COLLECTIVE LEARNING PROCESSES, NETWORKING AND 'INSTITUTIONAL THICKNESS' IN THE CAMBRIDGE REGION

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Abstract:

The paper investigates the nature and extent of regional collective learning processes and networking in the Cambridge region between innovative technology-based SMEs (small and medium-sized enterprises) and other organisations such as Cambridge University. It highlights the importance of preconditions for learning, and empirically documents the significant role of spin-offs, inter-firm and organisation networking, and regional scientific and managerial recruitment, as dynamic collective learning processes. It also, however, reveals the parallel and complementary importance of wider national and global technology networks, for innovation inputs, research collaboration and professional staff recruitment. Finally, it assesses the relevance of the concept of "institutional thickness" in evaluating firms' experience of regional support structures and services. The paper's authors gratefully acknowledge the financial support of the ESRC, and valuable discussions with colleagues in the EC-sponsored TSER European Network on regionally-clustered high-technology SMEs, coordinated by the Cambridge CBR.

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1. Introduction and Theoretical Framework

Recent theoretical research on the economic and technological development of dynamic European regions has drawn attention to the supposedly key role in such regions of "untraded inter-dependencies" between local firms and other organisations (Storper, 1995), involving informal inter-firm networking (Yeung, 1994) and processes of "collective learning" (Camagni, 1991; Lorenz, 1992; Lazaric and Lorenz, 1997; Lawson, 1997a). These processes, which involve exchange and development of technological expertise and high rates of technological and product innovation, are seen as being based on relationships of trust and reciprocity, while the networks and processes themselves are viewed as influential in the recent evolution of dynamic regional clusters of innovative small and medium-sized enterprises (SMEs; see Keeble, 1996). One important source for this work are the ideas of the GREMI (Groupe de Recherche Européen sur les Milieux Innovateurs) European school of regional economic research associated with Aydalot (1986; Aydalot and Keeble, 1988), Camagni (1991) and their fellow workers. This group has developed the concept of "collective learning" to connote a broad notion of the capacity of a particular regional "innovative milieu" to generate or facilitate innovative behaviour by the firms which are members of that milieu. Indeed, for Camagni (1991, 130), collective learning is central to the development and definition of a successful milieu; "the local 'milieu' may be defined as a set of territorial relationships encompassing in a coherent way a production system, different economic and social actors, a specific culture and a representation system, and generating a *dynamic collective learning process*" (italics added). However, as Lawson (1997a) points out, Camagni also and more directly defines the process of regional collective learning as being primarily concerned with regional mechanisms which reduce the uncertainty faced by firms in a rapidly-changing technological environment, such as that associated with a "competence gap" arising from the firm's limited ability to process and understand available information; a key example of such uncertainty is "the existence of technical problems whose solutions are obscure" (Camagni, 1991, 126). Reducing or eliminating this "competence gap" demands the development by the firm of effective "transcoding functions" which "translate external information into a language which the firm may understand", functions which can

merge both codified and tacit information into firm-specific knowledge, including R & D knowledge (Camagni, 1991, 127). For Camagni, a successful regional innovative milieu embodies "hidden, mainly tacit functions", in the form of "a collective learning process" operating "mainly through skilled labour mobility within the local labour market, customer-supplier technical and organisational interchange, imitation processes and reverse engineering, exhibition of successful 'climatisation' and application to local needs of general purpose technologies, informal 'cafeteria' effects, complementary information and specialised services provision".

Camagni's conceptualisation of regional collective learning thus focuses on links and networking between firms and via the regional labour market, accords it a central role in the development of a successful innovative milieu, and pinpoints a number of key mechanisms by which it may take place. A broadly related view is held by Lorenz (Lorenz, 1996; Lazaric and Lorenz, 1997) as reviewed in Lawson (1997a). Lorenz's starting point is however the literature on learning processes within the firm (for example March, 1991). This concerns the ways in which firms seek to overcome internal coordination problems by constructing shared knowledge in the form of commonly understood rules and accepted procedures. By extension, regional collective learning can be understood as the emergence of basic common knowledge and procedures across a set of geographically-proximate firms which facilitates co-operation and solutions to common problems. In this context, Lorenz identifies three areas in which firms need to develop shared knowledge. First, in terms of preconditions for learning, there is the need to establish a common language for talking about technological and organisational problems. This is closely related to the need for common standards of honesty and information sharing as the basis for the adaptation of industrial partners to unanticipated contingencies not explicitly provided for in formal contracts. As Lorenz (1996) points out, "a clear understanding and mutual consensus over the rules provides a basis for the progressive build-up of trust, which is arguably indispensable for innovative collaboration, given the uncertainties which surround its terms and outcomes".

Secondly, "there is a need for a shared knowledge of a more strictly technological or engineering sort, which allows different firms to effectively collaborate in a technological project" (Lorenz, 1996). This knowledge is not simply (or most importantly) concerned with core research, but with the more down-stream phase of innovation, involving detailed product design, testing, re-design and production. This "in-house" knowledge is often difficult to transfer because it is not easily codified as "its transfer depends ultimately on the mobility of individuals or teams" with practical experience in the technology concerned. The third kind of shared knowledge is organisational, examples suggested by Lorenz being how to manage

hierarchical relations, how to divide responsibilities among different occupations or services, or what procedures are needed to assure the consistency of collective decision-making.

Lorenz's approach, though from a different theoretical starting point, thus bears a number of similarities to Camagni's. There is the same stress on the need for firms to reduce uncertainties by sharing and collaborating, the same implicit emphasis on local inter-firm relations or networking, and the same recognition of the probable importance of such mechanisms or processes of regional collective learning as the movement of key research staff or entrepreneurs between firms; "mobile workers [are] the carriers of knowledge on the local labour market" (Lorenz, 1996). Equally, Camagni like Lorenz recognises the importance of establishing common "tacit codes of conduct... and the formation of common 'representations' and widely shared 'beliefs' on products and technologies", an aspect of regional collective learning which Camagni sees as likely to be encouraged by "synergy effects stemming from a common cultural, psychological and often political background, sometimes enhanced by the effectiveness of some local 'collective agent' " (Camagni, 1991, 133-4). Camagni's longer theoretical discussion is however more explicit about the key role of geographical proximity in the development of collective learning, stressing as it does the role of locally-rooted (at least to some extent) human capital resources whose "presence accounts for much of the local collective learning process", the "presence of an intricate network of mainly informal contacts among local actors, building what Marshall called an 'industrial atmosphere' ....., made up of personal face-to-face encounters, casual information flows, customer-supplier co-operation and the like" (Camagni, 1991, 133), and the local synergy effects associated with a common cultural background noted above.

2. The Cambridge Region: Context and Methodology

This paper reviews the role of collective learning processes in the recent growth of the dynamic regional cluster of technology-based SMEs which has developed in the Cambridge region, defined broadly as covering settlements located up to 15 miles around the city of Cambridge, but excluding Huntingdon and Peterborough. This area now contains a substantial cluster of small and medium-sized technology-intensive firms, estimated by the Cambridgeshire County Council's Research Group to have totalled 715 companies, employing 24,024 employees, in 1996. Descriptive statistics of this regional cluster are plotted in Figures 1-4. The cluster is historically focused on Cambridge university with its global reputation for research and scientific activity, and contains a diversity of technology-based sectors rather than being specialised on one particular sector (Keeble, 1989: Keeble and Moore, 1997). This diversity includes both high-technology manufacturing and services, the latter representing the dominant growth component in the Cambridge case in the 1990s (Keeble and Moore, 1997: Lawson, 1997b). The data reported here are derived from a 1996 interview survey by the

ESRC Centre for Business Research (hereafter called the CBR Survey) of 50 technology-intensive SMEs in this region, based on a stratified random sample designed to produce a representative balance of such firms between manufacturing and services, but with inclusion of a somewhat higher proportion of larger SMEs rather than very small firms.

3. Collective Learning Pre-Conditions and Processes

One of the most important, but also most elusive and difficult to measure, aspects of regional collective learning capacity stressed by both Camagni and Lorenz is the need for pre-conditions for learning, in terms of common regional culturally-based rules of behaviour, language of engagement and collaboration, accepted but tacit codes of conduct between firms, which enable the development of trust, itself essential for innovative collaboration (see section 1). As Camagni notes (1991, 133), the development of these "cultural" pre-conditions may also be "enhanced by the effectiveness of some local 'collective agent' ". The existence to a significant degree of common tacit codes of behaviour between Cambridge region technology-intensive SMEs can perhaps be inferred from the outcome of a high frequency of close inter-firm links documented later. More generally, however, qualitative discussions with entrepreneurs and managers during the course of the CBR survey strongly suggested the existence of two key sources (or local "collective agents") of such a regional code of behaviour, namely Cambridge University on the one hand, and a small group of large local R&D consultancies on the other.

Cambridge University is characterised by generally liberal and positive academic attitudes towards research collaboration, sharing and the development of new knowledge which appear to have spilled over into and helped shape, to a considerable degree, the wider culture of the local research-based business community, via university spin-offs, researcher recruitment and direct research collaboration (Keeble and Moore, 1997). Such attitudes and rules of research behaviour, with their positive valuation of research interaction, dissemination, debate and collaborative endeavour, arguably provide a local cultural context which is particularly conducive to the development of innovative and cross-fertilising research within and between local firms. Segal Quince Wicksteed (1985, 69) even go so far as to suggest that Cambridge University's culture and policy may be exceptional in this regard; "it is perhaps in these respects that the Cambridge approach stands in sharpest contrast to those of most other British Universities; a central perception of the strategic value of industrial links and a commitment to its realisation, and to do so through a reliance on research excellence and on liberal ground rules governing its exploitation rather than by means of formal regulation and institutional devices". Their 1985 Cambridge Phenomenon study also argued that a high proportion of then operating Cambridge high-technology firms owed their existence to

Cambridge University, either directly or indirectly by spin-off from firms themselves originally spinning-off from the University. This would support the 'culture of research collaboration' thesis suggested above.

The role of the region's large local R&D consultancies may also be significant in this development of a regional culture of trust and collaborative research. These R&D consultancies (notably Cambridge Consultants, PA Technology, Scientific Generics, and The Technology Partnership), which exist to carry out technology development and innovative research on behalf of national and global clients, have played a very significant role in generating and fostering local research-intensive spin-offs, in a pro-active and positive fashion. Again, the 1985 Segal Quince Wicksteed report noted that "Cambridge Consultants....launched in 1960 by a group of newly graduated scientists and engineers...has exercised a distinctive influence on the Cambridge high technology business scene, directly through the number of companies it has helped spin out from itself and indirectly....as indicative of the creativity and indivisual enterprise of the University's engineers and scientists". Their own internal organisational cultures were thus themselves shaped by University research values, which have arguably then been reproduced and diffused locally through active spin-off mechanisms. Both university and R&D consultancy activity may thus have encouraged a local culture of trust and collaborative activity which has been highly beneficial to continuing technological innovation and small firm growth.

4. Regional Collective Learning Processes

The regional collective learning literature reviewed earlier suggests that the development of a collective learning capability in the Cambridge region is likely to reflect three key mechanisms or processes of collective learning, namely the degree of local movement and spin-off of embodied technological and managerial expertise in the form of entrepreneurs, the frequency and importance of inter-firm networking and interaction, and the importance of flows of research and professional staff between local firms.

The CBR Survey reveals strong evidence of active processes of local spin-off and movement of research-focused entrepreneurs, with their embodied expertise, nearly all of whom choose to establish their new enterprises in the Cambridge region rather than move elsewhere. This is documented both in terms of the origins of the firms surveyed (Tables 1 and 2) and their own subsequent role in spinning-off further new technology-based firms themselves (Table 3), in a cumulative and mushrooming process. Thus 88% of the technology-intensive firms studied were originally set-up either as entirely new independent start-ups or spin-offs from an existing firm or institution, while in turn 81% of these were set up by founders who were

previously working within the Cambridge region, and most frequently for another local firm (56%). Employment in a local (usually Cambridge) university was the next most frequent origin (19%). These findings imply considerable local diffusion of embodied research expertise and capacity for technological innovation as well as of cultures, values, and codes of conduct developed in the "incubating" organisation. This judgement is supported by Table 2, which reveals that 77% of founders claim to have possessed previous research experience, while 69% claim previous managerial experience. This high degree of previous research and managerial expertise again reinforces the argument that entrepreneurial spin-off and start-up is an important process whereby technological and organisational expertise is diffused and a collective learning capability built up within a technology-based region such as Cambridge.

Table 3 further supports this by revealing that 48% of the surveyed high-technology firms reported cases of individuals who had in turn left them to set up their own companies. All the resultant spin-offs were set up locally within the Cambridge region, with 75% of these retaining links with the "parent" or "incubating" company. These involved a wide variety of interactions, ranging from continuing personal contacts, swapping of ideas and helpful comments to more formal sub-contracting, share holding or joint venturing arrangements.

Of course, most founders spinning off from existing local firms or organisations remain in the Cambridge region because of simple "geographical inertia", with 86% of new start-ups or spin-offs reporting that a major reason for locating the business in the region was simply that the founder(s) already lived there. However, it is also true that when asked about regional advantages for the firm's development, firms rated "informal local access to innovative people, ideas and technologies" (Table 4) as important more frequently than any other factor (out of 19) except the attractive local living environment and the reputation of a Cambridge address. The quality of the region's research staff came fourth, and availability of research staff sixth. These findings thus reveal an awareness on the part of many Cambridge SMEs of the existence and benefits of access to regional technological expertise and a collective learning capacity.

While recent SME surveys in Britain reveal an increasing frequency of collaborative or partnership arrangements by manufacturing and business service SMEs (Kitson and Wilkinson, 1996, 26-8), other research has argued that many SMEs exhibit low levels of local or even regional networking, if very small firms which exist simply to serve local customers and clients are excluded (Curran and Blackburn, 1994; Cooke ..... 1998). Table 5 is thus noteworthy in revealing that no less than 76% of Cambridge region high-technology SMEs claim to possess "close links" with other firms in the relatively small Cambridge region (see also Lawson et al., 1997 and Lawson, 1997b). For two-thirds of these firms (Table 6), links

with suppliers and sub-contractors are regarded as moderately, considerably or extremely important, while over half of these firms also regarded local links with service providers as important to their firm. Relatively high levels of informal contact between local managers and research staff in different local companies is revealed by Table 7, with four out of every five respondents reporting frequent or occasional meetings with individuals from other local companies. The CBR study also found that research links since formation with local universities, notably Cambridge University, and public sector research institutes, were reported by 50% of the surveyed high-technology SMEs, with over half (56%) of these regarding such links as being moderately, considerably or extremely important for the firm's development (Keeble and Moore, 1997). Taken together, then, these findings provide clear empirical evidence of the existence of frequent inter-firm and other organisational links within the Cambridge region, which significant numbers of firms regard as important for their development. This is in line with theoretical expectations of an "information rich" regional mileu possessing an effective and vibrant collective learning capacity.

The third collective learning process to which the theoretical literature draws attention concerns the extent and role of "skilled labour mobility within the local labour market" (Camagni, 1991, 127), this "mobility of individuals or teams" (Lorenz, 1996) again involving the diffusion of embodied and tacit expertise and technological know-how. In the Cambridge and Oxford region context, this is likely to focus particularly on the role and local recruitment of scientists, engineers and other research staff, and of managers experienced in guiding technology-based start-ups. However, such highly-qualified and high-income workers are known to be exceptionally mobile geographically, usually operating within national if not international rather than local labour markets (Green and McKnight, 1996). In addition, opportunities for local recruitment are bound to be limited by the very small scale of business activity and employment (250 thousand) within each of the two study regions compared, for example, with neighbouring South East England (6,900 thousand).

Given these qualifications, it is noteworthy that although the single most important source of recently recruited researchers and managers was UK-based firms from outside Cambridge, firms in the Cambridge region represent the second most frequent source of recruitment of both researchers and managers (Table 8), out of the six categories listed. In addition, one-fifth of firms had recruited at least one recently-appointed research worker directly from Cambridge University. In all, 38% of all research staff recruitment, and 33% of management staff recruitment, now comes from within the Cambridge regional milieu. Notwithstanding the 'footlooseness' of highly-qualified staff and the small size of local labour markets noted above, the region is characterised by considerable localised flows of embodied expertise, in the form of research and managerial staff, in addition to the spin-off and mobility of entrepreneurs

discussed earlier. And these flows in turn appear to result in a significant level of continuing inter-firm links which are rated highly by the firms involved (Table 9), with 35% of all firms surveyed regarding such links as important for their development. This finding may possibly be associated with the recent growth in the region of distinctive micro-clusters of small dynamic technology-based SMEs in such sectors as telecommunications, computer software and internet applications, and bio-technology (Keeble and Moore, 1997). Interview discussions with local firms suggested that there is a significant interchange of highly qualified staff within these clusters, with new local firms benefiting from a growing local pool of technological, research and professional expertise.

5. Global and National Innovation Networks

The above discussion supports the view that the Cambridge region cluster of technology-intensive SMEs is characterised by active collective learning processes which diffuse and develop technological and managerial expertise among, and enhance the innovativeness of, local firms. However, as Camagni (1991, 134-141) stresses, in a technologically-dynamic and highly uncertain world, local 'milieu' effects undoubtedly have their limits, and must be seen in conjunction with the parallel importance of wider inter-firm networks as an essential means of access to information on rapidly-changing technologies and market opportunities. This is particularly true "in those areas of production characterised by fast innovation and technological change" (Camagni, 1991, 137). Indeed, Camagni (1991, 139) argues explicitly that in such sectors, local firm involvement in wider national and global networks is absolutely essential for long-term regional growth, and that "the 'milieu' has to open up to external energy in order to avoid 'entropic death' and a decline in its own innovative capacity". For Camagni (1991, 139), regional collective learning or "'milieu' relationships and network relationships appear as complementary and mutually reinforcing 'operators', the former linking the firm to its contiguous environment through mainly informal, tacit (and often even overlooked and apparently unappreciated) relationships, the latter linking it explicitly to selected partners in its [wider] operational environment".

Camagni's stress on the importance of wider global and national innovation networks is powerfully supported by the empirical results of the Cambridge CBR survey (Keeble et al, 1997). This reveals the importance, and indeed dominance, of such wider networks in three strategic areas of local high-technology firm activity, namely external innovation inputs, inter-firm research collaboration, and scientific and professional labour markets.

First, when asked directly for the source(s) of the firm's "innovating activities" over the past three years, substantially higher (though small) proportions of firms rated external sources in

the rest of the UK or abroad (Table 10) as important than rated external sources within the Cambridge region itself. The most frequently cited geographical scale of innovation network was at the UK national level, with foreign sources of innovation inputs generally coming second. Only for university and consultancy sources was the Cambridge region ranked first or second. National and global innovation networks are thus appreciably more frequently rated as important than are local networks. However, it must also be stressed that the great majority of firms rated internal sources of innovation, within the firm, much more highly than external sources (Table 11), internal innovativeness in turn often reflecting previous local spin-off or recruitment of "embodied expertise" as documented in the collective learning section above.

Secondly, and equally noteworthy, Cambridge technology-based firms also report a much higher share of collaborative research activity with other firms in the UK, and even abroad, than with local firms (Table 12). For high-technology firms engaged in such collaboration, on average no less than 48% of collaborative activity was with other UK firms, and 37% with foreign firms, compared with only 14% locally. National and global research networks are thus again much more more important than local links.

Finally, as Table 8 has already demonstrated, and notwithstanding the existence of significant flows of expertise within the local labour market, most recruitment of research and management staff takes place nationally, with some recruitment (especially for managers) even globally. In all, 62% of research staff and 67% of management staff recently appointed by local technology-based firms were recruited from outside the local mileu. Wider global and national innovation and recruitment networks thus play a major role in the functioning and growth of high technology SMEs in the Cambridge region, arguably complementing regional collective learning processes as argued by Camagni.

6. Regional Collective Learning Processes and “Institutional Thickness”

The final issue addressed in this paper is the role of the regional institutional environment in enhancing and shaping the development of a collective learning capacity amongst technology-based SMEs in the Cambridge region. In this context, the concept of "institutional thickness" (see Table 13) as proposed by Amin and Thrift (1994; 1995, 102) may be helpful. Some evidence on the extent and use of available local institutional resources is provided in Tables 14-16. The first of these focuses on the role of local government-funded or collectively-organized business support and training agencies, providing help or advice to local technology-based firms. The local Training and Enterprise Council (TEC) is part of a national central-government funded system of skills training provision, while the Cambridge Enterprise Agency is a non-profit making organization which exists to advise new start-ups. The DTI

Enterprise Initiative provided part-funded consultancy assistance during the early 1990s. However, at most only one-third of firms reported receiving help or advice from one or other of these institutions, while only a third of these in turn rated this help as of some value. As of 1996, the Cambridge region did not appear to be characterised by public sector business support agencies which were widely used or valued by local technology-based enterprises. In this respect, local institutional thickness appears to be limited.

A second type of specific institutional support is the existence in the region of the Cambridge Science Park and St John's Innovation Park, established by Cambridge colleges (not government) to support and incubate high technology firms (Segal, Quince, Wicksteed, 1985: Keeble, 1989: Reid and Garnsey, 1996, 1997). These institutions have attracted widespread attention and global publicity, but cater for only a minority of local firms. Their most highly rated advantages (Table 15) are flexibility of tenure, car parking availability, inter-firm networking opportunities and conferred credibility. These ratings do support the view that this particular - though very specific - aspect of the institutional environment, which includes stimulating collective learning through inter-firm networking (Table 15), is beneficial to local technology-based firms able to afford the higher costs (Table 15) involved.

The final aspect of the institutional environment investigated by the CBR survey concerns the local provision of key business services by other firms (Table 16). Here, three areas of use of external firm expertise and service provision in which services and networks within the Cambridge milieu are both widely accessed and highly rated are evident. These are accountancy services (84% external use, 97% local use for 50% or more of the firm's needs, and 74% rating local service of significant or high quality), legal services (74%, 86% and 74% respectively), and design and printing services (76%, 81% and 88% respectively). In addition, although venture capital was accessed by only 20% of firms, two-thirds of these obtained finance from Cambridge-based venture capital firms and rated this highly (71%). In contrast, low local usage and quality ratings are recorded for management consultancy, public relations, market research and marketing agencies, while although local use is considerable, respondents rated both local banks and personnel and recruitment agencies surprisingly poorly in terms of the quality of the service provided (only 50% and 53% rated local provision of significant or high quality, respectively). These results do support the view that the Cambridge region has developed an effective supportive infrastructure of local accountancy, legal and design/printing firms, with specialist experience of the needs of small and medium-sized technology-based firms, and that a minority of such firms also benefit from the local availability of venture capital providers. Other "layers" of local private-sector institutional support within this milieu do not however emerge from this analysis so positively, with local banks in particular recording a relatively low quality rating by local high-technology

enterprises. This is particularly noteworthy given the stress in earlier accounts of the development of the Cambridge Phenomenon on the influential role of Barclays Bank in "brokering" and encouraging new technology-based start-ups in the late 1970s and early 1980s (Segal Quince Wicksteed, 1985; Keeble, 1989). Overall then, this analysis does suggest that the Cambridge region has developed some degree of institutional thickness in terms of the provision and effectiveness of particular local services, quite apart from the wider role of Cambridge University, and the positive activities of specific local agencies such as the St. John's Innovation Park.

7. Conclusions

The concept of regional collective learning focuses on the argument that regional clusters of small and medium-sized enterprises can, given favourable environmental, socio-economic and institutional conditions and sufficient historical evolution, develop a capacity for self-sustaining technological learning, innovation and the generation of new products and enterprises. The development of a regional capacity for collective learning involves both the establishment of pre-conditions for learning, in the form of culturally-based rules of behaviour, engagement and collaboration and accepted but tacit codes of conduct between individuals and firms which enable the development of trust, and active regional processes of inter-firm networking, interaction and exchange of expertise.

This study has attempted to apply these theoretical ideas to the case of the Cambridge region, where preconditions for collective learning may have been provided by the focal role of the university and its liberal ethos of unfettered and collaborative research enquiry, operating particularly through academic spin-offs and graduate researcher recruitment, together with the activities of large Cambridge R & D consultancies. It shows that the region is, in the 1990s, characterised by active processes of entrepreneur and firm spin-off, involving the transfer and diffusion within the region of "embodied" technological and managerial expertise, of inter-firm and organisation networking and linkages, and of research and management staff recruitment from the local labour market. At the same time, however, it also demonstrates the major importance to local technology-based firms of wider global and national innovation networks, research collaboration, and labour market processes, which complement regional collective learning processes by bringing into the region essential external technological and managerial expertise. Finally, it suggests that the degree of "institutional thickness" which has developed in the region to support local technology-based firms is perhaps limited, with the provision of Science Park accommodation (for those firms which can afford it) and of private sector accountancy, legal, design/printing and venture capital services being most highly rated by the firms themselves.

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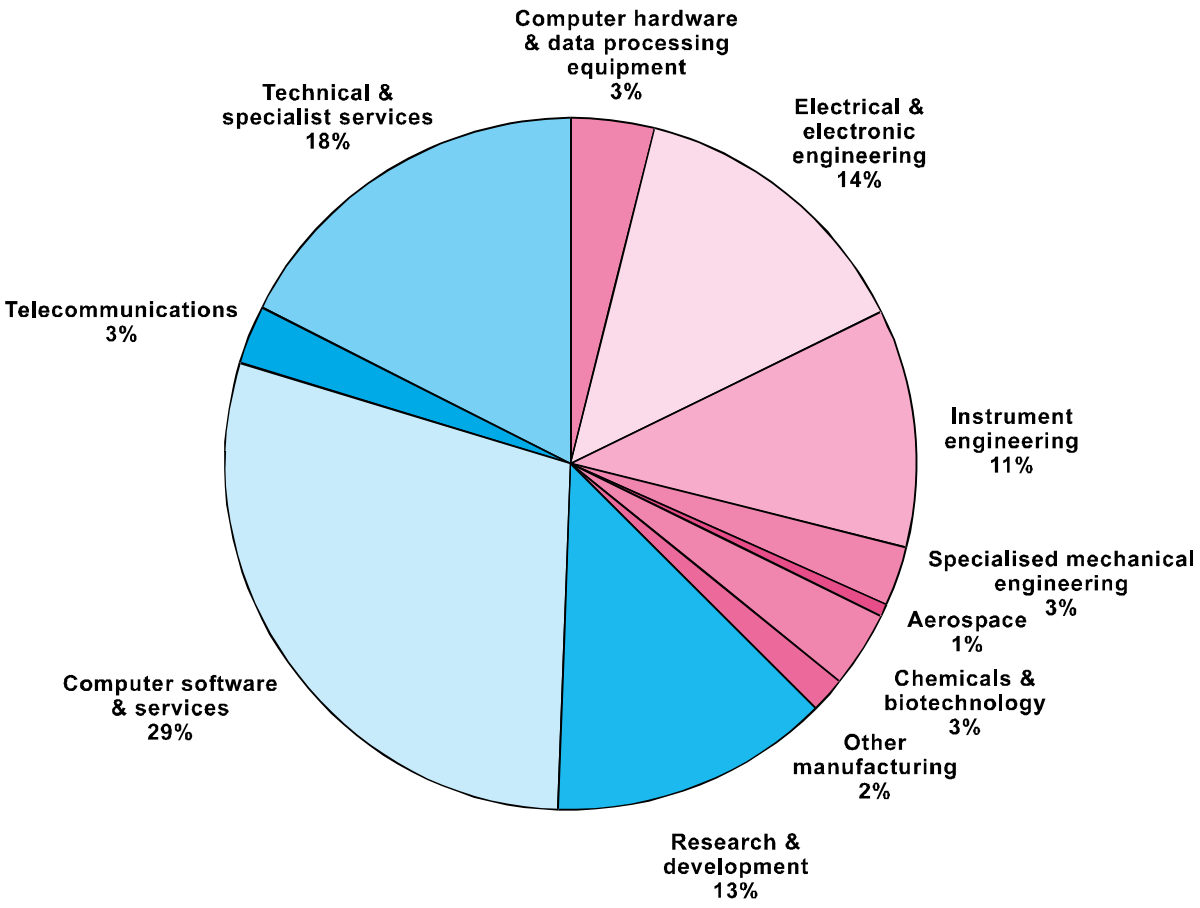
Figure 1

Number of High-Technology Firms in the Cambridge Region, 1996

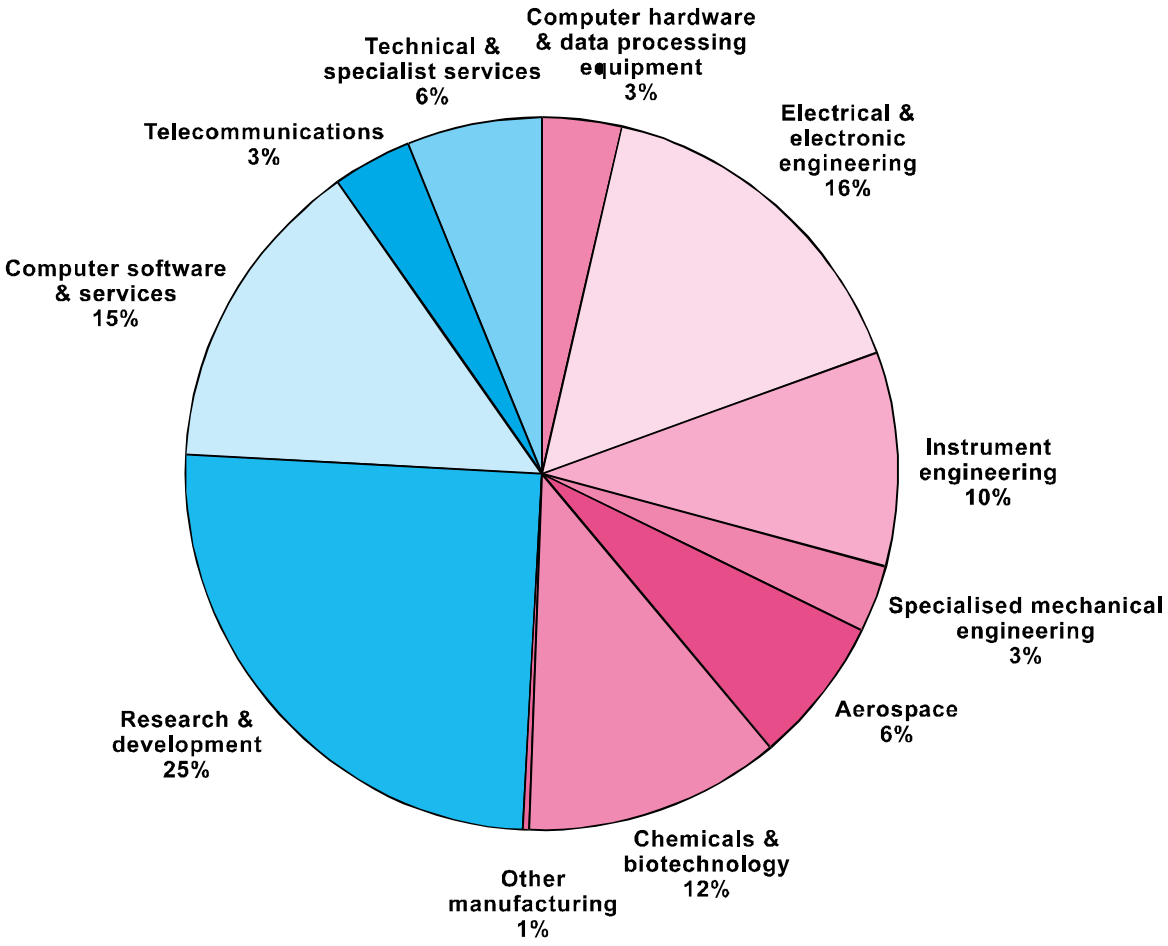


Total number of firms - 715

Source: Cambridgeshire County Council (1996)

Figure 2

Employment in High-Technology Firms in the Cambridge Region, 1996

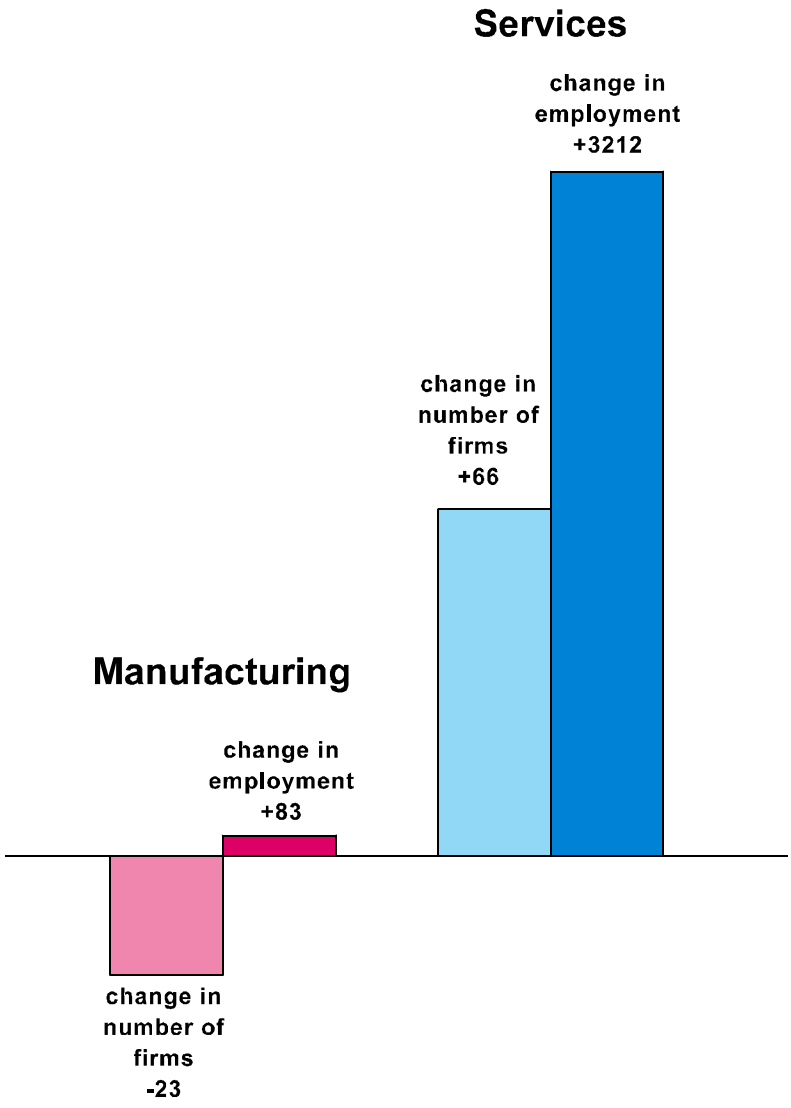


Total number of employees - 24,024

Source: Cambridgeshire County Council (1996)

Figure 3

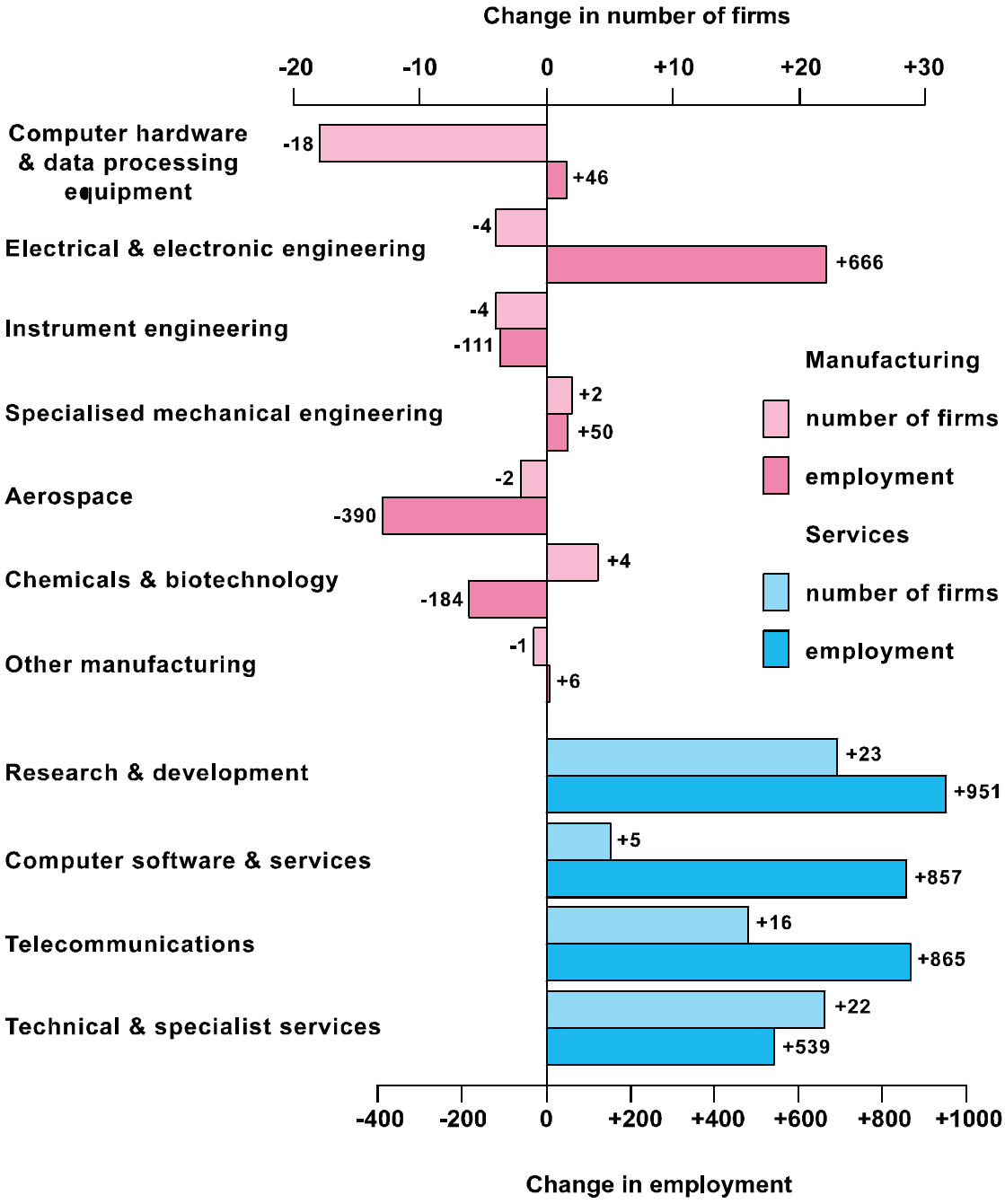
Change in High-Technology Firms & Employment in the Cambridge Region, 1991 - 1996



Source: Cambridgeshire County Council (1996)

Figure 4

Change in High-Technology Firms & Employment in the Cambridge Region, 1991 - 1996



Source: Cambridgeshire County Council (1996)

Table 1: Cambridge Region High-Technology SMEs: Founder's Origins, Locally-Generated

A. "Was your firm set up by another firm, as a spin-off from an existing firm/institution, or as a new independent start-up?"

Firm origin: set up	Number	%
by another firm	6	12
as a spin-off	16	32
as an independent start-up	28	56
Total	50	100

B. "For new start-ups and spin-offs only, where was the chief founder employed immediately previously?"

	Type of Firm or Organisation				
Location	Self employed/ Unemployed	University	Government Research Laboratory	Firm	Total
Cambridge region	2 (5)	8 (19)	1 (2)	24 (56)	35 (81)
Rest of UK (4) or abroad (4)	0	2 (5)	0	6 (14)	8 (19)
Total	2 (5)	10 (23)	1 (2)	30 (70)	43 (100)

Note: % of total respondents (43) given in brackets.
Source: CBR Survey

Table 2: Local Entrepreneurship and Research and Managerial Expertise

"Did the founder possess managerial qualifications, managerial experience, research qualifications and/or research experience?"

	Qualifications		Experience	
	No.	%	No.	%
Managerial	14	29	33	69
Research	30	63	37	77
Total	48	100	48	100

Source: CBR Survey

Table 3: New Cambridge Region Start-Ups by Former Employees and Inter-Firm Links

"Have any people who have left this company formed their own businesses?"

	No.	%
New business start-ups by former employees	24	(48)[1]
Start-ups located in Cambridge region	24	(100)[2]
of which:		
continuing links with 'parent' firm	18	(75)[2]
both formal and informal links	15	(83)[3]
only informal	3	(17)[3]

1 As % of all firms surveyed
2 As % of new business start-ups by former employees
3 As % of all firms with continuing links

Source: CBR Survey

Table 4: Region-Specific Advantages for Firm Development in the Cambridge Region

"How important have the following been for your firm's development?"

	% of firms reporting moderately, considerably or extremely important
Attractractive local living environment for staff and directors	80
Credibility, reputation and prestige of a Cambridge address	70
Informal local access to innovative people, ideas, technologies	54
Quality of local research staff	44
Access to London	44
Local availability of research staff	42
Availability of appropriate premises	42

Note: results relate to the seven most important (out of 19) advantages in terms of the number of firms rating the advantage 3, 4 or 5 on a scale from 1 indicating completely unimportant to 5 indicating extremely important.

Source: CBR Survey

Table 5: Local Inter-Firm Networking by Technology-Intensive SMEs in the Cambridge Region

"Do you have any *close* links with other firms in the Cambridge region?"

	Yes		
	No.	%	No. in survey
High-technology manufacturing	17	81	21
High-technology services	21	72	29
Total sample	38	76	50

Note: % is of total respondents in each row
Source: CBR Survey

Table 6: The Importance of Local Inter-Firm Links to Cambridge Region Technology-Intensive SMEs

"How important are *local* links with:"

	No.[1]	% of firms with local links
Suppliers or subcontractors	26	68
Firms providing services	20	53
Customers	12	32
Research collaborators	11	29
Firms in your line of business	10	26

[1] Firms rating the local link moderately, considerably or extremely important (3, 4 or 5) on a scale from 1 indicating completely unimportant to 5 indicating extremely important

Source: CBR Survey

Table 7: Opportunities for Informal Contact with Managers or Professionals from Other Local Firms

"How often do you have an opportunity to mix informally with managers or professionals from other local companies?"

	No.	%
Never	8	21
Occasionally	19	50
Frequently	11	29

Note: percentages are of total firms with local inter-firm links
Source: CBR Survey

Table 8: Research and Managerial Staff Recruitment and Mobility within the Cambridge Region

Firms reporting recruitment of at least one of their last three research/management staff from:

	Research staff		Management staff	
	No.	% [1]	No.	% [1]
Cambridge University	7	19	2	6
Other Cambridge firms or organisations	13	35	12	39
Other UK universities	10	27	3	10
Other UK firms/organisations	15	41	18	58
Overseas universities	4	11	1	3
Overseas firms/organisations	3	8	7	23

[1] Percentages are of total respondents to this question (37 for research staff, 31 for management staff)

Source: CBR Survey

Table 9: The Regional Research, Professional and Managerial Labour Markets

"Do any links exist between your firm and any other local firms because of *people* who have moved between these firms?"

	No.	%
Firms reporting links	23	48
Firms reporting that these links were moderately, considerably or very significant for their development	17	77

Note:
row 1 is % of all responding firms (48)
row 2 is % of firms with links due to staff movement (excluding 1 missing response): rating on scale of 1 not significant to 5 very significant.

Source: CBR Survey

Table 10: External Sources of Innovations in Products or Services over the Last Three Years

"Please rate the importance of the following as sources of your innovating activities"

	% of total respondents[1]		
	Source in Cambridge region	Source in Rest of UK	Source Outside UK
Suppliers of standardised materials or components	7	7	9
Suppliers of customised materials or components	4	11	7
Clients or customers	24	57	41
Competitors in your line of business	4	11	17
Consultancy firms	7	4	0
Universities/higher education institutions	17	22	9

[1] % rating source as moderately, considerably or extremely important (3, 4 or 5 on a scale from 1 completely unimportant to 5 extremely important)

Source: CBR Survey

Table 11: The Importance of Internal (Within-Firm) Innovation Sources for Cambridge Region Firms

	Firms	
Internal sources rated as:	Number	%
Not applicable	4	8.2
Totally unimportant	0	0.0
Slightly important	0	0.0
Moderately important	1	3.0
Considerably important	12	24.5
Extremely important	32	65.3
Total	50	100.0

Source: CBR Survey

Table 12: Global, National and Regional Research Collaboration Networks of Cambridge Region High-Technology Firms

Mean proportion of collaborative research activity with other firms, with firms in the following areas:	%
Cambridge Region	14.4
Rest of East Anglia and South East England	12.4
Rest of United Kingdom	35.6
Rest of Europe	19.4
Rest of World	17.8

Note: data relate to the 27 firms which responded fully to this question. Six others provided only very partial information which could not be used. It is probable that most of the remaining 17 firms carried out no collaborative research with other firms.
Source: CBR Survey

Table 13: "Institutional Thickness" (Amin and Thrift, 1994) and Regional Collective Learning

[We] "claim that social and cultural factors also live at the heart of [regional] economic success and that those factors are best summed up by the phrase 'institutional thickness'.

Institutional thickness is a multifaceted concept. ...the following factors...contribute towards the construction of institutional thickness. First and most obvious...is a strong institutional presence, that is a plethora of institutions of various kinds (including firms; financial institutions; local chambers of commerce; training agencies; trade associations; local authorities; development agencies; innovation centres; clerical bodies; unions; government agencies providing premises, land and infrastructure; business service organisations; marketing boards)....However, although the number and diversity of institutions constitutes a necessary condition for the establishment of institutional thickness, it is hardly a sufficient one. Three further factors are important.

The second factor is high levels of interaction amongst the institutions in a local area. The institutions...must...display high levels of contact, cooperation and information interchange. These contacts... are often embodied in shared rules, conventions and knowledge....The third factor must be the development, as a result of these high levels of interaction, of sharply defined structures of domination and/or patterns of coalition resulting in the collective representation of what are normally sectional and individual interests and serving to socialise costs or to control rogue behaviour. The fourth factor...is the development amongst participants in the set of institutions of a mutual awareness that they are involved in a common enterprise. This will almost certainly mean that there is a commonly held industrial agenda which the collection of institutions both depends upon and develops....

These four factors constitute a local institutional thickness defined as the combination of factors including inter-institutional interaction and synergy, collective representation by many bodies, a common industrial purpose, and shared cultural norms and values. It is a 'thickness' which....nourishes relations of trust..., stimulate[s] entrepreneurship and consolidate[s] the local embeddedness of industry."

(extract from A. Amin and N. Thrift, 1994, "Living in the Global", Chapter 1, *Globalization, Institutions and Regional Development in Europe*, A. Amin and N. Thrift, eds, Oxford University Press)

Table 14: Business Support Agencies and Technology-Intensive SMEs in the

14A "Have you received help or advice from any local agencies (government-sponsored or otherwise) over the last five years?"

	No.	% respondents
Training and Enterprise Council	16	32
District or City Council	6	12
Chamber of Commerce	15	30
Enterprise Agency	4	8
DTI Enterprise Initiative	18	36

14B "How useful was this help/advice?"

	No.	% respondents
No help sought	14	29
Of no value at all	9	18
Of slight value	9	18
Of moderate value	8	16
Of significant value	6	12
Of great value	3	6

Note: responses to 11B were ranked from 1 of no value at all to 5 of great value

Source: CBR Survey

Table 15: The Advantages of a Cambridge Science Park Location

For those firms (14) which had at some stage operated on a Cambridge region Science Park, "How helpful, if at all, were the following?"

	% firms
Flexibility of licensing/leasing of premises	86
Car parking availability	64
Opportunities to talk/network with other firms	57
Image and conferred credibility	57
Consultancy advice	36
Availability of shared facilities	36
Base to form (exploit) links with the University	14
Premises cost	0

Note: percentages are of firms reporting advantage as considerably or extremely helpful (4 and 5 on a scale from 1 to 5). Of the 14 firms, 7 had operated on the St. John's Innovation Park, 6 on the Cambridge Science Park, and 1 on the Melbourn Science Park.

Source: CBR Survey

Table 16: Institutional Support and the Provision and Quality of Local Services in

"In which of the following areas have you used external firms or services during the last five years? For those ticked, to what extent have you used firms from the Cambridge region as opposed to firms located elsewhere? How do you rate the quality of the service or advice provided?"

	Use external firm to provide service?		% responding 'yes' using local firms for 50% or more of their service needs	% of respondents using local firms rating quality of local service provided
	Yes	% firms		4 or 5[1]
Accountancy	42	84	97	74
Banking	40	80	87	50
Venture capital	10	20	67	71
Legal services	37	74	86	74
Management consultants	9	18	25	0
Public relations	15	30	31	40
Personnel and recruitment	25	50	83	53
Advertising	27	54	41	33
Market research	9	18	29	50
Marketing	6	12	40	50
Computer services	14	28	54	40
Design/printing services	38	76	81	88

[1] on a scale from 1 indicating poor quality to 5 indicating high quality

Source: CBR Survey