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## A Global 'Urban Roller Coaster'? Connectivity Changes in the World City Network, 2000-04

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**A Global 'Urban Roller Coaster'?  
Connectivity Changes in the World City Network, 2000-04**

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**A Global ‘Urban Roller Coaster’?**  
**Connectivity Changes in the World City Network,**  
**2000-04**

For Peer Review Only

## Abstract

A network model is used to assess the nature of change in inter-city relations from 2000 to 2004. Data are collected for 2004 on the office networks of the same global service firms that were used to describe global connectivities for 315 cities in 2000. This allows a new cross-sectional geography of connectivities to be produced for 2004, and for changes in connectivities between 2000 and 2004 to be computed. Simple visualisation and statistical techniques are used to explore the data. A distinction is made between 'normal change' and 'exceptional change' and only two cases of the latter are definitely identified: cities in both USA and sub-Saharan Africa are generally losing global connectivity in relation to the rest of the world. Thus 'normal change' predominates and we conclude that contemporary inter-city change does not correspond to Castells' image of an 'urban roller coaster'.

## Introduction: changing inter-city relations

This is an empirical paper that measures and interprets recent changes in inter-city relations at the global scale. How we understand changing inter-city relations depends on the way in which those relations are conceptualised. Traditionally, cities are arrayed hierarchically so that change is about cities 'moving up or down' in a zero-sum game. In the study of world cities this position is represented by FRIEDMANN's (1986) 'world city hierarchy' and its subsequent updating as 'a hierarchy of spatial articulations' (FRIEDMANN 1995, 23). The consequence of this approach is that change derives from inter-city competition; just such a model of

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7 'competitive cities' has dominated thinking generally on changing  
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9 inter-city relations (LEVER AND TUROK 1999). Thus for  
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11 FRIEDMANN (1995, 23) world cities

12  
13  
14 'are driven by relentless competition, struggling to capture  
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16 ever more command and control functions that comprise their  
17  
18 very essence. Competitive *angst* is built into world city politics.  
19  
20  
21 (p. 23)  
22

23  
24 A similar Darwinian image can be found in CASTELLS (1996) use of  
25  
26 SASSEN's (1991) global city concept wherein change results from  
27  
28 'fierce inter-city competition' (p. 382). For FRIEDMANN the outcome  
29  
30 is 'inherent instability' in a very 'volatile' pattern of inter-city change  
31  
32 (p. 23, 36), for CASTELLS it is an 'urban roller coaster' (p. 384).  
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38 It is our view that such statements from very influential writers in the  
39  
40 field grossly under-estimate the stability in world city inter-relations.  
41  
42 In this paper we employ a network model of inter-city relations based  
43  
44 on advanced producer service firms 'inter-locking' world cities  
45  
46 through their worldwide distributions of offices (TAYLOR 2001a,  
47  
48 2004a). The resulting world city network, like all networks  
49  
50 (THOMPSON 2003), is ultimately sustained by mutuality among its  
51  
52 components: *contra* Friedmann, in this approach the 'essence' of  
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54 inter-city relations is co-operation. Such modelling does not, of  
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7 course, mean that there is no competition between cities; we agree  
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9 with BEGG (1999, 807) that '(p)lainly cities compete ... (e)qually  
10  
11 cities co-operate'. But in our argument, the co-operation process is  
12  
13 prioritised because it entails the basic reproduction of the inter-city  
14  
15 relations. Competition is less fundamental but still significant. Thus in  
16  
17 our empirical studies of inter-city relations for 2000 we **have** recorded  
18  
19 a network with hierarchical tendencies (TAYLOR 2004a).  
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21

22  
23 Of course, any empirical study of change will produce some cities  
24  
25 doing better or worse than others. In the competitive model, such  
26  
27 changes are interpreted as cities rising or falling in the hierarchy.  
28  
29 Viewing cities as networks, on the other hand, leads to arguments  
30  
31 about cities improving, consolidating or reducing their nodal location  
32  
33 within the network. But these alternative interpretations are not in  
34  
35 themselves useful for empirical evaluation: how do we distinguish  
36  
37 between Friedmann's 'inherent instability' and the expectation from  
38  
39 our network model of more stability in inter-city relations? It is a  
40  
41 matter of degree, yes, but what degree? Obviously a situation where  
42  
43 opposite interpretations can be drawn from the same empirical  
44  
45 evidence is unsatisfactory because it tells us about the model used,  
46  
47 not about the changes in inter-city relations themselves. How can we  
48  
49 ensure that our use of a network model does not predispose our  
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7 empirics towards findings of inter-city stability? We confront this  
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9 problem at two levels.  
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14 First, the network model can and does incorporate 'hierarchical  
15  
16 tendencies' as previously noted. In this paper, we use network  
17  
18 connectivity within the interlocking model (TAYLOR 2001a) to  
19  
20 measure change. This enables both 'horizontal' and 'vertical'  
21  
22 relations to be identified (TAYLOR, CATALANO, WALKER and  
23  
24 HOYLER 2002). There is no equivalent incorporation of anything  
25  
26 other than competitive processes in hierarchy modelling. In addition,  
27  
28 this specification provides the key advantage of providing quantitative  
29  
30 measures of inter-city changes based upon large data matrices;  
31  
32 hierarchical city studies have created no equivalent measurement or  
33  
34 data to assess world city changes.<sup>i</sup>  
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43 Second, we model change in such a way as to allow notions of both  
44  
45 'instability' and 'stability' to be recorded. Since change is ubiquitous  
46  
47 we interpret stability not as an outcome ('no change') but as a  
48  
49 process. This process is change as myriad *small* forces that generate  
50  
51 a normal distribution. Deviations from such a distribution of changes  
52  
53 are interpreted as *large* forces that are distorting the normal pattern.  
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56 The latter are systematic biases in change patterns that can be  
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7 statistically tested and evaluated. They represent forces that are not  
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9 reproducing the normal distribution and therefore can be interpreted  
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11 as reflecting exceptional change in competitive processes. We think  
12  
13 this conceptualising of stability/instability contrast as  
14  
15 normal/exceptional change contrast to be a realistic approach to  
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17 revealing or not revealing a global 'urban roller coaster'.  
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23 This paper builds upon the first phase of interlocking modelling that  
24  
25 produced cross-sectional measurement and analyse of the world city  
26  
27 network for the year 2000 (TAYLOR, CATALANO and WALKER,  
28  
29 2002a, 2002b, 2004a; TAYLOR, CATALANO, WALKER and  
30  
31 HOYLER 2002; DERUDDER, TAYLOR, WITLOX and CATALANO,  
32  
33 2003; TAYLOR, 2004a). These results were derived from a database  
34  
35 of 100 global service firm office networks across 315 cities  
36  
37 worldwide. In the second phase of this research, we have updated  
38  
39 this matrix for 2004 and therefore can measure differences for 2000-  
40  
41 04. Thus the research adds a time dimension to the cross sectional  
42  
43 analyses for 2000. The argument is developed in five sections. First,  
44  
45 we briefly provide a resume of the world city network model, its data  
46  
47 requirements, and the measurement of connectivity. The second  
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49 section describes the problems involved in replicating the 2000 data  
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51 collection exercise for 2004, details the resulting matrices used in  
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7 subsequent analyses, and specifies the way in which we measure  
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9 change. Our results are presented in two ways. In the third section  
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11 we provide an initial introduction to the results through some simple  
12  
13 visualisations. These ‘tasters’ are important for getting a feel for the  
14  
15 data, model, and results before the statistical analyses. Fourth, in the  
16  
17 statistical analysis we identify systematic biases of change away  
18  
19 from normal distribution expectations. In a final conclusion we  
20  
21 interpret our findings in relation to the ‘change/stability’ debate.  
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## 28 **The Inter-Locking Model of Inter-City Relations**

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30 This section summarises detailed description of the model and its  
31  
32 application from earlier publications (TAYLOR 2001a; TAYLOR  
33  
34 2004a). The important point to make is that the measures reported  
35  
36 below are descriptions of a process, the servicing of global capital,  
37  
38 which is modelled as world city network formation by advanced  
39  
40 producer service firms. This is completely different from maps of  
41  
42 infra-structural flows (airlines, internet, etc.) that depict general  
43  
44 network patterns (see, for instance Choi *et al*/2006). This study is  
45  
46 about a specific process (stimulated by Sassen (1991/2001) and  
47  
48 subsequently used by Castells (1996)) and is not, therefore, a  
49  
50 general survey of how cities are faring in globalization.  
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7 To make this paper freestanding the following points need to be  
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9 understood.

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14 • The basic agents of world city network formation are global  
15 service firms with their worldwide office networks
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19 • These firms 'interlock' cities into a network in the course of the  
20 practice of their work to produce the world city network
- 21  
22  
23  
24 • Intra-firm flows of information, knowledge and direction can be  
25 estimated from the size and functions of pairs of city offices
- 26  
27  
28  
29 • In this way relations between cities can be computed as the  
30 sum of many intra-firm estimated flows
- 31  
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33  
34 • Aggregating for individual cities, a measure of that city's  
35 network connectivity – the importance of its location in the  
36 network – can be derived. This is the measure employed  
37 throughout this paper and it can be specified as follows.

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45 A universe of  $m$  advanced producer service firms located in  $n$  cities is  
46 defined. The *service value* of a firm  $j$  in city  $i$  is defined as the  
47 importance of its office in the city within its office network and is  
48 represented by  $v_{ij}$ . An  $n \times m$  array of all service values defines the  
49 service value matrix  $\mathbf{V}$ .

From the service value matrix  $\mathbf{V}$ , a basic relational element is derived as

$$r_{ab,j} = V_{aj} \cdot V_{bj} \quad (1)$$

This is an elemental interlock between city a and city b in terms of firm j. Aggregate city interlock can then be defined as

$$r_{ab} = \sum_j r_{ab,j} \quad (2)$$

Each city could have  $n - 1$  such links i.e. one to all the other cities in the matrix. The overall situational status of each city within the network can thus be defined as:

$$N_a = \sum_i r_{ai} \quad (\text{where } a \neq I) \quad (3)$$

$N_a$  is the global network connectivity for one city a. To ease interpretation ( $N_a$  will vary with size of matrix) the proportion to highest connectivity is defined as:

$$P_a = (N_a / N_h) \quad (4)$$

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7 where  $N_h$  is the highest network connectivity recorded in the network.  
8  
9 This is the measure widely used in the earlier studies for 2000 and  
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11 will initially be employed below. For a more detailed discussion of the  
12  
13 interlocking network model readers are referred to Taylor (2001a;  
14  
15 2004a).  
16  
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21 The data requirements for such an analysis are quite straightforward  
22  
23 (TAYLOR CATALANO and WALKER 2002a; TAYLOR 2004a): the  $m$   
24  
25 firms and  $n$  cities have to be identified and service values allocated  
26  
27 for each firm in each city. In the 2000 data collection 100 global  
28  
29 service firms were selected (18 in accountancy, 15 in advertising, 23  
30  
31 in banking/finance, 11 in insurance, 16 in law, and 17 in management  
32  
33 consultancy) and their office networks identified across 315 cities.  
34  
35 Selection was based upon sector rankings of firms, number and  
36  
37 location of offices, and availability of information on offices. Service  
38  
39 values were derived from information on the size and functions of  
40  
41 offices with scores ranging from 0 for no presence in a city to 5 for  
42  
43 the firm's headquarter city. Typical offices were scored 2, offices  
44  
45 lacking in basic size or function were scored 1, large offices were  
46  
47 scored 3 and offices with special important functions were scored 4.  
48  
49 Most of the information was derived from firm's websites, the result  
50  
51 was vast differences in types of information available and therefore  
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7 service values were allocated on a firm-by-firm basis. The end-result  
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9 was a 100 firms x 315 cities array of service values, thus  
10  
11 operationalising  $V$ , the services values matrix for which the equations  
12  
13 above are given. For a more detailed discussion of this measurement  
14  
15 methodology readers are referred to TAYLOR *et al* (2002a).  
16  
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## 18 19 20 21 **Measuring Global Network Connectivity – Phase II** 22 23

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26 Methods employed in the second phase of the world city network  
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28 research were identical to those used in 2000 to enable direct  
29  
30 comparability of the results. Though the process of data production  
31  
32 and analysis were consistent, a brief overview is given here for the  
33  
34 purpose of highlighting some unavoidable changes.  
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### 38 39 40 ***‘GaWC 100’ to ‘GaWC 80’ – Alterations to the Data Matrix*** 41 42

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45 Since the aim of the project was to compare city connectivities in the  
46  
47 world city network over time, it was necessary to maintain a  
48  
49 consistency in the data structure. Thus new data collection focussed  
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51 only on the original 100 firms and 315 cities. However while the latter  
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53 remained constant, we were unable to exactly replicate the 100 firms.  
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7 Data gathering for the second round of analysis in 2004 was faced  
8  
9 with a specific problem that illustrates the dynamic nature of the  
10  
11 global economy. Of the 100 advanced producer service firms from  
12  
13 2000, 2 firms were liquidated completely, 5 firms had to be deleted  
14  
15 because of mergers with other firms in the data, and 2 firms were  
16  
17 excluded because of the low quality of data on their 2004 web pages.  
18  
19 This resulted in a new list of 91 firms that could be used for  
20  
21 calculating connectivity for 2004. However, even after these  
22  
23 deletions, we were unsure of the comparability of new data with old  
24  
25 data for 11 additional firms. Basically firm reorganization meant that  
26  
27 information available for the two dates was quite different for these  
28  
29 particular firms. Some of these issues were typical of accountancy  
30  
31 firms that are often organised in membership networks: information  
32  
33 on offices of members, which was available in the public domain in  
34  
35 2000, is now only accessible to clients when they are referred by a  
36  
37 centralised contact in the networking organisation. While the issue is  
38  
39 most common in accountancy (6 out of the 11 firms), some  
40  
41 advertising firms and management consultancies also no longer  
42  
43 differentiate among their offices in terms of organisational hierarchy.  
44  
45 Since we wish to be sure that measurement of differences between  
46  
47 2000 and 2004 represent economic geography change rather than  
48  
49 data collection change, a smaller set of 80 firms is identified. It is this  
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7 data set that is used in analyses below; for 2000 connectivities have  
8  
9 been recalculated, for 2004 they are newly calculated.  
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14 Table 1 gives a comparative distribution of firms across sectors for  
15  
16 2000 and 2004. Note that the data changes from 2000 to 2004 have  
17  
18 affected the accountancy sector the most, with number of firms  
19  
20 included in the data almost reduced by a half. However, because  
21  
22 accountancy firms have much larger presence in terms of offices  
23  
24 across the world than other services in our data, it means that, to a  
25  
26 certain extent, the losses of connectivity due to this bias are  
27  
28 reasonably evenly spread out, rather than having a regional pattern.  
29  
30  
31 With respect to other sectors, changes in the matrix may have led to  
32  
33 increased influence of law and management consultancy in dictating  
34  
35 network structures. However, overall we think any bias resulting from  
36  
37 the changes is minimal.  
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#### 44 ***New Calculation of Global Network Connectivity and its Change***

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49 The proportionate measure of global network connectivity ( $P_a$  in  
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51 equation 4) is useful for listing cities in order of connectivity and  
52  
53 comparing ranks, which we do below, but it has severe limitations as  
54  
55 a way of understanding change.  $P_a$  is a closed number system that  
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7 distorts the measurement of change. However much more connected  
8  
9 it becomes, the leading city *cannot* show additional connectivity  
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11 through its  $P_a$  connectivity measure of unity. And, of course, in  
12  
13 ranking lists, the higher the rank the less the ability to make large  
14  
15 leaps in rank: the city ranked 125<sup>th</sup> can jump 20 places, the city  
16  
17 ranked 5<sup>th</sup> cannot. Ranking differences can have only limited utility  
18  
19 for understanding change; below we use them just as a starting point  
20  
21 for the discussion. An additional, alternative way of measuring  
22  
23 change is required.  
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31 Returning to the original measure of connectivity ( $N_a$  in  
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33 equation 3) is a solution but suffers from the inconvenience of the  
34  
35 measures being large numbers that are unwieldy. Because we are  
36  
37 ultimately using deviations from the normal distribution to distinguish  
38  
39 between types of change, it makes sense to use standardised  
40  
41 measures of change. This produces an open number system pivoting  
42  
43 on zero:  $Z_i$ , the standardised changes in city connectivities are  
44  
45 arrayed between -3 and +3. Results presented below will  
46  
47 concentrate on analysis of the measures  $P_a$ ,  $S_a$ , and  $Z_a$ .  
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## Change in the World City Network, 2000-04:

### I Visualizations

With large data sets it is important to understand the data through initial explorations of its patterns. We use elementary visualisations to this end. This approach allows us to literally see the data in various skeletal forms in order to provide some sense of the data.<sup>ii</sup> This will provide suggestions for subsequent statistical analyses and aid in interpreting the statistical results.

We present the visualizations at three levels of cities. First, we look at the *leading* world cities and concentrate on changes in ranking for the top 20 connected cities in 2000 and 2004. Second, we follow the main analyses we previously performed on the 2000 data and identify a roster of *significant* cities with  $P_a$  values of at least 0.2 (in practice one fifth of London's connectivity). A new cartogram showing the worldwide pattern of change is presented. Third, this geographical distribution of significant cities change is followed by discussion of the statistical distribution of *all 315 cities* as portrayed in a change histogram. In this section we elaborate on the normal distribution process and begin the task of searching out systematic biases, winners and losers beyond the normal distribution of change.

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7 As such this section acts as the link between visualizations and the  
8  
9 statistical analyses.  
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### 12 13 ***Change in Ranks among Top 20 Cities***

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15 The easiest method of showing change is to use city ranks in 2000  
16  
17 and 2004. Just such a comparison is illustrated in Figure 1 to provide  
18  
19 a visualisation of the changes in the top 20 world cities. Cities have  
20  
21 been ranked according to their *global network connectivity* in the  
22  
23 world city network, as represented by the 315 cities used in the  
24  
25 study.  
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33 The visualisation gives a very clear picture of change in the top  
34  
35 echelons of the world city network. Noteworthy aspects are:  
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- 37 • There is stability in the top 6 ranks showing that the world city  
38  
39 network is constant as far as the 'big six' cities are concerned –  
40  
41 *London, New York, Hong Kong, Paris, Tokyo and Singapore* have  
42  
43 retained their dominance of the network. In addition they have  
44  
45 retained their positions with respect to each other indicating  
46  
47 constancy in the complex roles they perform in the network.  
48  
49
- 50 • Considerable shuffling of cities has taken place below the ranks  
51  
52 of the 'big six'. The most significant losers are – *Chicago, Milan,*  
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54 *Los Angeles, Sydney, San Francisco and Taipei.* The big gainers  
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7 are – *Toronto, Madrid, Frankfurt, Brussels, Zurich and Buenos*  
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9 *Aires.*

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12 • The patterns that are most obvious in the changes in ranks are –  
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14 loss in position of large U.S. cities with the exception of New  
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16 York, rise of important European capital cities such as Madrid and  
17  
18 Brussels, and the increasing importance of Toronto as compared  
19  
20 to other North American cities. The veracity of such patterns of  
21  
22 change is assessed further for all 315 cities below.  
23  
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25  
26 • Despite these changes there is only two entries/exits to/from the  
27  
28 top 20: the inclusion of Kuala Lumpur and Buenos Aires and the  
29  
30 exclusion of San Francisco and Taipei. The rise of Buenos Aires  
31  
32 might seem unexpected given the financial collapse of the  
33  
34 Argentine economy in 2001, but it should be noted that economic  
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36 difficulties provide an increased market for some producer  
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38 services.  
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45 Clearly Figure 1 displays a mixture of stability and change among the  
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47 leading cities of the world city network; *we conclude tentatively that*  
48  
49 *stability appears the more dominant feature of connectivity among*  
50  
51 *leading world cities.* This is an interesting and suggestive starting  
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53 point – a visual taster of things to come - but it does not begin to do  
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55 full justice to the data we have collected. As an ordinal measure it  
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7 loses information provided by the actual connectivity measures but,  
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9 more important, the figure does not tell us anything below this limited  
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11 number of leading cities. Here we reach the Achilles heel of simple  
12  
13 visualisation: it cannot accommodate large numbers of changes into  
14  
15 a single diagram. But a critical feature of our interlocking model  
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17 approach has always been its incorporation of relatively large  
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19 numbers of 'cities in globalization' rather than just a few select world  
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21 or global cities (TAYLOR 2004a, 42).  
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### ***New Connectivity Cartograms of Significant Cities***

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29  
30 In the 2000 analyses (TAYLOR 2004a), the findings for connectivity  
31  
32 were presented for the 123 cities with the highest connectivities (as  
33  
34 previously mentioned, the cut-off point for inclusion being cities with  
35  
36 at least one fifth of London's connectivity). This number of cities  
37  
38 provided a suitable quantity for depiction on a simple cartogram  
39  
40 (TAYLOR 2004a, 71-2). The resulting diagram of connectivities  
41  
42 (using  $P_a$  from equation 4 above) shows the geography of significant  
43  
44 cities in the world city network for 2000 (TAYLOR 2004a, 73). This  
45  
46 cartogram is reproduced here as Figure 2 for comparative purposes.  
47  
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54 Replicating this methodology for 2004 data produces the geography  
55  
56 of significant cities in the world city network for 2004 (Figure 3). The  
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7 first point to make about this new diagram is that the roster of cities is  
8  
9 different. In 2004 there are only 107 cities in the roster (i.e. with  $P_a$   
10  
11 above 0.2), a net loss of 17. The exit/entry cities are listed in Table 2.  
12  
13 The first column shows the cities dropping out to be largely less  
14  
15 important US and European cities plus minor financial centres  
16  
17 (Hamilton, Panama City, Manama and Nassau); of those outside  
18  
19 these categories the exclusions of Nairobi and Lagos are the most  
20  
21 interesting in that it leaves inter-tropical Africa with no 'significant' city  
22  
23 in 2004 (note another African city, Casablanca, also drops out). The  
24  
25 second column shows the newly 'significant' cities for 2004, the key  
26  
27 features here is the inclusion of four central American capital cities  
28  
29 and two UK cities; outside these categories the inclusion of Osaka is  
30  
31 the most interesting in that this 'second city' (HILL and FUJITA 1995)  
32  
33 of the world's second largest 'national economy' was a surprise  
34  
35 omission from the 2000 roster. But these alterations to the shape of  
36  
37 the cartogram are only the marginal changes around an arbitrary cut-  
38  
39 off level; the prime interest is in comparing the geographies of  
40  
41 connectivity in 2000 (Figure 2) and 2004 (Figure 3). The diagrams  
42  
43 use a quite detailed division of city connectivities (6 levels are  
44  
45 mapped) and yet we find very similar geographies. In all regions,  
46  
47 apart from changes reported in Table 2, geographies are very similar:  
48  
49 it is the same cities with highest connectivities in every part of the  
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7 world. *In conclusion, this comparison of the two cross-sections*  
8  
9 *suggests stability in the geography of connectivities.*  
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13  
14 Acceptance of this finding requires support from actual change  
15  
16 measures. In Figure 4, changes in connectivity for the 123 significant  
17  
18 cities in 2000 using 2004 data are shown for  $Z_a$  (equation 7). The first  
19  
20 point to make about this map is that there is a very mixed  
21  
22 geographical distribution of positive and negative changes. This  
23  
24 supports the stability conclusion above. But there are suggestions of  
25  
26 systematic geographical biases in change. The most obvious is in the  
27  
28 USA where negative change clearly dominates positive change; this  
29  
30 contrasts with Europe where the changes appear to be much more  
31  
32 balanced. However, to fully explore systematic patterns in  
33  
34 connectivity change we need to consider all 315 cities.  
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### 42 ***The Statistical Distribution of Connectivity Change***

43  
44 Depictions of comparison and change among selected major cities  
45  
46 provide many hints about the nature of variation in the world city  
47  
48 network between 2000 and 2004 but full assessment requires use of  
49  
50 all 315 cities in the data sets. Thus we concentrate on the histogram  
51  
52 of 315 connectivity changes ( $Z_i$ ): the prime advantage of such a  
53  
54 large number of changes is that we can explore the statistical  
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7 distribution. Frequencies of city changes are depicted in Figure 5  
8  
9 where the histogram is compared to a normal distribution. Before this  
10  
11 comparison is described we need to indicate the importance of the  
12  
13 normal distribution.  
14

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16  
17  
18 Cities and their inter-relations are very complex phenomena and  
19  
20 there are infinite influences and forces that are forever changing  
21  
22 them. In such a situation where myriad small forces are contributing  
23  
24 to change, both reinforcing and counteracting each other in endlessly  
25  
26 intricate ways, the expected pattern of change measures is a normal  
27  
28 statistical distribution. On the other hand if there are any large  
29  
30 systematic forces influencing change, this will be reflected in  
31  
32 deviations from the normal curve. Here we look for such deviations  
33  
34 as a prelude to statistical testing for systematic forces. Thus we will  
35  
36 treat marked differences from normal as indicating possible major  
37  
38 influences distorting the myriad small forces process. Through  
39  
40 investigation of the distribution we will identify cities associated with  
41  
42 'non-normal' change that will suggest (with previous discussions  
43  
44 above) hypotheses to test in the next section.  
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53 Because we use standardised measures in Figure 5, the mean is  
54  
55 zero and the standard deviation is unity but skewness and kurtosis  
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7 can vary. These are computed as skewness = -0.298 indicating a  
8  
9 modal bias towards negative changes (compared to normal) and  
10  
11 kurtosis as -0.165 indicating leptokurtosis, a bias towards a flat  
12  
13 centre and enlarged tails. However, neither measure is particularly  
14  
15 instructive because the centre of the distribution is bimodal. This  
16  
17 latter feature is, in fact, a gross departure from normal and does  
18  
19 indicate that the myriad small forces model is appreciably distorted  
20  
21 (i.e. there are large forces to be identified).  
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28 Visual inspection of the distribution (Figure 5) suggests the following  
29  
30 elements.  
31

- 32 • The bimodal centre indicating fewer than expected near-zero  
33 changes  
34
- 35 • A three step negative profile starting with an enhanced tail and  
36  
37 progressing to separate 'rectangular' sections  
38  
39
- 40 • A smooth and quite normal profile of positive change but  
41  
42 culminating in a deficiency at the tail.  
43  
44  
45  
46

47 We can interpret the first two patterns as indicating more or less  
48  
49 cities indicating particular important forces affecting negative change.  
50

51 In contrast the third pattern suggests that positive change has not  
52  
53 been the result of any particular forces.<sup>iii</sup> Going back to the original  
54  
55 ranked list of 315 changes we select cities representing the patterns  
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7 described above. Basically we list the sizes of the 314 differences  
8  
9 between ranked cities and identify the large gaps to indicate possible  
10  
11 changes in process.  
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16 Using this method we compile four lists of cities: the 'hole' in the  
17  
18 middle of the distribution, the 'third mode' in the negative profile, and  
19  
20 for comparison, the two tails. The first two lists of cities are shown in  
21  
22 Table 3. The dearth of low positive change (the 'hole') is represented  
23  
24 by the list in the first column. Since this is an example of where  
25  
26 'missing' cities are not found (and they cannot be known), the cities  
27  
28 that are found here should not exhibit any particular pattern. And this  
29  
30 is the case – it would be hard to imagine a more motley collection of  
31  
32 cities! In contrast we can search for a pattern in the second column  
33  
34 which represents an excess of medium negative change. Of course,  
35  
36 we cannot know which are the 'additional cities' in the list above and  
37  
38 beyond what would be normal, but the fact that a third of these cities  
39  
40 are US cities (9 out of 27) does suggest a strong process operating  
41  
42 to the detriment of US connectivity changes, something previously  
43  
44 noted.  
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54 Lists of cities in the two tails are shown in Table 4. We have chosen  
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56 large gaps in the change ranks to find approximately 25 of the most  
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7 negative and positive change cities. The first thing to note is that in  
8  
9 comparing lists the negative changes are larger than the positive  
10  
11 changes through all ranks (e.g. the largest positive change  
12  
13 (Edinburgh's 2.301) is a smaller absolute value than 5<sup>th</sup> largest  
14  
15 negative change (Nairobi's -2.390)). In addition, all large gaps  
16  
17 between ranked cities ( $> 0.04$ ) are indicated and the negative tail list  
18  
19 has more of these (12 compared to 9) and they are generally larger.  
20  
21 This indicates a more 'bumpy' negative tail and is consistent with our  
22  
23 previous recognition of a smoother positive profile through visual  
24  
25 inspection of Figure 5. In terms of patterns of cities the US effect can  
26  
27 be seen again: there are 5 US cities in the negative tail but none in  
28  
29 the positive tail. Otherwise other patterns are hard to discern in the  
30  
31 negative tail: two New Zealand cities and two minor financial centres  
32  
33 are the only pairs of 'like-cities'. Of course, the myriad small forces  
34  
35 model produces 'random' cities in the tails of normal distributions and  
36  
37 Figure 5 shows little excess of cities in the negative. In the positive  
38  
39 tail, Figure 5 actually shows a dearth of cities so we expect no  
40  
41 patterns here. We do, however, have one suggestion – capital cities  
42  
43 seem to be well represented: 13 out of the 24 cities are state  
44  
45 capitals. (Although not state capitals, Edinburgh and Cardiff as newly  
46  
47 devolved UK 'national' capitals do suggest the same advantage for  
48  
49 'political cities'). Otherwise, there are only the odd specific  
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7 suggestions for the high positive change such as Sarajevo and  
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9 Belgrade recovering from the 1990s Balkan wars and Bratislava  
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11 becoming the capital of a new state.  
12  
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14  
15  
16 We have taken visual inspection of change results about as far as we  
17  
18 can. The next step is to convert some of these ideas for statistical  
19  
20 testing.  
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## 24 25 26 **Change in the World City Network, 2000-04: II**

### 27 28 **Statistical Analyses**

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33 Descriptions of changes in rank, geographies of connectivity, and  
34  
35 distributions of connectivity changes have raised a number of  
36  
37 hypotheses about the inherent structure, if any, in the dynamics of  
38  
39 the network of cities being studied here. For example, results from  
40  
41 various comparisons indicate loss of connectivity among American  
42  
43 cities or, in the last section, a tendency for positive change among  
44  
45 capital cities. These and other suggestions are combined with recent  
46  
47 literature that provides hints for change to create hypotheses for  
48  
49 testing. Significant results from the latter are then fed into a multiple  
50  
51 regression analysis to model changes in connectivity and show how  
52  
53 important the systematic distortions are individually and collectively.  
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9 ***Statistical testing of systematic factors producing connectivity***  
10 ***change***  
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16 Four sets of hypotheses are tested:  
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- 18 1. There is a simple *political hypothesis* focusing on state capital  
19 cities. The question we ask is: *are capital cities more likely to*  
20 *experience positive change in connectivity?* Here we are  
21 searching for a systematic political force influencing changing  
22 positions of cities in the world city network as suggested  
23 above. World cities are typically important political cities  
24 (TAYLOR 2005a, 2005b). Capital-city functions are common  
25 in world cities and although there are no political variables in  
26 our definition of the world city network, states are important  
27 markets for advanced producer services (ELMHORN 2001).  
28 Thus capital cities are attractive locations for major service  
29 offices. The reason why we suggest this force may be  
30 changing between 2000 and 2004 is that the world-economy  
31 was less buoyant in the first years of the twenty first century  
32 compared to the final years of the twentieth century and it may  
33 be that states have been picking up the slack in the market  
34 enabling globalization to continue apace.  
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7 2. There are two *concentration/dispersion hypotheses* that relate  
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9 to SASSEN's (1994) emphasis on the simultaneous  
10 concentration and dispersion of activities in economic  
11 globalization.  
12  
13  
14

15  
16 (a) *Has there been a concentration of additional*  
17  
18 *connectivity in the 'global cities'?* We interpret the latter  
19 as the top 25 cities as defined in the 2000 connectivity  
20 analyses (TAYLOR 2004a, 99). If indeed global cities  
21 are a 'new type of city' unique to contemporary  
22 globalization as SASSEN (2001, 4) insists, then we can  
23 suggest that they should be especially prospering with  
24 continuing globalization of the world-economy. There  
25 were initial hints at this in an earlier study of change  
26 (TAYLOR, CATALANO and GANE 2003).  
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39 (b) *Are the secondary cities within countries emerging*  
40  
41 *from the 'shadow' of the prime city in each country?* In  
42 other words, as globalization proceeds, is it extending  
43 beyond the main city in a country to 'second' other  
44 cities previously relatively neglected? For instance,  
45 BEAVERSTOCK *et al* (2000a) have suggested a 'New  
46 York shadow effect' on other US cities. However, the  
47 classic 'second city' case is usually taken to be Osaka  
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7 and its 'Tokyo problem' (HILL and FUJITA 1995) and  
8  
9 we noted above how this city has become appreciably  
10  
11 more connected. More generally, recent literature from  
12  
13 several countries has suggested cities beyond the main  
14  
15 city in a country have been 'catching up' (AGUILAR  
16  
17 1999; IPEA *et al* 2001a; GEYER 2003; LANG 2003;  
18  
19 PARKINSON *et al* 2004; ROSSI and TAYLOR 2006).  
20  
21  
22 The researches reported in these publications each  
23  
24 deal with a particular country; here we investigate  
25  
26 whether this is a more general process.  
27  
28  
29

- 30  
31 3. We have generated *global geographical hypotheses*. In  
32  
33 FRIEDMANN's (1986, 1995) hierarchical allocations, cities in  
34  
35 the semi-periphery are explicitly included suggesting an  
36  
37 important diffusion across the world-economy. This position  
38  
39 has been further developed by SASSEN's (2000, 151), who  
40  
41 asserts that there is a 'new geography of strategic places' that  
42  
43 'cuts across ... the old North-South divide'.  
44  
45

- 46  
47 (a) Thus we begin with original North-South divide as  
48  
49 depicted by the **Brandt Report (INDEPENDENT**  
50  
51 **COMMISSION ON INTERNATIONAL DEVELOPMENT**  
52  
53 **ISSUES 1980)**. *Are cities in the 'South' relatively*  
54  
55 *enhancing their city connectivities?*  
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7 (b) But this 'South' is a quarter of a century old and much  
8  
9 has happened since then, including, of course, the  
10  
11 globalization processes that are our subject. Thus we  
12  
13 define a 'new South' defining 'less developed' regions  
14  
15 as found in 2005 – Pacific Asia is omitted (see Taylor *et*  
16  
17 *al* 2006) and ex-USSR countries beyond the Black Sea  
18  
19 are added (new republics in Caucasian Europe and  
20  
21 Central Asia – see UNDP (2004)). *Are cities in the 'new*  
22  
23 *South' relatively enhancing their city connectivities?*

- 24  
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27  
28 4. We have generated *regional geographical hypotheses*: rather  
29  
30 than reforming the 'South' as a category it is argued that  
31  
32 whatever unity the 'South' category had, it has now splintered  
33  
34 into different regions with different reactions to globalization.  
35  
36 The general hypotheses is: *are there differences in patterns of*  
37  
38 *change based on cities in selected world regions?* This relates  
39  
40 to the basic finding in cross-sectional studies using the GaWC  
41  
42 100 data that globalization through advanced producer service  
43  
44 activity is largely regional in pattern (TAYLOR *et al* 2002b,  
45  
46 2004; TAYLOR 2004a, 2004b; DERRUDDER *et al* 2003). This  
47  
48 relates to globalization as an ongoing set of processes that  
49  
50 are having different outcomes over time and place. Many of  
51  
52 the processes reflected in the data used here have involved  
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7 economic practices developed in the world-economy core (for  
8  
9 instance management consultancy in the USA) and which  
10  
11 have subsequently expanded into other regions at different  
12  
13 levels of penetration. We select important world regions that  
14  
15 have been shown to be distinctive in studies of the data for  
16  
17 2000 (TAYLOR 2004b), 4 from the core zone and 4 from non-  
18  
19 core zones.  
20  
21  
22

- 23  
24 (a) *United States cities*. We know from the 2000 cross-  
25  
26 sectional analyses that these cities are less globally  
27  
28 connected than their European peers (LANG AND  
29  
30 TAYLOR 2004), from evidence above it would seem  
31  
32 that negative changes are increasing this feature.  
33  
34  
35 (b) *Western Europe cities*. The inverse of the above: have  
36  
37 these cities become more globally connected (TAYLOR  
38  
39 and DERUDDER 2005)?  
40  
41  
42 (c) *Pacific Asia cities*. This region has been the  
43  
44 globalization success story: is global integration of its  
45  
46 cities continuing apace (TAYLOR *et al* 2001)?  
47  
48  
49 (d) *East European cities*. We define this category as ex-  
50  
51 COMECON countries east of the Black Sea whose  
52  
53 cities have integrated immensely since 1990: is this  
54  
55 process continuing (TAYLOR and DERUDDER 2005)?  
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7 (e) *Sub-Saharan Africa cities*. The poorest region in the  
8  
9 world, evidence above suggests reduced connectivities  
10  
11 and this was also found in initial analyses of change  
12  
13 (TAYLOR, GANE and CATALANO 2003).  
14

15  
16 (f) *'Greater' Middle East cities*. This region extends from  
17  
18 Mediterranean Africa to Central Asia, traditionally a city-  
19  
20 rich world region, its cities appear not to have  
21  
22 prospered with globalization (TAYLOR 2001c): there  
23  
24 are indications from above that its city connectivities  
25  
26 are beginning to catch up.  
27  
28

29  
30 (g) *Latin America cities*. Indications from above, especially  
31  
32 for Central American cities, suggest increased city  
33  
34 connectivities for this region.  
35  
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37  
38 (h) *South Asia cities*. India appears to be following China's  
39  
40 lead in globalised economic growth: is it reflected in  
41  
42 enhanced city connectivities?  
43  
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47 Each hypothesis is statistically assessed using the simple binomial  
48  
49 test (SIEGEL 1956, 36-42). For every hypothesis there is a set  
50  
51 (sample) of  $n$  cities. These are divided into those that show negative  
52  
53 change and those that show positive change. The test focuses on the  
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55 smaller of these two frequencies,  $s$ . It is known that where the  
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7 negative and positive changes for a population are the same, the  
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9 following expression approximates a normal distribution (p. 41):  
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11

$$z = ((s \pm 0.5) - (n \times 0.5)) / \sqrt{(n \times 0.25)} \quad (6)$$

12  
13  
14  
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16 so that the probability of z occurring in a sample by chance can be  
17  
18 found.<sup>iv</sup> This probability is used to test imbalances between positive  
19  
20 and negative change using the conventional level of 0.05 as the cut-  
21  
22 off level for defining a statistically significant difference.  
23  
24

25  
26 The results of applying this test are shown in Table 5. The table  
27  
28 shows the frequencies of cities recording negative and positive  
29  
30 connectivity change: these columns emphasize that our hypotheses  
31  
32 are about *tendencias* not absolutes: there is no category with all  
33  
34 positive or all negative change. However, of the 13 hypotheses, 7  
35  
36 have probabilities that indicate a significant difference in the balance  
37  
38 between negative and positive change:  
39  
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41

- 42 • Capital cities are more likely to experience positive change  
43 than negative change  
44
- 45 • United States cities are more likely to experience negative  
46 change than positive change  
47
- 48 • Western Europe cities are more likely to experience positive  
49 change than negative change  
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- Pacific Asia cities are more likely to experience positive change than negative change
- Sub-Saharan cities are more likely to experience negative change than positive change
- 'Greater' Middle East cities are more likely to experience positive change than negative change

Note that all but one of the successful hypotheses is a regional sample of cities, confirming the basic regional structure (TAYLOR 2004b) of the world city network; these analyses extend the network structure into patterns of change. All four core regions record significant tendencies with US cities contrasting with cities from the other regions though their overall negative change. Two of four non-core regions record significant tendencies but in different directions: Sub-Saharan Africa cities are generally losing connectivity; Middle East cities are gaining it. In addition, our political hypothesis is confirmed: capital cities are more likely to experience positive change. All this means is that as well as the two other non-core regional hypotheses falling, both the global geographical and concentration/dispersion hypotheses are not supported by our analyses, indicating that Sassen's suggestion of a lessening of the 'North-South divide' through inter-city relations cannot be sustained.

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7 The above analyses provide very basic, and simple, findings in our  
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9 search for systematic forces operating to influence changing city  
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11 connectivities. Of the 7 significant tendencies identified, 5 are for  
12  
13 positive changes. This is counter to our expectations from visual  
14  
15 inspection of the histogram (Figure 5) above from which we predicted  
16  
17 the negative slope would be where the systematic influences were  
18  
19 more likely to be found. This contradiction is resolved in our final,  
20  
21 more sophisticated, analysis.  
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### ***A Multivariate Model of City Connectivity Change***

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33 The binomial statistical tests are a series of bi-variate analyses: they  
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35 involve treating explanatory (independent) variables, the city  
36  
37 categories, as separate influences on city connectivity change.  
38  
39 Furthermore, by using a positive/negative dichotomy to represent the  
40  
41 latter, a vast proportion of the variability in the dependent variable is  
42  
43 simple not taken into account (i.e., for instance, negative values of -  
44  
45 0.01 and -2.01 are treated as equivalent in the binomial testing). A  
46  
47 multivariate regression analysis using 315 standardized change  
48  
49 values ( $Z_a$ ) as dependent variable overcomes both problems.  
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51  
52 However, we do make direct use of the binomial test results: we  
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54  
55 employ just the seven independent variables from the hypotheses  
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7 with statistically significant results. Thus our regression model is  
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9 specified as

$$Z_a = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7) \quad (7)$$

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18 where all independent variables are binary measures:  $x_1$  is capital  
19 city = 1, all other cities = 0;  $x_2$  is US cities = 1, all other cities = 0;  $x_3$  is  
20 Western Europe cities = 1, all other cities = 0;  $x_4$  is Pacific Asia cities  
21 = 1, all other cities = 0;  $x_5$  is Eastern Europe cities = 1, all other cities  
22 = 0;  $x_6$  is sub-Saharan Africa cities = 1, all other cities = 0;  $x_7$  is  
23 'greater' Middle East cities = 1, all other cities = 0. The results of  
24 calibrating this equation as a linear model are shown in Table 6.  
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38 The first point to make about this model is that it confirms the general  
39 binomial finding that there are systematic forces operating on city  
40 connectivity changes: the regression is statistically significant at a  
41 very low probability level. However, the relationship itself is relative  
42 weak; the correlation of under 0.3 translates into only 6% (after  
43 adjustment) of city connectivity changes being accounted for  
44 ('explained') by the independent variables. The corollary is that 94%  
45 of changes remain unaccounted for. This latter can be interpreted as  
46 the myriad small forces of the normal distribution process (non-  
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7 systematic change or 'stability') that dominate Figure 5. Thus the first  
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9 finding from the regression model is that changes in city  
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11 connectivities between 2000 and 2004 are very largely small, non-  
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13 systematic variations indicating a structural stability but that larger  
14  
15 systematic forces are also at work, albeit to minor effect.  
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21 These systematic forces can be assessed using the regression  
22  
23 coefficients of the independent variables (B in Table 6). These  
24  
25 coefficients are gradients of change; they measure the change in the  
26  
27 dependent variable that occurs with a one-unit change in an  
28  
29 independent variable. For binary independent variables, regression  
30  
31 coefficients are particularly easy to interpret. For example, in Table 6  
32  
33 the coefficient of  $-0.1161$  for US cities means that being a US city  
34  
35 reduces standardised connectivity by 0.1161. The first point to note  
36  
37 about these coefficients is that despite selection from significant  
38  
39 binomial results, not all independent variables have significant  
40  
41 coefficients. Both capital cities and Pacific Asian cities have  
42  
43 coefficients that are effectively zero – whether a city is a capital city  
44  
45 or a Pacific Asian city adds or subtracts little or no city connectivity  
46  
47 change. Thus the possibilities of these results happening by chance  
48  
49 are high as represented by their high probabilities. These clear non-  
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51 significant results differ from the binomial findings, why? There are  
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7 two ways this can happen. First, changing the measurement scale of  
8  
9 the dependent variable from binary (positive/negative) to a much  
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11 more precise ratio scale will cause different results – both capital and  
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13 Pacific Asian cities have cities towards the middle of the distribution  
14  
15 where change of measurement scale will have a large effect.  
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19 Second, the regression model is a multivariate technique that  
20  
21 considers all variables simultaneously. This means that they correct  
22  
23 bi-variate significant findings that are caused by the effect of *another*  
24  
25 variable. For instance, in our analyses, the capital cities variable is  
26  
27 inversely related to the US cities variable because only one of the  
28  
29 latter's 44 cities is a national capital (the bi-variate correlation  $r_{12} = -$   
30  
31 0.31, the highest absolute simple correlation in our analyses). With  
32  
33 43 US cities automatically removed from the capital city sample, their  
34  
35 tendency towards negative change helps capital cities to record a  
36  
37 tendency towards positive change. In the multiple regression model,  
38  
39 this co-linearity effect is removed and capital cities lose their  
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41 statistical significance.  
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50 There are another three variables that do not record significant  
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52 regression coefficients but their probabilities are low enough to  
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54 suggest a possible systematic effect. Least likely are Middle East  
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56 cities with a probability of nearly one in five of occurring by chance,  
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7 and Western Europe cities fare only slightly better as a systematic  
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9 effect. East Europe cities are a different case, not quite significant, at  
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11 a one in eight chance the result is clearly suggestive of a specific  
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13 regional force in city connectivity changes. But there are two regional  
14  
15 sets of cities that do meet the significance threshold: US cities and  
16  
17 sub-Saharan cities. Here there is strong evidence that regional forces  
18  
19 are, in both cases, creating a strong propensity for relative loss of  
20  
21 connectivity between 2000 and 2004: as reported above, being a US  
22  
23 city reduces global connectivity change by about 0.12, being a sub-  
24  
25 Saharan African city reduces connectivity change by 0.09. These two  
26  
27 results are intriguing because the two regions represent opposite  
28  
29 ends of the globalization spectrum, one has been the powerhouse  
30  
31 behind global processes, the other has been the region most 'out of  
32  
33 the global loop'. The latter position of sub-Saharan Africa means that  
34  
35 the relative decline of its city's connectivity is not surprising: it has  
36  
37 previously been shown that withdrawal from these city 'outposts' of  
38  
39 global service provision has been a result of a less buoyant world-  
40  
41 economy (TAYLOR, GANE and CATALANO 2003). The US cities  
42  
43 result may therefore appear to be the more surprising but this is not  
44  
45 the case: as previously reported, the global connectivities of US cities  
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47 has not been what might be expected of the largest national  
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49 economy in the world (TAYLOR and LANG 2004). This latter  
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7 example will be considered further below in our final interpretation of  
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9 results.

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14 The key general point to be derived from the regression model is that  
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16 the two significant results are for hypothesized negative changes of  
17  
18 city connectivities. These patterns are so distinctive that their  
19  
20 inclusion in the multivariate analysis eliminates *all* previous  
21  
22 significant positive change results (due to co-linearity with cities in  
23  
24 four regions as well as capital cities). This is consistent with the  
25  
26 interpretation of the frequency distribution of connectivity changes  
27  
28 (Figure 5) where we noted the uneven negative profile as a probable  
29  
30 source of systematic changes. Thus, in this further analysis we have  
31  
32 overturned and completely reversed the majority of significant  
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34 positive change variables resulting from the binomial testing.  
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### 42 ***Summary of the quantitative results***

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44 *Political hypothesis.* There is some evidence for capital cities having  
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46 significantly more positive change (binomial test) but this finding does  
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48 not survive multivariate scrutiny: it is likely a co-linearity effect of US  
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50 cities.  
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7 *Concentration/dispersal hypotheses.* There is no evidence that  
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9 changes in city connectivities are related to these processes.  
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14 *Global geographical hypotheses.* There is no evidence that changes  
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16 in city connectivities are related to these processes.  
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21 *Regional geographical hypotheses.* These eight hypotheses provide  
22  
23 a range of findings. First, there is no evidence at all for systematic  
24  
25 forces making Latin America cities or South Asia cities distinctive in  
26  
27 their connectivity changes. Second, there are cities from 4 regions –  
28  
29 Western Europe, Pacific Asia, East Europe and 'greater' Middle East  
30  
31 - that are found to have significant results suggesting additional  
32  
33 positive changes in the binomial test but these findings do not carry  
34  
35 over into the multivariate model. This leaves two clear instances of  
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37 systematic forces creating relative negative connectivity changes:  
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39 cities in the USA and cities in sub-Saharan Africa.  
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47 Although two systematic forces have been identified, the final  
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49 outcome of this statistical analysis is that well over 90% of the  
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51 variation in city connectivity changes cannot be accounted for in this  
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53 manner. Thus we deduce that the normal process of myriad small  
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7 changes overwhelmingly dominates the way the connectivities of  
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9 cities have changed between 2000 and 2004.  
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## 16 **Conclusion**

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22 This has been a straightforward empirical paper in which we have  
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24 assessed the weakly-evidenced claims of Friedmann and Castells  
25  
26 that inter-city relations at the global scale are very unstable. Using a  
27  
28 conceptually-sound and empirically-rich approach, we have not found  
29  
30 evidence to support their image of an extremely competitive world of  
31  
32 cities. Our initial focus on visualisation suggested normal stability  
33  
34 overall, this was initially challenged by the first detailed statistical  
35  
36 analysis, but the final statistical modelling showed systematic bias in  
37  
38 city connectivity changes in just two regions thus moving us back to  
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40 the overall conclusion supporting the normal stability process. *There*  
41  
42 *was no global 'urban roller coaster' between 2000 and 2004.*  
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51 There are three considerations that should be taken into account  
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53 when discussing this finding. First, there is the question of the  
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55 specifics of the analyses. We have used a particular approach to  
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57 understanding changes in inter-city relations that follows Sassen's  
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7 emphasis on advanced producer services and derives city  
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9 connectivities from the office networks of global service firms.<sup>v</sup> At the  
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11 time of writing this appears to be the only large-scale method  
12  
13 available to assess the stability of worldwide inter-city business  
14  
15 relations.<sup>vi</sup> Other, as yet unknown, methods might produce  
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17 alternative findings. However this would not negate our analysis but it  
18  
19 would require modification of our interpretation. Instead of dismissing  
20  
21 the global urban roller coaster, we would have to begin exploring the  
22  
23 question of under what conditions this phenomenon were to be  
24  
25 found. The challenge to those researchers who hold the extreme city  
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27 competition position is to empirically turn the debate in this direction.  
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35 Second, there is one specific finding that can be used to make  
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37 another important point: the relative decline of US cities in our world  
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39 city connectivity analyses. It must be emphasized that our approach  
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41 is a one-scale method; we have studied connectivities generated by  
42  
43 service firms operating on a global scale. This is just one process  
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45 within the service sector that is itself just one part of wider economic  
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47 processes. Thus relative reduction in global network connectivity in  
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49 our analysis should not be translated simply into general economic  
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51 decline of a city. **The US situation illustrates this argument perfectly.**  
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56 **The key point is that large US producer service firms are in a**  
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7 different market location to firms from other countries. As profit-  
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9 maximising entities, these large US service firms can choose to  
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11 concentrate their investment in servicing the richest national service  
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13 markets in the world and with which they are familiar, or they can  
14  
15 choose to compete for new clients in unfamiliar smaller markets that  
16  
17 constitute the remainder of the world-economy. For many it will make  
18  
19 economic sense not to 'go global' but to continue to thrive in the rich  
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21 domestic market;; in the case of law this is clearly often the case  
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23 (BEAVERSTOCK *et al* 2000b). Hence, our analyses do not indicate  
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25 economic decline of US cities, they are highly successful producer  
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27 service centres but with less of their major firms engaging in global  
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29 servicing (TAYLOR and LANG 2005). New York is the exception to  
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31 this tendency and this is reflected in its bucking the US trend.  
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37 However, this argument certainly does not extend to sub-Saharan  
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39 cities: in all probability, our analyses do provide evidence of general  
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41 economic decline.  
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47 Third, there is the question of timing. If world city network change  
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49 were something as dramatic as a 'global roller coaster', then data  
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51 covering just five years will be enough to reveal it. However, more  
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53 generally we can note that this is a quite short period to measure any  
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55 global social change. Obviously the shorter the period the more likely  
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7 findings are going to show stability. In this case we are contrasting  
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9 two cross-sections generated in different economic contexts: the  
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11 geographical outcome in 2000 of decisions made in the late twentieth  
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13 century economic expansion against the outcome in 2004 resulting  
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15 from decisions made in the more uncertain years of the early twenty  
16  
17 first century (after the dot.com bust, Enron scandal, and collapse of  
18  
19 the Argentinean economy). Given the dearth of other measurement  
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21 of trans-state social change in globalization we have no way of  
22  
23 knowing whether our results can be generalised beyond the four  
24  
25 years we have studied. This paper is just a modest beginning to the  
26  
27 task of monitoring changing relations between cities in a globalising  
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29 world economy. Globalization is not itself an end-condition, it is an  
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31 ongoing process (TAYLOR 2000). Our results should only be  
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33 interpreted in this spirit.  
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## End Notes

<sup>i</sup> The empirical basis of Friedmann's competition findings is

'thumbnail sketches'... drawn from newspaper accounts and

sporadic readings' of the prospects of 17 individual cities .

<sup>ii</sup> For a discussion of visualization relating to earlier work on the world city network see TAYLOR (2001a and b)

<sup>iii</sup> It should be noted that we have used different scales and produced approximately the same shaped histogram: the three features above are most certainly not the product of choice categories in which to count frequencies.

<sup>iv</sup> Where  $n < 25$  a slightly different formula is used but the process is otherwise the same (SIEGAL 1956, 38-9).

<sup>v</sup> The approach has been criticised by ROBINSON (2002; 2005) for this narrow specialization on advanced producer services. SASSEN (2001) clearly shows these activities to be at the cutting edge of contemporary metropolitan economic success. Further, apart from some banks and insurance companies, global service firms are not among the largest capitalist enterprises in the world economy (as shown in, for instance, the "Fortune 500") but they can be reasonably interpreted as 'indicator enterprises'. By analogy with 'indicator species' in ecology, they are not dominant in quantitative terms but

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indicator firms do signify a successful, healthy capitalist city economy.

<sup>vi</sup> **As pointed out previously**, there are, of course, literatures on infrastructural links between cities that show changing inter-city relations. In particular airline passenger flows have been analysed to show changes over time. However, as often pointed out, these flows are general connections covering much more than business links. In addition they are typically 'hubbed' creating distortions relating to airline policies, both commercial and political. The work at Ghent using actual origin-destination flows of passengers overcomes the latter difficulty but the data are for part of one year only (2001) so that changes cannot be studied (DERUDDER and WITLOX 2005a, 2005b).

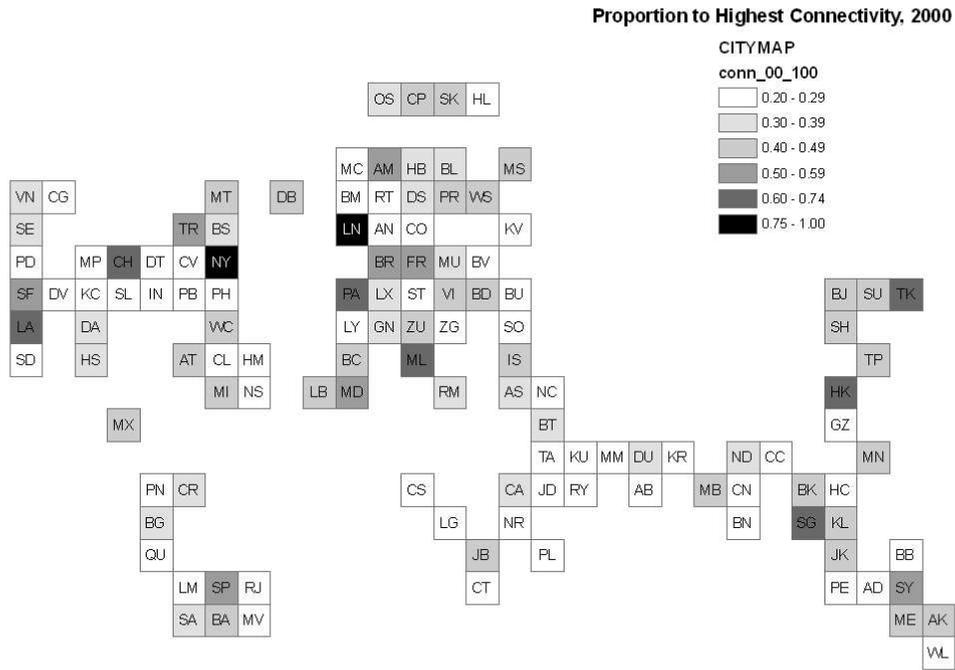
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**Figure 1: Change in Ranks 2000-04**

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.



Figure 2: Cartogram of Connectivity for GaWC 100, 2000



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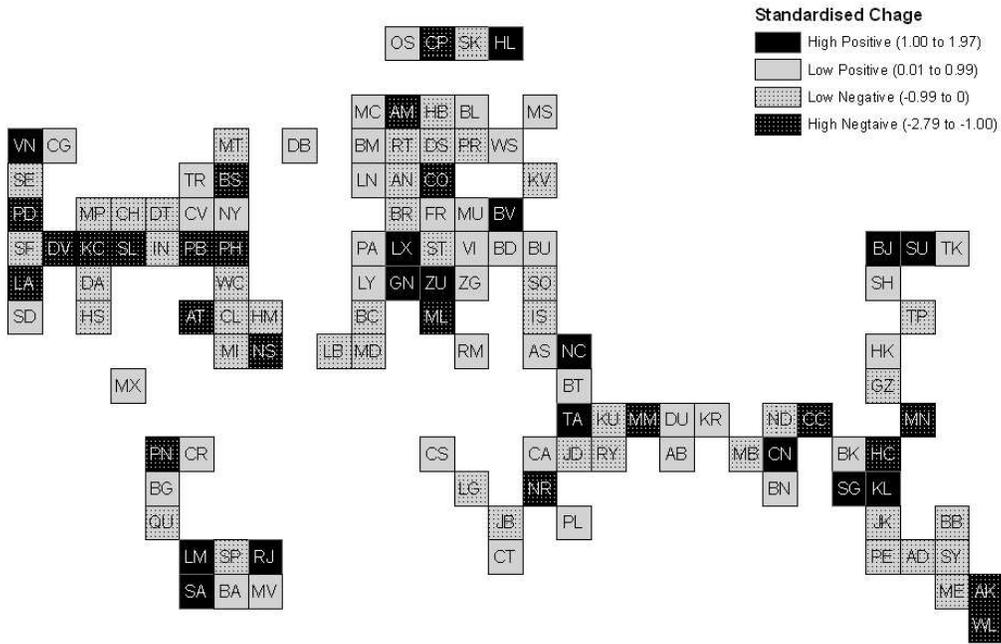
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**Figure 3: Cartogram of Connectivity for 2004**

For Peer Review Only

QuickTime™ and a  
Photo - JPEG decompressor  
are needed to see this picture.

Figure 4 : Cartogram of Standardised Change for 123 cities

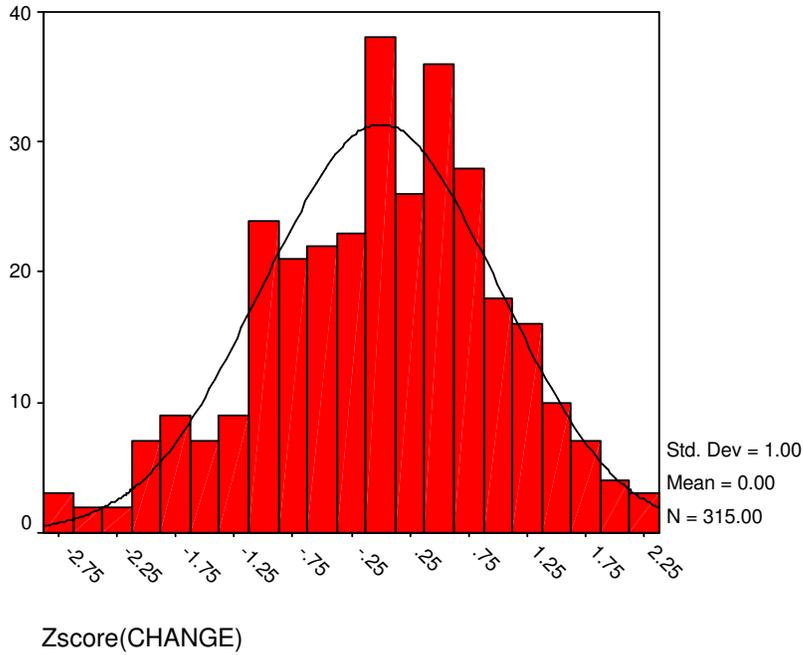


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Figure 5: Distribution of Standardised Change



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3 **Table 1 Comparative distribution of firms across sectors in 2000 and 2004**  
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Sector	2000 data	2004 data
	'GaWC 100'	'GaWC 80'
Accountancy	18	10
Advertising	15	11
Banking	23	18
Insurance	11	10
Law	16	16
Management Cons.	17	15

**Table 2 Changes between 2000 and 2004 for the Roster of 'Significant' Cities ( $P_a > 0.2$ )**

23 cities in 2000 roster but not 2004	7 cities in 2004 roster but not 2000
Adelaide Antwerp Calcutta Casablanca Charlotte Cologne Hamilton Indianapolis Kansas City Kiev Kuwait Lagos Lyon Manama Nairobi Nassau Panama City Pittsburgh Portland St Louis Sofia Wellington Zagreb	Bristol Edinburgh Guatemala City Osaka Quito San Jose (CR) San Salvador

Table 3 Selected City Lists Illustrating Particular Features of Figure 5

The 'hole' in the middle		The third mode	
City List*	Change	City List**	Change
Bogota	-0.327	San Francisco	-0.870
Cincinnati	-0.326	Recife	-0.878
Aberdeen	-0.325	Seattle	-0.885
Ahmadabad	-0.324	Mumbai	-0.894
Lyon	-0.320	Detroit	-0.907
Dublin	-0.306	Montreal	-0.919
Kobe	-0.305	Gothenburg	-0.929
Paris	-0.303	Taipei	-0.933
Labuan	-0.300	Sydney	-0.934
Trieste	-0.294	Windhoek	-0.976
Casablanca	-0.292	Antwerp	-0.981
Basel	-0.292	Prague	-0.981
Minsk	-0.273	Hartford	-0.983
Reykjavik	-0.265	Addis Ababa	-1.012
Yokohama	-0.262	Pittsburgh	-1.018
Yerevan	-0.259	Philadelphia	-1.024
		Quebec	-1.031
		Amsterdam	-1.037
		St Petersburg	-1.039
		Atlanta	-1.073
		Bilbao	-1.108
		Boston	-1.113
		Hanoi	-1.115
		Bulawayo	-1.121
		Milan	-1.124
		Columbus	-1.143
		Dortmund	-1.148

\* gap between *Omaha* and Bogota = 0.060

gap between Yerevan and *Strasbourg* = 0.047

\*\* gap between *Rabat* and San Francisco = 0.056

gap between Dortmund and *Bonn* = 0.088

Table 4 Lists of Cities in the Two Tails of Figure 5

The negative tail		The positive tail	
City List*	Change	City List**	Change
St Louis***	<u>-2.786</u>	Edinburgh	<u>2.301</u>
Manila	-2.674	Sanaa	<u>2.246</u>
Copenhagen	-2.642	Bristol	<u>2.159</u>
Bandor SB	<u>-2.590</u>	Luxembourg	1.975
Nairobi	<u>-2.390</u>	Guatemala City	<u>1.974</u>
Manama	<u>-2.267</u>	Cardiff	1.895
Abijan	<u>-2.175</u>	Sarajevo	1.882
Auckland	-2.101	Brazilia	1.851
Calcutta	<u>-2.095</u>	Malmo	<u>1.811</u>
Palo Alto	-2.044	Jerusalem	<u>1.762</u>
Asuncion	-2.009	Bratislava	1.702
Winnipeg	-1.967	Tijuana	1.677
Dhaka	<u>-1.954</u>	Guadalajara	1.657
Wellington	<u>-1.893</u>	Belgrade	1.634
Nuremberg	<u>-1.837</u>	Lima	1.588
Monterrey	-1.752	Tel Aviv	1.577
Ho Chi Minh City	<u>-1.751</u>	Krakow	1.577
Cologne	-1.691	San Salvador	<u>1.560</u>
Los Angeles	-1.679	Lille	1.511
Ruwi	-1.665	Geneva	1.499
Kansas City	-1.657	Kuala Lumpur	1.484
Denver	-1.642	Santiago	<u>1.469</u>
Panama City	<u>-1.638</u>	Gaborone	1.411
		Macau	<u>1.383</u>

\* gap between *Harare* and Panama City = 0.082

\*\* gap between *Macau* and Zurich = 0.056

\*\*\* all changes underlined are large gaps (> 0.04)

**Table 5 Binomial tests**

Hypotheses	Negative Change	Positive Change	Total	P value from one tailed Binomial Test
1. Capital cities	53	73	126	<i>0.0021</i>
2a. Global cities	14	11	25	0.345
2b. Secondary cities	94	95	189	0.4443
3a. Brundtland South cities	66	73	139	0.2514
3b. 'New' South cities	54	59	113	0.4602
4a. United States cities	31	13	44	<i>0.0021</i>
4b. Western Europe cities	34	53	87	<i>0.0162</i>
4c. Pacific Asia cities	14	23	37	<i>0.0505</i>
4d. East Europe cities	5	15	20	<i>0.021</i>
4e. Sub-Saharan Africa cities	20	10	30	<i>0.0228</i>
4f. 'Greater' Middle East cities	12	22	34	<i>0.0301</i>
4g. Latin America cities	17	22	39	0.2611
4h. South Asia cities	8	7	15	0.500

**Table 6 Multiple Regression Model**

General model summary		Regression coefficients		
		Variables	B	Prob.
Correlation (R)	0.2856	x <sub>1</sub> - Capital cities	-0.0172	0.5526
Determination (R <sup>2</sup> )	0.0816	x <sub>2</sub> - United States cities	-0.1161	0.0068
Adjusted R <sup>2</sup>	0.0606	x <sub>3</sub> - Western Europe cities	+0.0495	0.1504
Probability	0.0004	x <sub>4</sub> - Pacific Asia cities	+0.0078	0.8574
(Base constant)	0.0047	x <sub>5</sub> - Eastern Europe cities	+0.0977	0.0795
		x <sub>6</sub> - Sub-Saharan African cities	-0.0899	0.0503
		x <sub>7</sub> - 'Greater' Middle East cities	+0.0569	0.1971

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Ranks in 2000		Ranks in 2004
1. LONDON	↔	1. LONDON
2. NEW YORK	↔	2. NEW YORK
3. HONG KONG	↔	3. HONG KONG
4. PARIS	↔	4. PARIS
5. TOKYO	↔	5. TOKYO
6. SINGAPORE	↔	6. SINGAPORE
7. CHICAGO	→	7. TORONTO
8. MILAN	→	8. CHICAGO
9. LOS ANGELES	→	9. MADRID
10. TORONTO	→	10. FRANKFURT
11. MADRID	→	11. MILAN
12. AMSTERDAM	↔	12. AMSTERDAM
13. SYDNEY	→	13. BRUSSELS
14. FRANKFURT	→	14. SAO PAULO
15. BRUSSELS	→	15. LOS ANGELES
16. SAO PAULO	→	16. ZURICH
17. SAN FRANCISCO	→	17. SYDNEY
18. MEXICO CITY	↔	18. MEXICO CITY
19. ZURICH	→	19. KUALA LUMPUR
20. TAIPEI	→	20. BUENOS AIRES

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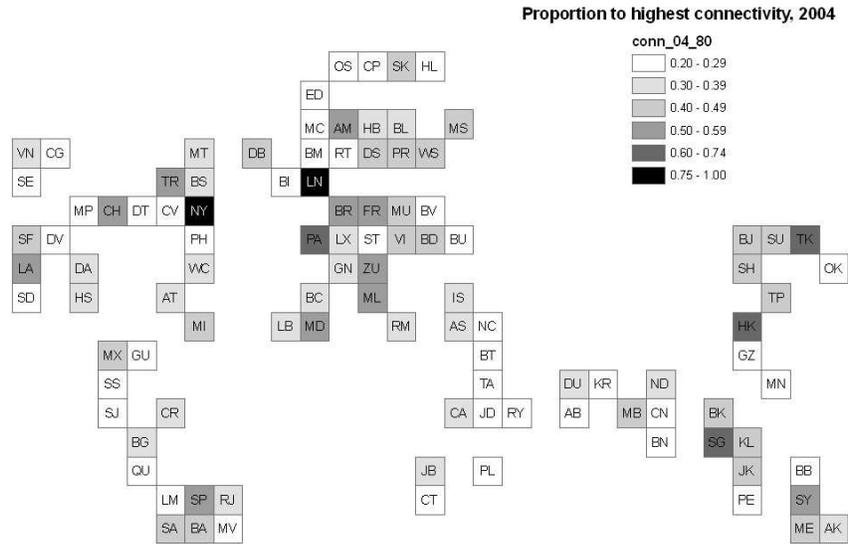
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