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The network dimension

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Introduction

There is now a considerable literature on the role of cities as key nodes in an increasingly globalized economy. One expression of this can be found in recent large edited volumes such as this one: for instance, Scott (2001), Brenner and Keil (2006), Taylor et al. (2007, 2011, 2013) and Derudder et al. (2012) have mustered over 300 chapters between them but still represent only the tip of this particular iceberg. Within this literature, the research in the context of the Globalization and World Cities (GaWC, http://www.lboro.ac.uk/gawc) research network has pioneered a *relational* approach to understanding cities in globalization as a 'world city network' (WCN). One area of focus has been the formal analysis of inter-city relations of cities based on a precise specification of the WCN as an 'interlocking network' (e.g. Taylor, 2001; Taylor et al. 2011). In the initial specification of this model and in much of the subsequent empirical WCN research, it is put forward that globalized producer services firms are the key 'network makers': drawing on the work of Sassen (1991) and Castells (1996), it is posited that these firms 'interlock' cities through their global, city-centred location strategies.

The purpose of this chapter is to provide a critical roundup of the research inspired by the 'interlocking world city network model' (IWCNM). To this end, we review the position of the WCN approach within the broader literature on 'world cities' and 'global cities', and present an overview of the analytical possibilities it offers. To this end, we present an IWCNM-based assessment of the position of Chinese cities in transnational urban networks in 2010. Although much of the chapter is purposefully empirical, our most important objective is conceptual: we aim to show that although the IWCNM is often equated with one of its many possible empirical outcomes, that is a 'global hierarchy of cities' (e.g. Bunnell and Sidaway, 2012), producing such a ranking is neither the purpose nor the fundamental outcome of the model. Rather, the IWCNM's key objective is to reveal one of the functional and spatial backbones of the transnational urban networks in which cities are entangled. In this chapter, we clarify and illustrate this vantage point as to

facilitate a critical appraisal of the possibilities and limitations of the WCN approach beyond the ranking clichés.

The remainder of this chapter is organized in four main sections. First, we introduce the overall rationale of the WCN approach by framing it in the evidential crisis that has long plagued the global/world city literature. Second, we discuss the WCN's general specification, its key underlying assumptions, and some connectivity measures that can be derived from this specification. The third section shows how the model is operationalized through a discussion of the source data, and an overview of the key features of the connectivity of Chinese cities in transnational networks. And fourth and finally, we discuss the analytical possibilities and limitations of this approach, thereby paying attention to some of the critiques that have been raised over the years.

The IWCNM approach: Addressing an evidential crisis

Although this is not the place to reiterate or debate the history and legacy of the 'world city' and 'global city' concepts, it is useful to remember that neither Friedmann (1982 with Wolff; 1986) nor Sassen (1991, 2006) devoted much attention to a methodical analysis of how and why cities could qualify. It is therefore no surprise that critiques of the narrow empirical basis of the world/global city concepts are basically as old as the literature itself. For instance, quickly after the publication of Friedmann's (1986) paper, Korff (1987, 491) argued that the identification of world cities 'involves a high degree of chance and a low degree of reasoning.' A decade later, Short et al. (1996, 698) observed that this situation had not really changed, as the privileged position of cities such as London, New York and Tokyo was 'more often asserted than clearly demonstrated.'

In parallel to the unanswered question which cities could be designated as global/world cities, the wider and *more relevant* issue of how cities could be convincingly arrayed in an overarching 'hierarchy' or 'system' also became debated. Smith and Timberlake (1995, 292), for example, noted that although

Friedmann's writing is full of references to how world cities relate to each other, the actual evidence presented is simply an amalgamation of commonsensical criteria at the level of individual cities. A case in point is Short et al.'s (1996) 'world city ranking', which is based on a combination of five straightforward indicators, that is the presence of (i) major financial institutions, (ii) corporation headquarters, (iii) telecommunications and (iv) transportation infrastructures and (v) global cultural events. Although most would find Short et al.'s (1996) ranking credible, it is flawed because it essentially remains the result of informed speculation that does not reveal how cities *relate* to each other, and thereupon constitute an overarching 'system' or 'hierarchy'. More generally, this problem relates to the fact that information on transnational *relations* between cities is usually not publicly available (Taylor, 1997).

Taken together, by the end of the 1990s there was a growing feeling that the global/world cities research was held back by the lack of evidence on the transnational *connections* of cities. This evidential crisis has since then been averted through two separate and distinctive meta-solutions (Derudder, 2006): (i) arraying primary data on worldwide corporate organization in such a way that cities' connections can be conjectured from these data (e.g. Alderson and Beckfield, 2004; Rozenblat and Pumain, 2007; Wall and van der Knaap, 2011), and (ii) using secondary data describing the global infrastructures connecting cities (e.g. Smith and Timberlake, 2001; Malecki, 2002; Tranos, 2011).[1]

[1] It can be noted that we continue to see the publication of rankings that suffer from a 'high degree of chance and low degree of reasoning' as they are based on commonsensical combinations of different measures of cities' 'importance'. Key examples include the rankings of consultancy firms such as Knight Frank's 'Prime Global Cities Index' (http://my.knightfrank.com/research-reports/prime-global-cities-index.aspx), AT Kearney's and Foreign Policy's 'Global Cities Index', (http://www.atkearney.com/gbpc/global-cities-index), PWC's 'Cities of Opportunity' (http://www.pwc.com/us/en/cities-of-opportunity/index.jhtml), and Mori's Global Power City Index (http://www.mori-m-foundation.or.jp/english/index.shtml).

The IWCNM specification is clearly part of the first solution to the evidential crisis. The starting point by Taylor (2001, 181) was that the world/global city 'system' was above all in need of a formal network specification, as '[w]ithout it there can be no detailed study of its operation – its nodes, their connections and how they constitute an integrated whole'.[2] Combining a series of techniques borrowed from social network analysis with the insights of Sassen (1991) regarding the rise of integrated producer services economies in major cities, the WCN was specified as an inter-locking network with three levels: a network level (the global economy), a nodal level (cities), and a critical sub-nodal level (firms providing the producer services). In the IWCNM, it is assumed that network formation takes place at the sub-nodal level: based on their attempts to provide a seamless service to their clients across the world, financial and business service firms have created global networks of offices in cities around the world. Each office network represents a firm's urban strategy for servicing global capital, and the IWCNM fundamentally projects a city's overall position by estimating the aggregated geographical patterns of flows within the office networks of such firms. As a consequence, in addition to a formal specification of how, in the words of Smith and Timberlake (1995, 292), 'world cities relate to each other', the IWCNM also has the distinct advantage of providing a clear indication of the data required: information on the office networks of producer services is needed. From this vantage point, the IWCNM can be seen as an answer to the empiricism and vagueness that were rife in this global/world city literature until the late 1990s. In the next section, we present the IWCNM specification, its key assumptions, and how this general specification gives way to detailed measures of cities' position in transnational urban networks.

[2] In GaWC research, the term 'network' is favoured over 'system': the idea of a system comes with baggage that implies a series of processes such as 'feedback loops' and 'tendencies toward equilibrium' that are not part of the (simple) model. As consequence, from this point onwards we will consistently use the term 'network'.

The IWCNM: Specification

The formal mathematical specification of the IWCNM begins with a city-by-firm matrix V_{ij}, where $v_{i,j}$ represents the 'service value' of city i to firm j. This service value is a standardized measurement of the importance of a city within a firm's office network, which depends on the size and functions of a firm's office(s) in a city (see below for the actual operationalization, which results in a six-point scale of values ranging from zero to five).

The basic measure in the IWCNM suit of measures is the city-dyad connectivity $CDC_{a\text{-}i}$ between cities a and i, which is defined as follows:

$$CDC_{a\text{-}i} = \sum_{i} v_{ai}.v_{ij} \qquad \text{(where } a \neq i\text{)} \qquad (1)$$

$CDC_{a\text{-}i}$ measures the potential working flows between any two cities within the WCN. It is based upon the assumption that the more important an office, the more working flows it generates; therefore, flows between two cities with many large offices will be appreciably greater than flows between two cities with fewer large offices (for alternative specifications see Neal, 2014).

Equation (1) shows that the IWCNM is essentially defined by the very simple notion of an interaction model. The thought upon which this builds is thus to answer the following question: if someone walked into the London office of a major advanced producer service firm, what level of service could he/she expect for his/her business needs in city X? One would expect first-class service for dealings in New York since almost all such firms in London also have an office in New York. But what if advice is needed for new work in Melbourne, Accra or Hamburg? Undoubtedly the chances of there being an office in these cities will be less than for New York, and the degree of service offered would likely be much less than in New York. Similarly there will be differences between these cities with respect to the likely intra-firm service available. The IWCNM provides a way of answering such questions quantitatively on a firm-by-firm basis. Of course, all global service firms'

networks are different in terms of their geographies and operations: they are idiosyncratic, depending on a firm's geographical origin, its agglomeration history, its clientele, its business model and so on. As a consequence, this method of deriving inter-city relations depends upon aggregating a large number of office networks to iron out the idiosyncratic, which in turn implies that results for cities housing only a small number of firms are unlikely to be robust.

Based on Equation (1), another basic measure can be calculated – the global network connectivity (GNC_a) of city, which is simply an aggregation of all its connections across the network:

$$GNC_a = \sum_i CDC_{a\text{-}i} \qquad \text{(where } a \neq i\text{)} \qquad (2)$$

Equations (1) and (2) are the backbone of the GaWC approach towards measuring world city *network* formation. Tables 1 and 2 show the workings of the model. Table 1 presents a (fictional) example of a city-by-firm matrix V_{ij} consisting of 5 cities and 6 firms, while Table 2 shows the $CDC_{a\text{-}i}$ and GNC_a measures derived from this dataset. To aid in showing that the IWCNM is more than merely counting the presence of firms, Table 1 also features the sum of a city's service values across all firms. The Tokyo/Beijing contrast is a clear case in point: although both cities harbour a similar mixture of firms (3/2/2/1/0/0), their overall connectivity GNC_a is different: Beijing is deemed more connected, in particular because its Barclays office produces major intercity connections $CDC_{a\text{-}i}$. This also implies that the Paris–Tokyo connection is less strong than the Paris-Beijing connection.

Table 1 City-by-firm matrix and summed service values

V_{ij}	*PWC*	*Deloitte*	*BNP Paribas*	*E&Y*	*LeBoeuf & Dewey*	*Barclays*	*Sum service values*
New York	5	4	4	2	5	4	24
London	3	5	3	3	3	5	22
Paris	0	2	5	0	4	4	15
Tokyo	2	3	2	1	0	0	8
Beijing	2	2	3	0	0	1	8

Table 2 Dyad connectivity and global network connectivity

$CDC_{a\text{-}i}$	*New York*	*London*	*Paris*	*Tokyo*	*Beijing*	*GNC*
New York	0	88	64	32	34	218
London	88	0	57	30	30	205
Paris	64	57	0	16	23	160
Tokyo	32	30	16	0	16	94
Beijing	34	30	23	16	0	103

Equations (1) and (2) encapsulate the IWCNM approach in general terms. However, over the years we have developed a number of more refined measures to tease out the geographies underlying a city's connections. This need for more refined measures is clear: although the Beijing/Tokyo contrast in Tables 1 and 2 show the opportunities offered by the IWCNM, it can be seen that a refined appraisal of a city's connections is hampered by the fact that $CDC_{a\text{-}i}$ largely 'follows' GNC_a: all cities are relatively well connected to London, and all cities relatively poorly connected to Tokyo (Neal, 2013). As a consequence, we developed a number of measures dealing with this problem. In this chapter, we focus on two alternatives.

A first alternative is to extract the *relative* strength of inter-city connections by calculating the concentration of two cities' potential working flows. This city-dyad relative connectivity ($CDR_{a\text{-}i}$) is calculated by dividing a city-dyad's connectedness relative to the two individual city's overall connectivity as indicated by the product of their global network connectivities:

$$CDR_{a\text{-}i} = CDC_{a\text{-}i} / (GNC_a \,.\, GNC_i) \qquad \text{(where } a \neq i\text{)} \qquad (3)$$

High values indicate many firms choosing to locate offices, often important offices, in both cities, suggesting extra business being conducted through this particular city-dyad; such city-dyads are relatively over-connected, we can think of these connections as 'punching above their weight' in the IWCNM.

A second alternative is to focus on particular *components* of a city's connections, that is the *relative* importance of its relations with a specific subset of cities. This subset may be 'hierarchical' (e.g. major cities across the globe), 'regional' (e.g. Pacific-Asian cities), or functional (e.g. Commonwealth cities) depending on the research question at hand. By way of example, in this chapter we focus on two straightforward possibilities: (1) the relative strength of a city's connections with the ten most connected cities (i.e. the 'globalism' of its connectivity), and (2) the relative strength of a city's connections with other cities in the same country (i.e. the 'localism' of its connectivity).

These measures can be calculated as follows:

$$\text{Globalism}_a = r_{a\text{-TOP10}} = 100 * \left(\frac{\sum_{i=\text{TOP10}} r_{a\text{-}i}}{\sum_{i=\text{all cities}} r_{a\text{-}i}} - \frac{\sum_{i=\text{TOP10}} GNC_i}{\sum_{i=\text{all cities}} GNC_i} \right) \quad (4)$$

$$\text{Localism}_a = r_{a\text{-country}} = 100 * \left(\frac{\sum_{i=\text{country}} r_{a\text{-}i}}{\sum_{i=\text{all cities}} r_{a\text{-}i}} - \frac{\sum_{i=\text{country}} GNC_i}{\sum_{i=\text{all cities}} GNC_i} \right) \quad (5)$$

The results of these measures are to be interpreted as follows: a positive value implies that city a has *stronger* connections with the top ten cities than expected; a negative value implies that city a has *weaker* connections with the top ten cities than expected; the larger the value, the stronger this tendency. As a consequence, a value 'close' to zero implies that city a has connections with the top ten cities that are neither particularly strong nor weak based on what can be expected from the involved cities' overall connectivities. Note that this is a *relative* measure that is therefore in principle *independent* from a

city's overall connectivity GNC_a. Localism scores can be interpreted along similar lines. In the next section, we show how these measures are operationalized, thereby focusing on the results for Chinese cities in 2010.

The IWCNM: Operationalization

The data requirements for operationalizing calculating of equations (1) through (5) are straightforward: information on advanced producer firms' networks is needed, that is which cities they have offices in, and differences in importance of these offices for their business needs. The operationalization and subsequent results described here are for the latest data collection, carried out in 2010.

Information was collected on the location strategies of major firms in a number of key service sectors: financial services, accountancy, advertising, law and management consultancy. In our research, firms were chosen by their ranking in lists of the largest firms in each sector. For financial services, the top 75 banking, insurance and diversified finance firms were identified as ranked in the Forbes composite index (www.forbes.com), which combines rankings for sales, profits, assets and market value. For the four other producer services sectors we included the top 25 firms as follows: for accountancy the ranking by revenues by www.worldaccountingintelligence.com; for advertising agencies the revenue ranking of 'marketing organizations' by Advertising Age (www.adage.com/); for law the Chambers Global list of corporate law firms (www.chambersandpartners.com/global); and for management consultancy firms the Vault Management & Strategy Consulting Survey, which ranks firms in terms of their 'prestige' (www.vault.com). These lists were the latest rankings available at the planning of the research in 2009 and tended to be based on 2008 data due to the usual time-lag in reporting such data. Substitute firms were identified for each sector (ranking just below the top 75 and 25) to cover for situations where a firm had disappeared (e.g. been taken over) in the two years before the actual data collection. There is, of course, no 'objective' way to choose the exact number of firms to be included per sector;

our choice to include more financial services firms is based on recent trends towards financialization in the global economy and the crucial role this entails for such firms (Pike and Pollard, 2010).

A few of the larger firms have branches in many hundreds, even thousands, of cities and towns. The data collection has been restricted to the more important cities for two reasons. The first is analytical: the more cities are being included, the sparser the final matrix will become with almost no offices present in the smaller cities and towns. The second is theoretical: the interest is in the more important inter-city relations, ultimately the WCN. Nevertheless, it is also important not to omit any possible significant node so that a relatively large number of cities need to be selected. Additionally, it is necessary to ensure that all continents are reasonably represented. The selection of cities is thus based on a number of overlapping criteria, whereby the selection is in part based on cities identified in previous GaWC research with additional cities based upon city size (all cities with populations over two million) and function (all capital cities of states with populations over a million) – 526 cities across the settled world were thus selected.

Assigning service values v_{ij} for the 175 firms' use of the 526 cities focused on two features of a firm's office(s) in a city as shown on their corporate websites: first, the size of office (e.g. number of practitioners), and, second, their extra-locational functions (e.g. regional headquarters). The resulting multifarious compilation of information on firms was codified into service values ranging from zero to five as follows. The city housing a firm's headquarters was scored five; a city with no office of that firm was scored zero. A typical office of the firm resulted in a city scoring two; reasons for moving away from this score were (i) with something missing (e.g. no partners in a law office), the score reduced to one, (ii) with particularly large offices the score was raised to three and (iii) with important extra-territorial functions (e.g. regional headquarters) a score of four was recorded. All such assessments were made firm by firm. The end result is a 526 cities x 175 firms matrix of 92,050 service values ranging between zero and five, which can be used as the input to the IWCNM as summarized in equations (1) through (5).

Chinese cities in the world city network in 2010

To provide an overview of the kind of insights regarding cities' *connections* that this approach can provide, here we describe the results for Chinese cities. First, there are the most basic calculations: $CDC_{a\text{-}i}$ and GNC_a as measures of the overall strength of a city's connections in the WCN.[3] Table 3 presents an overview of the 20 largest $CDC_{a\text{-}i}$ and GNC_a values for Chinese cities in 2010. The table shows that Hong Kong, Beijing and Shanghai are playing in their own league as these cities have far bigger connectivities than the other Chinese cities. Beyond this clear-cut top three, only Taipei as a special case and Guangzhou/Shenzhen are reasonably well connected in the office networks of global advanced producer services (APS) firms. Other major cities such as Nanjing and Chengdu, but perhaps especially Chongqing and Wuhan are far less connected in the WCN in spite of their size and unmistakeable economic importance within the Chinese space-economy (Ni, 2012).

A clearer example of what can be gleaned from the IWCNM can be obtained by calculating (1) the relative strength of inter-city connections $CDR_{a\text{-}l}$ as well as (2) the overall patterning of these connections as measured through 'Globalism' and 'Localism' scores. Table 4, in turn, shows the Globalism and Localism scores for the 20 most connected Chinese cities (the table also features these cities' GNC to facilitate comparisons). Table 5 shows the five most important connections of six Chinese cities: Beijing and Shanghai as Mainland China's major cities; Hong Kong and Taipei as well connected cities with a distinctive position *viz*. Mainland China; and Ningbo and Xiamen as cities with relatively limited connectivities.

[3] Note that for pedagogic and comparative reasons, measures of $CDC_{a\text{-}i}$ and GNC_a will in practice be presented as percentages of the largest values, as this makes results independent from the number of firms and cities in the analysis.

Table 3 Largest values of $CDC_{a\text{-}i}$ and GNC_a for Chinese cities in 2010

	City-dyad		*$CDC_{a\text{-}i}$*	*City*	*GNC_a*
1	London	Hong Kong	75.0	Hong Kong	73.0
2	New York	Hong Kong	69.0	Shanghai	62.7
3	Shanghai	London	62.1	Beijing	58.4
4	Shanghai	New York	58.7	Taipei	41.7
5	Beijing	London	55.6	Guangzhou	34.1
6	Beijing	New York	52.3	Shenzhen	25.8
7	Hong Kong	Singapore	51.6	Tianjin	16.8
8	Hong Kong	Shanghai	47.5	Kaohsiung	14.3
9	Hong Kong	Paris	47.2	Nanjing	13.5
10	Hong Kong	Tokyo	44.9	Chengdu	13.1
11	Beijing	Hong Kong	43.9	Hangzhou	12.5
12	Shanghai	Singapore	41.1	Qingdao	12.3
13	Shanghai	Paris	40.4	Dalian	12.0
14	Hong Kong	Dubai	39.8	Macao	10.9
15	Hong Kong	Chicago	39.7	Chongqing	8.9
16	Hong Kong	Sydney	39.2	Xi'an	8.7
17	Beijing	Singapore	38.8	Suzhou	8.6
18	Shanghai	Tokyo	38.4	Wuhan	8.0
19	Shanghai	Beijing	38.0	Xiamen	7.5
20	Hong Kong	Milan	37.0	Ningbo	7.5

Table 4 GNC, Globalism and Localism of the 20 most connected Chinese cities in the WCN in 2010

Rank	*City*	*GNC*	*City*	*Globalism*	*City*	*Localism*
1	Hong Kong	73.0	Hong Kong	3.11	Wuhan	10.02
2	Shanghai	62.7	Shanghai	2.87	Xiamen	9.17
3	Beijing	58.4	Beijing	2.68	Chongqing	8.92
4	Taipei	41.7	Taipei	1.72	Suzhou	7.98
5	Guangzhou	34.1	Guangzhou	1.05	Xi'an	7.25
6	Shenzhen	25.8	Wuhan	1.04	Ningbo	6.88
7	Tianjin	16.8	Tianjin	0.28	Qingdao	6.76
8	Kaohsiung	14.3	Dalian	-0.3	Dalian	6.52
9	Nanjing	13.5	Chengdu	-0.6	Chengdu	6.5
10	Chengdu	13.1	Xiamen	-0.65	Tianjin	6.19
11	Hangzhou	12.5	Suzhou	-0.68	Hangzhou	6.13
12	Qingdao	12.3	Shenzhen	-0.69	Nanjing	5.84
13	Dalian	12.0	Qingdao	-0.76	Shenzhen	4.59
14	Macao	10.9	Nanjing	-0.79	Guangzhou	3.57
15	Chongqing	8.9	Chongqing	-0.98	Beijing	3.34
16	Xi'an	8.7	Macao	-1.05	Macao	3.17

17	Suzhou	8.6	Hangzhou	-1.11	Shanghai	3.01
18	Wuhan	8.0	Xi'an	-1.44	Hong Kong	2.48
19	Xiamen	7.5	Kaohsiung	-1.73	Kaohsiung	1.42
20	Ningbo	7.5	Ningbo	-2.24	Taipei	1.37

Table 5 The five most important relative connections of six Chinese cities

Rank	*Hong Kong*	*Shanghai*	*Beijing*	*Taipei*	*Ningbo*	*Xiamen*
1	Palo Alto	Hong Kong	Palo Alto	Bangkok	Hangzhou	Qingdao
2	Singapore	Beijing	Shanghai	Palo Alto	Dalian	Dalian
3	Shanghai	New York	Hong Kong	Kuala Lumpur	Nanjing	Chengdu
4	Beijing	London	Tianjin	Singapore	Qingdao	Tianjin
5	London	Tianjin	Singapore	Sydney	Chengdu	Hangzhou

The most important finding contained in Tables 4 and 5 is that, although CDR, Globalism and Localism measures are *relative* in that these have no direct relation with overall connectivities, these rankings are nonetheless clearly interrelated with GNC: Hong Kong, Shanghai and Beijing stand out not only because of their sheer overall connectivity in comparison to other Chinese cities but also because of the strength of their connections with the world's leading cities. However, even though the connections of Hong Kong, Shanghai and Beijing are relatively more directed towards other major cities, there is still an important regional and national dimension to them: the three leading Chinese cities have (1) above-average national connections, (2) are strongly inter-connected (in all three cases, the other two cities rank in the top 5), while (3) the remaining major connections also have a regional dimension (e.g. major business connections with Singapore or Tianjin). In addition to the particular nature of connectivity profiles of this leading 'triad', Taiwanese cities (Taipei and Kaohsiung) also have idiosyncratic profiles combining small levels of Localism with strong regional connections beyond China.

For the remaining Chinese cities, the relation between globalism and GNC is slightly less clear-cut, although it is notable that overall only seven cities feature above-average connections with the world's ten most connected cities. In the case of the Guangzhou/Shenzhen pair, Guangzhou seems much

stronger connected to key cities in the global economy than Shenzhen in terms of its business service connections. Meanwhile, Wuhan features relatively strong connections with the world's major cities in spite of having a rather smallish GNC_a overall. The Localism scores of these Chinese cities are (roughly) inversely related to their Globalism. This is also shown by the major connections of the least-connected Chinese cities (Ningbo and Xiamen), which are consistent with other Chinese cities. This shows that within China's main cities myriad (emerging) global connections, there continues to be a distinctively Chinese layer of inter-city networking.

Discussion

Rather than presenting a set of results per se, the purpose of this chapter has been to provide a critical roundup of the research inspired by GaWC's 'interlocking world city network model' (IWCNM). Our brief summary of the connectivity profiles of major Chinese cities in the WCN offers a useful backdrop to review the purpose and possibilities of the approach, as well as addressing some of the critiques raised against this research agenda.

First, it should be clear that the ultimate objective of the IWCNM is not to produce a 'global ranking of cities'. Although such a ranking can be produced and often serves as a useful introduction to an analysis of connectivity in the WCN, it is neither a goal in itself nor the privileged way of conveying results. Above all, the interest is in revealing the functional and spatial outline of the transnational urban networks in which cities are enmeshed. The GaWC approach provides one specific method to approximate these networks, and analyses can be tailored to specific research interests. In addition, empirical results are not necessarily end products in and by themselves, but part of a wider research agenda in which there can be a complementary relation between quantitative and qualitative research. A good example of this can be found in a recent paper by Lai (2012). Lai's paper reports on intensive research using qualitative data on how Shanghai, Beijing and Hong Kong relate to each other in the context of the global and Chinese space-economy.

Drawing on previous quantitative results to set the scene, Lai analyses the reasons for the absolute and relative strength of the relations between China's major cities. Based on her research, she traces this intensity to the presence of 'dual-headquarter strategies' and 'parallel markets' in response to the different 'functions' of these cities in linking China up with the global economy. As Lai's (2012; see also Wójcik, 2011) research clearly shows, IWCNM-inspired research should not be seen as 'opposing' qualitative research, but as part of a much wider, critical-realist methodology where extensive research may provide formative input to intensive research that takes the research agenda further (see Sayer, 2002).

Second, one recurring pattern in our analyses is the variegated mix of hierarchical and regional tendencies. In this chapter, we, for instance, show that Hong Kong, Shanghai and Beijing are not only more strongly connected in the WCN as a whole, but also that their connections with other major cities are relatively stronger. At the same time, less-connected cities such as Ningbo and Xiamen are characterized by relatively stronger 'local' connections. In addition, inter-city relations are also influenced by geopolitical patterns, for example Taipei's strong connections with non-Chinese cities in Asia-Pacific. Taken together, the IWCNM approach to WCNs does not necessarily reflect or even advance a 'globalist' perspective on inter-city relations, as we identify multiple scales of city-network formation (global, regional, and national) (see Taylor et al., 2013).

Although the mathematical specification of the IWCNM in and by itself has only recently come under closer scrutiny (e.g. Neal, 2013), its (1) operationalization through a focus on producer services firms and (2) the way in which results are sometimes presented have been criticized over the years. Two major areas of critique stand out.

First, in addition to post-structuralist readings that dismiss measurement per se as the 'categories of "world" or "global" city are […] more and more meaningless' (RG Smith, 2003, 578), there have also been a number of post-colonial critiques lamenting the narrow empirical focus on producer services.

It is asserted that this results in a ‘biased’ reading that neglects myriad processes and cities. The most trenchant critique along these lines has been by Robinson (2002, 536), who complains that ‘millions of people and hundreds of cities are dropped off the map’. This exclusion is from two ‘maps’: (1) the geographical map as most cities in the ‘South’ are missing, which is in turn related to (2) the conceptual map as myriad types of connections between cities are not considered (see also MP Smith, 2001; Bunnell and Maringanti, 2010; Watson, this volume).

Second, critics have often focused on one of the most straightforward presentations of the empirical operationalization of the IWCNM, that is the GNC rankings and – although this initially stemmed from another research project – the associated identification of ‘levels’ of world cities (i.e. alpha/beta/gamma). For instance, when Bunnell and Sidaway (2012, xvi) state that in ‘the world/global cities literature [...] the assumption of hierarchical relations continues to present alpha [or, most recently, alpha++] cities as the leading edge of urban innovation, dynamism, and aspiration’, it is clear that they single out a very particular portion of the GaWC research agenda to address the research presented here and even the literature as a whole.

There is, of course, some truth in both critiques: (1) most IWCNM operationalizations do indeed focus on a narrow set of economic processes, while (2) in Taylor (2012) the citation ‘success’ of these rankings has been dubbed the ‘alpha-beta-gamma misgiving’. Nonetheless, we feel such critiques sometimes misunderstand what the research and therefore the results are all about.

First, the critique of the ‘missing’ cities/processes tends to confuse the encompassing concept of ‘cities in globalization’ with the initial purpose of ‘world city research’, revealing how and from which cities globalized capitalism is being (re)produced. We agree with Parnreiter’s (2010, this volume) observation that it is precisely the focus on advanced producer services that allows grasping the fundamental difference between the role of

cities in engendering globalization and the impacts of globalization on cities. At its core, WCN research is a city network-centred approach towards highlighting uneven development, and critiques of these analyses not being 'globally encompassing' ignore this core idea.

In addition, although in much of the empirical research drawing on the IWCNM the focus is on producer services firms, it is useful to point out that this model can be used for investigating 'other' WCNs. Thus there have been analyses based on the networks of 'non-economic actors' (e.g. NGOs as in Taylor, 2004), while regionally more relevant definitions of key network makers have also been applied (for example Bassens et al., 2010, on the importance of Islamic financial services in connecting the Gulf region to the WCN). As such, critiques of the IWCNM and its particular operationalization though producer services should be disconnected.

Second, most of the critics of the 'alpha/beta/gamma misgiving' are active in the blogosphere, where they tend to evaluate the research in terms of how it fits with their personal horizons.[4] These accounts are above all part of a contemporary 'list-mania', where the ranking is all that matters. Of course, ill-informed discussion in the blogosphere is an easy target, but peer-reviewed knowledge is by no means immune from the basic assumptions underpinning list-mania, in that results are used without much regard for the underlying rationale, let alone the more refined and labour-intensive nature of how results are produced. Specifically: in this chapter, we have tried to show that although empirical analyses based on the IWCNM are characterized by myriad assumptions that can and should be critically scrutinized, *there is a clear conceptual rationale that underlies its specification, measurement, analysis and objectives.* As a corollary, the 'meaning' of the empirical results produced through the IWCNM differs greatly from those put together by consultancy

[4] For example, the discussion on the ranking of US cities at http://www.city-data.com/forum/city-vs-city/1382110-world-city-rankings-according-gawc-2010-a.html.

firms such as AT Kearney's Global Cities Index.[5] In the latter case, all kinds of 'commonsensical' variables (and processes) are aggregated to develop city rankings to satisfy the needs of list-mania. The fact that these lists may or may not converge with some of the GaWC findings is simply irrelevant, as the overall rationale and purpose are miles apart. In this chapter, we have emphasized this by focusing on what has always been the key purpose of the IWCNM: advancing and exploring the idea of the importance of the external relations of major cities.

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[5] http://www.atkearney.com/gbpc/global-cities-index.

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