Information and Communication Technology (ICT) Skill Gaps and Company-Level Performance: Evidence from the ICT Professionals Survey 2000-01

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Abstract

This paper draws on the ICT Professionals Survey (carried out between December 2000-February 2001) and matching post-survey financial data to examine the determinants of ICT-related 'internal skill gaps' and their impact on company sales performance. The most common reasons for internal skill gaps (ICT professionals lacking full proficiency in their current jobs) are reported as 'lack of skills or experience of new technologies' and 'failure to train and develop staff'. Multivariate analysis reveals a significant negative relationship between the severity of ICT skill gaps and company sales performance, after controlling for capital assets, labour inputs, sector, region and other company characteristics. The analysis also provides some evidence of positive and statistically significant links between sales performance and provision of structured ICT training.

1. Introduction [1]

The Information and Communication Technology (ICT) Professionals Survey was commissioned in 2000 by the e-skills NTO (National Training Organisation), Skillset, the Engineering and Marine Training Authority (EMTA), the Department for Education and Skills (DfES) and the Department of Trade and Industry (DTI). Telephone interviews were carried out between December 2000-February 2001 with respondents for 3977 establishments employing 'ICT Professionals' who were defined as follows:

> 'staff who work with Information Technology or communications as a major function of their job…. those who manage or administer internal systems or support, have a training or development role in ICT, deal with…. customers on ICT-related queries or design and/or develop new ICT products or services' (e-skills NTO, 2002, p.17)

Sampling procedures for this survey were aimed at achieving a comprehensive survey of establishments employing ICT Professionals rather than a nationally representative survey of all types of establishment in the economy (ibid, p. 18). In ICT dedicated establishments (for example, in the ICT services and telecoms sectors), respondents were typically Human Resources Managers or their equivalents; in non-ICT dedicated establishments respondents were usually ICT managers or their equivalents. The sampling frame was confined to establishments with five or more employees.

Among other things the survey yielded detailed information on the size and composition of the ICT Professionals workforce in the UK economy which is reported in e-skills NTO (2002). The main occupational groups captured under this heading were:

- Development Professionals (eg, software development and systems development professionals)
- External Customer Services Professionals (eg, customer systems support professionals)

- Sales and Marketing Professionals (eg, ICT sales professionals and account managers)

- Internal Operations Professionals (eg, systems support operators / administrators and training professionals)

- Strategy and Planning Professionals (eg, business analysts and systems/network architects)

The survey also provided information on the extent and nature of ICT skills deficiencies, in particular, external skill shortages (skill-related recruitment difficulties) and internal skill gaps among existing employees.

Based on the survey findings, e-skills NTO (2002) estimates that around 6% of UK establishments with 5 or more employees had hard-to-fill vacancies for ICT Professionals at the time of the survey. The main roles where recruitment difficulties occurred were in software development and ICT sales (where scarcities of applicants with the required ICT skills were reported) and technicians/engineers and operations (where some employers had difficulty in finding applicants with the required experience).

At the same time an estimated 42% of establishments in the survey reported that at least one ICT Professional in their employ lacked 'full proficiency (in) their current job'. Overall an estimated 15% of ICT Professionals in employment were regarded as lacking full proficiency. E-skills NTO notes that 'few establishments were able to specify exactly which skills, technical or non-technical, were missing' (2002:48). However, those respondents that were able to specify the missing skills predominantly mentioned IT operating systems and networking skills, 'general IT user skills' and written communication skills. In general, the responses to questions about the main causes of internal skill gaps convey a strong impression of difficulties in keeping up to date with rapidly-changing ICT skill requirements: two thirds of all establishments with less than 100% ICT staff proficiency attributed the problem to 'lack of skills or experience of new technologies' (ibid, p. 51).

The aim of the present paper is to identify what effect, if any, ICT skill deficiencies may have had on post-survey financial performance among companies participating in

the survey. In what follows we focus on the effects of ICT-related internal skill gaps partly because, as described above, skill deficiencies among existing employees were a much more widespread problem than ICT-related recruitment difficulties. But another good reason for focussing on internal skill gaps is that the survey questions on this type of skills deficiency applied to all ICT Professionals employed in the surveyed establishments. By contrast, survey data on hard-to-fill vacancies were gathered only for two randomly selected ICT occupational areas within each establishment and therefore do not lend themselves well to our analysis.

The paper is ordered as follows. Section 2 provides descriptive statistics on the composition of the sample and the incidence of internal ICT skill gaps and ICT skills training. Section 3 examines the main determinants of such skill gaps. Section 4 describes the procedures by which post-survey financial data were matched to survey respondents. Section 5 reports on our multivariate analysis of the impact of ICT skill gaps on financial performance. Section 6 concludes.

2. Sample characteristics and the incidence of skill gaps and training

Tables 1-3 show the distributions of sample respondents by employment size-group, main business activity and region. Some 57% of participating establishments had less than 50 employees while only 3% had 500 or more employees. Just under a third of establishments were classified to 'Computer activities / R&D', including software and hardware services. The next two largest sectors were large IT-using sectors: education and retail/wholesale. Manufacturing sectors taken together represented 15% of the total sample. As expected, the regional distribution was dominated by London and the South East, with remaining regions accounting for roughly 4-9% each of surveyed establishments. Just over half of establishments were single-site enterprises. Of those establishments which were part of multi-site organisations, significant proportions were Head Offices (28% of all surveyed establishments) or regional offices (17%). In the remainder of this paper survey data are reported on an unweighted basis, making use of appropriate controls for employee size-group, sector, regional location and single-site or Head Office status in our multivariate analysis.

Table 1: Establishments in ICT Professionals Survey, analysed by employee size-group

Employment size-group	Freq.	Percent
5-9	792	20
10-24	900	23
25-49	538	14
50-99	674	17
100-199	598	15
200-249	161	4
250-499	179	5
500-999	90	2
1000+	45	1
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TOTAL	3977	100

Table 2: Establishments in ICT Professionals Survey, analysed by main business activity

Main Business Activity	Freq.	Percent
Computer Activities / R&D	1273	32
Education	469	12
Retail, Wholesale	430	11
Man. of Metals/Equipment	371	9
Business Services	267	7
Telecommunications	204	5
Public Admin and Defence	172	4
Man. Of Food/Textiles & Related	156	4
Financial Services	131	3
Health, Medical, Social Work	127	3
Construction	119	3
Man. Of Fuels/Non-Metals	68	2
Hotels, Restaurants	61	2
Transport, Storage and Distribution	61	2
Leisure / Entertainment	46	1
Recycling/Electricity, Gas and Water Supply	22	1
TOTAL	3977	100

Table 3: Establishments in ICT Professionals Survey, analysed by region

Region	Freq.	Percent
South East	819	21
London	495	12
East of England	368	9
North West	334	8
South West	311	8
Scotland	300	8
West Midlands	288	7
East Midlands	281	7
Yorkshire & Humberside	258	6
Wales	198	5
North East	163	4
Northern Ireland	162	4
TOTAL	3977	100

As described in Section 1, some 42% of sample establishments reported that at least one ICT Professional in their employ lacked 'full proficiency (in) their current job'. Table 4 shows that on average larger establishments were more likely to report internal skill gaps of this kind. However, the more serious levels of skill deficiency were not related to establishment size. Across the whole sample as many as 17% of establishments reported that a quarter or more of their ICT Professionals lacked full proficiency. This proportion applies as much to small and medium-sized establishments as to those with 500 or more employees.

Table 4: Distribution of ICT skill gaps, analysed by employment size-group

| Employment size-group | All staff fully Proficient | Percent of staff lacking full proficiency | | | | Total | n= |
		1-10%	11-25%	26-50%	50%-plus		
5-9	65	6	13	11	6	100	*792*
10-24	58	9	17	10	6	100	*900*
25-49	58	11	15	11	5	100	*538*
50-99	58	9	16	11	7	100	*674*
100-199	56	9	17	11	6	100	*598*
200-249	59	8	14	9	10	100	*161*
250-499	53	9	20	14	5	100	*179*
500-999	41	13	29	10	6	100	*90*
1000+	44	22	22	7	5	100	*45*
TOTAL	58	9	16	11	6	100	*3977*

Descriptive statistics do not point to marked differences between regions in the incidence of internal skill gaps (Table 5). However, there was considerable variation between industries in the extent to which severe skill gaps were reported. For example, the hotels, leisure/entertainment, telecommunications and retail/wholesale sectors all had well above average proportions of establishments reporting that 25% or more of their ICT Professionals lacked full proficiency (Table 6).

As described above, two thirds of all establishments with less than 100% ICT staff proficiency attributed the problem to 'lack of skills or experience of new technologies', reflecting difficulties in keeping up to date with rapidly-changing ICT skill requirements. The next most common explanation, cited by 32% of establishments with internal skill gaps, was their organisation's 'failing to train and develop staff'. In fact, as many as 90% of respondents reported some form of training provision for ICT Professionals. [2] However, only 58% of establishments cited evidence of a structured approach to training (for example, having a training plan or a training budget) and only 31% had both a training plan and a training budget. In Section 3 we make use of these indicators of structured training in multivariate analysis of the factors contributing to internal skill gaps.

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[2] Responses to an open question: 'Thinking about training in particular applications or other technical skills…. What methods of delivery are used for IT and Telecoms professionals?' This was one of the few training questions in the survey targetted at all ICT Professionals employed by participating establishments. More detailed questions about training provision were only asked about two randomly selected ICT occupational areas within each establishment.

Table 5: Distribution of ICT skill gaps, analysed by region

Region	All staff fully proficient	Percent of staff lacking full proficiency				Total	n=
		1-10%	11-25%	26-50%	50%-plus		
		Percent of establishments					
London	56	10	17	11	6	100	*495*
South East	61	10	15	9	5	100	*819*
South West	53	10	18	10	9	100	*311*
East Midlands	64	7	18	7	5	100	*281*
West Midlands	61	7	16	10	7	100	*288*
Yorkshire & Humberside	57	10	16	14	4	100	*258*
North west	58	11	14	11	6	100	*334*
East of England	55	8	18	13	6	100	*368*
North East	55	6	18	13	8	100	*163*
Scotland	61	6	14	10	9	100	*300*
Northern Ireland	57	8	16	14	6	100	*162*
Wales	63	8	14	11	5	100	*198*
TOTAL	58	9	16	11	6	100	*3977*

Table 6: Distribution of ICT skill gaps, analysed by main business activity

Main business activity	All staff fully Proficient	Percent of staff lacking full proficiency				Total	n=
		1-10%	11-25%	26-50%	50%-plus		
		Percent of establishments					
Man. of food/textiles	63	5	15	11	6	100	*156*
Man. of fuels/non-metals	60	9	13	15	3	100	*68*
Man. of metals/equipment	64	9	12	9	7	100	*371*
Recycling/electricity/gas and water supply	68	14	14	5	0	100	*22*
Construction	57	9	21	9	4	100	*119*
Retail, wholesale	57	9	14	13	7	100	*430*
Hotels, restaurants	54	5	16	16	8	100	*61*
Transport, storage and distribution	52	10	23	10	5	100	*61*
Telecommunications	53	11	15	12	10	100	*204*
Financial services	54	8	23	10	6	100	*131*
Business services	57	5	20	11	7	100	*267*
Computer activities / R&D	59	11	16	9	4	100	*1273*
Health, medical, social work	57	8	14	14	6	100	*127*
Public admin and defence	63	7	15	11	5	100	*172*
Education	56	6	19	11	9	100	*469*
Leisure / entertainment	61	7	9	15	9	100	*46*
TOTAL	58	9	16	11	6	100	*3977*

3. The determinants of internal ICT skill gaps

The determinants of ICT-related internal skill gaps are first investigated by estimating a logit model:

$$\Pr\left(SkillGap_i = 1 | X_i\right) = f\left(X_i \beta_h\right)$$

where:

$SkillGap_i$ = 1 if the establishment reported that at least one ICT Professional employee lacked full proficiency in his/her job; otherwise = 0.

and

X_i is a vector of establishment-level characteristics including information on employee size-group, sector, regional location, site functions and recent sales growth as well as other factors bearing on the skill levels of existing employees such as indicators of training.

In a second set of regressions an ordered measure of the presence of internal skill gaps is taken as dependent variable, of which the values range from 0 = 'No skill gap among ICT Professionals' to 4 = 'Half or more of ICT Professionals lacked full proficiency' (see Table 7, Row 2 for more details of this measure).

Apart from employee size-group, sector and regional dummies, the main independent variables in these equations are:

Single = 1 if the establishment is a single-site organisation

Head office = 1 if the establishment is Head Office for a multi-site organisation

Main IT-related product or service: binary indicators of whether the establishment's main product or service is classified to IT support services (installation, maintenance and repair); IT development (design, programming and implementation); IT consultancy services; IT sales/rental; IT training; Other IT-related products or services; or Non-IT products/services.

Growth in turnover / budget: binary indicators of whether sales turnover or annual budget increased, decreased or remained constant in the last full financial year

Structured training: Binary indicators of whether establishment had either a training plan or a training budget or both.

Summary statistics for all variables used in the analysis are shown in Table 7. Unfortunately the survey does not provide data on several other establishment-level characteristics which might have proved useful. For example, we do not have information on the level of investments in different kinds of ICT equipment or the intensity of their use. Nor is there information on the volume or coverage of ICT training expenditure for the establishment as a whole. In addition, it is not possible to control for the intensity of ICT-related employment at establishment level since no detailed information was gathered on total employment in non-ICT occupations in each establishment.

Table 7: Summary statistics (full sample)
(Reference categories for dummy variables in italics)

Variable		Observations	Mean	Std. Dev.
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Internal skill gaps:				
Skill gap – binary	1= Less than 100% proficiency among ICT Professionals	3907	0.415	0.493
Skill gap – ordered	0 = Full proficiency among ICT Professionals; 1 = 90-99% full proficiency; 2 = 75-89% full proficiency; 3 = 50-74% full proficiency; 4 = Less than 50% full proficiency	3907	0.971	1.311
ICT skills training:				
Structured training	1= Either training plan or training budget or both	3977	0.585	0.493
Training plan or budget	1= Either training plan or budget but not both	3977	0.274	0.446
Training plan and budget	1= Both training plan and training budget	3977	0.311	0.463
No training plan or budget	*1= Neither training plan nor training budget*	3977	0.396	0.489
Training plan or budget_not known	1 = No response to question about training plan or budget	3977	0.019	0.136
Employment size groups:				
Emp5_9	*1=total employment in 5-9 size band*	3977	0.199	0.399
Emp10_24	1=10-24 employees	3977	0.226	0.418
Emp25_49	1= 25-49 employees	3977	0.135	0.342
Emp50_99	1= 50-99 employees	3977	0.169	0.375
Emp100_199	1= 100-199 employees	3977	0.150	0.357
Emp200_249	1= 200-249 employees	3977	0.040	0.197
Emp250_499	1= 250-499 employees	3977	0.045	0.207
Emp500_999	1= 500-999 employees	3977	0.023	0.149
Emp1000plus	1= 1000 or more employees	3977	0.011	0.106

Table 7: (continued)

Regions:				
East Midlands		3977	0.071	0.256
London		3977	0.124	0.330
South East		3977	0.206	0.404
South West		3977	0.078	0.269
West Midlands		3977	0.072	0.259
Yorks & Humberside		3977	0.065	0.246
North West		3977	0.084	0.277
Eastern		3977	0.093	0.290
North East		3977	0.041	0.198
Scotland		3977	0.075	0.264
N Ireland		3977	0.041	0.198
Wales		3977	0.050	0.218
Sectors:				
Food / Textiles	Food / Textiles manufacturing	3977	0.039	0.194
Engineering	Engineering	3977	0.093	0.291
Construction	Construction	3977	0.030	0.170
Retail	Retail / Wholesale	3977	0.108	0.311
Hotels	Hotels, Restaurants	3977	0.015	0.123
Transport	Transport, storage and distribution	3977	0.015	0.123
Telecoms	Telecoms	3977	0.051	0.221
Financial services	Financial services	3977	0.033	0.179
Business services	Business services	3977	0.067	0.250
Computer services	Computer services	3977	0.320	0.467
Health	Health, medical and social work	3977	0.032	0.176
Public	Public administration and defence	3977	0.043	0.203
Education	Education	3977	0.118	0.323
Leisure	Leisure / entertainment	3977	0.012	0.107
Other industries	*Other industries*	3977	0.023	0.149
IT product areas:				
IT support	1= IT Support services (installation, maintenance and repair)	3977	0.068	0.252
IT development	1= IT Development (design, programming and implementation)	3977	0.127	0.333
IT consultancy	1= IT Consultancy services	3977	0.060	0.238
IT sales	1= IT Sales / rental	3977	0.080	0.272
IT training	1= IT Training	3977	0.057	0.232
Other IT	1= Other IT products or services	3977	0.102	0.302
IT product_nk	1= No response to question about main IT product/service	3977	0.004	0.061
Non-IT product	*1= Non-IT product/service*	3977	0.502	0.500
Change in sales:				
Sales up	1= Sales/budget increased over last full financial year	3977	0.533	0.499
Sales down	1= Sales/budget decreased over last full financial year	3977	0.084	0.278
Sales constant	*1= Sales/budget constant over last full financial year*	3977	0.175	0.380
Sales change_nk	1= Sales/budget change over last full financial year not known	3977	0.208	0.406
Single	1 = Only site in the organisation	3977	0.503	0.500
Head Office	1= Head Office of multi-site organisation	3977	0.277	0.447

Table 8 presents the results of multivariate analysis as follows:

Equations 1-2: logistic regressions with a binary indicator of internal skill gap as dependent variable

Equations 3-4: ordered logistic regressions with an ordered measure of internal skill gap as dependent variable

For ease of reading the main text, the results attached to employee size-group, sector and region dummies are only shown in full in Appendix A.

As expected from analysis of descriptive statistics, the probability of an establishment reporting an internal skill gap among ICT Professionals is positively related to employment size group. However, after controlling for size, sector, main IT product area and other establishment-level characteristics, regional variation is more apparent than suggested by descriptive statistics, with the relevant coefficients on London and the South West being significantly positive relative to the base regional category (East Midlands). In addition, Head Offices of multi-site organisations are significantly more likely to report ICT skills deficiencies than are other types of establishment.

With only a few exceptions the IT product indicators capture far more of the variation in the incidence of internal skill gaps than do the broad sector dummies. In Equations 1-2 the probability of reporting lack of full proficiency among ICT Professionals is significantly positively related to specialisation in IT development, IT sales and other IT products/services relative to the reference category (non-IT products). However, in Equations 3-4 – taking the ordered measure of the severity of skill gaps as dependent variable – telecoms stands out as more likely to experience problems relative to the base category (Other Industries) while, so far as IT product areas are concerned, only the miscellaneous IT products category remains significantly associated with skill gaps.

One of the most consistent findings across all four equations is that the probability of reporting an ICT skills gap is significantly positively related to indicators of structured training. For example, Equations 2 and 4 show that this probability actually rises monotonically when considering (1) establishments which have either a training plan or a training budget but not both, and (2) establishments which have both a training plan and budget. This is perhaps surprising given that almost a third of

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establishments with skill gaps attributed the problem in part to insufficient training. However, recall that our data on skill gaps are derived from interviewees' subjective responses to questions about the extent of full proficiency among ICT Professional staff. We conjecture that, for many of these interviewees, working in establishments with formal ICT training provision may be associated with high expectations of the skills which ICT professionals are expected to possess and thus greater awareness of employees' difficulties in keeping up with rapid changes in ICT skill requirements. But it also seems likely that investment in training constitutes a form of response to recognised internal skill deficiencies, with the implication that the training variables in our model are endogenous. Regrettably, the survey does not offer any other variables which might be suitable to be used as instruments for training in efforts to tackle this potential endogeneity problem.

Table 8: Determinants of ICT-related internal skill gaps

Dependent variable:	(1) Logit - Binary skill gap measure (1)	(2) Logit - Binary skill gap measure (2)	(3) Ordered logit - Ordered skill gap measure (1)	(4) Ordered logit - Ordered skill gap measure (2)
IT support	0.133	0.129	0.015	0.013
	(0.147)	(0.148)	(0.140)	(0.140)
IT development	0.246**	0.241*	0.107	0.104
	(0.124)	(0.124)	(0.112)	(0.112)
IT consultancy	0.113	0.110	0.085	0.083
	(0.157)	(0.157)	(0.150)	(0.150)
IT sales	0.273**	0.268*	0.177	0.174
	(0.137)	(0.137)	(0.129)	(0.129)
IT training	0.194	0.187	0.118	0.114
	(0.152)	(0.152)	(0.144)	(0.144)
Other IT	0.496***	0.491***	0.331***	0.328***
	(0.123)	(0.123)	(0.109)	(0.109)
Single	-0.000	-0.001	-0.004	-0.004
	(0.092)	(0.092)	(0.089)	(0.089)
Head office	0.241**	0.239**	0.170*	0.169*
	(0.096)	(0.096)	(0.089)	(0.089)
Sales up	0.021	0.019	0.032	0.031
	(0.091)	(0.091)	(0.086)	(0.086)
Sales down	-0.035	-0.036	0.057	0.057
	(0.139)	(0.139)	(0.138)	(0.138)
Structured training	0.230***		0.195***	
	(0.073)		(0.072)	
Training plan or budget		0.188**		0.168**
		(0.085)		(0.083)
Training plan and budget		0.272***		0.222***
		(0.086)		(0.083)
Constant	-1.202***	-1.193***		
	(0.285)	(0.286)		
Observations	3907	3907	3907	3907
Log-likelihood	-2589.01	-2588.54	-4756.57	-4756.34
Wald chi2	120.80	121.85	107.25	108.15
McF R-sqd	0.02	0.02	0.01	0.01
Robust standard errors in parentheses				
* significant at 10%; ** significant at 5%; *** significant at 1%				

Note: Full estimates for these equations are shown in Appendix A, including dummy variables for employment size-group, sector and region.

4. The matched financial dataset

In order to explore the relationship between ICT-related internal skill gaps and financial performance at firm level, we sought to match the ICT Professionals survey respondents against post-survey financial data provided by Dun and Bradstreet (D&B). D&B was chosen for this purpose because its financial database is more comprehensive than the BT Business Database which actually provided the sampling frame for the survey. It was therefore necessary to commission an electronic matching check of all survey respondents against D&B company names. Subsequently, the matched data were supplied to us in anonymised form (in order to maintain the confidentiality promised to survey respondents).

As Table 9 shows, by 2002 some 1009 of the 3977 surveyed companies could not be identified by D&B and another 19 were recorded as 'dormant'. A further 52 companies were identified as holding companies and were excluded from the analysis because of uncertainty over the correspondence between the interviewed unit and that which provided financial data to D&B. Manual checks were then carried out to ensure that, so far as possible, survey information about the employment size, main product/service area and regional location of each company was consistent with new information provided by D&B. This led to 925 companies being set aside because there was insufficient information to permit any such checks and another 34 companies had to be discarded because the checks cast doubt on whether a genuine match had been achieved.

Further attrition then occurred because of gaps in the financial data that were provided by D&B. In total the minimum data required for our analysis (employment, sales and assets) are available for at least one year for 742 companies, representing approximately 38% of all survey respondents which were identifiable, still in business and passed our matching checks; and 19% of the original sample.

Table 9: ICT Professionals Survey - Number of observations available for analysis

	2001
Original survey respondents	**3977**
Not identifiable	1009
Identifiable but dormant company	19
Identifiable but holding company	52
Identifiable but insufficient information to carry out matching check	925
Failed matching check	34
Sub-total: identifiable, not holding company and passed matching check	**1938**
Total respondents with usable financial data	
Employment, sales and assets 2000	742
Employment, sales and assets 2001	739
Employment, sales and assets 2002	390
Companies with usable financial data in 2000:	
as % of original sample	19%
As % of companies identified, still in business and passed matching check	38%

Table 10 shows that, compared to the original ICT Professionals sample, smaller companies (with fewer than 25 employees) are under-represented in the matched dataset which has been achieved, largely due to limited coverage of those size-groups by D&B. In terms of sectors, manufacturing companies turn out to be somewhat over-represented at the expense of computer services companies. In general, these selection biases are smaller than might have been feared and we can expect any potential impact on our regression parameters to be largely mitigated by the inclusion of size-group and industry dummies. In addition, the matched dataset still benefits from a fairly wide spread of companies across size-groups and sectors (with the exception of the very smallest 5-9 employee category).

Table 10: Comparison of original ICT Professionals sample and dataset matched to Dunn and Bradstreet data, analysed by employee size-group and sector

	Original samples	Matched dataset		Original samples	Matched dataset
	Percentages			*Percentages*	
Employee size-group:			Sector:		
5-9	20	4	Man. of food, textiles & related	4	7
10-24	23	12	Man. of fuels/non-metals	2	4
24-49	14	15	Man. of metals/equipment	9	14
50-99	17	25	Utilities, recycling, sanitation	1	1
100-199	15	25	Construction	3	3
200-249	4	8	Retail, wholesale	11	14
250-499	5	7	Hotels, restaurants	2	2
500-999	2	3	Transport, storage, distrib.	2	2
1000 plus	1	2	Telecommunications	5	4
			Financial services	3	5
			Business services	7	7
			Computer activities, R&D	32	26
			Health, medical, social work	3	3
			Public and community services	4	2
			Education	12	4
			Leisure, entertainment	1	1
TOTAL	100	100		100	100

5. The impact of ICT skill gaps on financial performance

Analysis of matched financial data for this survey poses particular problems because, while the survey originally targetted establishments employing ICT Professionals, the appropriate unit of analysis for financial data is of course the company to which establishments belong. Hence, in the analysis that follows, we make some effort to check the effects of the disparity between establishments and enterprises by comparing all results for the full sample of matched companies against findings which are restricted to (1) a sub-sample of single-site enterprises and (2) a sub-sample of companies for which the upper bound of the establishment's employment size-band corresponded to 50% or more of total company employment.

Values for total sales in each year were adjusted to constant prices using output price deflators for the United Kingdom that were assembled at a broad sectoral level from the National Accounts (OECD, 2003). Total sales were also adjusted to remove distortions caused by changes in a company's accounting period. Such changes in accounting periods mean that a small number of companies recorded total sales over a period of less than, or more than, 12 months; sales figures were adjusted pro rata to a 12-month basis as appropriate. Small numbers of cases in the matched dataset are excluded because of outlying values on the financial variables.

We base our analysis on an augmented Cobb-Douglas production function containing annual sales (Q), assets (K), employment (L) and a variety of additional variables (Z), including sector and region identifiers and indicators of ICT-related skill gaps or structured training provision.

The standard form of the Cobb-Douglas production function, with a single type of labour, takes the form:

$$Q=AK^{\alpha}L^{\beta}Z^{\delta} \tag{1}$$

Taking logs, one may obtain:

$$\text{Ln}(Q) = \ln(A) + \alpha\ln(K) + \delta\ln(L) + \beta\ln(Z) \qquad\qquad (2)$$

Equation (2) represents the basis for our analysis of the level of sales. The coefficient on that part of Z which relates to our indicators of ICT-related skill gaps and training will enable us to examine whether these have an impact on sales for given capital and labour inputs.

In what follows we first present cross-sectional estimates for 2001 based on the full sample of establishments for which matching financial data were obtained. To a large extent this makes use of post-survey data since the data-gathering for the survey was completed by February 2001. We then go on to check the robustness of our findings against results for two restricted sub-samples of establishments which (as described above) go some way to alleviating the obvious disparity between our establishment-level survey data and the enterprise-level financial data received from D&B.

Table 11 shows the results of cross-sectional regressions of the determinants of log sales in 2001, highlighting the key regressor variables relevant to our assessment of the impact of ICT skill gaps and training provision on company performance. Across all three equations the coefficients on capital and labour are positive, well-defined and broadly within the range of expected values. There are also positive and significant coefficients on the variables denoting London and the South East (relative to the East Midlands), the retail/wholesale sectors relative to Other Industries and IT consultancy and IT sales relative to Non-ICT products. By contrast there are negative significant coefficients attached to sector dummies for the hotels/restaurants, health, education and leisure industries and to single-site enterprises. (Full results for these regressions are shown in Appendix A).

In all three equations there is clear evidence of a significant negative relationship between the severity of ICT skill gaps and company sales performance, with an increase in the size of the significant negatively-signed coefficients on the skill gap indicators as they move from 26-50% of ICT Professionals deemed to lack proficiency in their jobs to 51% or more lacking proficiency.

By contrast there is less evidence of the structured training indicators being significantly related to sales performance. The coefficients on different training indicators are all positively-signed but it is only in Equation 3 that one of these coefficients (on a dummy variable representing establishments which have both a training plan and training budget) starts to attain statistical significance.

Further results presented in Table 12 shows that our main findings on the impact of ICT skill gaps remain entirely robust to using the restricted sub-sample of establishments which are single-site enterprises (Equations 1-3). Similarly, if analysis is confined to establishments for which the upper bound of the establishment's employment size-band corresponded to 50% or more of total company employment (Equations 4-6), the only real difference from the main regressions in Table 11 is that the skill gap coefficients are significantly negative on one rather than two of the skill gap categories.

By contrast, in respect of training provision, the regression results based on the two restricted sub-samples (Table 12) point to a rather stronger positive relationship between structured training and sales performance than that suggested in the main regressions (Table 11).

In an effort to examine the relationship between ICT training and performance in more detail, we estimated interacted versions of the main regressions which allowed for the possibility that training provision might have a moderating effect on the negative relationship between ICT skill gaps and sales performance. The results (available on request) continued to point to strong negative effects of skill gaps on performance in establishments/companies which did not offer any structured training. However, the coefficient on the relevant product term (ICT skill gap* training) was not statistically significant.

In addition, in view of concerns about the possible endogeneity of training indicators in our model of sales performance, the regressions for the full matched sample and both restricted sub-samples were run again omitting all training variables. In each

case the central findings on the negative impact of ICT-related internal skill gaps remained robust to the changes in specification (results again available on request).

Finally, we also estimated growth rate regressions for the period 2001-2002. However, the number of observations available for the growth rate analysis was less than half those available for the cross-section due to incomplete financial data for 2002 on the D&B database at the time data were purchased (mid-2003). This contributed to unsatisfactory results including particularly small and freqently non-significant coefficients attached to log capital assets. For this reason we are unable at the present time to make further use of 2002 financial data to pursue our main questions of interest.

Table 11: Impact of ICT-related internal skill gaps and ICT training on company performance, 2001 – Full matched sample -- Cross-Section regressions

	(1) Full matched sample	(2) Full matched sample	(3) Full matched sample
Log capital assets	0.098***	0.098***	0.098***
	(0.026)	(0.026)	(0.026)
Log labour input	0.913***	0.907***	0.907***
	(0.041)	(0.042)	(0.041)
Skill gap 1-10%	0.082	0.079	0.078
	(0.095)	(0.094)	(0.094)
Skill gap 11-25%	-0.088	-0.093	-0.093
	(0.078)	(0.078)	(0.078)
Skill gap 26-50%	-0.144*	-0.151*	-0.151*
	(0.079)	(0.081)	(0.081)
Skill gap 51%-plus	-0.290**	-0.281**	-0.282**
	(0.124)	(0.124)	(0.124)
Structured training	0.054		
	(0.064)		
Training plan or budget		-0.005	
		(0.070)	
Training plan and budget		0.116	0.118*
		(0.076)	(0.065)
IT support	0.281*	0.277*	0.277*
	(0.153)	(0.156)	(0.155)
IT development	-0.037	-0.051	-0.051
	(0.119)	(0.121)	(0.121)
IT consultancy	0.399***	0.388***	0.388***
	(0.121)	(0.122)	(0.121)
IT sales	0.406**	0.389**	0.389**
	(0.157)	(0.158)	(0.157)
IT training	0.157	0.145	0.145
	(0.143)	(0.143)	(0.143)
Other IT	0.121	0.109	0.108
	(0.109)	(0.109)	(0.109)
Single	-0.113*	-0.116*	-0.116*
	(0.062)	(0.062)	(0.062)
Constant	10.207***	10.236***	10.235***
	(0.307)	(0.306)	(0.304)
Observations	700	700	700
Adjusted R-squared	0.83	0.83	0.83

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Full estimates for these equations are shown in Appendix A, including dummy variables for sector and region.

Table 12: Impact of ICT-related internal skill gaps and ICT training on company performance, 2001 – Restricted sub-samples - Cross-Section regressions

	(1) Single-site enterprises	(2) Single-site enterprises	(3) Single-site enterprises	(4) Establishments representing 50%-plus of enterprise employment	(5) Establishments representing 50%-plus of enterprise employment	(6) Establishments representing 50%-plus of enterprise employment
Log capital assets	0.120**	0.119**	0.120**	0.102***	0.103***	0.103***
	(0.048)	(0.047)	(0.047)	(0.031)	(0.031)	(0.031)
Log labour input	0.843***	0.838***	0.839***	0.869***	0.861***	0.862***
	(0.087)	(0.087)	(0.086)	(0.052)	(0.053)	(0.053)
Skill gap 1-10%	0.009	0.011	0.017	0.005	0.002	0.004
	(0.181)	(0.180)	(0.178)	(0.104)	(0.102)	(0.102)
Skill gap 11-25%	0.014	0.016	0.021	-0.052	-0.056	-0.056
	(0.144)	(0.143)	(0.144)	(0.091)	(0.091)	(0.091)
Skill gap 26-50%	-0.373**	-0.380**	-0.403**	-0.114	-0.119	-0.118
	(0.157)	(0.159)	(0.158)	(0.095)	(0.098)	(0.098)
Skill gap 50%-plus	-0.455**	-0.442**	-0.431**	-0.346***	-0.329**	-0.327**
	(0.201)	(0.198)	(0.200)	(0.128)	(0.128)	(0.127)
Skill gap_nk	0.523	0.455	0.458	0.224	0.214	0.213
	(0.348)	(0.356)	(0.365)	(0.264)	(0.256)	(0.255)
Structured training	0.183*			0.091		
	(0.099)			(0.071)		
Training plan or budget_not known	0.277	0.295	0.254	0.137	0.138	0.130
	(0.280)	(0.282)	(0.283)	(0.177)	(0.178)	(0.170)
Training plan or budget		0.115			0.016	
		(0.116)			(0.078)	
Training plan and budget		0.260**	0.211*		0.165*	0.157**
		(0.125)	(0.118)		(0.084)	(0.072)
IT support	0.504*	0.519*	0.565*	0.232	0.214	0.215
	(0.299)	(0.301)	(0.302)	(0.174)	(0.178)	(0.178)
IT development	-0.151	-0.197	-0.195	-0.072	-0.093	-0.093
	(0.207)	(0.221)	(0.222)	(0.133)	(0.133)	(0.133)
IT consultancy	0.413*	0.383*	0.377*	0.295**	0.277**	0.275**
	(0.217)	(0.215)	(0.214)	(0.129)	(0.129)	(0.129)
IT sales	-0.029	-0.029	-0.032	0.439***	0.420**	0.417**
	(0.251)	(0.253)	(0.250)	(0.169)	(0.170)	(0.170)
IT training	0.078	0.056	0.058	0.171	0.155	0.155
	(0.252)	(0.256)	(0.261)	(0.165)	(0.164)	(0.164)
Other IT	0.234	0.224	0.241	0.173	0.145	0.145
	(0.164)	(0.167)	(0.168)	(0.126)	(0.127)	(0.127)
IT product_nk	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Single				-0.147**	-0.150**	-0.151**
				(0.067)	(0.067)	(0.067)
Constant	10.031***	10.059***	10.062***	10.329***	10.361***	10.366***
	(0.529)	(0.512)	(0.508)	(0.361)	(0.356)	(0.352)
Observations	220	220	220	533	533	533
Adjusted R-squared	0.79	0.79	0.79	0.77	0.77	0.77

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Full estimates for these equations are shown in Appendix A, including dummy variables for sector and region.

6. Summary and assessment

In this paper we have drawn on the ICT Professionals Survey (carried out between December 2000-February 2001) and matching post-survey financial data to examine the determinants of ICT-related internal skill gaps and their impact on company performance.

An establishment is here defined as suffering from an internal skill gap if it reported that at least one ICT Professional in its employ lacked 'full proficiency (in) their current job'. The probability of an establishment reporting an internal skill gap of this kind is found to be positively related to employment size group, to location in London and the South West, to being a Head Office of a multi-site organisations and to specialisation in IT development, IT sales, telecoms and other IT products/services.

The probability of reporting an ICT skills gap is also found to be significantly positively related to indicators of structured training, such as whether establishments have a training plan or a training budget. This is perhaps surprising given that almost a third of establishments with skill gaps attributed the problem in part to insufficient training. We conjecture that, for many of the survey respondents who reported lack of full proficiency among ICT Professionals, working in establishments with formal ICT training provision may be associated with high expectations of the skills which ICT professionals are expected to possess and thus greater awareness of employees' difficulties in keeping up with rapid changes in ICT skill requirements. But it also seems likely that investment in training constitutes a form of response to recognised internal skill deficiencies, with the implication that the training variables in our ICT skill gaps model are endogenous.

In our analysis of the relationship between ICT skill gaps and sales performance, our cross-sectional estimates for 2001 yield positive and significant coefficients on the variables denoting London and the South East (relative to the East Midlands), the retail/wholesale sectors relative to Other Industries and IT consultancy and IT sales relative to Non-ICT products. By contrast there are negative significant coefficients attached to sector dummies for the hotels/restaurants, health, education and leisure industries and to single-site enterprises.

In the main regressions covering the full sample of establishments for which matching financial data were obtained, there is clear evidence of a significant negative relationship between the severity of ICT skill gaps and company sales performance, with an increase in the size of the significant negatively-signed coefficients on the skill gap indicators as they move from 26-50% of ICT Professionals deemed to lack proficiency in their jobs to 51% or more lacking proficiency.

These findings remain entirely robust to using restricted sub-samples of (1) establishments which are single-site enterprises and (2) establishments for which the upper bound of the establishment's employment size-band corresponds to 50% or more of total company employment. These checks provide some reassurance that our main findings on the negative impact of ICT skill gaps on company performance are not distorted by the unavoidable disparity between our establishment-level survey data and the enterprise-level financial data which have been matched to them.

Finally, the analysis provides some evidence of positive and statistically significant links between sales performance and provision of structured ICT training. This evidence is stronger in the restricted sub-samples described above than in the full matched sample of establishments.

REFERENCES

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APPENDIX A:

Table 8: Determinants of ICT-related internal skill gaps

	(1)	(2)	(3)	(4)
Dependent variable:	Logit - Binary skill gap measure (1)	Logit - Binary skill gap measure (2)	Ordered logit - Ordered skill gap measure (1)	Ordered logit - Ordered skill gap measure (2)
Emp10_24	0.191*	0.190*	0.109	0.109
	(0.103)	(0.103)	(0.103)	(0.103)
Emp25_49	0.186	0.181	0.056	0.053
	(0.123)	(0.123)	(0.120)	(0.120)
Emp50_99	0.229*	0.224*	0.118	0.114
	(0.123)	(0.123)	(0.122)	(0.122)
Emp100_199	0.332**	0.327**	0.172	0.169
	(0.130)	(0.131)	(0.128)	(0.128)
Emp200_249	0.191	0.183	0.103	0.098
	(0.194)	(0.194)	(0.197)	(0.197)
Emp250_499	0.487***	0.475***	0.299*	0.290*
	(0.183)	(0.184)	(0.169)	(0.171)
Emp500_999	0.876***	0.856***	0.501**	0.486**
	(0.252)	(0.252)	(0.200)	(0.201)
Emp1000plus	0.816**	0.800**	0.330	0.318
	(0.334)	(0.334)	(0.261)	(0.262)
London	0.267*	0.266*	0.277*	0.276*
	(0.159)	(0.160)	(0.149)	(0.149)
South East	0.034	0.032	0.062	0.061
	(0.148)	(0.148)	(0.139)	(0.139)
South West	0.393**	0.390**	0.414**	0.412**
	(0.171)	(0.172)	(0.162)	(0.162)
West Midlands	0.082	0.082	0.126	0.127
	(0.176)	(0.176)	(0.168)	(0.168)
Yorkshire & Humberside	0.261	0.259	0.246	0.245
	(0.183)	(0.183)	(0.170)	(0.170)
North West	0.203	0.201	0.218	0.217
	(0.169)	(0.169)	(0.160)	(0.160)
Eastern	0.303*	0.304*	0.352**	0.352**
	(0.167)	(0.167)	(0.158)	(0.158)
North East	0.363*	0.359*	0.423**	0.420**
	(0.209)	(0.209)	(0.202)	(0.202)
Scotland	0.099	0.099	0.215	0.215
	(0.175)	(0.175)	(0.173)	(0.174)
N Ireland	0.297	0.299	0.329*	0.331*
	(0.207)	(0.207)	(0.198)	(0.199)
Wales	0.012	0.006	0.018	0.013
	(0.197)	(0.197)	(0.190)	(0.190)
Food/Textiles	0.070	0.072	0.174	0.173
	(0.282)	(0.283)	(0.270)	(0.270)
Engineering	-0.041	-0.039	0.022	0.021
	(0.249)	(0.250)	(0.236)	(0.236)
Construction	0.231	0.230	0.239	0.236
	(0.297)	(0.298)	(0.273)	(0.274)
Retail / Wholesale	0.308	0.309	0.385	0.384
	(0.249)	(0.250)	(0.236)	(0.237)
Hotels	0.438	0.420	0.564*	0.551*
	(0.340)	(0.340)	(0.333)	(0.334)
Transport	0.464	0.470	0.447	0.449
	(0.361)	(0.362)	(0.317)	(0.317)
Telecoms	0.407	0.407	0.519**	0.517*
	(0.279)	(0.280)	(0.265)	(0.265)
Financial Services	0.377	0.377	0.379	0.377
	(0.284)	(0.285)	(0.261)	(0.262)

Business Services	0.312	0.305	0.389	0.382
	(0.259)	(0.260)	(0.243)	(0.244)
Computer Services	0.147	0.146	0.156	0.153
	(0.242)	(0.243)	(0.226)	(0.227)
Health	0.187	0.183	0.321	0.316
	(0.289)	(0.289)	(0.274)	(0.275)
Public	-0.097	-0.104	0.032	0.025
	(0.276)	(0.276)	(0.260)	(0.260)
Education	0.288	0.279	0.395*	0.387*
	(0.244)	(0.245)	(0.230)	(0.231)
Leisure	0.129	0.117	0.311	0.302
	(0.372)	(0.373)	(0.383)	(0.384)
IT support	0.133	0.129	0.015	0.013
	(0.147)	(0.148)	(0.140)	(0.140)
IT development	0.246**	0.241*	0.107	0.104
	(0.124)	(0.124)	(0.112)	(0.112)
IT consultancy	0.113	0.110	0.085	0.083
	(0.157)	(0.157)	(0.150)	(0.150)
IT sales	0.273**	0.268*	0.177	0.174
	(0.137)	(0.137)	(0.129)	(0.129)
IT training	0.194	0.187	0.118	0.114
	(0.152)	(0.152)	(0.144)	(0.144)
Other IT	0.496***	0.491***	0.331***	0.328***
	(0.123)	(0.123)	(0.109)	(0.109)
IT product_nk	-0.128	-0.131	-0.174	-0.178
	(0.536)	(0.534)	(0.560)	(0.558)
Single	-0.000	-0.001	-0.004	-0.004
	(0.092)	(0.092)	(0.089)	(0.089)
Head office	0.241**	0.239**	0.170*	0.169*
	(0.096)	(0.096)	(0.089)	(0.089)
Sales up	0.021	0.019	0.032	0.031
	(0.091)	(0.091)	(0.086)	(0.086)
Sales down	-0.035	-0.036	0.057	0.057
	(0.139)	(0.139)	(0.138)	(0.138)
Sales change_nk	-0.322***	-0.319***	-0.280***	-0.278***
	(0.110)	(0.110)	(0.106)	(0.107)
Structured training	0.230***		0.195***	
	(0.073)		(0.072)	
Training plan or budget_not known	-0.072	-0.071	-0.164	-0.164
	(0.269)	(0.269)	(0.244)	(0.244)
Training plan or budget		0.188**		0.168**
		(0.085)		(0.083)
Training plan and budget		0.272***		0.222***
		(0.086)		(0.083)
Constant	-1.202***	-1.193***		
	(0.285)	(0.286)		
Observations	3907	3907	3907	3907
Log-likelihood	-2589.01	-2588.54	-4756.57	-4756.34
Wald chi2	120.80	121.85	107.25	108.15
McF R-sqd	0.02	0.02	0.01	0.01
Robust standard errors in parentheses				
* significant at 10%; ** significant at 5%; *** significant at 1%				

Table 11: Impact of ICT-related internal skill gaps and ICT training on company performance, 2001 – Full matched sample -- Cross-Section regressions

	(1) Full matched sample	(2) Full matched sample	(3) Full matched sample
Log capital assets	0.098***	0.098***	0.098***
	(0.026)	(0.026)	(0.026)
Log labour input	0.913***	0.907***	0.907***
	(0.041)	(0.042)	(0.041)
Skill gap 1-10%	0.082	0.079	0.078
	(0.095)	(0.094)	(0.094)
Skill gap 11-25%	-0.088	-0.093	-0.093
	(0.078)	(0.078)	(0.078)
Skill gap 26-50%	-0.144*	-0.151*	-0.151*
	(0.079)	(0.081)	(0.081)
Skill gap 50%-plus	-0.290**	-0.281**	-0.282**
	(0.124)	(0.124)	(0.124)
Skill gap_nk	0.070	0.062	0.062
	(0.192)	(0.188)	(0.187)
Structured training	0.054		
	(0.064)		
Training plan or budget_not known	0.053	0.054	0.057
	(0.130)	(0.130)	(0.123)
Training plan or budget		-0.005	
		(0.070)	
Training plan and budget		0.116	0.118*
		(0.076)	(0.065)
London	0.362***	0.356***	0.356***
	(0.122)	(0.122)	(0.122)
South East	0.390***	0.386***	0.386***
	(0.111)	(0.112)	(0.112)
South West	0.216*	0.217*	0.217*
	(0.131)	(0.131)	(0.131)
West Midlands	0.042	0.041	0.040
	(0.138)	(0.139)	(0.139)
Yorkshire & Humberside	0.000	-0.004	-0.004
	(0.141)	(0.140)	(0.139)
North West	0.166	0.153	0.154
	(0.129)	(0.130)	(0.130)
Eastern	0.308**	0.308**	0.308**
	(0.137)	(0.136)	(0.136)
North East	0.011	0.000	0.001
	(0.168)	(0.169)	(0.168)
Scotland	0.268*	0.259*	0.259*
	(0.155)	(0.154)	(0.154)
N Ireland	0.020	0.019	0.019
	(0.165)	(0.167)	(0.167)
Wales	0.106	0.093	0.093
	(0.150)	(0.151)	(0.151)
Food/Textiles	0.172	0.173	0.173
	(0.131)	(0.129)	(0.129)
Engineering	0.139	0.142	0.142
	(0.123)	(0.122)	(0.122)
Construction	0.334	0.342	0.341
	(0.221)	(0.224)	(0.224)
Retail / Wholesale	0.685***	0.700***	0.699***
	(0.132)	(0.132)	(0.132)
Hotels	-0.931***	-0.954***	-0.954***
	(0.145)	(0.143)	(0.143)

Transport	0.242	0.263	0.263
	(0.209)	(0.209)	(0.209)
Telecoms	0.194	0.182	0.182
	(0.194)	(0.192)	(0.192)
Financial Services	0.002	0.003	0.002
	(0.211)	(0.211)	(0.211)
Business Services	-0.125	-0.123	-0.123
	(0.174)	(0.171)	(0.171)
Computer Services	-0.247*	-0.253*	-0.253*
	(0.139)	(0.137)	(0.137)
Health	-0.134	-0.123	-0.125
	(0.282)	(0.273)	(0.272)
Public	-1.231***	-1.230***	-1.231***
	(0.186)	(0.188)	(0.187)
Education	-0.567***	-0.577***	-0.578***
	(0.175)	(0.174)	(0.174)
Leisure	-0.899***	-0.873***	-0.873***
	(0.192)	(0.190)	(0.190)
IT support	0.281*	0.277*	0.277*
	(0.153)	(0.156)	(0.155)
IT development	-0.037	-0.051	-0.051
	(0.119)	(0.121)	(0.121)
IT consultancy	0.399***	0.388***	0.388***
	(0.121)	(0.122)	(0.121)
IT sales	0.406**	0.389**	0.389**
	(0.157)	(0.158)	(0.157)
IT training	0.157	0.145	0.145
	(0.143)	(0.143)	(0.143)
Other IT	0.121	0.109	0.108
	(0.109)	(0.109)	(0.109)
IT product_nk	1.276***	1.221***	1.221***
	(0.129)	(0.136)	(0.136)
Single	-0.113*	-0.116*	-0.116*
	(0.062)	(0.062)	(0.062)
Constant	10.207***	10.236***	10.235***
	(0.307)	(0.306)	(0.304)
Observations	700	700	700
Adjusted R-squared	0.83	0.83	0.83

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 12: Impact of ICT-related internal skill gaps and ICT training on company performance, 2001 – Restricted sub-samples - Cross-Section regressions

	(1) Single-site enter-prises	(2) Single-site enter-prises	(3) Single-site enter-prises	(4) Establishments representing 50%-plus of enterprise employment	(5) Establishments representing 50%-plus of enterprise employment	(6) Establishments representing 50%-plus of enterprise employment
Log capital assets	0.120**	0.119**	0.120**	0.102***	0.103***	0.103***
	(0.048)	(0.047)	(0.047)	(0.031)	(0.031)	(0.031)
Log labour input	0.843***	0.838***	0.839***	0.869***	0.861***	0.862***
	(0.087)	(0.087)	(0.086)	(0.052)	(0.053)	(0.053)
Skill gap 1-10%	0.009	0.011	0.017	0.005	0.002	0.004
	(0.181)	(0.180)	(0.178)	(0.104)	(0.102)	(0.102)
Skill gap 11-25%	0.014	0.016	0.021	-0.052	-0.056	-0.056
	(0.144)	(0.143)	(0.144)	(0.091)	(0.091)	(0.091)
Skill gap 26-50%	-0.373**	-0.380**	-0.403**	-0.114	-0.119	-0.118
	(0.157)	(0.159)	(0.158)	(0.095)	(0.098)	(0.098)
Skill gap 50%-plus	-0.455**	-0.442**	-0.431**	-0.346***	-0.329**	-0.327**
	(0.201)	(0.198)	(0.200)	(0.128)	(0.128)	(0.127)
Skill gap_nk	0.523	0.455	0.458	0.224	0.214	0.213
	(0.348)	(0.356)	(0.365)	(0.264)	(0.256)	(0.255)
Structured training	0.183*			0.091		
	(0.099)			(0.071)		
Training plan or budget_not known	0.277	0.295	0.254	0.137	0.138	0.130
	(0.280)	(0.282)	(0.283)	(0.177)	(0.178)	(0.170)
Training plan or budget		0.115			0.016	
		(0.116)			(0.078)	
Training plan and budget		0.260**	0.211*		0.165*	0.157**
		(0.125)	(0.118)		(0.084)	(0.072)
London	0.564**	0.560**	0.571**	0.427***	0.420***	0.419***
	(0.233)	(0.233)	(0.233)	(0.130)	(0.131)	(0.131)
South East	0.220	0.216	0.229	0.424***	0.419***	0.419***
	(0.179)	(0.180)	(0.182)	(0.117)	(0.119)	(0.119)
South West	-0.187	-0.172	-0.137	0.091	0.085	0.087
	(0.207)	(0.208)	(0.206)	(0.138)	(0.139)	(0.139)
West Midlands	0.021	0.030	0.049	0.040	0.037	0.038
	(0.233)	(0.236)	(0.237)	(0.155)	(0.158)	(0.159)
Yorkshire & Humberside	-0.242	-0.254	-0.267	0.097	0.091	0.089
	(0.200)	(0.201)	(0.202)	(0.161)	(0.160)	(0.159)
North West	0.043	0.011	0.005	0.197	0.182	0.182
	(0.245)	(0.251)	(0.251)	(0.141)	(0.143)	(0.143)
Eastern	0.375	0.398	0.425	0.332**	0.331**	0.330**
	(0.290)	(0.286)	(0.290)	(0.144)	(0.143)	(0.143)
North East	-0.277	-0.267	-0.242	0.085	0.070	0.068
	(0.304)	(0.309)	(0.316)	(0.186)	(0.187)	(0.187)
Scotland	-0.121	-0.110	-0.078	0.324*	0.320*	0.320*
	(0.235)	(0.228)	(0.227)	(0.168)	(0.169)	(0.168)
N Ireland	-0.176	-0.170	-0.169	0.120	0.123	0.123
	(0.268)	(0.264)	(0.262)	(0.221)	(0.227)	(0.227)
Wales	-0.221	-0.206	-0.198	0.221	0.218	0.217
	(0.330)	(0.319)	(0.312)	(0.169)	(0.169)	(0.169)
Food/Textiles	0.528***	0.541***	0.549***	0.192	0.198	0.196
	(0.163)	(0.157)	(0.156)	(0.151)	(0.147)	(0.146)
Engineering	0.318*	0.334*	0.334*	0.154	0.167	0.168
	(0.184)	(0.180)	(0.179)	(0.141)	(0.138)	(0.138)
Construction	0.629	0.637	0.645	0.167	0.182	0.183

	(0.430)	(0.449)	(0.459)	(0.266)	(0.269)	(0.270)
Retail / Wholesale	1.004***	1.035***	1.047***	0.681***	0.706***	0.707***
	(0.215)	(0.218)	(0.214)	(0.153)	(0.152)	(0.153)
Hotels	-1.072***	-1.100***	-1.127***	-0.900***	-0.932***	-0.934***
	(0.167)	(0.158)	(0.162)	(0.194)	(0.192)	(0.191)
Transport	-0.167	-0.093	-0.064	0.085	0.119	0.119
	(0.228)	(0.234)	(0.247)	(0.270)	(0.267)	(0.266)
Telecoms	0.367	0.379	0.372	0.149	0.151	0.151
	(0.384)	(0.379)	(0.388)	(0.231)	(0.231)	(0.231)
Financial Services	-0.350	-0.377	-0.378	-0.259	-0.258	-0.257
	(0.292)	(0.286)	(0.283)	(0.225)	(0.223)	(0.223)
Business Services	-0.157	-0.127	-0.130	-0.049	-0.038	-0.039
	(0.379)	(0.372)	(0.364)	(0.201)	(0.197)	(0.197)
Computer Services	-0.240	-0.229	-0.226	-0.308*	-0.302*	-0.301*
	(0.216)	(0.211)	(0.209)	(0.159)	(0.157)	(0.157)
Health	0.096	0.134	0.174	0.020	0.030	0.033
	(0.344)	(0.351)	(0.343)	(0.336)	(0.322)	(0.321)
Public	-0.789**	-0.788**	-0.784**	-1.263***	-1.251***	-1.249***
	(0.329)	(0.336)	(0.333)	(0.254)	(0.256)	(0.255)
Education	-0.689***	-0.690***	-0.682***	-0.556***	-0.556***	-0.556***
	(0.229)	(0.220)	(0.218)	(0.184)	(0.182)	(0.182)
Leisure	-0.566*	-0.518	-0.529*	-0.892***	-0.854***	-0.856***
	(0.340)	(0.326)	(0.305)	(0.201)	(0.198)	(0.197)
IT support	0.504*	0.519*	0.565*	0.232	0.214	0.215
	(0.299)	(0.301)	(0.302)	(0.174)	(0.178)	(0.178)
IT development	-0.151	-0.197	-0.195	-0.072	-0.093	-0.093
	(0.207)	(0.221)	(0.222)	(0.133)	(0.133)	(0.133)
IT consultancy	0.413*	0.383*	0.377*	0.295**	0.277**	0.275**
	(0.217)	(0.215)	(0.214)	(0.129)	(0.129)	(0.129)
IT sales	-0.029	-0.029	-0.032	0.439***	0.420**	0.417**
	(0.251)	(0.253)	(0.250)	(0.169)	(0.170)	(0.170)
IT training	0.078	0.056	0.058	0.171	0.155	0.155
	(0.252)	(0.256)	(0.261)	(0.165)	(0.164)	(0.164)
Other IT	0.234	0.224	0.241	0.173	0.145	0.145
	(0.164)	(0.167)	(0.168)	(0.126)	(0.127)	(0.127)
IT product_nk	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Single				-0.147**	-0.150**	-0.151**
				(0.067)	(0.067)	(0.067)
Constant	10.031***	10.059***	10.062***	10.329***	10.361***	10.366***
	(0.529)	(0.512)	(0.508)	(0.361)	(0.356)	(0.352)
Observations	220	220	220	533	533	533
Adjusted R-squared	0.79	0.79	0.79	0.77	0.77	0.77

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%