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Extensive and intensive globalizations: explicating the low connectivity puzzle of US cities using a city-dyad analysis

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Abstract

The paper reports on an unusual principal components analysis of 27,966 city-dyads across five advanced producer service sectors. A two-component solution is found that identifies two types of globalization: extensive and intensive. The latter is characterised by very high component scores and describes the more important city-dyads focused upon London-New York (NYLON). The extensive globalization component heavily features London and New York but with each linked to less important cities. US cities score relatively high on this component and we use this finding to explain the low connectivities of US cities in previous studies of the world city network. The two components are tentatively interpreted in world-systems terms: intensive globalization is the process of core-making through city-dyads; extensive globalization is the process of linking core with non-core through city-dyads.

Key words

city-dyads, globalization, US cities, world city network

Introduction: an exploratory surprise

Serendipity. This is an important factor in all research but we do not like to talk about it as such. We will make an exception here because this paper reports two important findings that were made by chance. That is to say, we were experimenting with different ways we might analyse a data matrix and one of those ways produced unexpected interesting results. One result produced a new finding at a general level and the other, more specifically, solved a puzzle that had been eluding proper explanation for a decade. The point is that the analysis was not set in train to address either the general or the specific topics

that emerged. Hence this paper is based upon luck plus a little nous to spot the importance of what a new analysis happened to generate.

The prime data matrix in question is the Globalization and World Cities (GaWC) data, collected jointly with the Chinese Academy of Social Sciences (CASS) for 2008, that describe the office networks of 175 advanced producer service firms across 525 cities worldwide (Derudder et al 2010; Taylor et al 2011). The largest firms in the following sectors are included: the top 75 in financial services, and the top 25 each in accountancy, advertising, law and management consultancy. For each firm, its use of a city is coded from 0 (no presence) to 5 (for the city housing its headquarters) with scores of 1 through to 4 based upon size and functions of offices. The result is a 'service values matrix' that arrays 525 cities against 175 firms that defines the world city network (Taylor 2001, 2004). This exercise has been carried out on two previous occasions, 2000 and 2004; the methodology is further described in Taylor et al (2002a).

The working data matrix we have used is a reduced version of the above. This is because the matrix becomes very sparse (excessive zeros) with less important cities, and we know results are less robust the further down the connectivity ranking we go (Liu and Taylor 2010). We decided to limit the cities to those recording a global network connectivity of 0.10 and above. These connectivities are the chief result derived from the service values matrix and they measure the density of a city's connections within the world city network (Taylor 2001, 2004). They are usually presented as proportions

of the highest connectivity measure in the analysis (in this case London's); thus a value of 0.10 indicates just 10% of London's connectivity. There are 237 cities that meet this threshold and therefore the revised service values matrix that we start with is 237 cities x 175 firms. The analysis we employ is principal components analysis (PCA), a technique we have used previously to good effect (Taylor et al 2002b, Taylor 2011a). This is generally used as a data reduction technique; here we use it in a more exploratory mode.

We have produced a completely new form of principal components analysis (PCA) investigation that we term city-dyad analysis. This is described in the first section below in which the results reveal two distinctive forms of globalization that we label extensive and intensive. In the second section we delve further into these two globalization processes to locate the whereabouts of US cities. These cities have been found to be relatively 'under-connected' in all previous GaWC analyses (e.g. Taylor and Lang 2005): this is the puzzle referred to in our paper's subtitle. The distribution of US cities between the two different globalization components goes a long way to solving this puzzle. This double pay-off from our serendipity is considered in a concluding discussion of the inter-city power relations that may have been revealed.

Excavation of two globalizations

In the process of exploring our data we constructed a new and unusual matrix. Both objects (cities) and variables (firms) were re-specified. First, the

237 cities were replaced by all possible pairings of the cities resulting in 27,966 dyads. The justification for this move was that we are pre-eminently concerned for relations between cities and therefore substituting dyads for single cities seemed an interesting idea. For each city-dyad the connectivity between the cities can be computed from the service values matrix as the sum of the products of firms' service values in each pair of cities. The top ten city-dyads in terms of this measurement are shown in Table 1 for illustrative purposes. Note that London-New York, the only dyad with its own name – NYLON, is by far the most connected city-dyad. Note also that all the other nine city-dyads include either London or New York in each pairing: this further underlines the dominance of these two cities within the world city network. The other cities paired off with these two include all the most likely suspects – Hong Kong, Paris, Singapore, Tokyo – plus, interestingly, Shanghai.

This new definition of objects could have produced a 27,966 city-dyads x 175 firms matrix for analysis where each cell was created as the product of each pair of cities' service values. But this was not done because the problems of matrix sparsity and robustness arise again with such a large matrix. Therefore, for the second re-specification firms were replaced by their sectors to produce a 27,966 city-dyads x 5 sectors matrix. This was achieved by disaggregating the city-dyad connectivities by sectors. Again for illustration, the results for the top ten dyads are shown in Table 2. As expected NYLON has the highest connectivity for every sector but the degree of ascendancy varies greatly: in law it is very large which contrasts with advertising where it all but disappears. It is these differences across sectors in the 27,966 x 5

matrix that are the variability we explore through a principal components analysis.

It is clear now that with a 27,966 x 5 matrix we are not in the business of using PCA for a multivariate data reduction since we start with only five variables (the sectors). Nevertheless this long, slim matrix can be analysed to produce principal components but with just five variables there are only five components to be extracted. However, as in all PCAs, these are ordered in terms of the amount of variation in the matrix they encompass. In order to aid in selecting the number of components to study, a varimax rotation was undertaken to concentrate the variance in as few components as possible. In this case the first two components accounted for 83.41% of the total variance. This variance was split 46.50% to 36.91% between Components I and II respectively. These two components are the subject matter of the rest of this paper.

The usual way of interpreting and labelling components is through component loadings on the variables. These are shown in Table 3. Among the ten loadings there are three particularly large ones: accountancy and advertising on Component I, and law on Component II. Thus if we were to label by variables then Component I would be “accountancy-advertising” and Component II would be “law”. However the other two sectors split more evenly between the components but with financial services higher on I, and management consultancy on II. It is not at all clear what these further loadings are showing us; perhaps this focus on loadings is not best suited for

interpretation and labelling in this case, given that they provide only ten items of evidence.

With the focus on scores, we might expect the components to exhibit different geographies leading to simple geographical labels. But this is not the case here; the geography that emerges is a complex interweaving across continents. In Table 4 the top twenty (out of 27,966) city-dyads are ranked by their scores for each component. These two lists show two clear differences: in the mix of dyads and the actual magnitude of the scores themselves. Starting with the first difference, it can be noted that NYLON is first ranked for Component II. But this does not extend to London and New York dyads with other cities being concentrated on this component: there is little difference in the number of city-dyads including London and/or New York across the two components - 16 for Component I, 18 for Component II. The difference is therefore in the partners of the two leading cities. And the first point to note here is that eight of the top ten dyads from Table 1 are listed under Component II, with none under Component I. But Component II is not a simple mix of the most highly connected city-dyads: dyads featuring two new cities, Frankfurt and Washington are prominent. In fact both components include numerous Asian and European cities but with clear differences. In Asia there is a simple political divide: Component II includes cities from China and Japan, Component I has cities from other Asian countries. In Europe, Component II features more important cities – as well as London, Paris and Frankfurt, Moscow and Brussels appear - whereas Component I has Athens, Dublin, and Istanbul. If we consider the latter three as European examples of

what were, in 2008, widely viewed as recently emerging economies, then these components can be said to represent cities in emerging economies (Component I) and cities in established economies (Component II). But there is a glaring exception to this dichotomy: the Chinese cities in Component II are from the most recent of emerging economies. The labelling is not quite right yet.

Turning to the differences in the magnitude of the scores the first point to make is that all the scores listed in Table 4 are large in comparison to most principal components analyses. Scores are reported as standardised variables (mean = 0, standard deviation = 1) and are usually concentrated in the range +/- 2. But in this analysis we have 27,966 scores (one for each dyad) so that at the extremes (i.e. Table 4) we can expect some quite large values such as those reported for Component I. But the scores for Component II are another matter altogether. These exceptionally large values are measuring an unusual patterning of variables (dyads) constituting a component; they indicate a very intensive concentration of variance within the analysed matrix. Of course, since both components have a mean of zero, Component II's large scores must be compensated by lower scores than Component I in much of the remainder of the whole set of 27,966 scores. The point where the distribution of scores in the two components cross over is shown in Figure 1: it is at rank 278 with scores just above 3.7. It is the 'take-off' of the Component II graph from this point that defines the very distinctive intensity of the component.

It is this peculiar nature of Component II that has led us to label the components extensive and intensive globalization respectively. We can illustrate this further in Table 5, which features all cities in the top 75 dyads of both components. The interweaving and separation of their geographies derived from Table 4 is embellished here. First we can note that Component I – extensive globalization - has more cities (29) compared to Component II (22) and with a broader geographical spread – more Latin American cities with both the Middle East and sub-Saharan Africa now represented. The additional cities in Table 5 for Component II – intensive globalization – are merely additions in places already covered in Table 4 (i.e. Europe and the USA). Thus we have excavated two distinctive globalizations in our analysis – extensive globalization and intensive globalization.

The majority of cities listed in Table 5 are identified with just one of either extensive or intensive globalization. However, London and New York in particular, and seven other cities appear in both lists. Three of these are Chinese cities – Beijing, Hong Kong and Shanghai. Hong Kong is not a surprise since it is the city closest to London and New York in terms of overall connectivity (Taylor 2011a), but inclusion of Beijing and Shanghai in this select group is intriguing. Especially since the other Chinese city featured in Table 5, Taipei, is restricted to just extensive globalization. We can interpret London and New York along with the other established world/global cities – Hong Kong, Paris, Tokyo, Singapore and Milan – as acting as a hinge or conduit between extensive and intensive globalizations. It seems that alone among cities of emerging economies; Beijing and Shanghai are carving out

such a role for themselves. We have had a premonition of this happening: in analysis of GaWC 2004 data Taylor (2006a) found Beijing and Shanghai in a class of their own linking together groups of more and less important cities. This suggests Beijing and Shanghai are embarked on a distinctive path, perhaps leading towards an alternative to NYLON in articulating the world city network between extensive and intensive globalizations.

A solution to the low connectivity puzzle of US cities

Having excavated these two globalizations we have found that they can be used to help solve an enduring puzzle in our world city network analyses: the relatively low connectivities of US cities, excepting New York. This was first noted by Taylor and Lang (2005) in their study of US cities in the world city network based upon GaWC 2000 data. Their second finding was that 'US cities overall – and particularly non-coastal cities – are generally less globally connected than their European Union and Pacific Asian counterparts' (p. 1). This difference has been shown to have increased over time in analyses of GaWC 2004 data (Taylor and Aranya 2008) and GaWC 2008 data (Derudder et al 2010; Taylor 2011a). And this appears to be only a feature of GaWC analyses: other global analyses of inter-city relations generally show a much more important role for US cities than we find: see for example, Alderson and Beckfield (2004) using corporate headquarters and branches (factories, offices, etc.), Smith and Timberlake (2001) on global air travel links, and Malecki (2002) on the Internet's infrastructure. There have been theoretical

and quantitative comparisons between these different worldwide networks (e.g. Taylor et al 2007; Pereira and Derudder 2010; Taylor 2006b) but the question still remains: why does analysis of advanced producer service firms' office networks 'undervalue' US cities compared to these other analyses?

To answer this question, another, closely related finding has been brought into the argument. If just connections to 'local' cities are considered (e.g. US city relations to other US cities; EU city relations to other EU cities), it is found that US cities are exceptionally 'local' compared to cities in other regions or countries (Taylor and Lang 2005, 9) and this was especially so in 2008 (Taylor 2011b, 333-4). Therefore it follows that the USA appears to be operating as a distinctive market for advanced producer services within the wider world market. Taylor and Lang (2005, 11) give two reasons for this: a 'shadow effect' caused by many non-US service firms only locating in New York, and a 'comfort effect' caused by many US service firms not wanting to leave their large 'home market' for foreign risky investments. This has been most recently depicted as a case of American exceptionalism within the world city network (Vinciguerra et al 2010). But all these findings and interpretations have been predicated on analyses with single cities as objects, not city-dyads. Our new analysis casts fresh light on the US city connectivities puzzle.

In the intensive globalization list of city-dyads in Table 5, New York is not alone as a US city: Chicago, and especially Washington feature. We can explore this further by searching out more US cities. Conventionally in principal components analysis, the researcher focuses on scores above 1.0.

However, in this analysis, because of the size of the matrix, there are large numbers of objects with scores above this threshold: 3,686 such city-dyads for extensive globalization and 1329 city-dyads for intensive globalization. Note that this large difference in numbers does support our labelling of the two components: by this definition Component I is nearly three times more 'extensive' than Component II. We have located all US cities in the 1329 city-dyads above 1.0 in Component II. To provide equity in comparison, we have used the same number of city-dyads for searching out US cities in Component I. The results are shown in Table 6 and the contrast is clear to see. To begin with there are many more US cities in intensive globalization (27) than in extensive globalization (5). And this translates into membership of many more city-dyads: 799 to 120. There is a suggestion of North Atlantic bias to US in intensive globalization, notably Washington, Boston and Philadelphia are in the top six but none feature in extensive globalization. More generally we conclude that although US cities do not dominate Component II (see Table 4), this component does dominate US cities. This is a fascinating finding for understanding American exceptionalism in the world city network.

We suggest the following argument provides a solution to the US cities' low connectivities puzzle.

1. In terms of cities in globalization there are two main processes generating the world city network.
2. US cities are largely part of the second process, intensive globalization, and, with the exception of New York, do not feature much in extensive globalization.

3. But measures of global network connectivity do not recognise the two processes; this measure combines the outcomes of both processes.
4. However, unlike the principal components analysis where each sector as a variable is equally weighted, in measuring connectivities the contribution of a sector depends on the overall number of offices (and their weightings) in that sector.
5. Accountancy and advertising firms have far more offices across the world than law firms.
6. Therefore, because accountancy and advertising sectors are the main creators of extensive globalization and the law sector is the main creator of intensive globalization, it is the former globalization that is largely represented in global network connectivity measures.
7. Hence because US cities are particularly strong on intensive globalization, overall they do not figure prominently in global network connectivities.

This argument does not negate previous explanations, indeed it might encompass them, but it does specify a new logic based upon the new knowledge that is the excavation of extensive and intensive globalizations.

Conclusion: interpreting a bonus

Findings based upon luck are a bonus for any research project. We have used it to solve an enduring puzzle in our past researches but the result has broader implications than explicating US cities. Uncovering two processes

where we had previously assumed one opens up possibilities of fresh thinking. Consider, for instance, the implications of one geography of cities in globalization being replaced by two geographies of city-dyads in globalization. The prior notion of three main 'globalization arenas' – Northern America (mainly USA), Europe (mainly EU) and Pacific Asia – has to be rethought. The two globalization processes are to be found in each region but in quite distinctive ways. The intensive globalization is predicated upon NYLON and encompasses more important city-dyads than extensive globalization, but the latter compensates by being dominant beyond the key globalization arenas. The most difficult feature of this dyad geography is the dual roles of London and New York. These cities dominate both geographies but in different ways: as London with New York (NYLON) in opposition to London and New York (perhaps even London versus New York). There are two processes operating through the 'global twin-cities' and this should be sought after using other qualitative research strategies: it seems advanced producer service firms use city-dyads differently.

Without the latter follow-up research, we can only speculate what this finding of two globalizations through city-dyads actually means. However their distinctive natures as extensive and intensive, and with the latter centred on NYLON, both suggest power differentials operating within the world city network. Thus we might identify intensive globalization, in world-systems analysis terms, as a strong core-making process, and extensive globalization as integrating core processes with non-core processes (semi-peripheral cities and periphery beyond). Core-periphery models are often criticised for being

overtly simple; this new interpretation surely reveals the complexity of the core-periphery structure of the world-economy through city-dyads.

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Table 1 The top ten city-dyads, 2008

City-dyads	Dyad connectivity
London-New York	1731
Hong Kong-London	1390
Hong Kong-New York	1372
New York-Paris	1363
London-Paris	1356
New York-Tokyo	1237
London-Singapore	1234
New York-Singapore	1219
London-Tokyo	1193
London-Shanghai	1132

Table 2 Disaggregation of top ten city-dyad connectivities by sectors

City-dyad	Accountancy	Advertising	Financial services	Law	Management consultancy
London-New York	344	296	547	326	218
Hong Kong-London	336	212	540	186	116
Hong Kong-New York	254	281	486	169	182
New York-Paris	239	295	407	221	201
London-Paris	306	217	424	255	154
New York-Tokyo	206	282	448	135	166
London-Singapore	317	204	470	102	141
New York-Singapore	240	270	428	90	191
London-Tokyo	263	214	451	144	121
London-Shanghai	283	183	426	126	114

Table 3 Component loadings on service sectors

Service sector	Component I	Component II
Accountancy	0.894	0.241
Advertising	0.893	0.256
Financial Services	0.691	0.597
Law	0.161	0.911
Management Accountancy	0.473	0.732

Table 4 Top twenty scores for each component

City-dyad	Component I scores	City-dyad	Component II scores
London-Seoul	7.34	London-New York	35.96
New York-Seoul	7.11	London-Paris	27.46
London-Mumbai	7.10	New York-Paris	25.29
Kuala Lumpur-London	6.83	Frankfurt-London	22.76
Buenos Aires-New York	6.79	New York-Washington	22.31
Buenos Aires-London	6.72	Frankfurt-New York	21.59
Hong Kong-Seoul	6.66	Hong Kong-New York	20.01
Mumbai-New York	6.63	Hong Kong-London	19.95
London-Sydney	6.57	London-Washington	17.65
Dublin-London	6.43	Brussels-London	16.69
Kuala Lumpur-New York	6.38	New York-Tokyo	16.38
London-Toronto	6.36	London-Tokyo	16.08
Athens-New York	6.36	Beijing-New York	15.73
New York-Toronto	6.28	Beijing-London	15.58
Seoul-Tokyo	6.02	Frankfurt-Paris	15.42
Istanbul-New York	6.00	Hong Kong-Paris	14.48
Seoul-Singapore	5.97	London-Moscow	14.33
Hong Kong-Mumbai	5.96	London-Shanghai	14.09
Athens-London	5.91	Moscow-New York	13.60
Dublin-New York	5.91	Brussels-New York	13.48

Table 5 Leading cities in the two globalizations

Factor 1: Extensive Globalization			Factor 2: Intensive Globalization		
Rank	City	Frequency	Rank	City	Frequency
1	New York	17	1	London	17
2	London	15	2	New York	16
3=	Hong Kong	8	3	Paris	11
3=	**Seoul**	8	4	**Frankfurt**	9
5	Singapore	6	5	Hong Kong	7
6=	**Mumbai**	5	6=	Tokyo	5
6=	**Sydney**	5	6=	**Washington**	5
8=	**Buenos Aires**	4	8=	**Beijing**	4
8=	**Kuala Lumpur**	4	8=	**Brussels**	4
10=	**Taipei**	3	8=	**Munich**	4
10=	**Toronto**	3	11=	**Moscow**	3
12=	**Athens**	2	11=	Shanghai	3
12=	**Dublin**	2	13=	**Chicago**	2
12=	**Istanbul**	2	13=	**Madrid**	2
12=	**Jakarta**	2	13=	**Milan**	2
12=	**Johannesburg**	2	13=	Singapore	2
12=	**Lisbon**	2	13=	**Dusseldorf**	2
12=	**Mexico City**	2	18=	**Amsterdam**	1
12=	Paris	2	18=	**Los Angeles**	1
12=	**Tel Aviv**	2			
21=	**Jeddah**	1			
21=	Shanghai	1			
21=	Tokyo	1			
21=	**Zurich**	1			

Frequencies refer to the number of top 50 dyads a city belongs to. Cities located in only one list are emboldened

Table 6 US cities in the two globalizations

Extensive Globalization		Intensive Globalization	
US Cities	Frequency	US Cities	Frequency
New York	78	New York	96
Chicago	25	Chicago	80
Atlanta	8	Washington	73
Los Angeles	5	Boston	48
San Francisco	4	Dallas	47
		Philadelphia	47
		Los Angeles	46
		Houston	44
		Atlanta	40
		San Diego	40
		San Francisco	40
		Baltimore	28
		Miami	27
		Cleveland	26
		Seattle	23
		Columbus	19
		Minneapolis	18
		Tampa	14
		Pittsburgh	12
		Detroit	9
		Austin	8
		Charlotte	6
		Phoenix	4
		Hartford	1
		Indianapolis	1
		Milwaukee	1
		Portland	1

The frequencies are the number of dyads a city belongs to amongst the top 1329 components scores in each component. See text for choice of 1329.

Figure 1 The ‘take-off’ of Component II scores