Urban Hierarchy or Local Milieu? High-order Producer Service and (or) Knowledge-intensive Business Service Location in Canada, 1991-2001

Richard Shearmur
INRS-UCS
Laboratoire d'Aanalyse Spatiale et d'Économie Régionale
385 Sherbrooke est
Montreal H2X 1E3
Richard.shearmur@ucs.inrs.ca

and

David Doloreux,
School of Management,
University of Ottawa
136 Jean-Jacques Lussier,
Ottawa, K1N 6N5
Doloreux@management.uottawa.ca

ABSTRACT

The location of high-order producer services has been extensively documented for the 1970s and 1980s when researchers turned their attention to the effects of tertiarisation on regional development. In this paper we propose, on the one hand, to update the spatial analysis of high-order producer services by investigating whether they have continued to diffuse away from the top of the urban hierarchy between 1991 and 2001. On the other hand, we also propose to incorporate certain hypotheses from the KIBS literature - in particular possible spill-over effects, synergies between economic sectors and labour market effects - into the spatial analysis: over and above city size, do these factors contribute to our understanding of the spatial dynamics of high-order producer services? Overall we find that these services have reversed their diffusion process during the 1990s, decreasing their presence in smaller cities in peripheral regions. Labour market, synergies and spill-over effects contribute very little to understanding their overall spatial distribution and its evolution during the 1990s, but do contribute to understanding the location of some specific KIBS sectors.

Key words: high-order producer services, KIBS, location factors, Canada

1.Introduction

Interest in high-order producer services, and recognition of their increasingly central role in western economies, began in the late 1970s and early 1980s (Coffey, 2000). Prior to this period, manufacturing industries were often considered to be the driving force behind economic growth - whether at a national or a regional scale - and services of all sorts were seen as derivatives of manufacturing and primary production (Cohen & Zysman, 1988). These derivatives could be intermediate services (business or producer services, goods transport, warehousing), or consumer services (retail, personal services), the latter serving the population which itself tended to locate in proximity to basic industries.

As producer services became the fastest growing segment of the economy (Coffey & Shearmur, 1997; Daniels, 1985), and as their role in the competitiveness of regions became recognized, the attention of geographers and regional scientists turned towards these sectors (Drennan, 1987; Coffey & Polèse, 1987; Beyers & Alvine, 1985; Illeris, 1996). A key focus of their attention was the potential for regional development centered on producer services, and, more generally, the uneven spatial development that seemed to be reinforced by the spatial concentration of these services towards the top of the urban hierarchy.

In parallel, the role of producer services was also being analysed from the perspective of their role as facilitators in local milieu and in flexible production. From this perspective producer services are key vectors of information procurement and exchange: innovation and growth in manufacturing (and other) companies is linked to their access to, and use of, producer services (MacPherson, 1997; Cooke & Leydesdorff, 2006). From a very similar, but non geographic, perspective, an increasing proportion of research on innovation - which has tended to focus on manufacturing firms - is now turning its attention to the role of producer services in innovation systems and, more generally, in the process of innovation (Attewell, 1992; Antonelli, 1999; den Hertog, 2000; Muller & Zenker, 2001; Strambach, 2001; Miles, 2005; Wood, 2006).

These two approaches to the study of producer services intersect: to the extent that innovation systems are localized then milieu effects generated by producer services may lead to regional development and growth, as Cooke & Leydesdorff (2006), Gorman &

MacCarthy (2006) and Wood (2002a; 2005) suggest. However, these two approaches have, on the whole, remained distinct. Indeed, whereas the terms high-order producer services or business services are still used in the regional science and geographic literature (eg: Wernerheim & Sharpe, 2003; Keeble & Nachum, 2002), essentially the same group of services are known as Knowledge Intensive Business Services (KIBS) in the innovation literature (Simmie & Strambach, 2006; Bettencourt et al, 2002).

In this paper we propose, on the one hand, to update the spatial analysis of high-order producer services by investigating whether they have continued to diffuse away from the top of the urban hierarchy between 1991 and 2001. On the other hand, we also propose to incorporate certain hypotheses from the KIBS literature - in particular possible spill-over effects, synergies between economic sectors and labour market effects - into the spatial analysis: over and above city size, do these factors contribute to our understanding of the spatial dynamics of high-order producer services?

The shift towards the use of the term 'KIBS' is more than a mere semantic change, and we will examine some of its implications for studies that focus on the geography of these activities. This study not only examines the geography of these services, but also explores local and spatially diffuse connections between KIBS and certain labour-market, economic and socio-economic indicators. We specifically focus on the possible effects that the presence of KIBS may have in smaller, peripheral, communities.

2. Producer services, KIBS and geography

2.1 The definition and role of KIBS and high-order producer services

It is difficult to distinguish between high-order producer services and KIBS. Both terms are used to denote service sectors that are primarily intermediate in nature: in other words, 'business services' and 'producer services' are sectors whose clients are principally other companies, rarely individuals. 'High-order' denotes the type of service that requires the manipulation of complex symbols (Reich, 1992) and the processing and synthesis of often complex and non-standard information (Bryson et al, 2004; Daniels, 1985). The term 'high-order' is used to distinguish producer services such as security agencies and industrial cleaners from producer services such as management and engineering consultancies. Similarly, the term "knowledge intensive" can be interpreted either in

terms of labor qualification (Miles, 2005) or in terms of the conditions for the transactions between the service provider and the service user or procurer (Hauknes, 1999). Thus, a "knowledge intensive" firm refers to a firm that undertakes complex operations of an intellectual nature where human capital is the dominant factor (Alvesson, 1995). In practice, when such services are identified empirically, almost identical lists of economic sectors are put forward (see Coffey & Shearmur (1997) and Coe (1998) for high-order producer services; and Wood (2006) for KIBS). Although each selection of services is lightly different depending on data availability, purpose of the study and choices inevitably made by each researcher, the two terms refer to the same economic activities: "in practice, …, the distinctions between producer, business and knowledge intensive services remain no more than notional" (Wood, 2002, p3).

It does not follow, however, that each term refers to identical concepts (Wood, 2002, p3). Indeed, the way in which KIBS are conceptualized is fundamentally different - or at least issues from a fundamentally different perspective - than the conceptualization of high-order producer services.

Behind the idea of producer services lies the distinction between 'producers' and 'services'. Although the economy has tertiarised, and although the role of services has changed and increased since the 1970's (Bryson et al, 2004), there remains the inference that these two economic activities are distinct. Producers make tangible goods, and call upon producer services as sources of expertise when necessary. This conceptualization has greatly evolved, and it is recognized that high-order producer services are often suppliers to, and clients of, other such services. Furthermore, these services have been increasingly seen as producers and exporters in their own right. Nevertheless, the conceptual framework remains one closely connected with classification of economic sectors and their markets.

As Daniels and Bryson (2002) point out, this framework may not be as appropriate now as it was thirty years ago. According to them, the on-going transformation of advanced economies means that almost all commodities now "involve combinations of manufacturing and service functions" (p977). In an economy where knowledge has become a key commodity (Castells, 1996), a more appropriate distinction may be between economic activities that require high levels of knowledge input - that are, in

other words, knowledge intensive (whether services or manufacturing, intermediate or retail) - and economic activities that do not require such knowledge intensity. Thus, rather than making a primary distinction between 'manufacturing' and 'services', a primary distinction should be made between 'Knowledge-intensive' and 'Knowledge-poor' activities: it is only within this broad class of activities that it may be relevant to distinguish between manufacturing (the transformation of physical matter and its physical transport to markets) and services (the transformation of information, not necessarily involving physical transport to markets).

Another related aspect of the literature that focuses on KIBS rather then high-order producer services is that, from a geographic perspective, it pays more attention to regional innovation systems and local milieu. From a regional development perspective this approach emphasises that KIBS are not necessarily exporters in their own right, and may not even be growing particularly fast themselves, but may contribute to a region's dynamism as contributors to or facilitators of (manufacturing) innovative changes, or as co-coproducers of innovation (Cooke & Leydersdorff, 2006). These ideas have also been investigated from the geographic and regional science tradition (Coffey, 2000; Coffey, 1996), but have not been its principal focus of attention. It is the body of geographic literature closest to management and innovation studies (that dealing with innovative milieux - Malecki & Oinas, 1999; Cooke et al, 2004) that has explored in a more systematic way, and at a local and establishment level, the ways in which KIBS contribute to regional economic dynamism, and to regional innovation systems.

In short, there appear to be two converging academic traditions with the same object of study. Each tradition has conceptualized the same object (high-order producer services or KIBS) somewhat differently, though these conceptualizations have been evolving in a similar direction. The research traditions and methodologies developed under each approach have also tended to differ. The geographic/regional science approach has sought to document and understand the broad location patterns and behaviour of high-order producer services (Beyers & Lindhal, 1996; Wernerheim & Sharpe, 2003; Coffey & Shearmur, 1997; Harrington et al, 1991), whereas the innovation systems approach has sought to understand patterns of technological change, interactions and knowledge exchange between actors, KIBS being an important type of actor in a knowledge-based

economy. A few researchers, most notably Wood (1991; 2002a; 2002b; 2006), Daniels & Bryson (2002), Coffey & Bailly (1991) and (Coffey, 1996) have to some extent bridged the gap between these two approaches, but for the time being these two perspectives can still be said to inform different segments of the KIBS[1] literature.

2.1 KIBS, geography and economic development

As argued in the previous section, and at the risk of simplifying the numerous shades of emphasis evident in the literature, the relationship between KIBS and geographic space has been studied from two perspectives.

On the one hand, the location of KIBS has been studied at the macro-geographic level. Their location across the urban system (Coffey & Shearmur, 1997; Gong, 2001), their sensitivity to general agglomeration economies (Eberts & Randall, 1998; Poehling, 1999; Wernerheim & Sharpe, 2003) and their tendency to cluster in space (Keeble & Nachum, 2002; Coe, 1998) have all been documented using a variety of methodological tools. Often the motivation behind this research has been to understand regional economic dynamics in view of commenting upon the possibility of devising regional development policies, or, at the very least, on the likelihood that certain regions would benefit from these fast-growing, and potentially footloose, industries (Moyart, 2005).

On the other hand KIBS have been analysed as actors in economic space: the emphasis here has not been on their relative or topological location, but rather on the role that they may play as innovators (Tether, 2002), facilitators, carriers and sources of innovation within relatively closed regional innovation systems (Simmie & Strambach, 2006; Wood, 2005; Muller & Zenker, 2001; den Hertog, 2000). Underlying this approach is the idea that regions can generate a process of autonomous growth by creating a 'constructed advantage' (Cooke & Leydesdorff, 2006). The general argument is that by promoting key institutions, actors, and local dynamics, a process of endogenous growth can be generated. In the context of a knowledge-based economy, KIBS play a vital role in the innovation and growth process and, by extension, they play a key role in the construction of economic advantage. At the same time, little is known about the particular roles and functions of KIBS in creating and diffusing knowledge and fostering regions as

[1] To simplify the paper we will henceforth refer to high-order producer services / KIBS as KIBS.

innovation systems. As stated by Doloreux (2002: 259) ‘we do not know much about how these sectors are involved in the functioning of regional innovation systems and how they interact with knowledge-based firms…we do not know which services are the most vital to the system (and whether this) varies according to regions’

Taking a step back from the role of KIBS, these two approaches presuppose two fundamentally different sets of causal mechanisms. The macro-geographic approach allows that economic activities have spatialised markets and that, following classic location theories such as those developed by Christaller (1933) and Weber (see Polèse & Shearmur, 2004), their location in space will be dependent on the way in which they access these markets and deliver the services. In other words, regional development may not be dependent on local factors, but rather on wider geo-structural forces, often mediated by transport and communication technologies. Thus, it has been argued that as communication technologies have improved, the protection that distance affords to smaller markets may have eroded, and KIBS have tended to concentrate towards the top of the urban hierarchy (Polèse & Shearmur, 2004; Moyart, 2005). These services can, from this perspective, still interact with their distant clients for two reasons: first, communications technology enables frequent day-to-day contact; second, location in a large metropolitan area ensures ease of face-to-face contact since most air transport is now organised on a hub-and-spoke geometry. Even if face-to-face contact is not frequent, it can still occur at regular intervals or when necessary. The geo-structural forces at play in no way interfere with the general argument that KIBS are crucial actors for the creation and transmission of knowledge, or that they play a growing role in innovation processes. They do, however, suggest that spatial proximity is not a necessary condition for these activities to take place. Indeed, Britton (2004) and Echeverri-Carroll & Brennan (1999), for instance, suggest that innovation systems are decreasingly spatially bounded: particularly for specific high-order contacts, distance is not really an obstacle. It is only lower-order contacts that tend to take place locally.

Notwithstanding these processes recently evoked in the light of improving communications technologies, results covering the 1970's and 1980's have shown that KIBS, though very concentrated at the top of the urban hierarchy, have been growing faster in smaller and remoter cities (Coffey & Shearmur, 1997). The explanation for this

is that tertiarisation occurred first in and around metropolitan areas: as smaller and remoter cities caught up, KIBS grew faster there. Given the arguments referred to in the previous section, a key question is whether the diffusion process has now been supplanted by a technology driven metropolisation process.

The 'macro' approach just described contrasts with the innovative milieu approach, since the latter suggests that it is the *local* presence of KIBS that serves to generate local innovative dynamics: wider geo-structural forces (which drive the diffusion and concentration processes described above) are usually not evoked. From this perspective, the construction of economic advantage draws upon a variety of local attributes, in particular local economic actors, local governance, local knowledge infrastructure and local community (Leydesdorff & Eztkowitz, 2003). This suggests that endogenous innovation and development processes can be locally (or regionally) stimulated by the presence and interaction of these various attributes. From the perspective of KIBS, it is the *local* presence of these services that is important, not merely *access* to these services as suggested by the macro-geographic approach.

To some extent these distinctions are only relevant when KIBS are analysed in smaller cities and towns. KIBS usually cluster in larger cities, and it is also in larger cities that much (but not all) innovation is generated. A number of researchers have pointed out, however, that the clustering of KIBS in large cities does not indicate that they are interacting locally in any particular way. Gordon & McCann (2000), for instance, conclude that high-order services may indeed co-locate in London, but, apart from certain financial services in the city, interactions between these services are not necessarily localized. Similarly Keeble & Nachum (2002), whilst recognizing that local cluster dynamics exist in London amongst the small consultancies they investigate, also emphasize the fact that these companies choose London for its unrivaled accessibility to the rest of the UK and to international markets and clients. Furthermore, similar firms located outside London do not seem to exhibit any particular local networking behaviour (the location decision being most often related to the location of the founder's residence). Coe (1998), in his study of computer consultancies, also concludes that "localized links to partner and supplier firms do not appear to be an important influence on the development pattern of the sector" (p2064).

In sum, evidence that a *local* presence of KIBS may in some way stimulate the local economy, or may be driven by the *local* presence of clients, rests upon uncertain empirical grounds. It supposes that KIBS interact locally (not only between themselves, but with their clients), though evidence for this is only forthcoming from large metropolitan areas (Schwarz, 1993). These large metropolitan areas benefit from many other locational advantages (access to educated workforce, clients, suppliers, wider national and global markets, possibilities for collaboration, competition and information exchange) (Polèse & Shearmur, 2004): thus, even if innovation milieu dynamics are evident in large metropolitan areas, there is little reason to believe that they will be observed across the urban system as a whole (Eberts & Randall, 1998). Having said this, Wood (2006) suggests that smaller cities, if they are sufficiently close to a large metropolitan area (such as London) may develop complementary functions related to global markets, which may be KIBS-based.

In the sections that follow we investigate these questions across the Canadian urban system. The first question we address is that of the location and growth of KIBS across the Canadian urban system, paying particular attention to whether or not there has been a process of diffusion or metropolisation of these services. The second question concerns the existence of systematic links between the location of KIBS and factors such as industrial structure, workforce education, and employment rates. Should any systematic link be identified, further research will be necessary to identify causal relationships: such results would, however, lend credence to the idea that there may be a connection between the local presence of KIBS and certain local socio-economic factors.

3. Data and methodology

3.1 Which KIBS?

Before describing the data used and the nature of our analysis, it is important to specify which economic sectors have been retained as KIBS. Indeed, even if the list of sectors selected as high-order producer services or KIBS is often similar (as argued above), it is also true that the lists differ substantially both within and between the two nomenclatures.

Broadly speaking KIBS usually comprise business services (NAICS code 54 - Professional, scientific and technical services) and certain components of information services (NAICS code 51 - Information and cultural industries). Certain studies also include Financial, Insurance and Real Estate (eg: Wood, 2006; Wernerheim & Sharpe, 2003). However, as Wernerheim & Sharpe (2003) make clear, at least 50% of the client base for establishments in the FIRE sector is in fact retail, not other businesses. Thus, the extent to which the FIRE sector can be termed a 'business service' is debatable, even though it is knowledge intensive. In a similar way Shearmur & Alvergne (2002) suggest that certain professional services (such as legal services and accounting) are not necessarily business oriented. In order to restrict our study to Knowledge Intensive services with a predominantly business clientele, we have therefore excluded professional and FIRE services from our selection. This leaves computer and data services, technical services such as architecture and engineering, and certain business services such as management consulting in our selection.

Eberts and Randall (1998) argue that such a selection of business services may be too restrictive if one is attempting to examine KIBS across the entire urban system: they argue that business services provided by sectors closely related to specific industries (such as NAICS 1150 - Services incidental to farming; NAICS 4881 - Services incidental to air transportation) may often be knowledge intensive, and are certainly business services. These sectors are not usually considered as KIBS, although they display similar features (high levels of qualified labor and the use of new technologies). By omitting such services from a definition of KIBS one may automatically be biasing one's results towards only finding KIBS in larger metropolitan areas. Since our study purports to examine the location of KIBS across the Canadian urban system - including small peripheral towns - then the inclusion of these 'incidental' services is important.

Our selection of KIBS is presented in Table 1. The selection is comparable to that found in similar studies (Muller & Doloreux, 2007; Freel, 2006; Wong & He, 2005; Camacho & Rodriguez, 2005; Strambach, 2001), with the proviso that we have deliberately excluded knowledge intensive services with a high retail component: we focus on knowledge intensive *business* services. .

Table 1: KIBS sectors and employment in Canadian urban system in 2001

NAICS	Description
1150	Support activities for farms (1151 to 1152)
1153	Support activities for forestry
2131	Support activities for mining and oil and gas extraction
4881	Support activities for air transportation
4882	Support activities for rail transportation
4883	Support activities for water transportation
4884	Support activities for road transportation
5112	Software publishers
5133	Telecommunications
5141	Information services
5142	Data processing services
5413	Architectural engineering and related services
5414	Specialized design services
5415	Computer systems design and related services
5416	Management scientific and technical consulting services
5417	Scientific research and development services
5419	Other professional scientific and technical services

3.2 Data and methodology

Our data consist of census data for 1991 and 2001 covering 152 urban agglomerations and 230 rural areas in Canada. The data for economic sectors are employment data, the other data are socio-economic characteristics drawn from the census. The 1991 employment data are coded according to the 1991 SIC: these data are not directly compatible with the 2001 data, which are coded according to the 4-digit NAICS classification. For that reason our analysis of growth between 1991 and 2001 is limited to the KIBS sector as a whole and to a sub-selection of technical services, whereas the analysis of location and co-location in 2001 is considerably more detailed.

In order to examine the location of KIBS in 2001, the 152 agglomerations have been classified according to region (Atlantic Canada, Quebec, Ontario, Prairies and British Columbia) and according to city size. A distinction is made within identical size classes between central and peripheral locations - the centre and the periphery being defined by proximity to one of Canada's eight large metropolitan areas (Polèse & Shearmur, 2004b). In this way we can assess whether the concentration of KIBS varies across regions in Canada or across city size - and, if so, whether it follows the urban hierarchy. We also

compare this location pattern with data for 1991, to examine how it has evolved. The city size classes over which the location of KIBS is analysed are as follows:

AM1: metropolitan areas of over 1 million people in 1991 (Ottawa, Vancouver, Toronto and Montreal)

AM2 : metropolitan areas of between 500 K and 1 million people in 1991 (Quebec, Calgary, Edmonton, Winnipeg).

AC1 and AP1 : agglomerations of between 100 K and 500 K people, within (AC) or beyond (AP) 100km from a metropolitan area.

AC2 and AP2 : agglomerations of between 50 K and 100 K people, within (AC) or beyond (AP) 100km from a metropolitan area.

AC3 and AP3 : agglomerations of between 25 K and 50 K people, within (AC) or beyond (AP) 100km from a metropolitan area.

AC4 and AP4 : agglomerations of between 10 K and 25 K people, within (AC) or beyond (AP) 100km from a metropolitan area.

This classification will be referred to as the 'urban' classification, as opposed to the classification of cities by regions (the 'regional' classification).

Given that, in 2001, we have selected 17 different KIBS sectors, we first perform a principal component analysis in order to reduce the number of variables to be studied. We find that there exist 5 principal components, each representing an independent distribution of KIBS across the 152 urban areas. The general location pattern of each of these components is compared to that of all KIBS.

In order to assess whether KIBS tend to co-locate with particular economic sectors or with certain types of labour-force, we correlate the KIBS location quotients with the location quotients of 13 economic sectors (see annex 1), and with variables measuring population size, the percentage of university graduates, the percentage of post secondary graduates with no university qualifications, work income per worker, total income per capita and activity rate. All correlations are performed after controlling for city size and region: we add each variable separately to a general linear model that contains the regional and city size effects, and examine the increase in r^2 that the variable accounts for.

The 13 sectors retained in the analysis can broadly be considered 'basic' sectors: the primary sector (and 3 specific sub-sectors), three types of manufacturing (first transformation and low-tech, medium tech, high-tech), FIRE services, professional (non-KIBS) services, education and public administration. If KIBS sectors systematically co-locate with these sectors across the Canadian urban system then this may indicate that KIBS are attracted to particular markets. This will, in turn, indicate that their location pattern is not only determined by the urban hierarchy.

We recognize that the effect of KIBS may not be strictly localized: in other words, it is possible, for instance, that a high concentration of KIBS in small towns is related to high concentrations of first transformation manufacturing in the *surrounding* rural areas. Thus, each of the possible correlates of KIBS location is analysed in two ways. First as a local, non spatialised variable, measuring the relative concentration of each factor *within* the city where the KIBS are located. Second as a local, spatialised, variable measuring the relative concentration of each factor both *around* the city where the KIBS are located.

For a factor 'X', say percentage of graduates, the two variable types are measured as follows:

1) Local variable (*within the city*):

$$p_{ij} = \frac{n_{ij}}{N_j} \qquad (1)$$

where p_i = percentage of people with characteristic i in city j; n_i = number of people with characteristic i in zone j ; N = population of reference in zone j (depending on the variable, the reference population is total employment, total population over 15 years of age, total population with some post-secondary qualification).

2) Spatialised variable (*around the city*):

$$p_{ij} = \frac{\sum_{k=1}^{381} n_{ij} \Big/ d_{jk}}{\sum_{k=1}^{381} N_j \Big/ d_{jk}}; d_{jk} \neq 0 \qquad (2)$$

where p_i = ratio of potentials, at city j, of people with characteristic i to reference population. It is also important to note that although KIBS are only being analysed within the urban system (there are too few KIBS in non-urban areas to justify a statistical

analysis), possible correlates of KIBS are being measured across the entire territory, including rural areas (total of 382 zones). Thus, this spatialised variable takes into account the characteristics of workers and residents in all areas except city j, particularly those immediately surrounding city j.

Finally, the presence of KIBS in city j is measured by the location quotient as follows:

$$LQ_{ij} = \frac{\left(e_{ij} / e_j\right)}{\left(e_i / E\right)} \qquad (3)$$

where LQ_{ij} = location quotient of sector i in city j; e_{ij} = employment of sector i in city j; e_i = employment of sector i in Canada; E = total employment in Canada.

The analysis proceeds in three steps. After presenting a few descriptive statistics, the location of KIBS in the Canadian urban system is compared between 1991 and 2001 by analyzing mean location quotients in different classes of city. Then, a detailed analysis of the location of KIBS in 2001 examines the distribution of component scores across the Canadian urban system. Finally, possible correlates of KIBS location and of KIBS growth are analysed, in order to investigate the extent to which the location of KIBS is determined by geo-structural (region and city classes) or local socio-economic factors.

4. The location of KIBS in the Canadian urban system

To begin this analysis, a few descriptive statistics will be commented[2]. In 2001, about 75% of all KIBS in the Canadian urban system were located in Canada's eight largest metropolitan areas (table 2). This percentage has increased by approximately 3.8%[3] between 1991 and 2001, indicating substantially faster KIBS growth in Canada's largest cities.

The fastest growing KIBS sectors are management consulting and computer and data services. Employment in these sectors has nearly tripled over the period studied. Overall KIBS have grown substantially faster in metropolitan areas than in the rest of the urban system. Two sectors stand out: management consultancy is the only sector that has grown

[2] Due to limitations in our data and to the change from SIC to NAICS industrial codes between 1991 and 2001, not all of these service sectors are available for study in 1991 (see table 2).
[3] Table 2 uses a sub-sample of the sectors indicated in table 1: the 2001 sub-sample gathers 85% of the KIBS employment of the full KIBS selection.

faster in smaller cities, and the process of metropolisation is most marked in telecommunications, which has tended to decline in smaller cities and grow in the larger ones.

These numbers serve as a general backdrop to the analysis which follows, where the focus is on the location of KIBS and upon the identification of certain location factors.

[table 2 about here]

4.1 The location of KIBS in 1991 and 2001

The overall distribution of KIBS across the Canadian urban system is almost entirely related to urban size and centrality (figure 1): in 2001, the regional and urban classifications account for 54% of the variance in KIBS location quotients across the urban system, with only the urban classification entering the model significantly[4]. KIBS are highly concentrated in the largest urban areas and there is a monotonic decrease in KIBS concentration as one moves down the urban hierarchy. In 2001, the mean location quotient of KIBS in peripheral cities is almost identical to that in central cities: it is urban *size*, and not the centre/periphery dichotomy, that principally explains differences in the concentration of KIBS.

[figure 1 about here]

The distribution of KIBS in 1991 (also shown on figure 1) is very similar to the distribution in 2001. However, certain key changes can be noted. The most interesting change is that the concentration of KIBS in peripheral cities has dropped markedly: whereas in 1991, after controlling for city size, peripheral cities tended to have higher concentrations of KIBS than central ones, this difference has disappeared by 2001. The increased use of communication technologies over the 1990s seems to have reduced the protection that distance offered peripheral cities: in 1991, local central places in the periphery still had their own KIBS suppliers, compensating for their lack of proximity to KIBS in metropolitan areas. By 2001, this compensatory effect is no longer evident.

A second important difference between 1991 and 2001 is that the concentration of KIBS has also decreased in *all* sizes of central city: it is only the four largest metropolitan

[4] In an ANOVA model of the type: LQ_{KIBS} = f(regions, urban), the regional classification is not significant in either 1991 or 2001. It has nevertheless been left in the model (results presented graphically in figure 1) in order to ensure that the urban hierarchy results are not affected by regional variations.

areas that have, on average, increased their concentration of KIBS. Given that KIBS were already highly concentrated there in 1991, this result is of key importance: the metropolisation of KIBS, which Coffey & Shearmur (1997) suggested had slightly eased between 1971 and 1991, gathered new steam over the 1990s.

Finally, the explanatory power of the two simple classifications (urban and regional) has increased from 28% in 1991 to 54% in 2001: there is far less variation of KIBS location quotients within each class in 2001 than in 1991, suggesting that, in general, the location of KIBS is increasingly organised along a straightforward hierarchical continuum. The idea that KIBS may be footloose and may - *in a direct way* - contribute to the development of smaller cities and regions is not supported by these results.

4.2 A more detailed look at the location of KIBS

In the previous section we have only analysed an aggregate indicator of KIBS, based upon the variables that we can measure in both 1991 and 2001. However, certain KIBS may have location patterns that differ from the overall pattern described above: it is therefore important to analyse in more depth the location of KIBS sub-sectors.

We have identified - even using our strict selection criteria - 17 KIBS sub-sectors, from which we have extracted 6 principal components with variance greater than 1, 5 of which we will analyse in detail. The components are as follows (see annex 1):

- High-order business services: 5419, 5414, 5112, 5417, 5416, 5415, 5142[5], v=23%[6]
- Mining support and engineering : 2131, 5413, v=9%
- Forestry support and transport : 4884, 1153, v=9%
- Communications and air transport support : 4881, 5133, 5141, v=8%
- Agriculture support / Maritime support : 1150, 4883, v=7% (note that this component is positively related to agriculture support, and negatively related to maritime support)

[5] The NAICS code for all sectors correlated at 0.48 or higher with the component are indicated. 0.48 has been chosen as a cut-off because the next highest correlation is 0.41, and a cut-off in the vicinity of 0.50 was being sought. No sector is correlated (at the 0.48 level) with two components.
[6] This percentage indicated the variance explained by each component.

These components immediately suggest that there is considerable difference between the 'core' KIBS sectors (principally those in NAICS 54) and the other selected sectors. Even if the various support services are indeed knowledge intensive, they quite clearly do not display the same location patterns as core KIBS. The only exception is engineering consultancies that tend to concentrate in locations similar to those where support for mining and gas industries can be found. The components identified are consistent with what we know of each type of sector: engineering consultants are often very active in and around new resource developments, as are, by definition, support services for mining and gas. In many smaller forestry communities transport is a major employer (since transporting the wood from stands to sawmill, and then to markets, is closely associated with forestry). Finally, support to agriculture (which is an activity principally concentrated far from the sea, in the Prairies) will tend to locate in different areas than support to maritime transport.

[table 3 about here]

Notwithstanding the very strong explanatory power that the urban classification has for explaining the location of KIBS as a whole, it is only significant at the 99% level for one of the five components, the 'core' KIBS component (table 3). For each of the four other components, it is the regional classification that is the most significant: indeed, only for the *forestry and transport* component does the urban classification explain part of its location pattern (this component is strongly present in smaller peripheral locations - see figure 2).

[figure 2 about here]

The regional distribution of KIBS (figure 3) reveals a strong connection between broad economic characteristics at the regional level and the type of KIBS found there. *Mining support and engineering*, for instance, is highly concentrated in Alberta - a province with an economy dominated by the oil and gas industry (and, to a lesser extent, by agriculture). *Agricultural support services* locate principally in agglomerations in the Prairies and Alberta - Canada's bread basket and an area where most Canadian cattle is raised. *Forestry and road transport support* is strong in British-Columbia and Quebec, the two principal logging regions in Canada. And finally, *Communications and air*

transport support seem to concentrated in Canada's remoter regions, where distance from major centres may still lead to local employment in these KIBS.

[figure 3 about here]

In short, and before having analysed any local explanatory variables, it can already be said that there is a regional logic to the distribution of KIBS. Except for the 'core' KIBS', where an urban hierarchical logic predominates, the smaller and more specialized KIBs sectors tend to locate within range of their markets: at the broad provincial scale, there is a connection between regional economic structure and the local KIBS profile .

4.3 Location factors for KIBS

So far we have established that there are strong geo-structural determinants of growth and location of KIBS within the Canadian urban system. Furthermore, the distribution of 'minor' KIBS over geographic regions suggests that at a broad regional scale the KIBS profile is connected with regional economic structure.

From the perspective of innovative milieu research, two important comments come to mind with regard these results. The first is that certain local (as opposed to broad regional) factors may themselves explain these geo-structural regularities: for example, if workforce education levels are closely related to urban size, then it may be education, and not urban size, that is the driving factor behind observed regularities. The second is that even if one accepts that these structural regularities exists - and that they reflect wider non-local factors such as accessibility to national and international markets, economies of juxtaposition (the fact that there is a great variety of actors and activities in metropolitan areas) - it does not mean that certain local factors have no independent effect: it may be that by adding certain local factors to these regional structures more insight can be gained into local variations in the concentration of KIBS.

In order to address both these questions a series of variables representing local factors that may be associated with KIBS location have been added to the basic model containing the urban and regional effect. The increase in r^2 that each variable contributes is noted (as is the sign and significance of the variable's coefficient as it enters the model) in order to assess whether it provides additional information (table 4). Although all coefficients significant at the 5% level have been noted in table 2, only increases in r^2 of particular note will be commented upon.

[table 4 about here]

Core KIBS behave as one would expect: they are strongly connected to other command and control functions (Sassen, 2004) such as FIRE, professional services and public administration. They are also very strongly connected with the presence of an educated workforce, with a stronger connection to social science-type qualifications than to science, engineering or management. The only type of qualification which tends to be less present the higher the concentration of *Core KIBS* are technical qualifications.

Surprisingly, *Extraction support and engineering* KIBS are not co-located with the primary, or even with the mining and gas extraction, industries. At a local scale, there is no evidence that, given their strong presence in Alberta, they seek to locate in cities close to extraction activities. In general they are not attracted to cities with a high proportion of graduates, but they do seem to locate in cities with a high proportion of scientists. The cities where they are located have high wages and incomes and high occupation rates. These KIBS are therefore quite closely connected with some aspects of the local labour force, but only weakly to the local economy (they co-locate only with non-KIBS professional services).

Each of the other three components tends to co-locate with the production sector it most closely serves (forestry, air transport and agriculture). The communications and air transport component is of particular interest since, as well as its connection with air transport, it co-locates with public administration and non-KIBS services, in fairly isolated cities (tendency for population to be low in surrounding areas) with good incomes and occupation rates. It is also the only component, other than *Core KIBS*, which co-locates with a more educated workforce. This pattern of co-location suggests that the *Communications and air transport support* services locate in local central places, seats of government and local centres for communications and transport networks. It is interesting to note that notwithstanding the better transport links that these places have (presence of air transport services), there are lower concentrations of manufacturing in and around these cities than elsewhere (negative relationship with first transformation and medium value added manufacturing): given the remoteness of these areas, their transportation and communication advantages do not suffice in making them even marginally more attractive to manufacturers.

Finally, it is worth noting the positive relationship between *Forestry and road transport support* and wages. This is not carried through to per capita income, and is evidence of the intrusive rentier syndrome. This term is used by Polèse & Shearmur (2006) to describe cities dominated by a small number of highly capitalized (and high wage) employers. Often these higher wages are associated with lower occupation rates - since it is problematic for SMEs to start up in a high wage environment.

Overall, these results suggest that there are at least three different processes at work behind these location patterns:

1. *Core KIBS* locate at the top of the urban hierarchy, and serve their markets (local, national and international) from there: they are connected to their locality by way of the work force, but not in any systematic way with particular sectors. Their co-location with other command and control functions may merely reflect their similar location and labour force requirements, though it is highly probably that they also benefit from interacting amongst each other.

2. Second, the *Extraction support and engineering* KIBS locate within general reach of their specific market, but not necessarily in close proximity: this suggests some form of spatial interaction, but not necessarily the generation of local (city-scale) milieu effects.

3. Finally, the other KIBS sectors locate close to their principal client sectors. However, we have seen that the location of the three remaining KIBS components also has a strong regional component which can be explained by referring to the type of market within each region: thus, it would appear that these KIBS function in a similar way as *Extraction support and engineering* (at a provincial scale), but also in a more localized (city-scale) way.

4.4 KIBS Growth factors

To conclude the analysis, the impact of the same factors (measured, this time, in 1991) has been assessed on the subsequent growth of KIBS (table 4). Only the total KIBS sector, and a sub-sector approximately corresponding to 'Core' KIBS, can be analysed, these results are not directly comparable with the preceding ones. The results are easy to summarise.

First, the urban and regional model is very poor at explaining KIBS growth: on the whole the KIBS sector has not grown in any systematic way across these dimensions. This result does not contradict the general trends described earlier (table2 and figure 1): rather it reflects the fact that KIBS have concentrated in a very small number of metropolitan areas (four to eight). This is not a sufficient number to influence the statistics: figure 1 shows that there has tended to be slower growth in all types of city beneath 500 000 population (144 cities), and the poor explanatory power of the model reflects the fact that there has been much growth and decline in all types of city beneath the metropolitan level.

Second, there is no connection between initial population, education, income or occupation levels and subsequent growth in the KIBS sector. The only relationship that comes to light is between high initial wages and faster *Core KIBS* growth - probably due to the fact that this sector has grown faster in and around the oil patch in Alberta, and in metropolitan areas, both of which are high wage locations.

Third, KIBS have grown faster in cities with a high proportion of mining, oil and gas extraction - further emphasizing that KIBS growth over the 1990s has been driven, to the extent that it has been driven by something other than metropolisation, by resource development activities.

5. Discussion and conclusion

In this paper we set out to investigate the location of KIBS in Canada drawing from two distinct (but connected) bodies of literature. On the one hand, there are theories and empirical results that indicate that KIBS locate towards the top of the urban hierarchy. Such locations enable KIBS to access wider international markets (Sassen, 2004), but also to gain maximum access to dispersed markets within their own country (Polèse & Shearmur, 2004a, 2004b). Furthermore, knowledge spillover and agglomeration effects,

together with labour market considerations, mean that large local markets also exist within agglomerations: the clients of high-order producer services are predominantly other service providers, and manufacturing appears to be a small and diminishing market (Wood, 2006). Thus large metropolitan areas are not only key nodes enabling access to global and national markets, but are important markets in their own right to the extent that KIBS clients (other service providers, but also head offices of manufacturing companies and public administration) also locate their.

On the other hand, work on innovation and innovative milieu has emphasized the contribution that KIBS - by way of knowledge creation and exchange with local actors - make to regional growth. KIBS, from this approach, are an important part of a region's knowledge infrastructure, and this knowledge infrastructure is a key factor of innovation and growth (Cooke & Leyderdorff, 2006).

Our results demonstrate that the geo-structural approach to understanding the location of KIBS is powerful. Our principal result is that, over the 1990s the spatial distribution of KIBS has become *increasingly* organised around the urban hierarchy. Not only are large metropolitan areas the only type of city to have increased their specialization in KIBS, the explanatory power (as measured by the r^2) of a simple geo-structural location model has increased from 28% to 54%. Peripheral cities - those located over an hour's drive from a metropolitan area - have seen significant and systematic decreases in the local presence of KIBS, suggesting that even if *Core KIBS* may have been locating there to serve local markets in the early 1990s, by 2001 it was no longer necessary to locate in the periphery to access these markets.

An important distinction has been made between *Core KIBS* - essentially management consulting, computer and software design and services and R&D - and other KIBS (including engineering consulting). These other KIBS show far more propensity to locate close to their markets, but this location operates at two distinct scales. On the one hand, most non-core KIBS locate in Canadian *regions* where their market is to be found: this does not imply immediate co-location or immediate proximity, but general proximity at the scale of the province. On the other hand many non-core KIBS (but not all of them) also seek out specific locations within these regions where their client sectors can be

found: this implies the need for local proximity and suggests the possible existence of local synergies of the type described in the innovation systems literature.

Thus KIBS - even very specialized KIBS - do not always seek to locate in local proximity to their markets. Rather, they seek out general, regional proximity, and only sometimes immediate local proximity. This reflects the fact that services can be delivered over long distances, and that service providers often travel to their clients (or *vice-versa*) (Daniels, 1985). For instance, even if one's client-base is manufacturing, one will not necessarily locate in or near manufacturing areas: however, one will tend to locate in a region with good access to manufacturing areas.

From this perspective, the lack of geographic connection between KIBS and manufacturing can be understood. These sectors tend to be located, in Canada, in central areas, within 100km or so of metropolitan areas (Polèse & Shearmur, 2004b). Following our argument, KIBS which serve a manufacturing base will *not* necessarily leave metropolitan areas to locate close to manufacturing, but may consider themselves to be sufficiently close to their markets if they remain within metropolitan areas. On the other hand, mining and resource activity has tended to concentrate, particularly over the 1990s, in Alberta and the Prairies: even if some *Extraction support and engineering* KIBS favour metropolitan locations, they will tend to choose *Albertan and Prairie* metro areas. Thus, we detect little or no *local* connection between *Extraction support and engineering* and primary sectors, but a *regional* connection emerges.

It seems that an important question for the innovation systems literature to address is that of scale: over what distance does a 'knowledge infrastructure' function? Our hypothesis is that there are a number of different scales in Canada. At one level, there is a national knowledge infrastructure: KIBS in Canada's largest metropolitan areas interact with establishments across the whole of the country, as well as with establishments in their local (metropolitan) and regional markets. At a regional (approximately provincial) level there is another, more local, infrastructure, tailored to specific regional institutions and actors. Finally, at the local (city) level, our results support the idea of local knowledge infrastructures, at least for more specialised KIBS

Our results also demonstrate that, even after controlling for city size and region, there is some connection between the profile of the local labour market and the location of

KIBS. *Agricultural support* KIBS co-locate with workers holding agricultural science qualifications, *communications and air transport* KIBS with social scientists and managers, *Extraction support and engineers* with scientists, and *Core KIBS* with all types of higher qualifications.

These results, based upon statistical analysis, are suggestive of processes operating at diverse scales. KIBS operate over large distances, and increasingly so as metropolisation occurs. They also react to regional markets, and, in keeping with innovation systems literature, sometimes they appear to be connected to very local markets. A key question, that can only be addressed by more qualitative work, is whether the *Non-Core* KIBS operate as local and regional vectors of knowledge and innovation, or whether they merely provide routine services - with *Core KIBS* dominating knowledge transfer and exchange from a distance.

References

Alvesson, M. 1995, *Management of Knowledge-intensive Companies*. Berlin and New York: de Gruyter

Antonelli, C., 1999, The Evolution of the Industrial Organization of the Production of Knowledge, *Cambridge Journal of Economics*, 23, 243-260

Antonelli, C. and M.Quéré, 2002, The Governance of Interactive Learning within Innovation Systems, *Urban Studies*, 39. 5/6, 1051-1063

Attewell, P., 1992, Technology Diffusion and Organizational Learning: the Case of Business Computing, *Organization Science*, 3.1, 1-19

Bettencourt, L., A.Ostrom, S.Brown and R.Roundtree, 2002, Client Co-production in Knowledge Intensive Business Services, *California Management Review*, 44.4, 100-128

Beyers, W. and M.Alvine, 1985, Export Services in Postindustrial Society, *papers in Regional Science*, 57, 33-45

Beyers, W., and D.Lindhal, 1996, Explaining the Demand for Producer Services: Is Cost-driven Externalization a Major Factor?, *Papers in Regional Science*, 75: 351-374

Britton, J., 2004, High Technology and Extra-regional Networks, *Entrepreneurship and Regional Development*, 16.369-390

Bryson, J, P.Daniels and B.Warf, 2004, *Service Worlds: People, Organizations and Technology*, London: Routledge

Camacho, J.A. and M. Rodriguez 2005, How Innovative are Services? An Empirical Analysis for Spain, *Service Industries Journal*, 25, 2, 253-71.

Castells, M., 1996, *The Rise of the Network Society*, Oxford: Blackwell

Christaller, W., 1933, *Die zentralen Orte in Süddeutschland*, [Central Places in Southern Germany], Jena (Germany): Gustav Fischer

Coe, N., 1998, Exploring Uneven Development in Producer Service Sectors: Detailed Evidence from the Computer Service Industry in Britain, *Environment & Planning A*, 30: 2041-2068

Coffey, W., 1996, Forward and Backward Linkages of Producer Service Establishments: Evidence From the Montreal Metropolitan Area, *Urban Geography*, 17, 604-632

Coffey, W., 2000, The Geographies of Producer Services, *Urban Geography*, 21.2, 17-183

Coffey, W., and A.Bailly, 1991, Producer Services and Flexible Production: An Exploratory Analysis, *Growth and Change, 22.4, 95-117*

Coffey, W. and M.Polèse, 1987, Trade and Location of Producer Services: a Canadian Perspective, *Environment & Planning A*, 19, 597-611

Coffey, W. and R.Shearmur, 1997, The Growth and Location of High-Order Services in the Canadian Urban System, 1971-1991, *Professional Geographer*, 49.4, 404-418

Cohen, S. and J.Zysman, *Manufacturing Matters: the Myth of the Post-Industrial Society*, Cambridge (MA) : MIT Press

Cooke, P., M.Heidenreich and H-J. Braczyk (eds), 2004, *Regional Innovation Systems: the Role of Governance in a Globalized World*, London: Routledge

Cooke, P and L.Leydesdorff, 2006, Regional Development in the Knowledge-based Economy: The Construction of Advantage, *Journa; of Technolofy Transfer*, 31, 5-15

Daniels, P., 1985, *Service Industries: a Geographical Appraisal*, New York : Methuen

Daniels, P., and J.Bryson, 2002, Manufacturing Services and Servicing Manufacturing: Knowledge-based Cities and Changing Forms of Production, *Urban Studies*, 39.5/6, 977-991

Den Hertog, P.,2000, Knowledge-intensive Business Services as Co-producers of Innovation, *International Journal of Innovation Management* 4(4): 491-528.

Doloreux, D., 2002 What we should know about regional systems of innovation, *Technology in Society*, 24, 3, 243-263.

Drennan, M, 1987, New York in the World Economy, *Survey of Regional Literature*, 4, 7-12.

Gong, H. (2001) A Hierarchical Change Model of Business and Professional Services in the United States *Urban Geography*, 22.340-359

Eberts.D., and J.Randall, 1998, Producer Services, Labor Market Segmentation and Peripheral Regions: The Case of Saskatchewan, *Growth & Change*, 29, 401-422

Echeverri-Carroll, E. et W.Brennan, 1999, Are Innovation Networks Bounded by Proximity?, in *Innovation, Networks and Localities*, eds. Fischer, M., L.Suarez-Villa et M.Steiner, Springer: New-York

Freel, M., 2006 Patterns of Technological Innovation in Knowledge-intensive Business Services, *Industry and Innovation*, 13, 3, 335-58.

Gorman, G. and S.MacCarthy, 2006, Business Development Support and Knowledge-Based Business, *Journal of Technology Transfer*, 31, 131-143

Gordon I. and McCann,P., 2000, Industrial Clusters: Complexes, Agglomeration and/or Social Networks?. *Urban Studies*, 37.3, 513-532

Harrington,J., A.MacPherson, J.Lombard, 1991, Interregional Trade in Producer Services: Review and Synthesis, *Growth and Change*, 22.5, 75-94

Illeris, S., 1996, *The Service Economy: A Geographical Approach*, Chichester: Wiley

Keeble, D., and L.Nachum, 2002, Why do Business Service Firms Cluster? Small Consultancies, Clustering and Decentralization in London and Southern England, *Transactions of the Institute of British Geographers*, NS27, 67-90

Leydesdorff, L. and H.Etzkowitz, 2003, Can 'the Public' be Considered as a Fourth Helix in University-Industry-Government Relations?, *Science and Public Policy*, 30.1, 55-61

MacPherson, A., 1997, The Role of Producer Service Outsourcing in the Innovation Performance of New York State Manufacturing Firms, *Annals of the Association of American Geographers*, 87, 52-71

Malecki, E. J. et Oinas, P. (eds), 1999, *Making Connections: Technological Learning and Regional Economic Change*. Ashgate, Aldershot.

Miles, I., 2005, Knowledge Intensive Business Services: Prospects and Policies, in *Foresight - The Journal of Future Studies, Strategic Thinking and Policy*.

Moyart, L., 2005, The Role of Producer Services in Regional Development: What Opportunities for Medium-sized Cities in Belgium?, *Services Industry Journal*, 25.2, 213-228

Muller, E., and A.Zenker, 2001, Business Services as Actors of Knowledge Transformation: the Role of KIBS in Regional and National Innovation Systems, *Research Policy*, 30, 1501-1516

Poehling, R., 1999, Locating Producer Services in the Rural South of the US: The Case of Alalbama, Florida and Georgia, paper presented at the *Meetings of the North American Regional Science Association*, Montreal, November 1999

Polèse, M. and R.Shearmur, 2004a, Culture, Language and the Location of High-Order Service Functions: The Case of Montreal and Toronto, *Economic Geography*, 80.4, 329-350

Polèse, M., and R.Shearmur, 2004b, Is Distance Really Dead? Comparing Industrial Location Patterns over Time in Canada. *International Regional Science Review*, 27,4: 431-457

Polèse, M., and R.Shearmur, 2006, Why Some Regions Will Decline: A Canadian Case Study with Thoughts on Local Development Strategies, *Papers in Regional Science*, 85.1, 23-46

Reich, R., 1992, *The Work of Nations*, New York: Vintage Books

Sassen, S., 2001, *The Global City: New York, London, Tokyo* (2nd edition), Princeton: Princeton University Press

Shearmur, R. and C.Alvergne, 2002, Intrametropolitan Patterns of High-order Business Service Location: A Comparative Study of Seventeen Sectors in Ile-de-France, *Urban Studies*, 39.7, 1143-1163

Simmie, J., and S.Strambach, 2006, The Contribution of KIBS to Innovation in Cities: and Evolutionary and Institutional Perspective, *Journal of Knowledge Management*, 10.5, 26-40

Strambach, S., 2001 Innovation Processes and the Role of Knowledge-intensive Business Services (KIBS). In K. Koschatzky, M. Zulicke and A. Zenker (eds.), *Innovation networks: concepts and challenges in the European perspectives*, Heidelberg: Physica-Verlag.

Wernerheim, M., and C.Sharpe, 2003, 'High-Order' Producer Services in Metropolitan Canada: How Footloose are They?, *Regional Studies*, 37.5, 469-490

Wong, P. K. and Z. L. He, 2005, A Comparative Study of Innovation Behaviour in Singapore's KIBS and Manufacturing Firms, *Service Industries Journal*, 25, 1, 23-42.

Wood, P., 1991, Flexible Accumulaton and the Rise of Business Services, *Transactions of the British Institute of Geographers*, NS16, 160-172

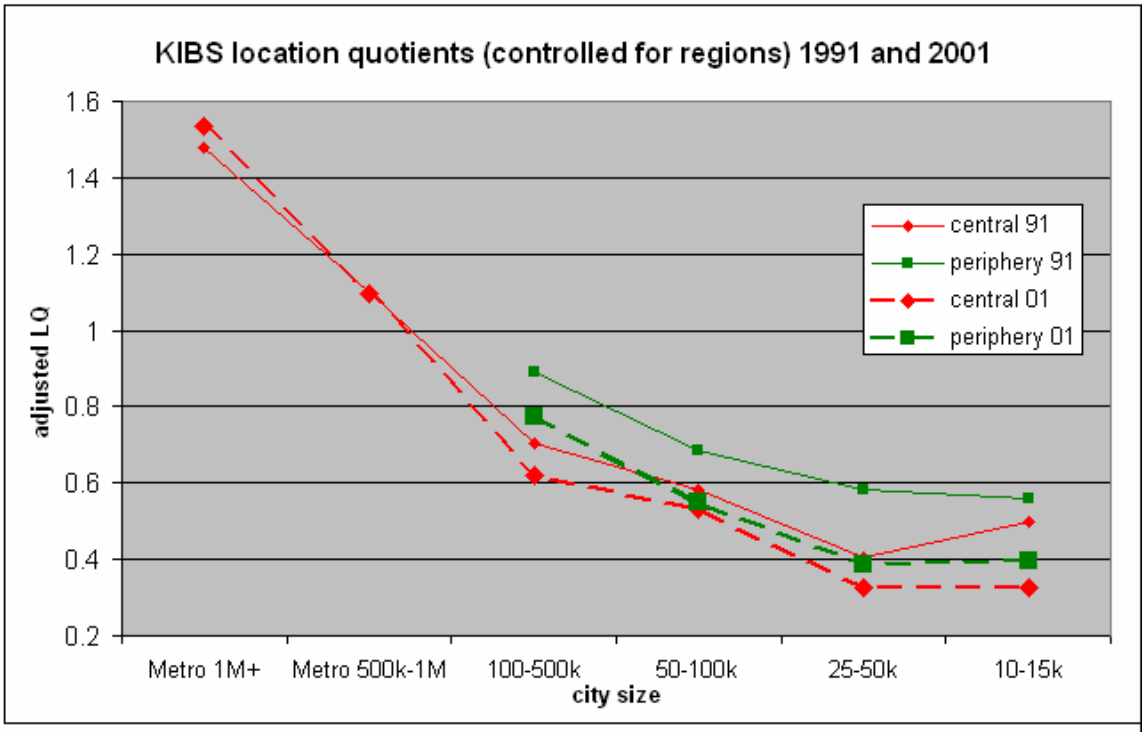
Wood, P., 2002a, Knowledge Intensive Services and Urban Innovativeness, *Urban Studies*, 39.5/6, 993-1002

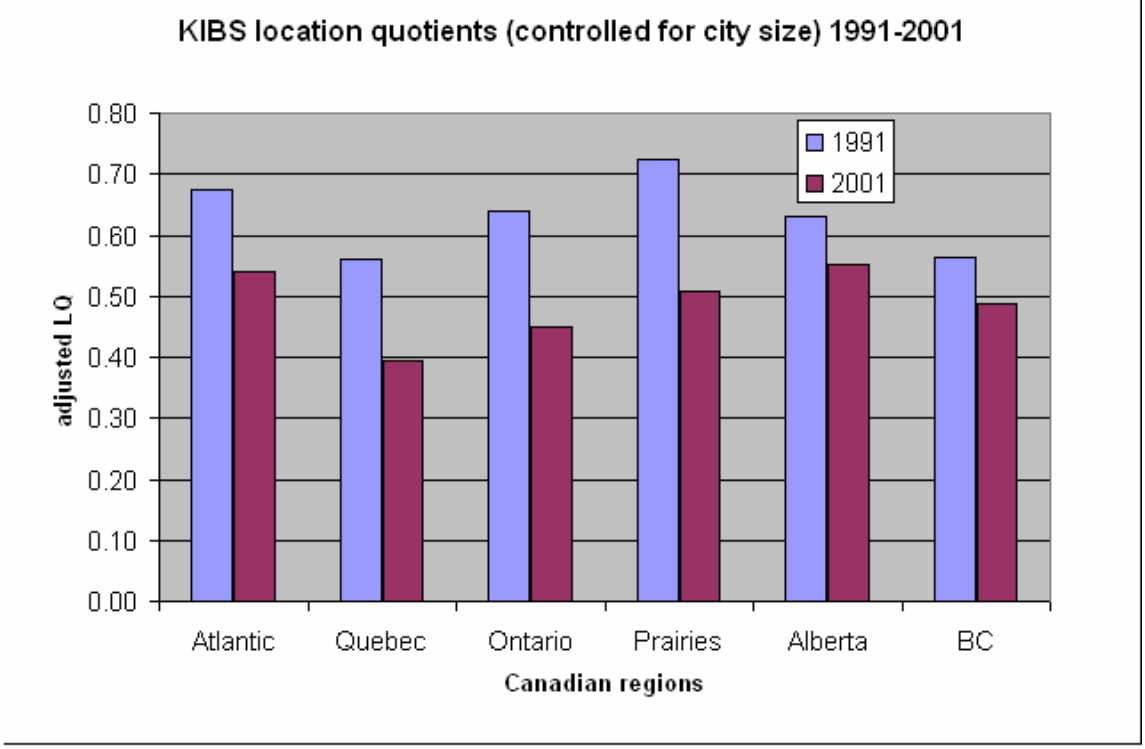
Wood, P. (ed), 2002b, *Consultancy and Innovation: the Business Service Revolution in Europe*, Routledge: London

Wood, P., 2005, A Service-Informed Approach to Regional Innovation - or Adaptation?, *The Service Industries Journal*, 25.4, 429-445

Wood, P., 2006, Urban Development and Knowledge Intensive Business Services: Too Many Unanswered Questions?, *Growth & Change*, 37.3, 335-361.

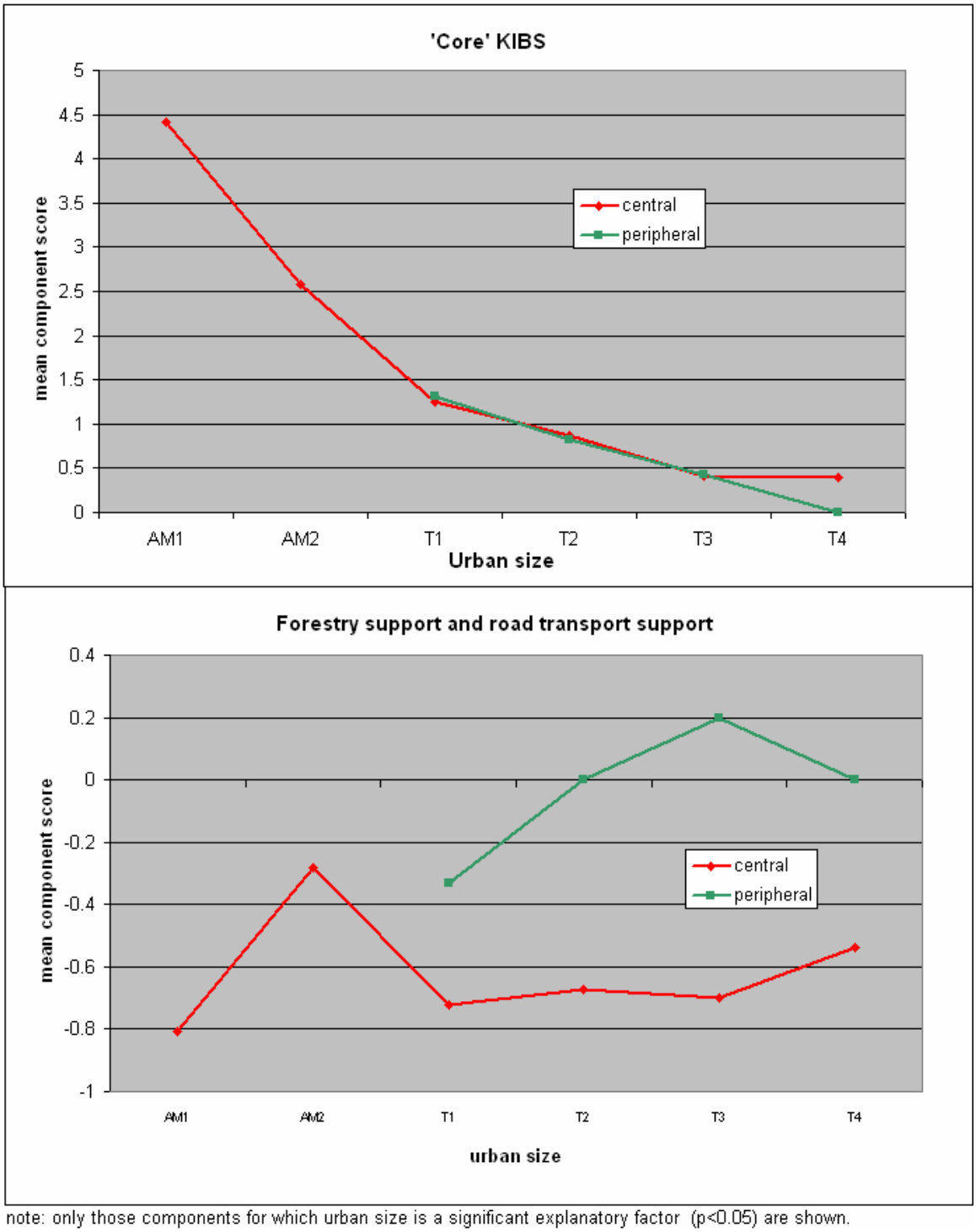
Figure 1: KIBS Location scores by region and city size (adjusted), 1991-2001





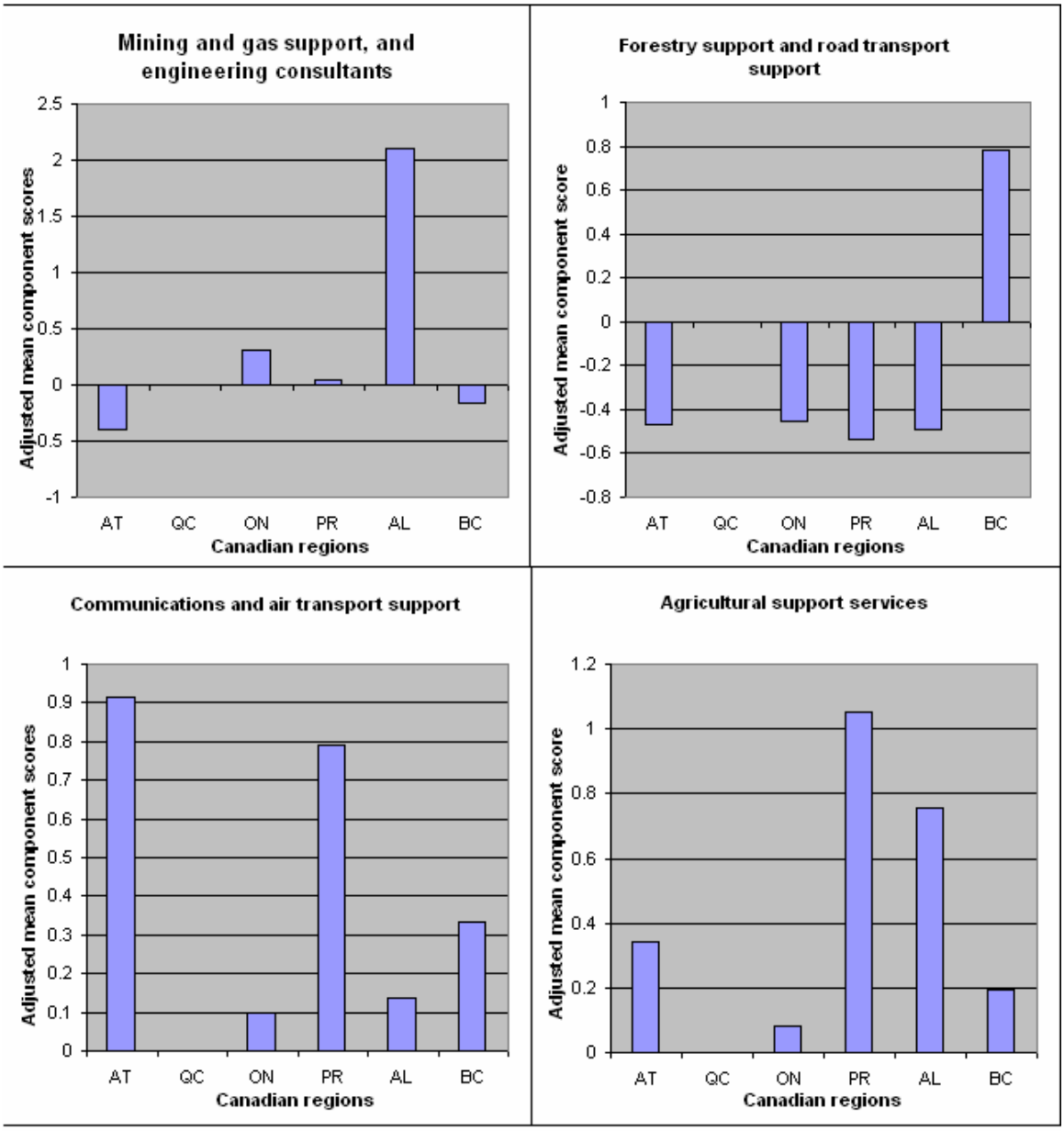
These figures show the mean location quotient (for all KIBS) after adjusting for regional variations (top figure) and variations over the urban hierarchy (lower figure). They correspond to the regression coefficients for the model LQ = f(regions, urban), where the 6 regions and the 10 urban classes are represented by dummy variables (the omitted region and urban class being assigned the intercept value). In 1991 the r2 of the model is 28%, in 2001 it is 54%.

Figure 2: KIBS Component scores by city size (adjusted for region), 2001



note: only those components for which urban size is a significant explanatory factor ($p<0.05$) are shown.

Figure 3: KIBS Component scores by region (adjusted for city size), 2001



note: Base region is always Quebec. The absolute value of the scores is not relevant: only their relative value is. Only components where the regional classification is significant at $p<0.05$ have been shown.

Table 2 : KIBS in the Canadian urban system: descriptive statistics, 1991-2001

Total employment	1991		2001	
	8 metros	152 agg.	8 metros	152 agg.
4881 Support activities for air transportation	8 473	12 106	13 660	18 710
4883 Support activities for water transportation	7 507	11 588	5 655	8 655
5133 Telecommunications	76 417	115 526	92 435	123 115
5112, 5141, 5142, 5415 Computer and data services	76 845	96 104	215 145	268 120
5413, 5414, 5417 Engineering, Architects and R&D	108 087	147 022	170 790	226 970
5416 Management consulting	32 070	39 978	81 810	106 255
Total KIBS	309 399	422 324	579 495	751 825
Total employment	6 215 605	10 238 326	7 407 160	12 051 105

Process of metropolisation *(employment in 8 metros as % of urban system's)*	1991 metro/all	2001 metro/all	Change
4881 Support activities for air transportation	70.0%	73.0%	**3.0%**
4883 Support activities for water transportation	64.8%	65.3%	0.6%
5133 Telecommunications	66.1%	75.1%	**8.9%**
5112, 5141, 5142, 5415 Computer and data services	80.0%	80.2%	0.3%
5413, 5414, 5417 Engineering, Architects and R&D	73.5%	75.2%	**1.7%**
5416 Management consulting	80.2%	77.0%	-3.2%
Total KIBS	73.3%	77.1%	**3.8%**
Total employment	60.7%	61.5%	0.8%

Growth 1991-2001 *(% growth of employment between 1991 and 2001)*	8 metros	144 other
4881 Support activities for air transportation	**61%**	39%
4883 Support activities for water transportation	**-25%**	-27%
5133 Telecommunications	**21%**	-22%
5112, 5141, 5142, 5415 Computer and data services	**180%**	175%
5413, 5414, 5417 Engineering, Architects and R&D	**58%**	44%
5416 Management consulting	**155%**	209%
Total KIBS	87%	53%
Total employment	19%	15%

note: this table, and all analysis comparing 1991 and 2001, is based upon SIC classifications.

Table 3: KIBS component scores by region and city size (ANOVA analysis)
DF Model = 14, (urban: 9, région: 5)

Component 1 = f (urban, region)			
	r2	F	p(F=0)
MODEL :	***0.685***	***21.32***	***<.0001***
classes de ville		***31.54***	***<.0001***
régions		1.51	0.1893

Component 2 = f (urban, region)			
	r2	F	p(F=0)
MODEL :	***0.380***	***6.01***	***<.0001***
classes de ville		1.74	0.0851
régions		***13.38***	***<.0001***

Component 3 = f (urban, region)			
	r2	F	p(F=0)
MODEL :	***0.382***	***6.06***	***<.0001***
classes de ville		***2.19***	***0.0259***
région		***8.45***	***<.0001***

Component 4 = f (urban, region)			
	r2	F	p(F=0)
MODEL :	***0.187***	***2.25***	***0.0087***
classes de ville		0.74	0.6746
régions		***2.66***	***0.025***

Component 5 = f (urban, region)			
	r2	F	p(F=0)
MODEL :	0.125	1.40	0.1628
classes de ville		0.98	0.4613
régions		***2.95***	***0.0146***

Annexe 1: Components and component loadings, KIBS, 2001

Sector names and NAICS (1997) codes	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Communality
5415 Computer systems design and related services	**0.86**	-0.01	-0.12	0.19	-0.12	0.07	0.80
5112 Software publishers	**0.75**	-0.14	-0.07	0.12	-0.12	-0.08	0.63
5414 Specialized design services	**0.74**	0.14	0.00	-0.16	0.06	-0.09	0.61
5416 Management, scientific & technical consulting services	**0.73**	0.35	-0.02	0.28	-0.02	-0.03	0.74
5417 Scientific research and development services	**0.62**	-0.11	-0.09	0.12	0.01	-0.06	0.43
5142 Data processing services	**0.62**	0.18	-0.11	-0.05	-0.06	0.27	0.50
5419 Other professional scientific and technical services	**0.54**	-0.11	0.37	-0.04	0.15	-0.18	0.50
5413 Architectural engineering and related services	0.35	**0.70**	-0.04	0.15	-0.11	0.02	0.65
2131 Support activities for mining & oil & gas extraction	-0.18	**0.77**	0.00	0.00	0.07	0.00	0.64
4884 Support activities for road transportation	-0.04	-0.06	**0.77**	-0.01	0.04	-0.01	0.61
1153 Support activities for forestry	-0.17	0.03	**0.80**	-0.03	-0.07	0.01	0.67
4881 Support activities for air transportation	-0.16	-0.06	-0.19	**0.71**	0.15	-0.27	0.67
5141 Information services	0.41	0.08	0.00	**0.48**	-0.03	0.22	0.45
5133 Telecommunications	0.29	0.15	0.14	**0.58**	-0.11	0.16	0.50
4883 Support activities for water transportation	0.03	-0.35	0.14	0.15	**-0.65**	0.02	0.59
1150 Support activities for farms	-0.04	-0.24	0.11	0.15	**0.80**	0.11	0.74
4882 Support activities for rail transportation	-0.09	-0.01	-0.03	0.02	0.09	**0.90**	0.82
Variance explained by each component	3.92	1.52	1.50	1.31	1.18	1.09	

note: only the first five components are analysed in the paper: however, all components with variance greater than one were retained.