A. THE CAREER TRAJECTORIES OF KNOWLEDGE WORKERS

by

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Introduction

The diffusion of knowledge throughout the learning economy is of crucial relevance to economic prosperity and growth. But, as this paper attempts to show, the promotion of flexible labour market policy has to be treated with some caution. Even though it appears that one major way of diffusing knowledge throughout the economy is to promote labour mobility between firms, empirical evidence concerning the actual functioning of this labour flow is hard to come by. In this paper we utilise some recent data and arrive at some unexpected results.

We begin by analysing some of the attributes of knowledge workers (including S&T workers). Then it is demonstrated that external mobility (the mobility of workers between firms) can have some negative consequences. Internal mobility (the mobility of workers within firms) has some significant benefits, which must be considered by policy makers.

In terms of innovation (and hence economic growth) the proportion of scientists and engineers within firms is a significant factor – this result might lend some support to the notion of external mobility. However, we argue that the promotion of networks and collaborations of firms and other research institutions should not be pushed aside. The diffusion of knowledge and learning can be promoted by employees of different firms and organisations working together rather than shifting jobs. Knowledge intensive business services (KIBS) can have a vital role to play in facilitating knowledge transfers as an alternative to external mobility. We analyse firm level data that show the benefits of such collaborations and also refer to earlier work, which revealed the impact of KIBS at macro level.

S&T workers in the context of the learning economy

Following Lundvall's work on knowledge and learning economies, an earlier paper (Tomlinson 1999a) identified 'knowledge workers' (KWs) as comprising Standard Occupational Classification (SOC) groups 1-3[16] (which include S&T workers along with managers and other professionals). The paper showed that, if the movement of these workers was traced over time, there had been a significant shift of knowledge workers **into** services from other sectors, but very little the other way round. Furthermore, very little movement from non-technical occupations to technical occupations was observable during the 1980s. It was postulated that this is because there are significant barriers for workers outside this group to enter into technical occupations. This makes the dynamics of this group of particular importance in the study of labour markets.

16. A detailed description of the SOC is found in the Annex.

The knowledge "embodied in" these workers (to use the standard, if misleading, terminology) is particularly specialised. Its diffusion throughout the economy is therefore of particular importance. It is important to recognise that these workers do not only apply their knowledge through being employees of the firms that are using it to produce and distribute their wares. Increasing numbers of such KWs are active in the specialised service firms; knowledge intensive business services (KIBS). KIBS play an important role in the learning economy, not least in terms of fostering innovative behaviour.[17] And non-manufacturing sectors in general have seen the highest levels of growth in S&T workers in the 1980s (OECD 1998), partly as a result of the growth of these services (though also in part in consequence of the explosion of IT use in financial and other services, and the associated need for software, network, and other professionals within these services). This paper seeks to disentangle the importance of knowledge diffusion through two channels: firstly the mobility of labour (including especially KWs) and secondly through the development of networks of collaborators (including the facilitation of production by KIBS).

Data used

There are two main sources of data used in the analyses of this paper. These are the UK Community Innovation Survey 2 (CIS2) firm level dataset (1998) and the *Employment in Britain* (EIB) dataset of employees (1992).

The CIS2 data is a random sample of around 2 400 firms taken in the United Kingdom in 1998. The data has several items dealing with innovation, collaboration, R&D and other research activities and some information about firm level human resource practices. The dataset has comparable information for both manufacturing and service firms and has been weighted to represent the UK population (by firm size and sector).

The *Employment in Britain* data set was collected in 1992. The data were generated from a random sample of employed and self-employed people aged between 20 and 60. Detailed information was collected from 3 855 respondents, about their current occupation and attitudes to work. One significant aspect of this dataset is that detailed and complete career history data were also collected. This means that, for example, we can trace what a person was doing when they left education and follow them through to 1992. Thus, we can trace the shifts of skilled or knowledge based workers between firms or explore job shifts within an organisation at the employee level. The dataset also features several sections dealing with the nature of work and employment conditions in 1992 and how these were changing. [A detailed sociological analysis of these data can be found in Gallie *et al.* (1998)].

Breaking down some of the variables in the EIB data by occupational groups (Table 1) we find some differences between different types of knowledge workers. For example, more technical workers have used computers and had training than other groups, as we might expect. But, on the other hand, flexible working seems to predominate in managerial and other professional occupations as do skill increases and the increased provision of training. Technical staff appear to be more likely to have had training in the last 3 years and slightly more likely to think they will receive training in the future. But flexible working seems to predominate in managerial and other professional occupations, as do skill increases and an increased provision of training.

Perhaps the most interesting result from our point of view is that very few technical workers (17%) think that it would be very difficult to find another similar job – compared with 37% of managers and 28% of other professionals. This shows the more buoyant nature of S&T labour markets compared with other

17. One evident result of this is the prominence of these services in recent R&D data – in Britain, for example, the "R&D services" branch is responsible for some 10% of all BERD.

KWs, and reflects the high demand for this type of employee. Average tenure times also seem significantly lower for S&T workers than for all other categories (Table 2).

Table 1. Some characteristics of knowledge workers (%)

	Managers	Technical	Other profs.
Use microcomputers	68	78	65
Ever had training	64	85	79
Can work independently (v. true)	55	53	52
Often move between diff. types of work	34	26	27
Expected to be more flexible (v. true)	45	31	42
Keep learning new things (agree strongly)	30	40	48
Use past experience almost all the time	48	52	59
Skill increase last 5 years	73	65	74
Variety of tasks increased last 5 years	70	75	72
Provision of training increased 5 years	46	35	47
Had training last 3 years	55	77	69
Very likely to get training in future	41	42	39
If left job very difficult to get another job	37	17	28

Source: Authors.

Table 2. Average times in current job by occupational group

Group	Average time in current job (months)
Manager	49.9
Tech professional	37.5
Other professional	53.2
Administrative	41.9
Craft/Skilled	72.0
Personal service	55.1
Sales	45.2
Manual	68.5
Unskilled manual	61.5

Source: Authors.

At the firm level

At firm level it is easy to show that the proportion of the workforce that are qualified scientists and engineers, has a significant relationship impact on the introduction of radical new innovations to the market. This is the case whether we look at manufacturing or services (see Table 3). This, of course, does not simply mean that taking on QSEs makes it more likely that the company will innovate. The composition of the workforce is an outcome of strategic choices reflecting the firm's efforts to achieve competitiveness through innovation. Although this result may seem tautological, it must be borne in mind that the coefficient is still significant after controlling for the size and sector of the firm.

Table 3. Logistic regressions predicting new to the market innovations (data is UK CIS2, weighted)

	All firms	Nace 1 - 4	Nace 5 - 7
Log no. employees	0.333***	0.374***	0.284**
Percentage of S&T employees	2.215***	4.726***	1.152*
Import of reducing unit lab cost	-0.081	-0.047	-0.077
Nace Group:			
Mining/food/textiles	0.346	.642*	
Paper/fuels/chemicals/ metals etc	0.183	0.383	
Electrical/transport equipt	0.841***	1.007***	
Utilities/construction	-1.962**	Base	
Whole/retail/repair/hotel	-1.005***		-1.250***
Transport/finance	0.482*		0.219
Other business/public	Base		Base
Constant	-3.044***	-3.637***	-2.594***
Chi sqr	194***	76***	117***

Source: Authors.

The diffusion of knowledge embodied in S&T workers

It is widely held that the diffusion of technical expertise as embodied in KWs is taking on a new importance in the era of the knowledge economy. Not only does having a workforce of KWs enhance firm performance, but the mobility of KWs, and particularly of S&T workers, is seen as crucial to enhancing innovation and thus economic growth throughout the rest of the economy. Thus, restrictions on labour mobility are liable to be seen as harmful to economic prosperity in the long term as they restrict the diffusion of useful knowledge. One of the reasons for the advantages of the US is the higher mobility and 'brain gain' in the S&T labour market – or so the story goes. The account is plausible enough, but our data analysis suggests we need to be cautious in assuming its general applicability at least in the United Kingdom.

On the basis of such a positive view of labour mobility, policy relevance to S&T labour markets is a key to enhancing economic gains within the OECD countries. The OECD jobs study thus highlighted the relevance of breaking down barriers between public/private sector job mobility, enhancing relevant training programmes and increasing networks and partnerships where information and knowledge can be exchanged and diffused.

However, if we take a step back, we do not know what the trade-off is between *internal* and *external* labour mobility. What are the relative benefits of the two? Is there a trade-off between tenure time and job shift? How can a firm reconcile fostering life long learning at the same time as accepting a need for some level of labour turnover?

In order to explore such issues, we can use the concepts of 'dynamic' and 'static' knowledge transfer. We will assume that, when a job shift takes place, there are liable to be the most significant advantages to the receiving firm when the knowledge transferred is **dynamic**. Dynamic knowledge transfer is connected with the individual's *learning new skills* and *developing* new competences. Our argument goes that, if a worker does not learn anything new in his/her new position then, although some tacit or embodied knowledge may be applied in the receiving firm, it will do much less to enhance the capabilities of that firm than would a more active fusion of the knowledge brought in with the worker and that generated within the firm. Where the worker has knowledge that can be introduced to the firm's routines and enhance or change them, this

process will usually involve learning on both sides: the individual workers will have to learn new things, and the organisation gains and modifies its own capabilities. Otherwise, the new employee may fit the job description, but some of his/her knowledge goes by unrecognised; and this knowledge is fairly **static**. There are undoubtedly cases where the absorbing firm can benefit a good deal by acquiring people with specialised knowledge to undertake specific missions, and where these people need not learn too much about the firm's own core knowledge. This is often the case with junior software employees – not systems analysts – with people employed for various sectoral marketing tasks, etc. However, we need to find the relative benefits of learning vis-à-vis job shifts as a whole rather than within specialised sectors.

Our data can be used to examine the impact of job shifts within a firm and between firms (i.e. internal and external) on several learning indicators. This will give us an empirical indication of whether these shifts involve static or dynamic knowledge, after we control for other factors such as tenure, occupation and age.

Table 4. Models predicting learning, skill increases and increased variety of tasks at work (logit – after controls for occupation)

	Dependent variable		
Models:	Learning	Upskilled	Increased variety
Independent variables:			
1. No. jobs since 1987	.085**	.139***	0.098***
2. No. jobs since 1987	.125***	.153***	.129***
Log tenure	Ns	Ns	Ns
3. No. jobs since 1987 (same employer)	.141***	.307***	.200***
4. No. jobs since 1987 (same employer)	.157***	.333***	.218***
No. jobs since 1987 (different employer)	Ns	.063*	Ns
5. No. jobs since 1987 (same employer)	.201***	.342***	.246***
No. jobs since 1987 (different employer)	.083*	.078*	.077*
Log tenure	Ns	Ns	Ns
6. Log tenure	Ns	-.094***	Ns

Source: Authors.

Table 5. The effects of age on knowledge indicators rather than tenure (logits - base age is 50-60 years old)

	Dependent variable		
Models	Learning	Upskill	Inc variety
1. No. jobs since 1987	.063*	.095***	Ns
Twenties	.323*	.725***	.745***
Thirties	Ns	.539***	.417***
Forties	Ns	.512***	.373***
2. No. jobs since 1987 (same employer)	.142***	.297***	.179***
No. jobs since 1987 (different employer)	Ns	Ns	Ns
Twenties	.349**	.774***	.778***
Thirties	Ns	.535***	.413***
Forties	Ns	.515***	.374***
3. Twenties	.396**	.833***	.799***
Thirties	Ns	.601***	.446***
Forties	Ns	.540***	.387***

Source: Authors.

Table 6. Effects of inter- and intra-firm-shifts on commitment and other indicators (logits after controlling for occupation)

	Independent variable	
Dependent variable	Job shifts same emplr	Difft emplr
Work harder	Ns	-.095**
Proud to be in org	Ns	-.140***
Values similar	Ns	Ns
Success depends	Ns	Ns
Take any job	Ns	-.078*
Noticed	Ns	Ns
Had training	.400***	Ns
Increased flexibility	.346***	Ns
Use computers	.358***	Ns
Aiming to get better job	.346***	.376***
I will leave within the next year	.108**	.305***

Source: Authors.

Discussion

From Table 4 we see that the number of job shifts appears to affect our three learning indicators (model 1). However, there appears to be a significantly greater effect from job shifts *within* organisations rather than *between* them (models 3, 4, 5). There also appear to be very weak effects from tenure, suggesting that the amount of time spent in a job has little impact on learning and skills. (There was only a significant effect in one model, which disappears when job shifts are controlled for.) Age has a much more significant impact on learning than tenure (Table 5).

These results indicate that an element of caution must be exercised in promoting job mobility as a way of diffusing knowledge. In terms of dynamic knowledge flows, as represented by our three dependent variables, it appears that the impact of mobility, i.e. within firm shifts is much more beneficial than between firm shifts. Although between firm shifts undoubtedly allow knowledge to diffuse, it appears to be knowledge of a more static kind.

These results therefore suggest that inter-firm job shifts tend not to involve as much learning and upskilling after taking occupation into account. This in turn suggests that people are hired from outside because they *already* have a specific portfolio of required skills rather than being hired into jobs where they can enhance their own stock of competences. This may, of course, be an effective way of importing knowledge into a firm. But if the individual who "embodies" this knowledge is not learning much, him or herself, from the new location, it is likely that this knowledge is remaining compartmentalised and tied to that person: there is little interactive learning. The firm as a whole will not possess much resource, in consequence, if the person moves on. And even while the individual is in place, the firm may not be able to profit from using him/her flexibly, from truly capitalising on that person's skills.

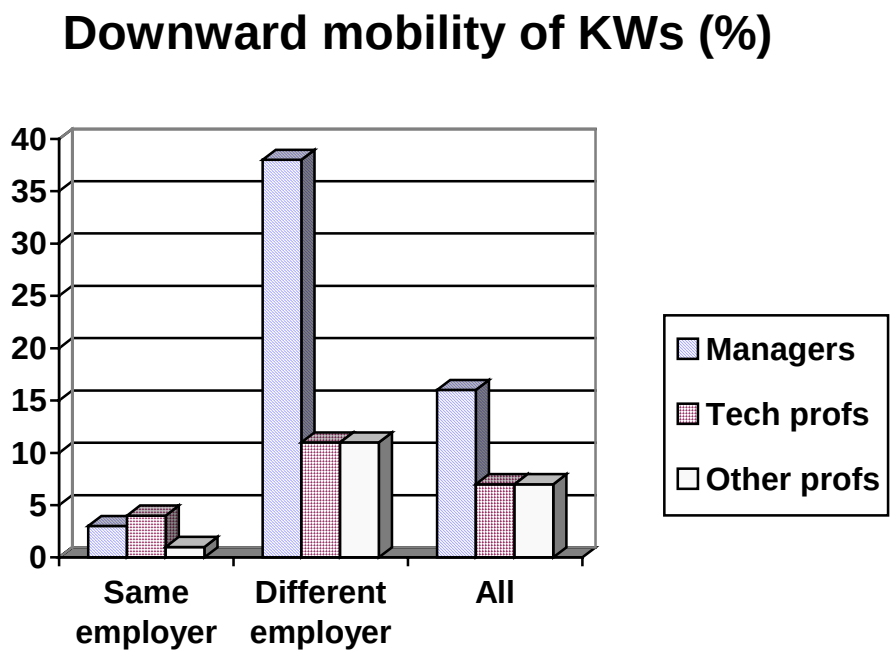
In terms of an ethos of lifelong learning, there is a potential contradiction emerging between the diffusion of embodied knowledge through the labour market and a commitment to self-improvement. People are more likely to improve their portfolio of skills by moving around within their organisation.

If this is the case, it could be argued that one of the disadvantages of fostering a high degree of external mobility would be a lack of commitment to any particular organisation. While those firms fostering an internal labour market might reap other benefits from their employees in terms of extra effort or dedication to the organisation. Table 6 shows the results of several models predicting organisational commitment

variables. Perhaps surprisingly, it appears that within firm job shifts appear to have no significant impact on organisational commitment after controlling for occupation. However, those workers who have moved between firms the most have significantly negative attitudes to three of the organisational commitment indicators: 'I would work harder in order to make this organisation succeed'; 'I am proud to be working for this organisation'; and 'I would take any job in order to stay with this organisation'. Although there is a potential problem with the interpretation here (workers who have shifted between many firms may do this because they are intrinsically uncommitted) the results again call into question the advocacy of external labour mobility.

Furthermore, Table 6 also reveals evidence that workers who enjoy more internal job mobility appear to have significantly greater access to training, are increasingly flexible and use technology (computers) more often than workers who have external mobility. These indicators were shown to have significant benefits in terms of the learning economy framework in a previous paper (Tomlinson, 1999a). However, both types of job shift appear to influence the employees' commitment to find a better job and to leave their present employer within the year.

A final downside to an uncritical perusal of occupational mobility figures is revealed in Figure 1 which shows the relative chances of downward occupational mobility of KWs depending on whether they switched firms or not between 1987 and 1992. The results show that workers who switched firms were much more likely to have less skilled jobs in 1992 than they had in 1987. (Downward mobility of a KW is here defined as a move out of KW status – i.e. moving out of SOC 1-3).



Source: Authors.

In terms of policy, it would appear that caution is required in the promotion of external labour mobility for its own sake. Perhaps other forms of knowledge transfer should be given significant consideration. For example, there is evidence that collaboration between firms is a significant benefit to innovation (Coombs and Tomlinson 1998). Perhaps the best way of transferring knowledge is through innovation and production networks that do not have to entail personnel transfers between the organisations. Firms can

learn from each other without losing their staff. On the other hand there will undoubtedly be situations where this is not possible and some degree of labour market flexibility is therefore desirable. With respect to KIBS this issue is addressed in the next section.

There is also the possibility that these results reflect a UK situation which does not generalise too well. The United Kingdom is well known for not training workers on the grounds that they will migrate. This does not invalidate the policy questions raised, but warns against the automatic assumption that what we find in the United Kingdom will apply elsewhere. We need more work from other countries to validate the "generalisability" of these findings.

KIBS, innovation and economic networks

Knowledge is often described as organised information, and this is a reasonable description of knowledge-representing artefacts. However, it is more helpful to see knowledge itself as an active process involving the **ability to organise information**; not just as the results of applying that ability. It is more of a practice, than a thing. Thus knowledge is a matter of learning. It may be developed in a variety of ways – through learning by doing and by experimentation, communication, formal training etc. Knowledge transfer thus typically requires more interaction between the participants than information transfer.

One of the most important developments in recent economic change has been the dramatic growth of what are variously known as strategic business services, advanced producer services, or, as we shall call them here, Knowledge-intensive Business Services (KIBS). KIBS exemplify, and foster, the knowledge-intensification of industrial economies. Their growth reflects increased demands for knowledge in the economy, and also exemplifies an ongoing division of labour. In this case, the division of labour leads to specialised services emerging and playing prominent roles in knowledge accumulation and transfer. KIBS are important agents in the development of new technologies. This especially applies to the development of applications of these technologies to the specialised requirements of particular businesses or groups of businesses. KIBS assist in the widening of this technical knowledge, as their interaction with clients leads to greater client understanding of the technical choices and solutions they may undertake. This contributes to an amassing of **technological capabilities** in the economy.

Miles *et al.* (1994), listing KIBS and distinguishing them from other services, described KIBS as services that:

- Rely heavily upon professional knowledge. Thus, their employment structures are heavily weighted towards scientists, engineers, and experts of all types. Many are practitioners of technology and technical change. Whatever their technological or professional specialism, they will also tend to be leading users of Information Technology to support their activities.
- Either supply products which are themselves primarily sources of information and knowledge to their users (e.g. measurements, reports, training, consultancy).
- Or use their knowledge to produce services which are intermediate inputs to their clients' own knowledge generating and information processing activities (e.g. communication and computer services). These client activities may be for internal use or supplied to yet other users in turn.
- Have as their main clients other businesses (including public services and the self-employed). Indeed, knowledge-intensive activities will frequently tend to be business-related, since as labour-intensive activities they will be relatively costly. (Educational and medical services demonstrate that delivery to final consumers often has to be mediated through collective service organisation.)

These authors distinguished new technology-based KIBS, the key repositories of S&T knowledge and workers, from more traditional professional services. (Software and telematics services versus accountancy and legal services; environmental and engineering services versus staff counselling and public relations services, etc.). However, the traditional professional services are often intensive and advanced users of new IT, and there is some cross-over from traditional professional services to KIBS, reflecting the general process of knowledge-intensification. "Spin-offs" and new firm formation occur where KIBS emerge from traditional professional services. For example, professionals with experience of new technology, in particular IT, establish vertical niche markets promoting the application of technology into their old specialisms (or sometimes to their old clients). They often generate new applications, combinations, etc. of basic technologies. (Examples include: accountancy firms selling financial software to clients; specialised training companies heavily utilising computer-assisted training; firms selling software and database applications to building service companies.) The spin-off from professional services into technology-based KIBS is largely similar to the spin-off from other sectors into KIBS.

Because of their role in interactive learning, KIBS typically require more supplier-user interaction than more standardised "symbol-processing" services (such as packaged software, broadcasting, telephony, standardised financial services). KIBS thus fit the stereotype of services as involving high levels of interaction relatively closely. Their roles may vary: from adding innovative knowledge originating from the KIBS itself (*KIBS as a source of innovation*), originating innovative knowledge from another source to the client firm (*KIBS as carrier of innovation*) or helping out a client in implementing new knowledge mostly developed in house (*KIBS as a facilitator of innovation*). One way of summarising this is to see them as playing *catalytic* roles, or as acting as *interfaces* in innovation systems. Often what is involved is a *co-production* of knowledge with a client or network of collaborators. At one extreme this may be little more than a pooling of the knowledge resources of each party – the service supplier provides generic knowledge, which is combined with the user's specific problem-related knowledge. In other cases there is more active joint production of new knowledge that involves sharing work on the problems and solutions.

The size structure of KIBS, like many other services, is very skewed. A few international firms typically coexist with a huge tail of small and micro-businesses. This is less so in some of the more hardware-intensive sectors, but software exemplifies the point extremely well. A recent Eurostat report (*Statistics in Focus* 1998/99 Business Services Statistics, Software and Computer Services), presents data on a survey of software and computer services in five EU countries, and reveals, among other things, that firms in the sector are generally small – the vast majority have fewer than ten employees, though such firms contribute a disproportionately small share of the sector's total turnover.[18] The majority of workers here are young – between 25-39. (But there are relatively few aged below 25 suggesting that most employees are highly qualified, undertaking studies before age 25.) Unlike many other service fields, these IT services are heavily male-dominated in most countries (an exception was Italy). Perhaps surprisingly, work in the sector is overwhelmingly permanent and full-time and the much-touted home-based teleworking is most uncommon at present.

The employment structures of KIBS are heavily weighted towards white-collar, skilled workers. This is apparent from the OECD skills dataset – results for the UK are presented in Table 7 below, and though KIBS are hidden away within a category of "real estate and business services", the extremely high share of such workers is apparent.

18. A similar picture, though less pronounced, emerges for engineering services in studies by Statistics Canada, (cf. Hamdami 1998).

Table 7. Skill Structures of UK Services, 1991, OECD dataset

	Shares of total employment				
Sector:	White collar	Blue collars	High skill white collar	High skill	Low skill
Real estate & business services	93%	7%	56%	60%	40%
Total services	87%	13%	41%	47%	53%
Total economy by occupation	71%	29%	36%	52%	48%

Source: OECD data set.

The labour market for KIBS workers

Direct social relationships with staff, partners, suppliers and clients are very important in protecting knowledge in KIBS, not least because the sorts of knowledge with which they deal are hard to protect through IPR arrangements like copyright. The sorts of control attempted may involve informal relationships, or be formally governed by employee law, or by contractual arrangements between collaborating or trading firms.

A recent survey[19] of three sorts of KIBS in the UK contrasted technological KIBS (environmental engineers) with professional services (accountants), with architects forming a third and intermediate case. Internal working practices are very widely cited as important means of protection, especially by larger firms. The threat of losing knowledge embodied in key members of staff becomes increasingly important, and is increasingly the focus of management effort, in larger bodies. It is also among the most common methods used by smaller environmental engineering firms.

For firms in all KIBS staff recruitment was one of the main means of acquiring external knowledge, but the emphasis varied: for accountants this was used to acquire routine knowledge, for the environmental engineers specific knowledge. Departure of personnel was thought to be a *major source of threat of losing competitive knowledge* for the latter group, and least so for the architects. Again, this tells us something about the sorts of knowledge that make firms in the three branches of KIBS competitive, and suggests that the S&T workforce's knowledge is particularly valuable. We have examined the correlation between emphasis on internal working methods and the types of knowledge deemed important by the firm, however, and here an interesting result emerges. There is no significant correlation between emphasis on S&T knowledge and on internal working practices, at the firm level; but there are strong relations between the latter and knowledge of policies and regulations, and knowledge of markets and after sales support systems. The results, of course, are bound to be influenced by the specific choice of sectors we have studied here. However, the suggestion is that what is valued in employees is not just their generic technical knowledge (which presumably can be obtained as "paper qualifications") but their having the *ability to contextualise* this in the world of problems which clients confront.

19. See I. Miles, B. Andersen, M. Boden & J. Howells forthcoming, Services Processes and Property, *International Journal of Technology Management*. The sample was of 50 firms in each sector.

Evidence from the CIS2 on KIBS and other institutions as drivers of radical innovation

Finally, using the CIS2 data we can assess the impact of various collaborative factors on radical innovation in the UK economy. It can be shown that collaboration with academia, the use of business consultancy and the use of extramural R&D services (both KIBS) significantly contribute to the development of new to the market innovations. This is after controlling for the size and sector of the enterprise and the number of qualified scientists and engineers within the firm. These results are shown in Table 8.

Table 8. Logistic regressions predicting new to the market innovations (data is UK CIS2, weighted)

	Model 1	Model 2	Model 3
Log no. employees	0.337***	0.321***	0.335***
Percentage of S&T employees	2.824***	2.837***	2.910***
Collaborate with:			
Academia	1.250***		
Business consultants		1.720***	
Use extramural R&D services			1.695***
Nace group:			
Mining/food textiles	0.412	0.505*	0.427
Paper/fuels/chemicals/ metals etc	0.286	0.383*	0.276
Electrical/transport equipt	0.921***	1.034***	0.935***
Utilities/construction	-2.187***	-2.191***	-2.182***
Whole/retail/repair/hotel	-0.960***	-0.973***	-.0963***
Transport/finance	0.491*	0.431	0.514*
Other business/public	Base	Base	Base
Constant	-3.705***	-3.723***	-3.744***
Chi sqr	260***	283***	277***

Source: Authors.

What these results suggest is that as well as the proportion of the workforce that are S&T workers, collaborations with KIBS and other knowledge generating institutions such as universities have significant impacts on the radical innovative performance of UK firms. In other words, assuming a transfer of knowledge takes place or new knowledge is generated during the transactions and collaborations, no personnel transfers need take place for useful knowledge to be transmitted. Other work along these lines also confirms this result and interpretation. For example, Tomlinson 1997, and Tomlinson 1999b and 1999c showed, using macroeconomic data (input-output tables) for the United Kingdom, Japan, Germany and the Netherlands, that KIBS had a significant impact on both output and productivity in the economies as a whole and that the influence of KIBS was generally increasing over time. Coombs and Tomlinson (1998) also showed that collaborative linkages were significantly related to increases in innovative resources using the CBI firm level UK innovation trends survey.

None of the above arguments indicate that flexibility in labour markets is not a good thing, merely that there must be a balanced view that takes into account the other ways in which useful knowledge can be spread throughout economic systems. The balance may shift between sectors and at different times. Also this data may be more applicable to the United Kingdom or Europe and not hold in other countries such as the United States or Japan. More detailed work is required to assess these findings.

Conclusions

- The benefits in terms of 'dynamic knowledge' flows in labour markets appear to be fostered more by intra-firm job shifts than inter-firm shifts. Inter-firm shifts are more connected with static knowledge.
- Caution is therefore required when formulating policy to promote labour market flexibility and occupational mobility as a driving force for knowledge diffusion throughout the economy. The benefits of organisational internal mobility must not be ignored.
- S&T workers are particularly prone to job shifts having lower tenure times and relative ease in finding other jobs. But external job shifts appear to have some negative consequences in terms of organisational commitment, for example.
- It might be better to promote diffusion of tacit or embodied knowledge through firm collaborations and networks rather than personnel transfers?
- Certain producer services (especially KIBS) are essential for fostering connections between firms that can promote efficient networks for the diffusion of information and knowledge.
- Collaboration with KIBS and other knowledge institutions are significant factors in determining radical innovation within firms. KIBS inputs can lead to increased productivity at the macroeconomic level.

ANNEX 1. THE STANDARD OCCUPATIONAL CODING SCHEME

This occupational scheme has a 3-digit code at its most detailed level. For the purposes of this paper the first digit is used to define the broad occupational groups as follows (see Goldthorpe and Heath, 1992):

Group	Subgroup	Description
1	10	General managers and administrators in national and local government, large companies and organisations
	11	Production managers in manufacturing, construction, mining and energy industries
	12	Specialist managers
	13	Financial institution and office managers, civil service executive officers
	14	Managers in transport and storage
	15	Protective service officers
	16	Managers in farming, horticulture, forestry and fishing
	17	Managers and proprietors in service industries
	19	Managers and administrators nec
2	20	Natural scientists
	21	Engineers and technologists
	22	Health professionals
	23	Teaching professionals
	24	Legal professionals
	25	Business and financial professionals
	26	Architects, town planners, surveyors
	27	Librarians and related professionals
	29	Professionals nec
3	30	Scientific technicians
	31	Draughtspersons, quantity and other surveyors
	32	Computer analysts and programmers
	33	Ship and aircraft officers, air traffic planners and controllers
	34	Health associate professionals
	35	Legal associate professionals
	36	Business and financial associate professionals
	37	Social welfare associate professionals
	38	Literary, artistic and sports professionals
	39	Associate professionals and technical occupations nec
4	40	Administrative, clerical officers, and assistants in civil service and local government
	41	Numerical clerks and cashiers
	42	Filing and records clerks
	43	Clerks not otherwise specified
	44	Stores and despatch clerks, storekeepers
	45	Secretaries, personal assistants, typists, wp operators
	46	Receptionists, telephonists and related occupations
	49	Clerical and secretarial occupations nec
5	50	Construction trades
	51	Metal, machine fitting and instrument making trades
	52	Electrical and electronic trades
	53	Metal forming, welding and related trades
	54	Vehicle trades
	55	Textiles, garments and related trades
	56	Printing and related trades
	57	Woodworking trades
	58	Food preparation trades
	59	Other craft and related occupations nec
6	60	NCOs and other ranks, armed forces
	61	Security and protective service occupations
	62	Catering occupations
	63	Travel attendants and related occupations
	64	Health and related occupations

	65	Childcare and related occupations
	66	Hairdressers, beauticians and related occupations
	67	Domestic staff and related occupations
	69	Personal and protective service occupations nec
7	70	Buyers, brokers and related agents
	71	Sales representatives
	72	Sales assistants and check-out operators
	73	Mobile, market, and door-to-door salespersons and agents
	79	Sales occupations nec
8	80	Food, drink and tobacco process operatives
	81	Textile and tannery process operatives
	82	Chemical, paper, plastics and related operatives
	83	Metal making and treating process operatives
	84	Metal working process operatives
	85	Assemblers/lineworkers
	86	Other routine process operatives
	87	Road transport operatives
	88	Other transport and machinery operatives
	89	Plant and machine operatives nec
9	90	Other occupations in agriculture, forestry and fishing
	91	Other occupations in mining and manufacture
	92	Other occupations in construction
	93	Other occupations in transport
	94	Other occupations in communication
	95	Other occupations in sales and services
	99	Other occupations nec

Source: Goldthorpe and Heath, 1992.

ANNEX 2. THE DEFINITION OF TECHNICAL OCCUPATIONS

The following 3 digit SOC codes were used to define technical occupations within the data set.

3 digit SOC code	Description
126	Computer systems and data processing managers
200-209	Natural scientists
210-219	Engineers and technologists
300-309	Scientific technicians
320	Computer analysts/programmers

Source: Authors.

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