cities (nodes level). This in turn constitutes an important part of the overall network that makes up the global service economy (net level). The underlying assumption is that daily working flows need input from multiple offices and thus connect (interlock) city locations with each other. In other words, cities are considered nodes at the center of a working flow: the more company offices there are to create these working flows through a given city, the greater a city’s connectivity.

When considering economic flows from and to more peripheral cities, this interpretation of connectivity only offers a limited understanding for the dynamics of a city’s global linkages. First, because this type of cities often score below-average when it comes to advanced producer services. This means that working flows created by the need for multiple offices to work together are much scarcer. In this context, Taylor talks about ‘subordinate’ cities in which one can find a large number of ‘normal’ but very few higher-level offices (higher-than-one) in the service industry (Taylor, 2004, 93). The higher office scores (regional or global headquarters) are far less likely scores for cities such as Lagos in Nigeria or Quito in Ecuador. Another problem lies in the explanatory value of such non-hub city data. A comparison between various cities that have a similar peripheral status, based on this quantitative model, becomes more ‘flat’ and creates much less distinction between cities than is the case between major hubs of the advanced producer services network.

In other words, peripheral cities should not be seen as a node at the center of the working flow—what could be labeled ‘mid-nodes’—but rather constitute nodes at the receiving end of those same flows. The latter type city could instead be called

'end-nodes'. Although Taylor offers an interesting framework to city network research, this is useful particularly when looking at cities positioned at the center of the global network, or 'mid-nodes'. Taylor's approach provides valuable insights in a city's relative position in a global business network and enables researchers to make a distinction between dominant or subordinate nodes of the network. However, it offers only limited insights when it comes to city networks in economic sectors that are found outside the realm of advanced producer services. It is therefore appropriate to assess a city's position in a different way.

To do so, the concept of end-nodes provides a first starting point: if cities are positioned at the end of global working flows, it is more appropriate to look at the connection to those cities in the network that are other end-nodes. Similarly, cities could be considered 'start-nodes', if they host headquarters of certain (local) companies that follow international expansion strategies in their specific sector. As this article focuses on the outer end of the network, which seldom hosts large local company headquarters with international ambitions, the following sections focus on the 'end-nodes' concept.¹ The following sections explore how an alternative method for assessing a non-hub city's position within the WCN could look like. I argue that two changes are required to make the idea behind the interlocking model work for non-hub cities. First, one should look *at something different*, as the global service sector does not provide sufficient explanatory value for emerging market cities. Second, one should look *in a different way* at what constitutes a city's position in the global economy.

4.1. Prime sectors: looking at something different

The first argument simply leaves the realm of advanced producer services, and moves the focus of enquiry to the local economy and what matters to a city's economic performance. For example, Rotterdam might not score very high as a global service hub, and in fact might not have the ambition either. Rotterdam is the third largest port city in the world and depends on international trading companies much more than on its service industry. Although the city's GaWC connectivity score is not particularly encouraging, few would go as far as saying that Rotterdam is less connected to the global economy than for example Brisbane, Zagreb or Stuttgart, as ranked in the GaWC connectivity 2008 audit. In fact, many of the multinational companies serviced by the well-connected cities rely on Rotterdam as their primary import and export node. As Sassen argues: '[...] global cities that actually arise from the need to handle the complex functions of ports are different from a city like London, which arises not only from its past port functions but also from finance and commerce' (Sassen, 2010, 155). A similar case can be made for other cities positioned in niche and/or emerging economies. In a recent article, Taylor in fact makes a similar argument, when investigating the two advanced producer service sub-sectors advertising and financial services. He explains how these sub-sectors create different types of networks in the case of Beijing and Shanghai. For each city, a specific economic sector has a particular relevance, which should be seen as a complementary asset vis-à-vis other cities (Taylor, 2012).

1 The idea of 'start-nodes' might become an important element when looking at emerging market cities that are already more integrated into the global economy (e.g. the importance of the Chinese city Baoding with the Yingli Solar company headquarters and its connections to the global solar PV sector).

Following this argument, it is suggested to analyze a city's linkages 'bottom-up', by starting with the local context. This is in line with Sassen's call to shift from 'imperial centers to distributed operations' and to address the 'spatial dimension that marks a globality that is specific to a region' (Sassen, 2010, 157). Any given city has its specific business portfolio, which is defined by the city's dominant industries, or 'prime sectors', which often act as the driving force behind economic developments. These prime sectors might often be geographically defined (as is the case for example in port cities), but can also include sectors that are deliberately promoted by the local authorities, such as tourism in the case of Cape Town or Dubai's airline industry. In network analysis terms, this entails that the node serves as the first entry point for an assessment, and shifts the attention to the sector-specific (business) network of a given city.

Figure 2 presents this new framework, which builds on Coe et al.'s understanding for GPN research. This modification moves from a comprehensive analysis that includes a wide range of stakeholders such as consumers, states, etc. (left) to a firm-specific analysis (right). Such a city ego-network can be individually defined, and helps to understand how a city connects to the world economy using a sector-specific lens. This turns around Taylor's 'top-down' notion of connectivity, which derives city connections from a world-wide network of multi-national service companies.

When having established such a local economic profile of a city, the selected prime sectors provide a good basis for further analysis, similar to how Taylor assesses advanced producer services. As shown in Figure 3, a prime sector of a given city consists of a number of city offices (illustrated by the four arrows from city 1b to cities 2, 3, 6 and 7 in Figure 3), and thus creates a (national, regional, global) network of cities that are art of the same sector.

4.2. A city's ego-network: looking in a different way

The second is a more conceptual argument and looks at how city networks can be assessed in a different way. As argued earlier, non-hub cities could be considered end-nodes of the WCN. Office locations in peripheral cities are often smaller, and are generally not central to a company's international working flows. Office locations therefore constitute the receiving end of a corporate locational policy, and make the interpretation in terms of 'connectivity' markedly different as a consequence.

A company's decision to start operations in a given city invites for a comparison with those cities that are also end-nodes of the same sector. For example, it would be unfair to argue that a city with tourism as its prime sector is poorly connected to international cotton production networks. Instead, the presented network assessment benefits from including only those cities that could be called 'peer cities' of the same sector. This way, the distribution of office locations across the globe determines the sector-specific city network of which a city is part: a city's ego-network. Everett and Borgatti, define ego-networks as 'networks consisting of a single actor (ego) together with the actors they are connected to (alters) and all the links among these alters. These networks are also known as the neighbourhood networks or first-order neighbourhoods of ego' (Everett and Borgatti, 2005, 31). However, in the case of such a first-order neighborhood, the ego-network would include the alters and those cities that are end-nodes connected to the alters. In our case, we are interested in the linkages between the alters themselves. This means that the resulting network is not a closed network, and could be called a second-order neighborhood network. This has similarities with

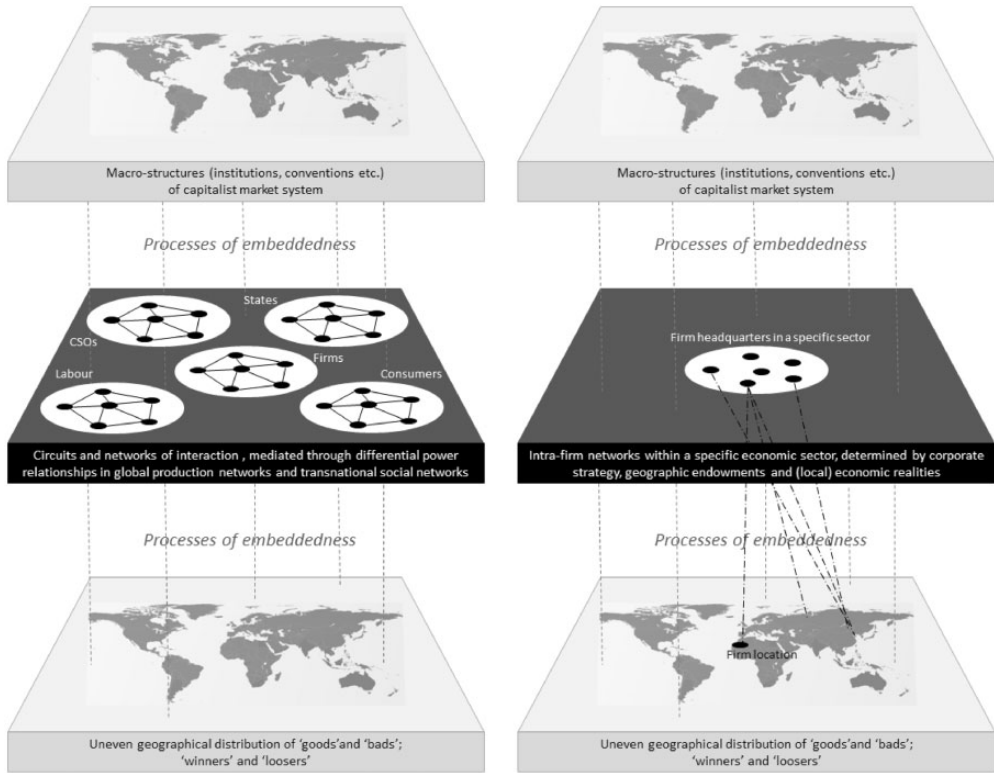


Figure 2. Translating the heuristic framework for GPN research (Coe et al., 2010, left) into a WCN-inspired framework for a city network assessment from a local perspective.

the concept of structural equivalence, where two nodes of a network hold similar positions ‘based on a shared profile of ties yet are not actually connected personally’ (Allen, 2008). It also relates closely to what Beaverstock et al. call ‘shared presence’: the ‘number of firms with offices in both cities’ when comparing so-called alpha world cities (Beaverstock et al., 2000, 127). When applied to the second-order neighborhood network, this translates into counting the number of sector-specific office locations in a particular city, and compare them with those end-nodes, which have a similar sector-specific profile: peer cities.

As a result, it is possible to establish a city’s status as a business location to sector-specific firms that are present in the city, and how a city is linked to its peers—be it in the region or elsewhere in the world. Such an approach uses the idea behind structural equivalence to assess city networks at the outer end of the global economy. Although such an assessment does not offer a city ranking in terms of connectivity, it helps depicting the geographic scope of a given sector-specific network. Although firms and the resulting working flows remain the key determinant for the network, it is not the working flows *between* cities (mid-node) created by those companies that are of interest, but the working flows *towards* cities (end-node) of the same sector. This way, we have moved away from economic hubs, towards non-hub cities. For the purpose of readability, this type of second-order neighborhood network will be referred to as a

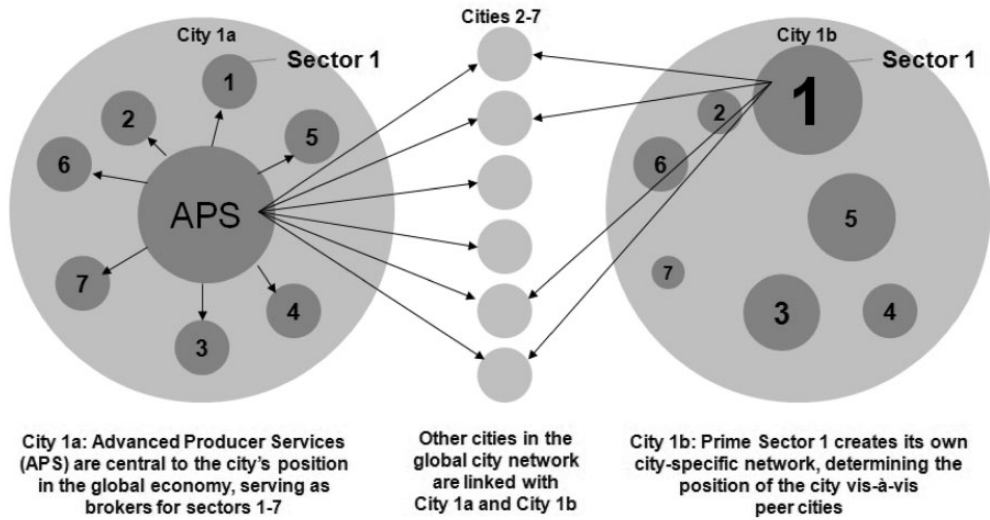
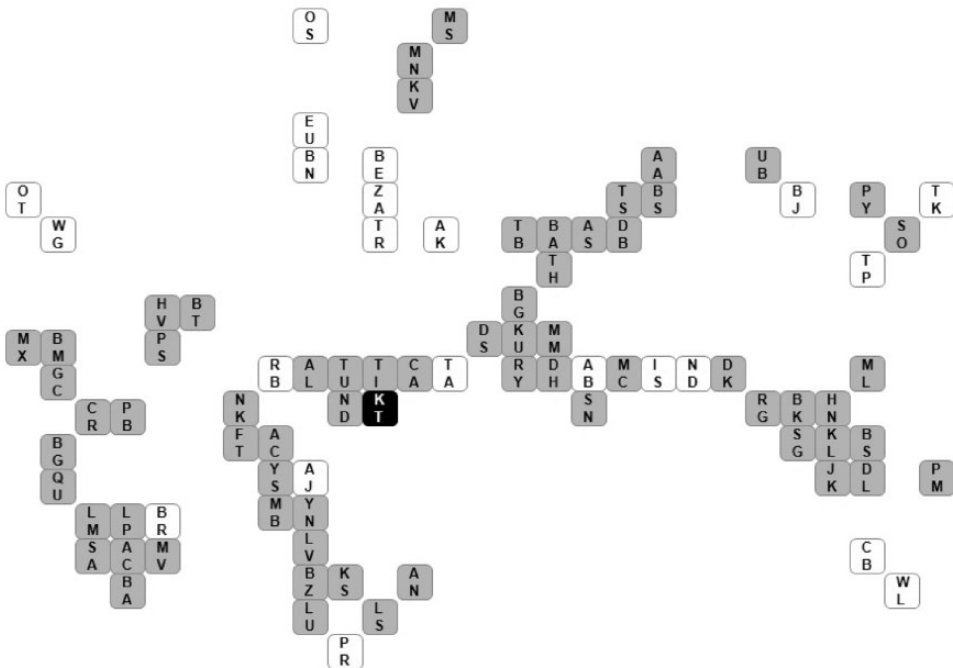


Figure 3. City networks based on advanced producer services (left) versus a prime sector (right).



City Legend (white): OT Ottawa, WG Washington, BR Brasilia, RB Rabat, OS Oslo, EU European Union, BN Bern, AJ Abuja, PR Pretoria, BE Belgrade, ZA Zagreb, TR Tirana, AK Ankara, TA Tel Aviv, AB Abu Dhabi, IS Islamabad, ND New Delhi, BJ Beijing, TP Taipei, CB Canberra, WL Wellington, TK Tokyo. These capitals are not considered in the final selection.

Figure 4. Political capitals of oil-producing countries, based on Taylor's visualization for global city networks (in white: to-be-excluded industrialized countries' and/or non-economic capitals).

city's 'ego-network' in the following sections, thereby emphasizing the 'local' element that is specific to the city's individual economic profile.

By using these two concepts—a city's prime sector and its ego-network—it is possible to bring the GCC and WCN discourses closer to the GPN understanding of the importance of the local context for investigating the territorial articulations of the global economy and provide a new investigative tool for looking at non-hub cities. First, this is done by taking the most dominant business sectors for a given city as the unit of analysis, and second by identifying office locations in peer cities. This way, it is possible to establish to what extent a particular city is, in Robinson's words, *global in its own ways*.

To put this conceptual tool to the test, the capital of Sudan, Khartoum, provides for an interesting case study of a city at the outer end of the world economy: 'Sudan is politically radioactive for multinational companies [where...] the reputational risks outweighs any benefits' (Walt, 2007). Yet, Khartoum can at the same time be considered a success story, with annual growth figures often more than 10% (in particular before the financial crisis hit the world markets in late 2008). In the period 1999–2009, the city might have been isolated due to sanctions from United States and European markets, but it created a significant wealth through alternative business networks. Looking at Khartoum's prime sector, and establishing its economic linkages based on its sector-specific ego-network can provide valuable insights into Khartoum's position as an office location within a global network of companies in a selected business sector.

5. Case study Khartoum²

In terms of the classic city network indicators, Khartoum offers a discouraging picture. Based on advanced producer and financial services, Khartoum ranks 459 and 399, respectively (out of 525 cities worldwide) in the 2008 GaWC connectivity audit. Other international business indicators offer a similar conclusion. According to the 2009 version of the Forbes 2000 list of companies, there are only two out of 77 companies in the telecommunication sector—a major industry in the country—that have an office in Khartoum. When looking at the 2009 MEED list of top 100 Middle East companies, cities such as Beirut and Muscat feature as the headquarters of top 100 companies, while Khartoum does not. The World Bank's Doing Business Index 2011 ranks Sudan 135 out of 183 countries, and it ranks third in the Failed States Index in 2009 and 2010 (and second in 2008).

A 2009 assessment by the World Bank explains Sudan's economic performance by two key drivers: in macro-economic terms, the negative factor responsible for Sudan's economic development rests in its massive debt burden. The government owes US\$ 34 billion, which is considered not sustainable without major debt relief initiatives (World Bank 2009). On the positive side, the country's emergence as oil producer led to fast and significant growth rates since 2000 and a heavy reliance on the sector in budgetary

2 The presented findings are based on literature research and fieldwork in Khartoum between January 2009 and February 2010. The author used Internet sources, official documents and semi-structured interviews with key stakeholders, collecting relevant information on economic developments in the city in the period 1999–2009. Note: data on Khartoum's economic indicators, especially the petroleum sector cannot be independently verified.

terms. In 2008, oil production accounted for an estimated 95% of exports (World Bank, 2009). Khartoum, being the country's economic and political capital, therefore represents the undisputed entry point for anyone doing business in the country.³ This particularly counts for oil-related services and for the large agricultural sector, but other sectors, too rely on Khartoum as the place where economic activities in production, trade and services come together. The WCN approach to Khartoum regarding its global connectivity neglects these developments, and does not offer an adequate understanding of Khartoum's position in this part of the global economy.

5.1. Khartoum's prime sectors

According to the Central Bank of Sudan, the national GDP distribution in 2008 accounted 29.3% for agriculture, 15.5% for petroleum, 14.4% for commerce, restaurants and hotels and 11.8% for transport and communication (CBOS, 2008). In contrast, the labor market lists 80% of the work force of 2008 employed in agriculture, 7% in industry (which includes the petroleum sector) and 13% in services (CIA World Fact Book). When looking at growth, the national economy reveals yet another ranking. The four national sectors that have the largest average growth rate for the period 2000–2007 include petroleum (19.0%), manufacturing (8.6%), transportation and communication (8.0%) and building and construction (6.8%).

The situation is different when looking at Khartoum in particular. The biggest national GDP contributor, the agricultural sector, is replaced by petroleum, and building and construction enters as a fourth biggest sector. One of the largest growth sectors in the national economy, manufacturing and handicraft, is replaced by (i) electricity and (ii) real estate. The latter two are sub-parts of the official categories (Figure 5), but are interesting because they represent key services for any type of business infrastructure: electric power and land use.

As Figure 5 shows, there are two economic sectors that qualify as Khartoum's 'prime sectors', with high scores in terms of both size and growth. One is the petroleum industry, a major driving force behind the economic boom of Khartoum. Another prime sector is transport and communication, which could be seen as a multiplier because it facilitates economic growth in other sectors. In terms of importance however, the petroleum sector is much more relevant to Khartoum's economic heartbeat. The generated export revenue and the resulting foreign currency inflow has enabled much of what has attracted national and international investors in other sectors to turn towards the city. This article therefore refrains from discussing the data on transport and communication; instead the findings presented in the following paragraphs are based on the petroleum industry.⁴

As discussed in the first part, the idea of a prime sector requires the selection of peer cities in order to assess Khartoum's position in a global context. When looking at the

3 Since the separation of South Sudan and North Sudan in July 2011, this situation has changed. In particular the oil sector has been affected by the political turmoil, as most of the oil infrastructure is on South Sudanese territory. This article refers to the situation in 2009.

4 As part of this research project, the author also investigated Khartoum's network linkages, as discussed in this article, by assessing the city connections resulting from 27 selected Khartoum-based companies in the international transport and communication sector. More information is available on request.

	Agriculture, Livestock, Forestry & Fishing	Petroleum	Other Mining and Quarrying	Manufacturing and Handicraft	Electricity and Water	Building and Construction	Commerce, Restaurants and Hotels	Transport and Communication	Finance, Insurance, Real Estate and Business Services	Community, Social and Personal Services
GDP (national)	●	●					●	●		
Growth (national)		●		●		●		●		
GDP (Khartoum)		●				●	●	●		
Growth (Khartoum)		●			●	●		●	●	

Four of the official GDP categories have been excluded from this table: Nominal Financial Institutions; Government Services; Private non-profit services to Households and Import Duties. These were considered irrelevant for this study.

Figure 5. Khartoum’s prime sectors.

petroleum sector, it is possible to include those cities as peers, which are part of the global oil industry. As Khartoum is the economic hub of an oil-producing (rather than oil consuming) country, international (daily) production data (which is always based on national figures) provides a first starting point. In 2009, the list includes 114 countries (CIA World Factbook), with Sudan ranking 33rd. To establish a list of peer cities to Khartoum, which is a political capital in a non-industrialized country, we limited the selection to only those countries that (i) have a political capital, which is also the economic capital⁵ and (ii) are non-industrialized countries. See Figure 4 for a world map⁶ showing the result of this filtering process.

A first analysis could therefore be done by looking at all economic capitals from non-industrialized countries that make part of the global oil industry—from the minor producers to the important OPEC capitals. This includes 66 capitals in total (marked in

5 Khartoum being an economic and political capital, it attracts investors for two reasons: access to business networks and access to political decision-makers. To create a level playing field of peer cities, it is useful to select only those cities that have the same status as Khartoum in this regard.
 6 This map uses the visualization method introduced by Taylor, placing a city at the proximate location on the world map in the form of a small square. The name of the city is indicated with a two-letter abbreviation in each square. In each map, Khartoum is indicated in black, with the abbreviation KT.

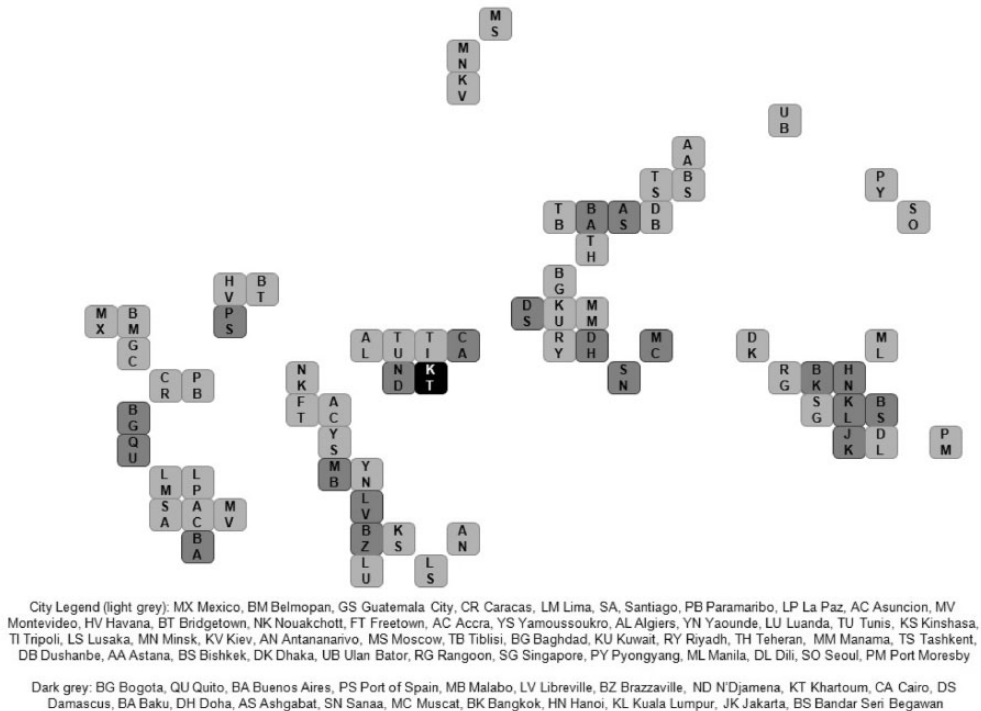


Figure 6. Khartoum's 66 peer cities: 20 capitals that have similar oil production (dark gray), and the remaining 46 oil-producing capitals with significantly more/less oil production (light gray).

light gray in Figure 4). However, differences in production volumes in this ranking are significant, with Riyadh (1st) producing 22 times more than Khartoum, and Khartoum producing 17 times more than Asuncion (112th). For a more refined assessment, we therefore limit the selection of Sudan's peer cities to the 10 closest rankings.⁷ This provides two separate lists of peer cities (Figure 6), which can in turn be used for an assessment in terms of the city's ego-network.

5.2. Khartoum's ego-network

To conduct a network assessment based on the concept of ego-networks, two things have to be done. First, it is necessary to find an adequate selection of international petroleum companies with operations in Khartoum. This can be done by identifying at the various company registries of the Sudanese oil industry.⁸ In total, 30 international

7 Six capitals have been deleted due to the selection criteria: Canberra (Australia, 31st); Copenhagen (Denmark, 38th); Pretoria (South Africa, 41st); Rome (Italy, 45th); Berlin (Germany, 46th); Tokyo (Japan, 47th).

8 The oil industry in Sudan is tightly controlled by the national government, and little information is publicly available. Because of the political sensitivities, a business registry for the sector is not available. Instead, a list of 30 companies was compiled on the basis of various different sources (such as the one compiled by the Genocide Intervention Network) and personal interviews. Only those with a physical office location in Khartoum and a company website have been selected.

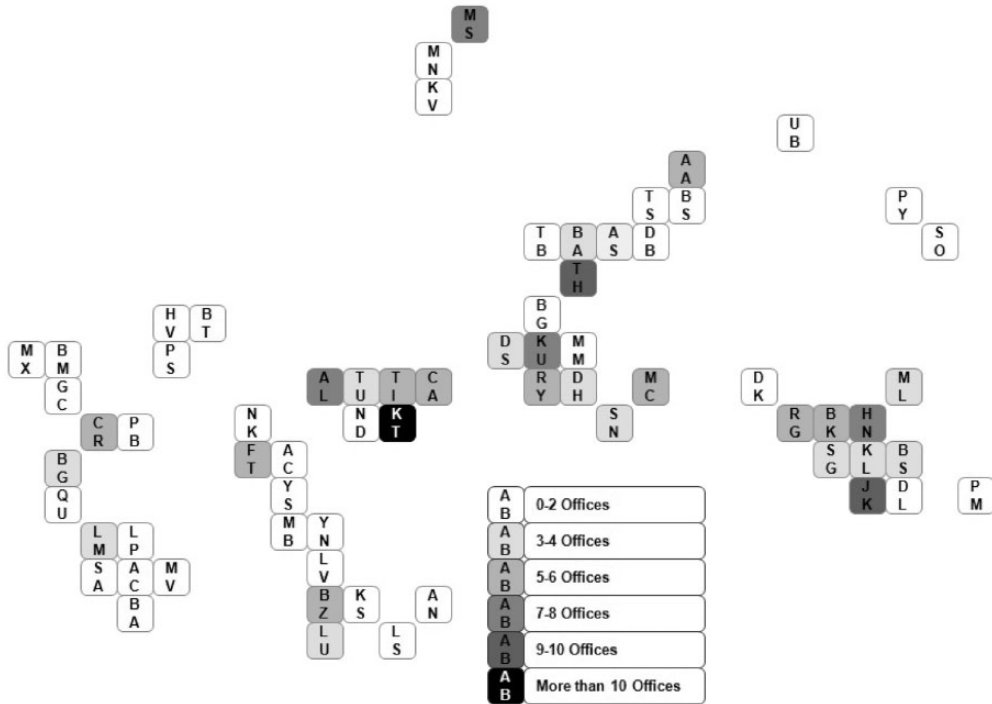


Figure 7. Khartoum's ego-network: 66 peer cities in the petroleum industry.

companies were selected for this purpose. A second step requires a database of all the office locations in Khartoum's peer cities, based on information presented on the company websites.⁹ The more offices a peer city 'scores', the closer it is to Khartoum's standing as an end-node office location. These data can then be translated into different maps, which highlight the major linkages between the petroleum firms, Khartoum, and its peer cities across the globe. The first map is based on the larger dataset (66 peer cities) and gives an indication of capital cities of oil-producing countries anywhere in the world, in which the selected petroleum companies have an office location, next to Khartoum. This is irrespective of a country's level petroleum production. Each city is shaded according to the number of offices present in the city (Figure 7).

Looking at this petroleum sector map, there are two findings that seem interesting—both from an economic and geopolitical perspective. First, many of the higher scores (darker colors) can be found in the Middle East, North Africa and in Asia. International companies present in Khartoum seem to be more active in the Middle East than on the African continent. This supports the view that Khartoum's oil industry is—as often claimed—indeed part of the Middle East business region. The city is far less connected to the East and West African markets, even though there are numerous capital cities across these two regions that are part of the global petroleum sector, such

9 In the case of some companies, office locations were not listed on the website, but could be derived from other business-related websites.

as N'djamena, Luanda or Malabo. This means that companies that are active in West-Africa tend not to have an office in Khartoum. Congo's Brazzaville is the only exception in this regard. Luanda and N'djamena both score a mere three office presences in contrast to five, six, and seven for Riyadh, Muscat and Kuwait City, respectively. The high score for Algiers (seven) can be explained by the relative high number of French companies (five) in the sample: international business networks are often influenced by language (and historic links such as a colonial past). The case of Khartoum illustrates that a French company can create a network of peer cities for Khartoum that are in the French language domain. Second, two capitals with high scores are similar to Khartoum inasmuch they also faced US sanctions in 2009: Teheran (nine) and Rangoon (six). This indicates that international companies in the petroleum sector base locational strategies not necessarily on regional considerations (investing in various locations in the same region), but also look at a similar investment climate. Investing in high-risk environments can be a strategic choice for a company, and is a well-known feature of so-called 'wildcat outfits' operating in the oil industry. In other words, these data confirm that Khartoum is an interesting location for companies that are global players specialized in niche markets. Both of these findings highlight the limitations of the WCN if it focuses on advanced producer services perspective. By adding the GPN and GCC's local lens, it is possible to unravel another level of economic networks across non-hub cities.

In contrast to such a comprehensive overview of Khartoum's standing in the world of petroleum, the smaller dataset (based on 20 peer cities) presents a more narrow network, including only those political and economic capitals of non-Western countries with an oil production that is *similar* to Sudan. This gives an indication of Khartoum's linkages to other end-node locations within the business network in this particular range of the global petroleum sector. It is important to stress that this does not necessarily reflect the 'status' of the city, or a ranking score. Rather, this map indicates where Khartoum-based international oil companies also have an office presence,¹⁰ i.e. which other locations are peer cities for Khartoum (Figure 8).

The findings of this second assessment offer valuable insights. First, many of the identified peer cities have at least one office presence. This suggests that there indeed is a correlation between the level of oil production and the type of company that invests in a certain location. If this is the case, the original idea of ego-networks provides a valid starting point for studies in economic geography: to understand the position of city end-nodes within the international economy, it helps to identify a city's ego-network for a selected prime sector.

Second, the capitals with the largest number of petroleum companies can be found in the three Asian capitals of Jakarta (10), Hanoi (seven) and Bangkok (6). African capitals are less 'targeted' by corporate locational strategies, which stands in contrast to the larger sample of non-peer cities. In other words, African cities with a similar oil production seem to be less interesting to those companies that are present in Khartoum. The high score for Jakarta might be explained by the high number of Malaysian companies in the sample (8). In general, however, Khartoum's direct

10 In the case of Kuala Lumpur, which hosts a number of company headquarters while also ranks similar to Khartoum in terms oil-production, only offices of non-Malaysian companies were included in the final score.



Figure 8. Khartoum's ego-network: 20 peer cities in the petroleum industry.

peer cities as shown in Figure 6 (highest office scores) can be found in Central, South and East Asia. This is a noteworthy finding, whereas most analyses of Khartoum's political economy include East and sometimes South Asia, little is said about the city's connections towards Central Asia. Khartoum's ego-network reveals that the city has linkages to this particular region because it is part of the global oil industry.

When looking at how Khartoum's ego-network connects to headquarters locations of the selected petroleum companies (de facto combining end-node with mid-node office data), this results in two maps, showing the city's indirect connections to peer cities.

This exercise presents more diversified result than one could have expected (Figures 9 and 10), whereas Khartoum's key trading partners are commonly stated to include China and the Middle East, the findings when singling out the petroleum sector are less clear-cut. The Chinese impact on Khartoum's petroleum economy certainly is crucial in terms of volume, but there are only four companies that feature on the two lists used for this study. In contrast, there are eight Malaysian companies that are based in Khartoum and there is a variety of European-based companies, including Italian, German, French, Swedish and British, that have operations in the Sudanese capital (Figure 9). This suggests that Khartoum is the end-node of a highly diverse set of internationally operating companies, headquartered in Asia, Europe and the Middle East.

6. Conclusion and discussion

The case of Khartoum confirms that the concepts of prime sectors (looking at something different) and ego-networks (looking in a different way) offer an alternative way to assess a city's economic linkages, while combining GCC, WCN and GPN perspectives. This

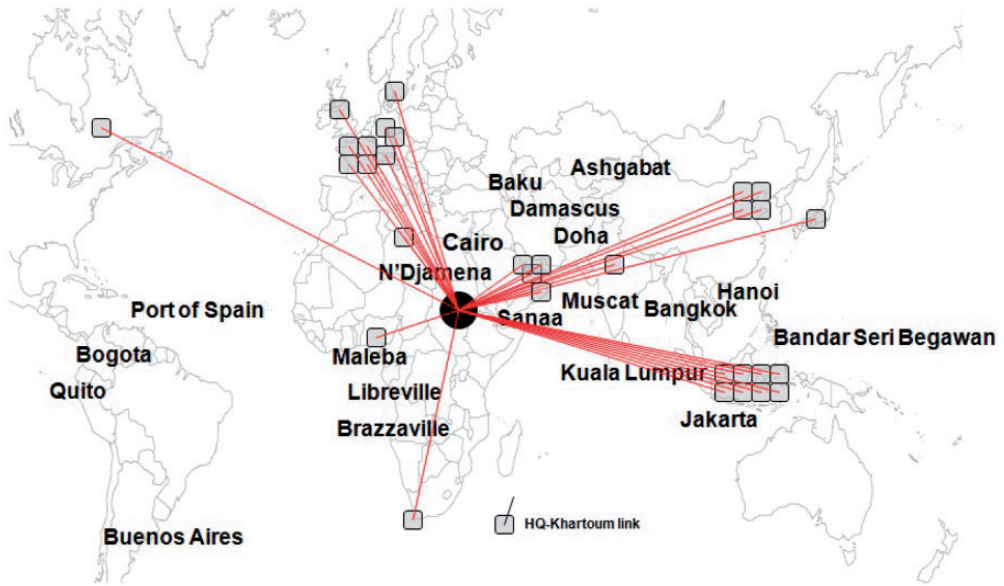


Figure 9. Office linkages into Khartoum, originating from 30 selected petroleum company headquarters.

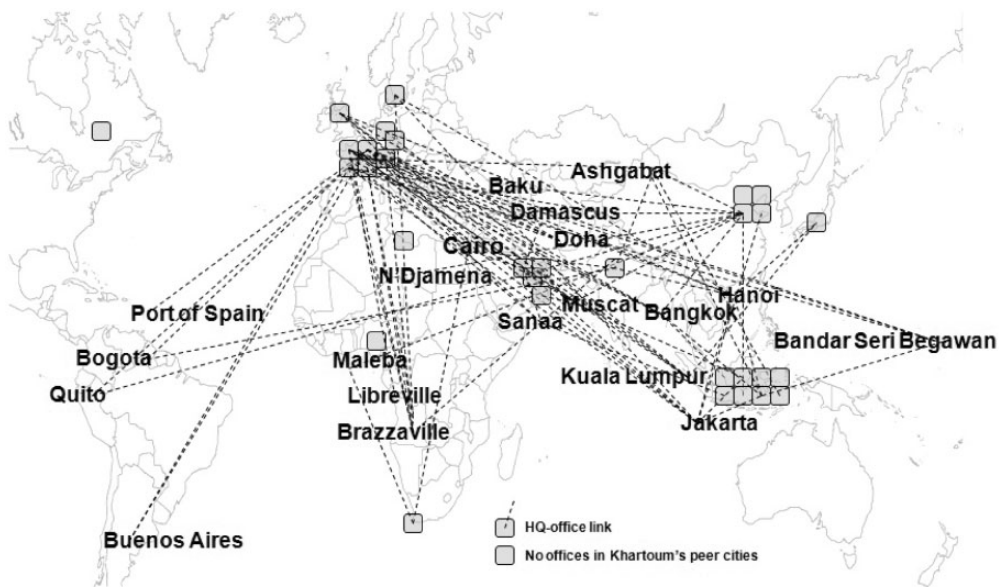


Figure 10. Office linkages into Khartoum's peer cities, originating from 30 selected petroleum company headquarters.

type of assessment introduces a new interpretation of the networks that link non-hub cities to the global economy. Building on the notion that every city is global in its own way, I argue that the local economic context provides a more appropriate starting point to understand the economic position of a city at the end of the classic connectivity spectrum. The peer city approach takes this argument a step further, and identifies those end-nodes that are part of the same sector-specific network. By embedding a non-hub city within such a peer city network structure, it is possible to look more in-depth at the economic opportunities that originate at the outer end of the global economy.

The findings of the case study illustrate how empirical analysis of a city's ego-network provides valuable insights about the position of a given city in sector-specific firm networks. Khartoum is an interesting example of how one of the most marginal cities in the world economy still connects to the global market place, when looking from a local perspective. Based on the ego-network data, it is then possible to establish sector-specific clusters of cities with a similar economic profile, and to assess a city's linkages with its peer cities in that particular sector. This helps to limit a WCN analysis to peer cities, and to present an assessment of the city's status within the prime sector's business networks.

The conceptual underpinnings of such an analysis provide a timely contribution to the current debate on GCC, GPN and WCN. A city network analysis of a city's particular ego-network and its relationships with peer cities results in an improved understanding of the existing networks that are created through corporate locational strategies. It also helps highlighting how these spatial configurations relate to the broader, geo-economic (or geopolitical) landscape of a particular sector. In other words, the local GPN lens brings the WCN approach closer to the rest of the world, and serves to reduce the WCN pro-Western bias. As a consequence, a more GPN oriented way of city network analysis calls for WCN scholars to rethink some of the quantitative arguments used for their assessments. To what extent should one investigate the individual city networks from a local, sector-specific perspective to understand how cities create economic linkages in an increasingly multipolar world?

The findings suggest that this alternative assessment leads to a new interpretation of the key linkages Khartoum has developed in the period since oil production began in 1999. The prime sector and peer city approaches create useful synergies between GCC, WCN and GPN. The focus on a city-specific prime sector answers the GPN call for a more contextual analysis, while keeping firm-networks central as suggested by GCC and WCN advocates. Because the analysis starts with the ego-network of a given city and its sector-specific peer cities, it zooms in on the position a city has vis-à-vis other business locations that are part of the same sector-specific network. This way, the concept of peer city allows researchers in economic geography to move beyond the standardized network scores that the WCN discourse offers. Further, it moves beyond the holistic approach of the GPN discourse, as it delimits the enquiry to a city-specific assessment based on prime sectors.

Research in relational geography and on city networks in particular would therefore benefit from: (i) a shift in research interest towards the role of prime sectors; and (ii) adopting and fine-tuning the concept of ego-networks. This way, cities at the outer end of the global economy no longer feature as unconnected nodes of the overall WCN, but can be discussed as a distinctive end-node, in a specific sector: each city is a global city in its own ways.

At the same time, it should be noted that this methodology does not offer an entirely neutral analysis of a city's level of integration in international working flows. In the case of Khartoum, there are of course more international companies in the petroleum sector, many of which have offices in some of Khartoum's peer cities, but not in Khartoum itself.¹¹ Future research could therefore start an analysis with a global list of the international companies in a certain sector, instead of using a list of companies that are only present in that particular city. Although the local perspective produces interesting results and can be applied to even the most peripheral cities, a broader scope based on such a global company list would allow for an analysis of 'medium range' cities and their sector specific networks. This is of particular relevance for fast-growing medium-size cities in the emerging market countries, such as India, China or Brazil. In this light, scholars working in the field of relational economic geography are invited to suggest possible modifications to investigating city linkages to peer cities in emerging economies.

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11 For example Lundin Petroleum, which is still included in this 2009 dataset, left Sudan in 2009 and would only show office locations elsewhere.

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