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Enterprise Product Strategies and Employer Demand for Skills in Britain: Evidence from the Employers Skill Survey

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Editor's Foreword

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Abstract

It is now widely recognised that employer demand for skills in Britain is quite low by comparison with several other industrialised nations, reflecting the fact that a large proportion of British enterprises have adopted relatively low value-added product (or service) strategies. In many companies, therefore, production tends to be concentrated towards the more standardised and less complicated end of the quality spectrum for which skill requirements are relatively low. At the same time there are certain industries where many British-based suppliers have apparently been pushed into higher value added activity as a result of competitive pressure from lower-cost foreign producers of low value added products.

To date much of the evidence on the incidence of product strategies has been based on international comparisons (typically involving case studies). There has been little quantitative research investigating differences *between* British-based companies in the links between product strategies, skill levels and indicators of economic performance.

This paper makes use of new measures of product strategy and workforce skills derived from the 2001 Employers Skills Survey to submit two widely-argued propositions to empirical scrutiny at establishment level:

- All else being equal, high (low) workforce skill levels are positively associated with high (low) value added product strategies
- All else being equal, high (low) value added product strategies are positively associated with a high (low) degree of exposure to foreign competition

Both these propositions receive support from multivariate analysis which controls for employee size-group, sector, regional location, site function, recent sales growth and a number of other factors that influence skill requirements and export performance. Among other things, high-specification, high-skill product strategies are found to be highly correlated with a focus on national and international product markets rather than less competitive local and regional markets.

Estimates of the impact of changes in product strategy on skill requirements suggest that, when enterprises do seek to upgrade their product strategies, the process may have a polarising impact on demand for skills. In sectors characterised by

relatively high proportions of firms deploying high value added skill-intensive product strategies, further efforts to move up-market in response to competitive pressures are associated with disproportionately large increases in employers' demand for skills. Conversely, in sectors where low-end product strategies currently predominate, the impact on demand for skills of firms upgrading their product strategies appears to be relatively modest.

The paper identifies a striking amount of within-industry variation – as well as between-industry variation -- in the degree of specialisation in 'high', 'medium' and 'low end' activities along the product quality spectrum, with associated variation in skill requirements. While there is clearly some form of correspondence between product strategy choices and skill requirements, the sheer diversity of such correspondences between and within industries shows that there is no question of an entire national economy (or even regional economy) being locked into any single kind of product strategy/skills 'equilibrium'.

One key issue for policy-makers concerns the *sustainability* of the product strategies underlying different types of production. In product areas where local, regional and even national demands for basic-quality standardised goods and services are strong, product strategies based on low-skill, low value added production may well be viable into the foreseeable future for many firms. Such firms are likely to be resistant to government policy designed to encourage moves to more skill-intensive product strategies.

However, the analysis also finds that high-end (low-end) product strategies are positively and significantly associated with recent growth (decline) in sales and with a relatively high (low) level of capacity utilisation. This implies that a significant proportion of British firms pursuing low value added product strategies could in fact enhance their competitiveness by moving to higher specification, more skill-intensive products and services.

Two challenges for policy-makers are, therefore, to be able to identify the types of enterprises whose existing product strategies are unsustainable and, secondly, to develop new strands of education, training and industrial policy which will help to ensure that the future skill needs of such employers can be met.

1. Introduction [1]

It is now widely believed that improvements in workforce skills are essential in order to help achieve higher levels of economic performance. Hence, many people in Britain are surprised by continuing evidence suggesting that employer demand for skills is largely satisfied and indeed may be over-supplied. Two examples of such evidence are the following:

1. A large scale telephone survey of a nationally representative sample of employers in 2001 – the Employers Skill Survey (ESS) -- found that only 10% of establishments reported having either skill-related recruitment difficulties or an 'internal skills gap' (lack of full proficiency among existing staff) at the time of the survey. The remaining 90% of establishments did not report either type of problem (Hogarth, Shury, Vivian and Wilson, 2001). [2]

2. Estimates based on a nationally representative sample of employees (2001 Skills Survey) suggest that the numbers of qualified people in Britain now substantially exceed the numbers of jobs which require formal qualifications. The apparent imbalances between qualifications required and supplied are greatest at NVQ levels 2 and 3. At NVQ level 4 (graduate and higher intermediate levels of qualification) supply and demand are broadly in balance (Felstead, Gallie and Green, 2002).

As always in research of this kind, interpretation of these findings needs to proceed cautiously due to the difficult methodological and measurement issues which are involved. In the case of the Employers Skills Survey, there is evidence from related case studies that skill problems are under-reported by individual managerial respondents to telephone surveys. Indeed, the case studies suggest that not all skill shortcomings are necessarily recognised as such by managers (NSTF, 1999). And a

[1] I am grateful to the Centre for Skills, Knowledge and Organisational Performance (SKOPE) for financial support during the preparation of this paper and to the Department for Education and Skills for permission to make use of the ESS dataset. However, neither SKOPE nor the DfES are responsible for the views expressed in the paper. I would also like to thank John Forth, Philip Stevens, Andy Dickerson and Rob Wilson for valuable discussions during the ESS project reported in Mason and Wilson (2003) and Ray Barrell, Francis Green, Ken Mayhew, Mary O'Mahony, Kate Robinson and Michela Vecchi for comments and advice. The usual disclaimer of responsibility for any errors applies.

[2] The 2001 ESS included establishments with one to four employees. If attention is confined to establishments with 5 employees or more, then the proportion reporting at least one skill-shortage vacancy or one internal skill gap or both rises to 20% in 2001, compared to 25% of establishments with 5 or more employees in the 1999 ESS (Forth and Mason, 2003).

great deal of other evidence from the 2001 Skills Survey shows that, even if there is an over-supply of formal qualifications at lower levels of qualification, this coexists with generally rising skills requirements in the majority of jobs (Felstead et al, 2002).

However, the broad tenor of the two sets of survey findings is consistent with a widely-argued proposition that employer demand for skills in Britain remains quite low, reflecting the low value-added product (or service) strategies adopted by large numbers of British enterprises. This perspective derives in part from cross-country comparisons of matched samples of production establishments which found that – relative to countries such as Germany – a large proportion of British output tends to be concentrated towards the 'lower' (more standardised, less complicated) end of the quality spectrum for which skill requirements are relatively low (Prais, 1995). Following Finegold and Soskice's (1988) suggestion that the British economy may be trapped in a 'low skills / low quality equilibrium', Redding (1996) developed a theoretical model in which such an outcome may develop as a result of interdependent incentives governing workers' decisions to invest in human capital formation and employers' decisions to invest in research & development (R&D).

To date, in spite of intense interest in the relationship between enterprise product strategies and workforce skills development, there has been little effort to carry out empirical research in this area which would permit some quantification of the mix of product strategies in different industries and seek to explore the links between product strategies, skill levels and indicators of economic performance. The present paper aims to start filling this gap. It is ordered as follows: Section 2 briefly discusses the concept of 'product strategy' and reviews the evidence linking skill requirements to product strategies. Sections 3 and 4 then draw on Employers Skill Survey data to assess the relative importance of product strategies in determining current skill levels and the extent of any links between product strategies, skills and performance at establishment level. Section 5 concludes with a discussion regarding the conceptual framework underlying present debates on the relationship between product strategies and employers' demand for skills; the development of policy with the aim of encouraging more enterprises to move to skill-intensive product strategies; and the future research agenda in the area of product strategies and skills

2. Product strategies and skills

2.1 Conceptual issues

The term 'product strategy' attempts to capture the choices made by enterprises about product or service differentiation within particular markets. Do they produce in relatively high volumes for a mass market or do they aim to be niche suppliers producing goods and services in relatively low volumes? In a related question, how customer-specific are their products and services? Do they attempt to compete at the lower-priced end of given markets or do they attempt to offer a high-quality product which will sell at a premium price?

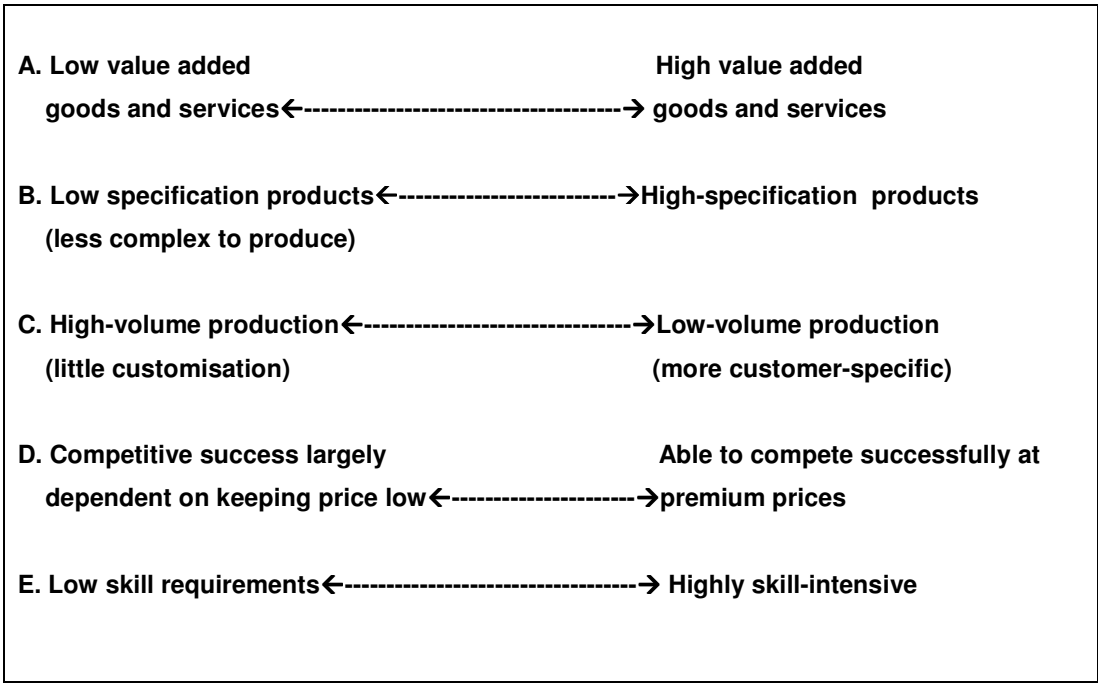
The British-German matched-plant comparisons in the 1980s and 1990s suggested that – in several different industries -- there were systematic differences between producers in each country in the predominant mix of product strategies. For example:

- In the clothing industry comparison, typical batch sizes in British plants were roughly a hundred times greater than in Germany, and British products were generally made to lower quality standards in the sense of using plainer materials and fewer constituent pieces (thus making for less 'tailored' garments) (Steedman and Wagner, 1989).
- In a food processing comparison based on biscuit production, the more basic (undecorated) varieties of biscuits accounted for a much larger share of total output in the British sample than in the German sample. In addition to requiring much less secondary processing and packaging, basic types of biscuits are typically produced in large batches and are thus more amenable to automation of production than are the higher-quality grades of biscuit (Mason, van Ark and Wagner, 1994)
- More recently, a new comparison based on automotive components has found that some German suppliers specialise in producing high value added components and sub-assemblies which are simply not made any more in Britain. To some extent this reflects the greater involvement of the German component suppliers' domestic customer base -- German-based auto assemblers -- in the production of 'luxury' grades of car (Mason and Wagner, 2002).

In these and other industries, the tendency for British producers to focus on less elaborate, less complex types of product than are commonly made in Germany has been found to be strongly associated with lower levels of workforce skill than are required in Germany.

These contrasts suggest that an 'enterprise product strategy' may be conceived as referring to the positions occupied by different enterprises on a series of spectra relating to value added, complexity of product specification, volumes and price dependence, all of which may have implications for skill requirements (Figure 1). Note that 'quality' as defined here refers to the complexity of the processes required for the manufacture of different products (or delivery of different services) as well as the functionality of the products in question (or service attributes). This differs from the way in which the term quality is used in many workplaces where efforts to improve quality focus on achieving a higher proportion of products or services which fall within stipulated tolerances without needing to be reworked or repeated. In this context, for example, a manufacturing plant may be achieving 'high quality' defined in terms of a relatively low reject rate but the product in question may still be of a relatively 'low specification' -- inherently less complex, more limited in its functionality and commanding a lower price – compared to other products in the same area.

Figure 1: Examples of product strategy spectra



2.2 Diversity in product strategies

Intuitively, it might be expected that establishments can be characterised as operating a relatively high (low) value added product strategy to the extent that they are positioned towards the right (left) hand side of each of the different spectra shown in Figure 1. However, there is a great deal of evidence which suggests that product strategies (and related skill demands) cannot be classified in such a straightforward way. For example:

- High value added production does not necessarily involve small-batch or one-off production volumes across the board. In some manufacturing sectors, the use of microelectronics-based equipment has permitted the development of 'mass customisation', that is, the ability to configure mass-produced components to meet a range of different customers' specific requirements. Thus, in automotive production, the German industry tends to specialise in high value added market segments but production volumes among Germany's leading car producers are far from small. Indeed, the annual output of roughly 800,000 'upper medium / luxury' grade cars in Germany equates to half the total output of the British industry in lower value added segments of the auto market (Table 1).
- Similarly, high value added products do not always have complex specifications. The 'premium images' and high prices commanded by some products may simply reflect the effects of marketing and advertising rather than the complexity of production conditions (Wensley, 1999).
- And in some industries, high value added products and services are by no means associated with higher levels of skill. For example, luxury hotels tend to offer more labour-intensive services than do cheaper grades of hotel (eg, more staff to carry luggage and wait on tables) but do not necessarily provide more skill-intensive services (Mason et al, 2000).

Another problem in seeking to classify the different product strategies adopted by enterprises is that many of them adopt a 'segmented' approach to product or service delivery rather than focus on a single type of market. Thus, for example, in comparisons of US, British and German banking establishments engaged in

commercial lending, the American banks were found to combine a 'volume banking' approach to small business customers with a highly labour-intensive 'relationship banking' approach to larger, potentially more profitable customers. Measured labour productivity in the US banking sample was reduced by the high labour intensity at the upper end of the commercial lending market but the US banks outperformed their British and German counterparts in terms of average net revenue per employee (Mason, Keltner and Wagner, 1999).

Table 1: Passenger car production, UK and Germany, 2000, analysed by market segment

	Germany	**UK**			
Total car output in 2000 (units)	4.7 million	1.6 million			
				Examples:	
	% of total			**Germany**	**UK**
Segment:					
Mini	2.0	0.4		VW Lupo	BMW Mini
Small	11.2	27.0		VW Golf	Ford Fiesta
Lower medium	37.6	32.6		Opel Astra	Vauxhall Astra
Medium	26.2	22.1		Audi A4	Nissan Primera
Upper medium / luxury	17.1	3.4		BMW Serie 5; Mercedes Class S	Jaguar S type
Sport /Coupe	4.1	2.7		Porsche 911	Jaguar XJ/XK
Sports utility vehicles	0.0	8.9		na	Land Rover Freelander
Other	1.8	2.9		na	na
TOTAL	**100**	**100**			

Source: Zoom, 1995-2001 Worldwide Automotive Production / Sales Statistics (www.mavel.com)
Note: The classification of vehicles to different market segments is based on a classification published in *Automotive Quarterly Review* (Automotive World Publications, see www.automotiveworld.com for contact details)

These examples show that there may be considerable variation within (as well as between) industries in the degree of correspondence at enterprise or establishment level between value added, product complexity, production volumes and workforce skills. Furthermore, enterprises pursuing market segmentation strategies may be particularly hard to categorise on these dimensions. However, given the potential importance of product strategies in shaping employer demand for skills, the apparent diversity of such strategies at both industry and enterprise level is a strong motivation to carry out new empirical work in this area. In particular, there is a need to develop better ways of defining and measuring the constituent elements of product strategies

and to learn more about the relationship between product strategies and skill requirements.

2.3 Policy issues

In view of the apparent prevalence of relatively low quality, low skilled production in some British industries, a key question for policy-makers concerns the *sustainability* of the product strategies underlying this type of production. To the extent that companies engaged in low value added production are able to survive comfortably in their existing markets, they are likely to be unresponsive to government exhortation and policy initiatives designed to encourage shifts to higher value-added, more skill-intensive activities. Conversely, other companies may well face uncertain futures with their existing product or service strategies. A key role for policy-makers is then to ensure that, so far as possible, policy reforms and initiatives are supportive of enterprise efforts to move into new higher value added product areas.

Some light has been shed on these issues by cross-country comparisons of matched samples of establishments which suggest that the degree of exposure to foreign trade and competition is instrumental in determining the sustainability of low value added product strategies. Thus, for example, in food processing where there is a strong domestic market for standardised products, a product strategy based on low-skill, low value added bulk production may well be a viable strategy into the foreseeable future for many firms. However, in some other industries such as engineering, British firms have long faced severe competitive pressure from mass producers of standardised goods in lower-wage countries and this has obliged many British engineering suppliers to refocus production towards small- and medium-batch production of higher value added products (Mason, van Ark and Wagner, 1996).

In the context of competitive pressures to move up-market in industries such as engineering, previous research suggests that policy-makers need to pay particular attention to the adequacy of human capital supplies which may be needed to support the implementation of higher value added product strategies. For example, case studies carried out for the National Skills Task Force in 1999 found that in many companies the formulation of human resourcing and skills strategy tends to lag behind changes in product strategy, work organisation and production methods or service delivery. In these circumstances hitherto unrecognised gaps may start to emerge

between current skill levels and those required for future success in competitive markets (NSTF, 2000; Bosworth, Davies and Wilson, 2001).

2.4 Hypotheses of interest

On the basis of the above discussion, we can identify two widely-argued propositions which have some basis in case study evidence but which now need to be restated as hypotheses, and to be submitted to detailed empirical scrutiny at establishment level:

H1: All else being equal, high (low) levels of workforce skills are positively associated with high (low) value added product strategies

H2: All else being equal, high (low) value added product strategies are positively associated with a high (low) degree of exposure to foreign competition

We now go on to test these hypotheses using new measures of product strategy positioning and workforce skills derived from the Employers Skill Survey (ESS) carried out in 2001.

3. Product strategy and skill measures in the ESS

3.1 Sample characteristics

The ESS in 2001 was a nationally representative telephone survey of 27,031 establishments in England (where some 85% of the UK labour force is located). In most establishments with 100 or more employees the principal respondents were senior managers in human resource or personnel departments; in smaller establishments the respondents tended to be owners or general managers. The main stage of interviewing was carried out between November 2000 and April 2001 and the overall response rate from employers was 53 per cent (Hogarth et al, 2001).

In the present paper we focus on private sector establishments in order to make detailed use of the responses to certain questions on product strategy which were tailored to private sector establishments. [3] We also confine the analysis to establishments with five or more employees since, as Forth (2003) has shown, exclusion of micro-establishments with 1-4 employees permits a substantial degree of sectoral disaggregation while retaining confidence in the national representativeness of the sectoral sub-samples under consideration.

As Table 2 shows, these selection criteria yield a sample of 17653 private sector establishments of which roughly 16% were in manufacturing sectors, 7% in construction and 77% in service industries. In four sectors -- public administration, primary education, secondary education and higher education – the numbers of establishments fall well below the threshold of 400 recommended by Forth (2003) as the minimum cell size for estimates of proportions of establishments in sectoral sub-samples to have a reasonable degree of precision, and these sectors are therefore not included in tables showing descriptive statistics; however, private establishments in these sectors are retained in the regression analyses reported in Section 4.

[3] Similar questions, but by no means the same ones, were also asked of public sector establishments. For an analysis which draws on ESS data on product and service strategies covering public sector as well as private establishments, see Dickerson, Mason and Forth (2003).

Table 2: Sample of private sector establishments with five or more employees, analysed by sector

SIC (1992) codes		Number of unweighted establish-ments	Number of grossed-up establish-ments	% of grossed-up establish-ments
151-160	Food, drink and tobacco	352	4538	1.0
221-223	Printing, publishing, recorded media	452	10602	2.4
241-252	Chemicals, rubber and plastics	472	6939	1.6
281-287	Fabricated metal products	606	11523	2.6
300-335	Electrical, electronic and instrument engineering	353	8216	1.9
271-277, 291-297, 341-355	Mechanical engineering, vehicles and other engineering	722	12424	2.8
171-212, 231-232, 261-268, 361-366, 371-372	Other manufacturing industries	755	17172	3.9
452	Building of complete constructions; civil engineering	924	14742	3.4
451, 453-455	Building installation, building completion and other construction activities	799	14200	3.3
501-505	Sales of motor vehicles, parts, fuel	347	18632	4.3
511-517	Wholesaling	665	32995	7.6
522-524	Retailing - specialised stores	872	55225	12.7
521, 525-527	Retailing - non-specialised stores; other retail and repair	619	12576	2.9
551-552	Hotels, motels and other accommodation	591	8599	2.0
553, 555	Restaurants, canteens, catering	896	16257	3.7
554	Bars	709	17208	3.9
601-603,611-623	Transport services	692	11846	2.7
641-642	Postal and telecommunications services	266	3891	0.9
631-634	Auxiliary transport activities, travel agents	441	7885	1.8
651-652, 660, 671-672	Financial services, including insurance	610	18020	4.1
721-726	Computer services	409	9051	2.1
741	Legal, accounting, auditing, business and management consultancy, etc.	717	15482	3.6
742-743	Architectural and engineering activities and related technical consultancy; technical testing, analysis	475	11008	2.5
701-703, 712-721, 730-732, 744-748	Other business services	1330	39371	9.0
751-753	Public administration	31	1427	0.3
801	Primary education	73	3691	0.8
802	General secondary education	61	971	0.2
803-804	Higher education, adult education and other education	116	4627	1.1
851	Human health activities	395	8290	1.9
853	Social work	718	13554	3.1
926	Sporting activities, arenas, stadia	305	5128	1.2
852, 900,911-913, 921-925, 927, 930	Other service industries	880	19962	4.6
	TOTAL	**17653**	**436052**	**100**

Note: Percentages may not sum to 100 due to rounding

Just over three quarters of all grossed-up establishments employed fewer than 25 employees but these establishments accounted for only 29% of all employees (Table 3A). Conversely, establishments with 500 or more employees represented less than 0.5% of grossed-up establishments but had 13% of total employees. Some 29% of the grossed-up number of establishments were primarily office and administration sites, 20% were mainly engaged in sales and other customer-facing activity while 18% were production sites (Table 3B). The remainder were classified to functions such as warehousing or distribution; catering, entertainment or leisure; education, training or health care; and research, design and development.

Table 3: Sample of private sector establishments with five or more employees, analysed by employee size-group, site function and region

	Unweighted Establishments	Grossed-up Establishments	Grossed-up Employees
	Percentages		
(A) Employee size-group:			
5-9	17	42	10
10-24	23	35	19
25-49	26	12	15
50-99	14	6	15
100-199	11	2	11
200-499	8	2	17
500-999	2	0.3	7
1000+	1	0.1	6
TOTAL	*100*	*100*	*100*
(B) Main function carried out at establishment:			
Office, administrative services, finance or accounts	29	29	31
Factory, production or construction	23	18	25
Warehouse or distribution depot	7	8	7
Design, research and development	2	2	2
Catering, entertainment or leisure	14	11	8
Shop, showroom or other customer- or client-facing sales activities	13	20	15
Education, training or health care	7	6	6
Other activities	5	5	5
TOTAL	*100*	*100*	*100*
(C) Region:			
Eastern	12	11	11
East Midlands	10	8	8
London	15	17	18
North East	7	4	4
North West	12	13	13
South East	14	17	16
South West	10	10	9
West Midlands	11	11	11
Yorkshire & Humberside	10	10	10
TOTAL	*100*	*100*	*100*

3.2 Classification of product strategies

The ESS asked a number of questions relating to product strategy which invited respondents to say where their establishment was positioned on different four- or five-point scales -- as compared to other establishments in the same industries -- in respect of the following characteristics: [4]

- production volumes
- product complexity
- the extent to which competitive success depended on price
- the extent to which the establishment competed in a 'premium quality' product market as compared to a 'standard or basic quality' product market
- the extent to which the establishment provided 'a demonstrably better quality product or service than similar or competitor establishments'
- the extent to which the establishment 'tend(ed) to lead the way' in the development of new products, materials or techniques [5]

The responses to these questions across all private sector establishments are summarised in Tables 4 and 5. In general terms, high values on the scales assessing production volumes, product complexity, product quality and price-dependence equate to positions near the right hand sides of the product strategy spectra shown in Figure 1, that is: small-batch or one-off production volumes, high complexity, premium quality and low price-dependence. [6]

Although the subjective nature of the questions gives cause for concern that respondents might tend to overstate their own establishments' positioning relative to competitors, there is a fair degree of variation in the responses to nearly all these questions. For example, less than half the respondents rated themselves at points 4 or 5 on the five-point scale for product complexity and only a quarter claimed to be

[4] Respondents were asked to generalise about 'the products or services provided by (their) establishments'. In the case of any establishments pursuing segmented market strategies, it seems likely that the answers referred to their 'principal' product or service. However, alternative types of response cannot be ruled out, for example, efforts to give some kind of 'average' responses across several different types of products or services. The survey data do not permit any exploration of this issue.

[5] For this question, respondents were not asked to position themselves on a five-point scale but rather to say how applicable a statement regarding this kind of innovation leadership was to their establishment. The four potential responses – Not at all applicable, Not very applicable, Fairly applicable, Very applicable – are allocated to a 1-4 point scale in Table 3.

[6] Where appropriate the five-point scales used in the original questionnaire have been inverted so that high values always represent a high-end positioning on the product strategy spectra.

definitely 'leading the way' within their industry in terms of developing new products, materials or techniques (Table 4, Row 6). However, as many as 77% of all establishments awarded themselves 4 or 5 points in relation to producing 'a demonstrably better quality product or service' than their competitors. The wording of this particular question on product quality seems to be the most likely of the six questions to have prompted some defensive or self-congratulatory responses and it is notable that fewer establishments classified themselves to points 4-5 in relation to competing in a 'premium quality' product market as compared to a 'standard or basic quality' product market (Table 4, Row 4).

In part, these differences in response patterns must reflect the different meanings associated with the term 'quality' as discussed in Section 2 above. Since the term 'premium quality' is conceptually much closer to the notion of a 'high specification' product or service than is the term 'better quality', the responses to the 'premium quality' question are included in our later calculations of a summary measure of product strategy for each establishment while the responses to the 'better quality' question are omitted.

Table 4: Summary of responses to product strategy-related questions in ESS 2001 (private sector establishments with five or more employees)

Survey question		**1**	**2**	**3**	**4**	**5**	**Don't know**	**Total**	**% 4/5**
		Percentages							
c9a	Low volumes	23	21	31	12	8	5	100	20
c9b	High complexity	12	12	30	20	25	2	100	45
c9d	Low price-dependence	15	17	37	15	13	2	100	28
c9ka	Compete in premium quality market	8	8	25	23	33	2	100	56
c9l	Provide better quality product than competitors	1	3	17	34	43	2	100	77
		1	**2**	**3**	**4**		**Don't know**	**Total**	**% 4**
c9m2	Lead on development of new products, materials or techniques	20	23	31	24		2	100	24

Note: See text and footnote 5 for explanation of the scales relating to each survey response.

Table 5: Summary of responses to product strategy-related questions in ESS 2001 (private sector establishments with five or more employees), analysed by sector

% in top two categories out of five (c9a-c9l) *% in top category out of four (c9m2)*	**Low volumes**	**High complexity**	**Low price-dependence**	**Compete in premium quality market**	**Provide better quality product**	**Lead on new product develop-ment**
	c9a	c9b	c9d	c9ka	c9l	c9m2
	% 4/5	% 4/5	% 4/5	% 4/5	% 4/5	% 4
Food, drink and tobacco	18	37	24	55	83	27
Printing, publishing, recorded media	21	47	26	55	78	24
Chemicals, rubber and plastics	18	46	26	56	80	28
Fabricated metal products	26	45	22	52	79	16
Electrical, electronic and instrument engineering	36	55	18	60	81	29
Mechanical engineering, vehicles and other engineering	30	50	23	63	77	27
Other manufacturing industries	31	44	25	62	83	22
Building of complete constructions; civil engineering	26	44	21	51	76	12
Building installation, building completion and other construction activities	19	47	23	50	78	13
Sales of motor vehicles, parts, fuel	16	44	23	60	69	28
Wholesaling	19	40	18	48	70	22
Retailing - specialised stores	18	42	27	49	74	27
Retailing - non-specialised stores; other retail and repair	12	31	22	46	72	24
Hotels, motels and other accommodation	17	21	23	36	63	14
Restaurants, canteens, catering	16	32	33	54	81	28
Bars	14	25	30	44	74	18
Transport services	13	35	25	45	76	19
Postal and telecommunications services	19	44	27	65	78	32
Auxiliary transport activities, travel agents	14	48	25	52	80	29
Financial services, including insurance	17	51	29	56	76	26
Computer services	35	76	38	81	87	41
Legal, accounting, auditing, business and management consultancy, etc.	17	62	38	68	80	23
Architectural and engineering activities and related technical consultancy; technical testing, analysis	24	69	28	75	84	25
Other business services	21	45	30	59	83	26
Human health activities	20	70	50	73	83	24
Social work	13	63	51	65	84	22
Sporting activities, arenas, stadia	14	28	33	53	72	26
Other service industries	18	45	37	58	77	27
TOTAL (a)	**20**	**45**	**28**	**56**	**77**	**24**

(a) Includes private sector establishments in public administration and the primary, secondary and higher education sectors. Results for these sectors are not shown separately due to relatively small cell sizes.

Although, as discussed in Section 2 above, there is no reason in principle to expect a direct correspondence between establishments' positions on the product strategy spectra, Table 6A does in fact show a significant degree of positive correlation between the establishment ratings on product complexity, premium quality, price-dependence and innovation leadership. However, these four characteristics are all negatively correlated with low-volume production and the degree of correlation is much smaller. Accordingly, we have chosen to retain production volumes as a separate variable and to carry out a factor analysis of the other four dimensions of product strategy. This analysis extracted a single factor with an eigenvalue in excess of unity which explained 42% of the total variation of the four variables. As Table 6B shows, all four variables loaded positively on this factor which is readily interpretable as an indicator of positioning towards the 'high end' of a product strategy spectrum.

Table 6: Results of correlation and factor analysis carried out on establishment ratings of production and product characteristics

A: Correlations

	Production volumes	Product complexity	Price-dependence	Premium quality	Innovation leadership
Production volumes	1				
Product complexity	-0.10***	1			
Price-dependence	-0.06***	0.20***	1		
Premium quality	-0.09***	0.35***	0.23***	1	
Innovation leadership	-0.14***	0.20***	0.11***	0.21***	1

n=17166-17981
Pairwise correlations: ***statistically significant at 1% level or better; ** 5%

B: Variable loadings on 'product strategy' factor

Product complexity	0.72
Price-dependence	0.56
Premium quality	0.74
Innovation leadership	0.54

n=16836
Estimated by principal-components factor method.
Kaiser-Meyer-Olkin measure of sampling adequacy: 0.649
Bartlett's test of sphericity: p=0.000***

Descriptive statistics on the derived variable summarising product strategy show a marked variation both between and within sectors. The highest mean scores were found in computer services and health services, followed by technical business services (eg, architectural and engineering consultancy), social work and legal,

accounting, management consultancy and related business services (Table 7). By contrast, the lowest mean product strategy scores were in hotels, bars and transport services. A standard measure of dispersion (Column 4) shows that within-sector variation was lowest in sectors with either relatively high or relatively low mean product strategy scores (Figure 2). The highest levels of dispersion of product strategy scores were found in postal and telecommunication services, printing and publishing and specialised retailing.

Table 7: Product strategy scores, ESS 2001, analysed by sector
(ranked by mean product strategy score)

	N	Mean	Median	Quartile deviation/ median
Computer services	393	0.77	0.81	0.6
Human health activities	334	0.61	0.71	0.7
Architectural and engineering activities and related technical consultancy; technical testing, analysis	446	0.46	0.49	1.2
Social work	637	0.46	0.46	1.5
Legal, accounting, auditing, business and management consultancy, etc.	652	0.41	0.48	1.3
Electrical, electronic and instrument engineering	330	0.19	0.16	4.7
Financial services, including insurance	547	0.17	0.18	3.7
Other service industries	820	0.11	0.13	5.3
Mechanical engineering, vehicles and other engineering	693	0.10	0.16	4.2
Other business services	1245	0.09	0.13	4.9
Chemicals, rubber and plastics	443	0.08	0.13	6.0
Postal and telecommunications services	247	0.08	0.07	12.8
Other manufacturing industries	720	0.06	0.11	6.1
Auxiliary transport activities, travel agents	415	0.04	0.07	9.4
Printing, publishing, recorded media	426	0.01	-0.05	11.8
Food, drink and tobacco	324	-0.05	-0.12	6.1
Sales of motor vehicles, parts, fuel	323	-0.07	-0.09	6.0
Restaurants, canteens, catering	861	-0.07	-0.15	4.0
Retailing - specialised stores	827	-0.08	-0.07	9.1
Sporting activities, arenas, stadia	284	-0.12	-0.18	3.5
Fabricated metal products	572	-0.14	-0.13	5.6
Building installation, building completion and other construction activities	762	-0.20	-0.23	2.8
Wholesaling	622	-0.23	-0.20	3.3
Building of complete constructions; civil engineering	877	-0.25	-0.35	1.9
Retailing - non-specialised stores; other retail and repair	577	-0.28	-0.35	1.8
Transport services	654	-0.33	-0.31	2.4
Bars	688	-0.39	-0.42	1.4
Hotels, motels and other accommodation	567	-0.52	-0.53	1.3
	---	---	---	---
TOTAL (a)	16531	0	0.1	9.2

(a) Includes private sector establishments in public administration and the primary, secondary and higher education sectors. Results for these sectors are not shown separately due to relatively small cell sizes.

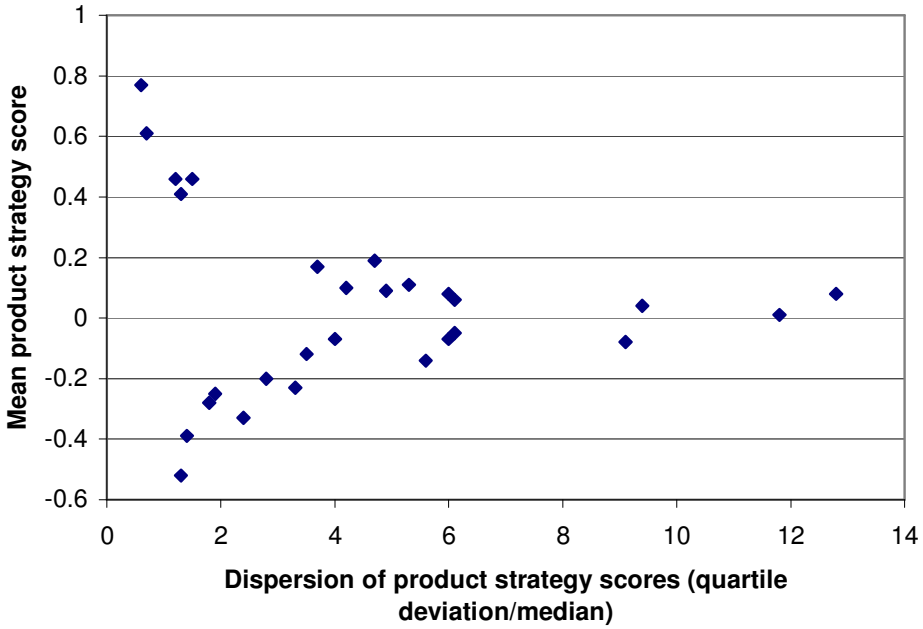


Figure 2: Mean product strategy scores and measure of dispersion, ESS 2001, analysed by sector

3.3 Measurement of average skill levels

The main ESS question relevant to estimates of workforce skill levels asked respondents to cite the 'most common level of (formal) qualification' amongst each of nine occupational groups. This can be combined with Labour Force Survey data on the mean hourly earnings of each of five qualification groups in the UK economy to derive a wage-weighted qualifications index which serves as a proxy measure of workforce skills. [7] At establishment level this skills score is then defined as:

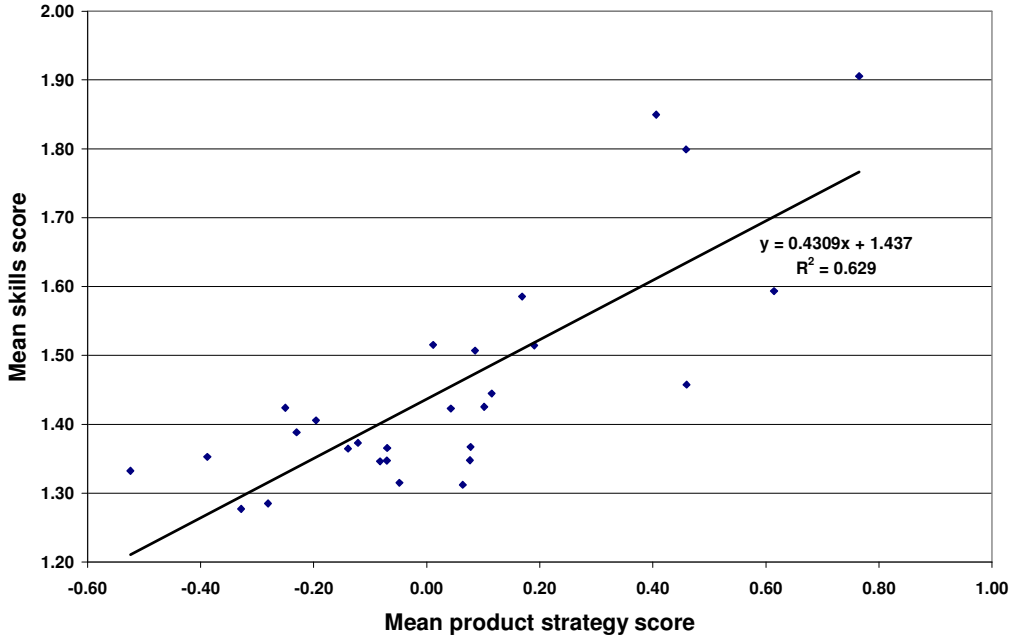
$$skills = [\sum_{i=1}^{5} w_i q_i] / N$$

where w_i = mean hourly earnings of qualifications group i (indexed to unity in the case of the 'no formal qualifications' group), q_i= numbers employed in qualifications group i and N = total employment in establishment.

[7] The five qualification groups are: NVQ 4 and above (including, for example, Higher degrees, First degress and BTEC Higher National awards), NVQ3 (eg, A levels and trade apprenticeships), NVQ2 (eg, GCSE grades A-C and City & Guilds craft qualifications), NVQ1 (eg, GCSE below grade C and GNVQ foundation awards) and No Formal Qualifications. Mean hourly earnings for these qualification groups in 2000 were (Index numbers: No formal qualifications = 100): NVQ1 109; NVQ2 123; NVQ3 146; and NVQ4 and above 226 (Source: Labour Force Survey).

The variation by sector in this skills index is shown in Table 8. The highest-ranked sectors are computer services; legal, accounting and related business services; and architectural, engineering and other technical business services. The two lowest are non-specialised retailing and transport services. The dispersion of mean skill scores within sectors (Table 8, Column 4) tends to be wider in the higher-skilled sectors than in those with relatively low mean skills scores. This contrasts with the product strategy measure derived above which tended to be most widely dispersed in sectors which were intermediate between those with relatively high mean product strategy scores and those with relatively low mean product strategy scores. Nonetheless, at sector level there is a high level of correlation between mean skill scores and mean product strategy scores (Figure 3).

Figure 3: Mean product strategy scores and mean skills scores, analysed by sector



Notes:
Mean product strategy scores: see Table 7 and related text. Mean skills score: see Table 8 and related text.

Table 8: Workforce skill scores (wage-weighted qualifications indices), ESS 2001, analysed by sector *(ranked by mean skills score)*

	N	Mean	Median	Quartile deviation/ median
Computer services	360	1.91	2.02	0.17
Legal, accounting, auditing, business and management consultancy, etc.	667	1.85	1.86	0.13
Architectural and engineering activities and related technical consultancy; technical testing, analysis	434	1.80	1.85	0.18
Human health activities	338	1.59	1.52	0.16
Financial services, including insurance	558	1.59	1.46	0.17
Printing, publishing, recorded media	383	1.52	1.46	0.15
Electrical, electronic and instrument engineering	301	1.51	1.49	0.10
Other business services	1133	1.51	1.40	0.18
Social work	646	1.46	1.40	0.11
Other service industries	773	1.44	1.36	0.12
Mechanical engineering, vehicles and other engineering	626	1.43	1.36	0.11
Building of complete constructions; civil engineering	779	1.42	1.36	0.11
Auxiliary transport activities, travel agents	383	1.42	1.32	0.10
Building installation, building completion and other construction activities	665	1.41	1.38	0.08
Wholesaling	561	1.39	1.30	0.09
Sporting activities, arenas, stadia	249	1.37	1.31	0.10
Postal and telecommunications services	224	1.37	1.28	0.10
Sales of motor vehicles, parts, fuel	280	1.37	1.32	0.09
Fabricated metal products	518	1.36	1.30	0.09
Bars	632	1.35	1.28	0.09
Chemicals, rubber and plastics	395	1.35	1.31	0.09
Restaurants, canteens, catering	816	1.35	1.28	0.09
Retailing - specialised stores	760	1.35	1.28	0.09
Hotels, motels and other accommodation	482	1.33	1.28	0.09
Food, drink and tobacco	302	1.32	1.28	0.10
Other manufacturing industries	634	1.31	1.26	0.09
Retailing - non-specialised stores; other retail and repair	525	1.29	1.25	0.06
Transport services	579	1.28	1.24	0.08
TOTAL	15257	1.45	1.36	0.13

(a) Includes private sector establishments in public administration and the primary, secondary and higher education sectors. Results for these sectors are not shown separately due to relatively small cell sizes.

3.4 Product strategies and skills at sector level

The observed inter-sectoral differences in the distribution of product strategy scores at establishment level are not easy to account for. Since the ESS questions asked respondents to position themselves in relation to 'others in your industry', it might have been expected that all sectors would exhibit similar patterns of dispersion of product strategy scores around a mean score level. One problem is that respondents in broadly similar product areas may conceive of the 'industry' in which they are operating in different ways. For example, the relevant basis of comparison for many may only be a very small number of direct competitors; for others it may be a wider industry to which they regard themselves as belonging. It also seems likely that respondents varied in the extent to which they compared themselves to foreign-based producers in the same product or service area as well as to UK-based competitors. [8]

One possible reason for systematic variation between sectors in the dispersion of product strategy scores is that establishments in sectors which are above-average in skill-intensity may be more likely on average to view themselves as engaged in complex and demanding activities while the reverse may be true for establishments in sectors with relatively low average levels of workforce skill requirements. Given the correlation between mean skill and product strategy scores at sector level, this could help to explain the more limited dispersion of product strategy scores in sectors whose mean product strategy scores are either relatively high or relatively low (Figure 2).

Another factor contributing to inter-sectoral variation in the dispersion of product strategy scores at establishment level may be differing degrees of exposure to foreign trade in each sector. For example, if we consider manufacturing sectors engaged in tradable goods production, then Table 9 shows that it is the engineering sectors -- electrical, electronic and optical equipment and mechanical engineering and transport equipment (primarily motor vehicles and aerospace) – which rank highest in terms of product strategy and export-intensity and import penetration. Conversely, in food and drink manufacturing and fabricated metal products, the domestic market is less exposed to foreign trade and competition and firms are less likely to be pursuing a high value added product strategy than in electrical/electronic engineering or

[8] Recent analysis of responses to a 1-5 scale question on product complexity in the Employer Perspectives Survey 2002 suggests that some 44% of respondents awarded themselves a different rating when asked to assess their product specifications against those of foreign-based competitors compared to their self-assessment when asked to rank themselves against 'others in (their) industry' without explicit reference to overseas organisations (Mason and Rincon-Aznar, 2004).

mechanical engineering and transport equipment. In the most trade-exposed sectors, the case study evidence described in Section 2.3 suggests that it is hard for UK-based establishments to survive for any length of time with a relatively low-end product strategy which might place them in direct competition with producers based in relatively low-wage countries. In these kinds of sector it is perhaps not surprising, therefore, to find a majority of establishments positioned towards the high end of the 1-5 scales in their responses to ESS questions on product strategy.

Given these and other sector-specific factors which may be at work in shaping the establishment responses incorporated in the product strategy measure, it is important to control for sectoral characteristics in any investigation of the determinants of product strategy at establishment level and this forms an important part of the multivariate analysis to which we now turn.

Table 9: Manufacturing sectors: mean product strategy scores, export/sales and import penetration ratios
Ranked by mean product strategy score

	Mean product strategy score	Exports/ sales ratio, 1998	Import penetration ratio, 1998
Electrical, electronic and instrument engineering	0.19	0.51	0.55
Mechanical engineering, vehicles and other engineering	0.10	0.73	0.74
Chemicals, rubber and plastics	0.08	0.43	0.40
Food, drink and tobacco	-0.05	0.16	0.21
Fabricated metal products	-0.14	0.16	0.16

Source:
Trade data: OECD, DSTI (STAN Industrial database) 2000

Note:
Import penetration ratios are defined as [Imports *divided by* (Output – Exports + Imports)]

4. Product strategies and skills at establishment level: multivariate analysis

4.1 Empirical models

Recall the two main hyptheses which we wish to submit to empirical scrutiny at establishment level:

H1: All else being equal, high (low) levels of workforce skills are positively associated with high (low) value added product strategies

H2: All else being equal, high (low) value added product strategies are positively associated with a high (low) degree of exposure to foreign competition

As discussed in Section 2, international comparisons of matched samples of establishments suggest that an establishment's choice of product strategy in terms of complexity of product specification and other factors is strongly influenced by the extent of competition in the principal market(s) for its main product or service. In particular, these studies suggest that an establishment is more likely to pursue a high value added product strategy if the alternative option of supplying relatively low value added products or services is threatened or precluded by competition in its main markets from low cost foreign producers. Therefore, in order to assess the evidence relating to H1 and H2, we first model the determinants of product strategy as follows:

[1] $PS_i = f(Mkt_i, Dem_i, X_i)$

where *PS* = product strategy score; *Mkt* = indicator of exposure to foreign competition in the principal market served by the establishment; *Dem* is a vector of indicators of market demand for the establishment's output relative to supply, eg, measures of recent growth or decline in sales and of capacity utilisation; and X_i is a vector of other establishment-level characteristics which may influence product strategy (eg, employee size-group, sector, region, site function and technology indicators).

The coefficients on *Mkt* are expected to provide a clear test of H2, that high (low) value added product strategies are positively (negatively) associated with the degree of exposure to foreign competition. Expectations regarding the coefficients on the components of *Dem* are mixed. Sales and capacity measures are both indicators to some extent of the sustainability (or otherwise) of current product strategies. If the relevant coefficients are positively signed, this would suggest that, all else being

equal, establishments with high-end product strategies face more favourable market conditions than establishments at the lower end of the product strategy spectrum. Conversely, negatively-signed coefficients would imply that the relationship between product strategies and market demand is dominated by establishments competing successfully in relatively low value added product strategies.

Subsequently, we seek to model the relationship at establishment level between product strategy and skill requirements. Much of the literature suggests that an establishment's demand for skills is a *derived demand* which flows from prior choices made regarding markets and product types and specifications. Indeed, Keep and Mayhew (1999) argue that skills are often 'a third-order issue', lagging behind second-order choices regarding work organisation and job design as well as enterprise decisions on product strategy.

This perspective is supported by the case study evidence cited in Section 2.3 which suggests that the formulation of human resourcing and skills strategy tends to lag behind (rather than precede or even accompany) changes in product strategy. This evidence on the primary direction of the product strategy / skills relationship is borne out by several key findings in the 1999 Employers Skill Survey. Firstly, more than nine in ten companies that were planning to move to higher value added products (or to improve the quality of their existing products) expected new or additional skill requirements to arise *as a result* of the change in product specification (NSTF, 2000, Figure 6.6). At the same time, when establishments that were making no effort to move to higher quality-grades of product were explicitly asked about the constraints on their moving up-market, only a small minority referred to skill deficiencies which were heavily outweighed by financial constraints (ibid, Figure 6.7).

However, in principle, some element of reverse causation might also be expected since – all else being equal – firms' willingness to move up-market in terms of product strategy may be enhanced (constrained) by ready availability (shortages) of the required skills within the firm. This proposition is central to the model developed by Redding (1996) who argues that firms' investments in product innovation and quality-enhancement and workers' investments in skill acquisition both exhibit pecuniary externalities and are strategic complements.

Taking these theoretical arguments and empirical evidence into consideration, we choose to model skills as a function of product strategy and other establishment characteristics:

[2] $Skills_i = f(PS_i, X_i)$

and then tackle the potential endogeneity problem through use of instrumental variable (IV) techniques. Establishment skill levels are here measured by the wage-weighted qualifications index described in Section 3.3 above.

In what follows we employ log-linear specifications in order to be able to interpret coefficient estimates as elasticities and to reduce sensitivity to outliers. Our estimating equations are therefore:

[3] $\ln PS_i = \alpha_i Mkt_i + \beta_i Dem_i + \gamma_i X_i + \varepsilon_t$

[4] $\ln Skills_i = \alpha_i \ln PS_i + \beta_i X_i + \varepsilon_t$

Since PS (product strategy) is a standardised factor score with mean zero and standard deviation of one, it needs to be converted to positive values across its entire distribution before logs can be taken. This is achieved by a linear transformation to obtain a product strategy index which ranges from just above zero to 100, and which leaves the distribution of the PS variable unaffected.

Descriptive statistics are shown in Table 10 for all private sector establishments with five or more employees. [9] Independent variables in the regressions include:

Geographical market focus: dummy variables capturing survey responses to a question asking 'Is the market for this establishment's main product or service primarily local / within your region / within the rest of the UK / within the European Union / within other parts of the world'.

Export share: exports as percent of sales (Banded on 1-6 scale: 1=zero; 6=50% or more)

Sales growth: dummy variables indicating the extent to which each establishment's sales had increased or decreased in the 12 months prior to the survey (the base category was sales 'stayed the same').

Capacity: an ordered 1-4 variable where 1 = establishment operating 'considerably below full capacity'; 2 = 'somewhat below full capacity'; 3 = 'at full capacity'; 4 = 'at overload'.

Low volumes: a binary variable where 1 = response of five on a five-point scale regarding production volumes (see Table 4 above)

[9] See Appendix A for descriptive statistics on sector, region and size group dummies.

Information technology: an ordered 0-5 variable based on responses to a question about how each establishment's IT systems and networks compared with others in their industry (ranging from 0 = 'no use of IT' to 5 = 'state of the art').

New technology indicator: in the absence of more straightforward data on the introduction of new technology apart from IT, this is an ordered 0-4 variable based on responses to questions about whether skill needs in nine different occupational groups had changed in order 'to cope with the introduction of new technology' (ranging from 0 = no occupation cited in response to this question to 4 = four or more occupations cited)

New work practices indicator: a similar variable to the new technology indicator but based on responses to questions about whether skill needs in the different occupational groups had changed in order 'to cope with new working practices'

New products indicator: a similar variable to the new technology indicator but based on responses to questions about whether skill needs in the different occupational groups had changed in order 'to develop new products or services'

4.2 Product strategies and skills: full sample results

The estimated determinants of product strategy are shown in Table 11 for all private sector establishments with five or more employees (Columns 1-2) and for all establishments engaged in exporting (Column 3). After controlling for site function, sector, region and other factors, the incidence of high-end product strategies is found to be strongly positively related to establishment size across the whole economy and also to foreign ownership, recent growth in sales, a market orientation which goes beyond local and regional level and the introduction of new products/services. By contrast, high-end product strategies are significantly negatively associated with single-site enterprises and recent declines in sales.

In respect of site function, the characteristics of a high-end product strategy are significantly more common in establishments primarily engaged in research, design and development than in the reference category of office/administrative establishments, and the same is also true of establishments involved in education / health activities. Conversely, the product strategy scores for establishments engaged primarily in production, distribution and catering, entertainment and leisure are significantly lower than for office/administrative establishments.

Across the whole economy the deployment of high-end product strategies is positively associated with the measure of IT utilisation but the coefficients on the conceptually less satisfactory indicator of new technology adoption (based on responses to questions about changing skill needs related to new technologies) are very small and not statistically significant.

The results provide strong support for H2 since in Table 11, Column 1 the coefficients on the geographical market focus variables increase monotonically as the market orientation broadens from regional to national to European and finally world dimensions. For example, the average product strategy score for establishments catering primarily for the national market is -- all else being equal -- on average 8.7% higher than in establishments in the reference category (mainly serving local markets). For establishments serving European markets the equivalent differential in average product strategy scores is 12.8% while for establishments competing primarily in world markets the differential rises to 18.5%.

This support for H2 is confirmed by the results in Columns 2 and 3 in which an alternative measure of exposure to foreign competition (export share of sales) is positively and significantly related to the product strategy score. Most of the determinants of product strategy for exporting establishments (about 23% of the total) are broadly similar to those identified for the whole economy but with certain exceptions: for example, low volumes are positively correlated with the product strategy index in the case of exporters (Column 3) but not for the economy as a whole (Column 2). Other differences relate to declining sales and most types of site function which are not significantly related to product strategy for exporters, in contrast to the results for all establishments.

The results shed light on the question of sustainability of different kinds of product strategy since a high-end (low-end) product strategy is not only positively and significantly associated with recent growth (decline) in sales but also with a relatively high (low) level of capacity utilisation. These findings support the widespread supposition described above that – after controlling for sector-specific factors, geographical market focus and other factors affecting performance -- low-end product strategies are generally more likely to be vulnerable to competitive pressures than are high-end strategies.

Table 12 shows the estimated determinants of skill requirements at establishment level as specified in [4] above for all establishments and for exporting establishments. In order to address the potential endogeneity of the product strategy measure, OLS estimates are compared with IV variants. The instruments employed comprise two variables which fulfil the requirements of being highly correlated with the product strategy index but uncorrelated with the error term in the main skills regression equation in each case: the indicator of capacity utilisation and the new products indicator.

As shown in Columns 2, 4 and 6 of Table 12, the validity of each combination of instruments is supported by Hansen J test statistics. [10] In all three pairs of equations the coefficients on log product strategy are positively-signed and statistically significant in both the OLS and IV specifications but they are substantially larger in each of the IV cases. However, the relevant C statistics suggest that in all three cases the more efficient OLS estimates should be preferred to the IV estimates. [11]

Before going on to assess these results, recall that the measure of skills in this case is a wage-weighted qualifications index ranging from 1.00 (for establishments where no employees hold formal qualifications) to 2.26 (for establishments where all employees hold qualifications at NVQ Level 4 or above). Intermediate values on this index are 1.09 (NVQ1), 1.23 (NVQ2) and 1.46 (NVQ3). [12] On this index the mean skill value for the whole economy is 1.42, that is, just below an average skill level associated with NVQ3.

The estimates in Table 12 provide strong support for H1 that high (low) levels of workforce skills are positively associated with high (low) value added product strategies. Drawing on the preferred OLS estimates for all establishments (Column 1), a one standard deviation increase in the product strategy index leads to the mean value of the skills index for the whole economy increasing by 2.2% to reach the average NVQ3 skill level of 1.46.

The estimates in Table 12 also point to other important determinants of average skill levels at establishment level. It is striking that, even after controlling for product strategy, the workforce skills measure in the preferred OLS equation for all

[10] Baum, Shaffer and Stillman (2003) suggest that Hansen J tests of overidentifying restrictions are appropriate in the presence of heteroscedasticity which is here clearly indicated by the Breusch-Pagan statistics for each equation.

[11] In the presence of heteroscedasticity the C statistic is an appropriate test of a null hypothesis that the potentially endogenous regressor (product strategy) is in fact exogenous.

establishments (Column 1) is strongly positively related to the orientation of establishments to regional and national markets (as compared to local markets) and particularly to foreign markets. The coefficients on the export share variable in Columns 3 and 5 are also positively-signed and strongly significant.

Other findings are that, after controlling for product strategy, average skill requirements across the whole economy are positively and significantly related to foreign ownership, to employment in offices, R&D establishments and education and health establishments, to rapid growth in sales and to indicators of IT utilisation and adoption of new work practices (Table 12, Column 1).

[12] See Footnote 7 above for further details of these estimates.

Table 10: Variable definitions and descriptive statistics (all private sector establishments with five or more employees)

A: Product strategy and skills indices (a), analysed by sector

Sector	Variable	Obs	Mean	Std. Dev.
Whole economy:	Log product strategy	16760	4.021	0.425
	Log skills	15548	0.354	0.204
Engineering:	Log product strategy	1587	4.072	0.388
	Log skills	1445	0.346	0.175
Chemicals:	Log product strategy	443	4.053	0.412
	Log skills	395	0.311	0.155
Construction:	Log product strategy	1629	3.909	0.425
	Log skills	1444	0.340	0.179
Retail/wholesale:	Log product strategy	2019	3.954	0.456
	Log skills	1846	0.276	0.159
Hotels, restaurants and bars	Log product strategy	2103	3.928	0.456
	Log skills	1930	0.285	0.158
Transport and communications	Log product strategy	1304	3.961	0.449
	Log skills	1186	0.279	0.181
Financial and business services	Log product strategy	3271	4.127	0.363
	Log skills	3152	0.494	0.229

(a) See Sections 3.2 and 3.3 of main text for definitions of product strategy and skill indices

B: Other variables (whole economy) (b)

Variable name	Definition	Obs	Mean	Std. Dev.
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Single	=1 if establishment is a single-site enterprise	17982	0.451	0.498
Foreign-owned	=1 if wholly or partly foreign-owned	17982	0.133	0.340
Export share	Exports as percent of sales (Banded on1-6 scale: 1=zero; 6=50% or more)	16377	1.560	1.300
Low volumes	=1 if provide one-off or very low volume products	17074	0.068	0.252
Capacity utilisation	Ordered 1-4 variable where 1= operating considerably below full capacity and 4= operating at overload	17671	2.581	0.663
Use of Information Technology	Ordered 0-5 variable where 0= no use of IT and 5= using 'state of the art' IT	17597	3.104	1.360
New products	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to development of new products or services	17529	0.974	1.404
New work practices	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to introduction of new work practices	17529	1.433	1.542
New technologies	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to introduction of new technologies	17529	1.610	1.554
Geographical market focus dummies (Reference category = local market focus):				
Local market focus	=1 if market for establishment's main product or service is primarily local	17949	0.337	0.473
Regional market focus	=1 if market for establishment's main product or service is primarily regional	17949	0.204	0.403
National market focus	=1 if market for establishment's main product or service is primarily within the UK	17949	0.322	0.467
European market focus	=1 if market for establishment's main product or service is primarily within the European Union	17949	0.040	0.195
World market focus	=1 if market for establishment's main product or service is primarily outside Europe	17949	0.098	0.297

Table 10B (continued):

Variable name	Definition	Obs	Mean	Std. Dev.
Site function dummies (Reference category = office sites):				
Office site	Office, administrative services, finance or accounts	17969	0.294	0.456
Production site	Factory, production or construction	17969	0.227	0.419
Distribution site	Warehouse or distribution depot	17969	0.069	0.253
R& D, design	Research, development, design	17969	0.021	0.144
Catering / leisure	Catering, entertainment or leisure	17969	0.144	0.351
Shop, showroom, sales	Shop, showroom or other customer- or client-facing sales activities	17969	0.128	0.334
Education or healthcare site	Education, training or health care	17969	0.069	0.253
Other activities on site	Other site functions not classified above	17969	0.048	0.215
Sales change dummies (Reference category = no change in sales):				
No change in sales	=1 if sales stayed the same in previous 12 months	17982	0.238	0.426
Rapid growth in sales	=1 if sales grew a great deal in previous 12 months	17982	0.161	0.368
Some growth in sales	=1 if sales grew a little in previous 12 months	17982	0.375	0.484
Some decline in sales	=1 if sales declined a little in previous 12 months	17982	0.097	0.296
Sharp decline in sales	=1 if sales declined a great deal in previous 12 months	17982	0.027	0.161
Change in sales_nk	=1 if change in sales in previous 12 months not known	17982	0.092	0.289

(b) See Appendix A for descriptive statistics on sector, regional and size group dummy variables.

Table 11: Estimated determinants of establishment product strategies, All Sectors - All Establishments and All Sectors - Exporters Only, OLS regressions (Dependent variable = log product strategy index)

	(1) All sectors	(2) All sectors	(3) All sectors – exporters only
Regional market focus	0.038***		
	(0.010)		
National market focus	0.087***		
	(0.010)		
European market focus	0.128***		
	(0.017)		
World market focus	0.185***		
	(0.013)		
Export share		0.029***	0.024***
		(0.003)	(0.004)
Single	-0.042***	-0.037***	0.007
	(0.008)	(0.008)	(0.015)
Foreign-owned	0.040***	0.038***	0.022
	(0.010)	(0.011)	(0.017)
Low volumes	-0.017	-0.012	0.096***
	(0.015)	(0.016)	(0.023)
Rapid growth in sales	0.082***	0.090***	0.072***
	(0.010)	(0.011)	(0.018)
Some growth in sales	0.037***	0.040***	0.037**
	(0.008)	(0.009)	(0.017)
Some decline in sales	-0.057***	-0.051***	-0.035
	(0.014)	(0.014)	(0.024)
Sharp decline in sales	-0.076***	-0.078***	-0.027
	(0.024)	(0.025)	(0.031)
Capacity utilisation	0.031***	0.030***	0.033***
	(0.005)	(0.005)	(0.009)
Use of Information Technology	0.020***	0.021***	0.019***
	(0.003)	(0.003)	(0.005)
New products	0.006*	0.006**	0.008*
	(0.003)	(0.003)	(0.005)
New work practices	0.000	0.001	0.006
	(0.003)	(0.003)	(0.005)
New technologies	0.000	-0.000	-0.002
	(0.003)	(0.003)	(0.005)
Production site	-0.029**	-0.031**	-0.047**
	(0.012)	(0.012)	(0.018)
Distribution site	-0.033**	-0.031*	-0.028
	(0.016)	(0.017)	(0.029)
Research, development, design	0.065***	0.073***	0.032
	(0.018)	(0.019)	(0.024)
Catering, entertainment or leisure	-0.051***	-0.063***	0.018
	(0.019)	(0.021)	(0.056)
Shop, showroom, sales	-0.000	-0.019	-0.045
	(0.014)	(0.015)	(0.034)
Education or healthcare site	0.052***	0.043**	-0.025
	(0.019)	(0.021)	(0.057)
Other activities on site	-0.025	-0.026	-0.043
	(0.017)	(0.018)	(0.032)
Constant	3.804***	3.779***	3.841***
	(0.027)	(0.029)	(0.067)
Observations	15062	13914	3199
Adj. R sqd.	0.12	0.11	0.11
SEE	0.40	0.40	0.35
No. of observations	15062	13914	3199
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. See text of Section 4.1 for further details of variable definitions.

Table 12: Estimated determinants of establishment skill levels – All Sectors (All Establishments) and All Sectors (Exporters Only), OLS and IV regressions (Dependent variable = log skills index)

	(1)	(2)	(3)	(4)	(5)	(6)
	All sectors – OLS	**All sectors – IV**	**All sectors – OLS**	**All sectors, - IV**	**All sectors, exporters only - OLS**	**All sectors, exporters only - IV**
Log product strategy index	0.052***	0.119*	0.055***	0.151**	0.072***	0.224*
	(0.004)	(0.069)	(0.004)	(0.074)	(0.009)	(0.133)
Regional market focus	0.019***	0.016***				
	(0.004)	(0.005)				
National market focus	0.036***	0.031***				
	(0.004)	(0.007)				
European market focus	0.063***	0.054***				
	(0.008)	(0.012)				
World market focus	0.098***	0.085***				
	(0.007)	(0.014)				
Export share			0.012***	0.009***	0.010***	0.006*
			(0.001)	(0.003)	(0.002)	(0.004)
Single	-0.009***	-0.006	-0.006*	-0.002	0.013*	0.014*
	(0.003)	(0.005)	(0.004)	(0.005)	(0.007)	(0.008)
Foreign-owned	0.020***	0.018***	0.023***	0.020***	0.030***	0.027***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.009)	(0.009)
Low volumes	0.011*	0.013*	0.013**	0.015**	0.023**	0.009
	(0.006)	(0.007)	(0.006)	(0.007)	(0.011)	(0.017)
Rapid growth in sales	0.025***	0.019**	0.029***	0.019**	0.024**	0.012
	(0.005)	(0.008)	(0.005)	(0.009)	(0.010)	(0.015)
Some growth in sales	0.018***	0.015***	0.019***	0.015***	0.017**	0.010
	(0.004)	(0.005)	(0.004)	(0.005)	(0.008)	(0.011)
Some decline in sales	0.002	0.006	0.005	0.010	0.005	0.010
	(0.005)	(0.007)	(0.005)	(0.007)	(0.010)	(0.012)
Sharp decline in sales	-0.001	0.005	-0.004	0.004	0.002	0.008
	(0.009)	(0.011)	(0.009)	(0.012)	(0.016)	(0.018)
Capacity utilisation	0.002		0.003		0.005	
	(0.002)		(0.002)		(0.004)	
Use of Information Technology	0.003***	0.002	0.003***	0.001	0.006**	0.002
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
New products	0.000		0.001		0.001	
	(0.001)		(0.001)		(0.003)	
New work practices	0.003***	0.003***	0.004***	0.004***	0.003	0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
New technologies	0.000	0.000	-0.000	-0.000	-0.001	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Constant	0.115***	-0.144	0.093***	-0.270	0.121**	-0.468
	(0.019)	(0.268)	(0.019)	(0.289)	(0.053)	(0.523)
Observations	13284	13284	12314	12314	2820	2820
Adj. R sqd.	0.31		0.30		0.38	
SEE	0.17		0.17		0.16	
Hansen J (p-value)		0.94		0.91		0.87
Breusch-Pagan (p-value)		0.00		0.00		0.00
C statistic (p-value)		0.32		0.19		0.23
Instruments		New products Capacity utilisation		New products Capacity utilisation		New products Capacity utilisation
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, region and site function. See text of Section 4.1 for further details of variable definitions.

4.2 Sectoral results

Similar analyses carried out for seven broadly-defined sectors also provide support for H1 and H2 but with marked differences between sectors in the strength of the product strategy-skills relationship.

Table 13 shows the estimated determinants of product strategy for establishments in two manufacturing sectors (engineering, chemicals), construction and three service sectors (retail and wholesale, hotels and restaurants, transport and communications and financial and business services). In all of these sectors except (predictably) for hotels, high value added product strategies are positively and significantly related to establishments' exposure to international market competition.

In varying degrees the adoption of high-end product strategies is also significantly correlated with rapid growth in sales in engineering, hotels, transport/communications and financial/business services and with high levels of capacity utilisation in engineering, chemicals, hotels and financial/business services. To the extent that sales growth and capacity measures can be taken as indicators of the sustainability of product strategies, these findings suggest that the greater vulnerability of low value added strategies to competitive market pressures applies in a range of service sectors as well as in the more export-oriented manufacturing sectors.

Tables 14-15 show the estimated determinants of establishment skill levels in the same seven sectors, with OLS results and IV variants reported in each case for the same reasons as discussed above in relation to the full sample results. The instruments used here include indicators of capacity utilisation, new products, new work practices, use of Information Technology, single site enterprise status and the rank order of the product strategy index. [13]

In six sectors (all except construction) OLS estimates show skill levels to be positively and significantly related to the product strategy measure and in five of these six sectors these findings are robust to the use of IV techniques – thus providing substantial support for H1. Tests for the endogeneity of log product strategy suggest that OLS estimates should be preferred in the case of retail/wholesale and hotels/restaurants while IV estimates are preferred for engineering, chemicals and

[13] While the rank order is still highly correlated with the product strategy measure itself, it is purged of 'errors in variables' (measurement error) that might be related to the error term in the main skills regression (see Durbin, 1954; Johnston, 1972, Chapter 9.4).

financial/business services. In the case of construction, the positive coefficient on log product strategy lacks significance in the OLS equation (Table 14, Column 5) but is strongly significant in the IV case (Column 6), and it is the IV estimates which are preferred. In transport/communications the reverse applies: skill levels are positively and significantly associated with product strategy in the preferred OLS equation (Table 15, Column 5) but not in the IV equation (Column 6).

Table 16 shows the estimated increases in average skill requirements following a one standard deviation increase in the product strategy index in each of the seven sectors. In general, the impact on skill requirements of upgrading product strategies is greater in sectors with above-average skill levels than it is in lower-skilled sectors. Indeed, across the seven sectors the percentage increases in skill levels associated with one standard deviation increases in the product strategy measure are highly correlated with mean skill levels (r=0.64).

For example, in the case of financial/business services, the preferred IV estimates point to a 4.6% increase in average skill requirements following a one standard deviation increase in the product strategy measure, equivalent to an increase in mean skills from 1.64 to 1.72 (well above the 1.46 level associated with NVQ level 3). Conversely, for the hotels/restaurants sector, the equivalent increase in average skill requirements is estimated at only 1.1% (derived from the preferred OLS estimates), taking average skill levels in hotels/restaurants from 1.33 to 1.35, still only midway between NVQ2 and NVQ3.

These findings suggest that upgrading of enterprise product strategies has a polarising impact on demand for skills. In sectors characterised by relatively high proportions of firms deploying high value added skill-intensive product strategies, further efforts to move up-market in response to competitive pressures will lead to disproportionately large increases in employers' demand for skills. Conversely, in sectors where low-end product strategies currently predominate, the impact on demand for skills of firms upgrading their product strategies appears to be relatively modest.

Table 13: Estimated determinants of establishment product strategies - Engineering, Chemicals, Construction, Retail and wholesale, Hotels, restaurants and bars, Transport and communications, Financial and business services - OLS regressions (Dependent variable = log product strategy index)

	Engineer-ing	Chemicals	Construct-ion	Retail and wholesale	Hotels, restaurants and bars	Transport and commun-ications	Financial and business services
Regional market focus	0.022	0.116	-0.001	0.068**	0.061**	0.093**	0.057***
	(0.054)	(0.143)	(0.029)	(0.029)	(0.027)	(0.040)	(0.021)
National market focus	0.098**	0.108	0.104***	0.085***	0.025	0.116***	0.097***
	(0.045)	(0.135)	(0.032)	(0.032)	(0.032)	(0.034)	(0.020)
European market focus	0.131***	0.173	0.269***	0.082	-0.045	0.107*	0.133***
	(0.050)	(0.141)	(0.077)	(0.071)	(0.081)	(0.055)	(0.034)
World market focus	0.203***	0.267**	0.329***	0.181***	0.014	0.179***	0.184***
	(0.046)	(0.133)	(0.060)	(0.042)	(0.054)	(0.040)	(0.024)
Single	0.026	0.040	-0.056**	-0.037	-0.037	-0.096***	-0.051***
	(0.025)	(0.049)	(0.027)	(0.029)	(0.026)	(0.028)	(0.015)
Foreign-owned	0.067**	0.025	0.043	0.039	0.042	0.066**	0.031*
	(0.027)	(0.050)	(0.059)	(0.031)	(0.027)	(0.031)	(0.017)
Low volumes	0.097***	0.042	-0.066	0.002	-0.173**	-0.155*	-0.019
	(0.028)	(0.102)	(0.046)	(0.066)	(0.071)	(0.084)	(0.026)
Rapid growth in sales	0.121***	0.094	0.042	0.046	0.070**	0.117***	0.101***
	(0.029)	(0.071)	(0.035)	(0.034)	(0.032)	(0.039)	(0.019)
Some growth in sales	0.034	0.023	0.002	0.058**	0.016	0.068**	0.043**
	(0.025)	(0.054)	(0.027)	(0.029)	(0.026)	(0.032)	(0.018)
Some decline in sales	-0.035	-0.046	-0.035	-0.071	-0.069*	0.004	-0.060
	(0.033)	(0.062)	(0.053)	(0.044)	(0.039)	(0.050)	(0.040)
Sharp decline in sales	-0.051	-0.048	-0.046	-0.158	-0.208**	0.118	0.005
	(0.047)	(0.095)	(0.063)	(0.111)	(0.086)	(0.088)	(0.052)
Capacity utilisation	0.057***	0.062**	0.011	0.011	0.049***	0.006	0.021**
	(0.014)	(0.028)	(0.017)	(0.018)	(0.016)	(0.021)	(0.009)
Use of Information Technology	0.012	0.024	0.025***	0.020**	0.017**	0.022**	0.024***
	(0.008)	(0.016)	(0.009)	(0.008)	(0.007)	(0.010)	(0.005)
New products	-0.010	0.008	-0.005	0.018**	0.008	0.002	0.013**
	(0.008)	(0.016)	(0.010)	(0.009)	(0.010)	(0.012)	(0.006)
New work practices	0.011	-0.007	0.019**	0.000	-0.005	-0.011	-0.009*
	(0.008)	(0.015)	(0.009)	(0.009)	(0.011)	(0.011)	(0.005)
New technologies	0.006	0.009	-0.020**	-0.012	0.003	-0.001	0.003
	(0.007)	(0.017)	(0.010)	(0.008)	(0.010)	(0.011)	(0.005)
							(0.019)
Constant	3.621***	3.468***	3.719***	3.714***	3.532***	3.672***	3.814***
	(0.086)	(0.213)	(0.073)	(0.083)	(0.081)	(0.089)	(0.047)
Observations	1462	413	1491	1837	1964	1208	2960
Adj. R sqd.	0.14	0.08	0.05	0.06	0.10	0.12	0.13
SEE	0.36	0.39	0.42	0.44	0.44	0.42	0.34
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, region and site function. See text of Section 4.1 for further details of variable definitions.

Table 14: Estimated determinants of establishment skill levels – Engineering, Chemicals, Construction - OLS and IV regressions (Dependent variable = log skills index)

	(1)	(2)	(3)	(4)	(5)	(6)
	Engineering - OLS	**Engineering - IV**	**Chemicals - OLS**	**Chemicals - IV**	**Construction - OLS**	**Construct-ion - IV**
Log product strategy index	0.071***	0.092***	0.071***	0.108***	0.015	0.035***
	(0.015)	(0.014)	(0.021)	(0.021)	(0.012)	(0.013)
Regional market focus	-0.005	-0.006	-0.047	-0.054	0.013	0.013
	(0.021)	(0.021)	(0.039)	(0.036)	(0.011)	(0.011)
National market focus	-0.022	-0.024	0.019	0.014	0.022	0.019
	(0.016)	(0.016)	(0.033)	(0.031)	(0.014)	(0.014)
European market focus	-0.005	-0.007	0.029	0.017	0.047	0.042
	(0.020)	(0.020)	(0.037)	(0.035)	(0.045)	(0.045)
World market focus	0.030*	0.026	0.072**	0.060*	0.087*	0.077
	(0.018)	(0.018)	(0.036)	(0.034)	(0.051)	(0.051)
Single	0.000	-0.000	0.005	0.004	-0.070***	-0.069***
	(0.012)	(0.012)	(0.017)	(0.017)	(0.013)	(0.013)
Foreign-owned	0.033**	0.031**	0.068***	0.068***	0.014	0.012
	(0.013)	(0.013)	(0.023)	(0.022)	(0.035)	(0.034)
Low volumes	0.018	0.016	-0.011	-0.009	0.017	0.020
	(0.013)	(0.013)	(0.023)	(0.023)	(0.017)	(0.016)
Rapid growth in sales	0.010	0.007	0.014	0.008	0.060***	0.057***
	(0.016)	(0.015)	(0.028)	(0.027)	(0.015)	(0.015)
Some growth in sales	0.001	0.001	-0.026	-0.024	0.046***	0.045***
	(0.012)	(0.011)	(0.021)	(0.021)	(0.012)	(0.012)
Some decline in sales	-0.005	-0.005	-0.036	-0.034	0.016	0.016
	(0.014)	(0.014)	(0.024)	(0.022)	(0.017)	(0.016)
Sharp decline in sales	-0.034*	-0.033*	-0.004	-0.000	0.017	0.017
	(0.018)	(0.017)	(0.032)	(0.030)	(0.039)	(0.039)
Capacity utilisation	0.002		-0.002		-0.002	-0.003
	(0.007)		(0.012)		(0.008)	(0.007)
Use of Information Technology	0.007*	0.007*	-0.003	-0.004	-0.001	
	(0.004)	(0.004)	(0.007)	(0.007)	(0.004)	
New products	0.004	0.004	-0.001	-0.001	-0.006	-0.003
	(0.003)	(0.003)	(0.006)	(0.006)	(0.005)	(0.004)
New work practices	-0.004	-0.004	-0.004	-0.004	0.007	
	(0.003)	(0.003)	(0.007)	(0.006)	(0.004)	
New technologies	0.003	0.002	0.001	0.001	0.004	0.006*
	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
Constant	0.022	-0.049	0.010	-0.128	0.271***	0.196***
	(0.067)	(0.063)	(0.096)	(0.094)	(0.055)	(0.057)
Observations	1287	1287	350	350	1275	1275
Adj. R sqd.	0.15		0.19		0.08	
SEE	0.16		0.14		0.17	
Hansen J (p-value)		0.89		0.75		0.28
Breusch-Pagan (p-value)		0.00		0.00		0.00
C statistic (p-value)		0.01		0.00		0.00
Instruments		Rank order product strategy Capacity utilisation		Rank order product strategy Capacity utilisation		Rank order product strategy Use of Information Technology New work practices
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, region and site function. See text of Section 4.1 for further details of variable definitions.

Table 15: Estimated determinants of establishment skill levels – Retail and wholesale, Hotels, restaurants and bars, Transport and communications, Financial and business services - OLS and IV regressions (Dependent variable = log skills index)

	(1) Retail and whole-sale - OLS	(2) Retail and whole-sale - IV	(3) Hotels, restaur-ants and bars - OLS	(4) Hotels, restaur-ants and bars - IV	(5) Trans-port and commun-ications - OLS	(6) Transport and commun-ications - IV	(7) Financial and business services - OLS	(8) Financial and business services - IV
Log product strategy index	0.043***	0.049***	0.024***	0.022**	0.038***	0.030	0.109***	0.125***
	(0.007)	(0.010)	(0.009)	(0.010)	(0.013)	(0.093)	(0.011)	(0.012)
Regional market focus	0.035***	0.034***	0.012	0.012	0.025*	0.025	0.007	0.006
	(0.010)	(0.010)	(0.010)	(0.010)	(0.015)	(0.017)	(0.011)	(0.011)
National market focus	0.070***	0.070***	-0.012	-0.012	0.045***	0.046***	0.029***	0.028***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.013)	(0.016)	(0.010)	(0.010)
European market focus	0.122***	0.121***	0.028	0.028	0.098***	0.099***	0.051***	0.049**
	(0.031)	(0.030)	(0.036)	(0.036)	(0.025)	(0.026)	(0.019)	(0.019)
World market focus	0.130***	0.128***	0.023	0.022	0.114***	0.114***	0.086***	0.083***
	(0.021)	(0.021)	(0.019)	(0.019)	(0.022)	(0.027)	(0.015)	(0.015)
Single	-0.000	-0.000	0.006	0.007	-0.004		-0.017**	-0.016**
	(0.011)	(0.011)	(0.009)	(0.009)	(0.012)		(0.008)	(0.008)
Foreign-owned	0.026**	0.026**	0.025**	0.025**	-0.007	-0.005	0.018	0.017
	(0.011)	(0.011)	(0.011)	(0.011)	(0.016)	(0.017)	(0.011)	(0.011)
Low volumes	0.003	0.002	-0.018	-0.018	0.033	0.032	0.013	0.014
	(0.020)	(0.020)	(0.023)	(0.022)	(0.032)	(0.037)	(0.012)	(0.012)
Rapid growth in sales	0.027**	0.027**	0.005	0.005	0.014	0.016	0.028**	0.026**
	(0.011)	(0.011)	(0.012)	(0.012)	(0.016)	(0.021)	(0.011)	(0.011)
Some growth in sales	0.020**	0.020**	0.001	0.001	0.003	0.004	0.025***	0.024**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.013)	(0.014)	(0.010)	(0.010)
Some decline in sales	0.019	0.020	-0.006	-0.006	-0.006	-0.006	0.002	0.003
	(0.012)	(0.012)	(0.013)	(0.013)	(0.019)	(0.019)	(0.018)	(0.018)
Sharp decline in sales	0.023	0.025	-0.032	-0.031	0.055*	0.056	-0.034	-0.034
	(0.032)	(0.032)	(0.028)	(0.028)	(0.032)	(0.035)	(0.026)	(0.026)
Capacity utilisation	0.002	0.002	-0.003		0.009	0.009	0.009*	0.009
	(0.006)	(0.006)	(0.006)		(0.008)	(0.008)	(0.006)	(0.005)
Use of Information Technology	0.004	0.004	-0.001		-0.003		0.004	0.003
	(0.003)	(0.003)	(0.003)		(0.004)		(0.003)	(0.003)
New products	-0.003		-0.001	-0.001	0.005	0.005	-0.001	
	(0.003)		(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	
New work practices	0.001	-0.000	0.005	0.005	-0.003	-0.003	0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
New technologies	0.005	0.004	-0.003	-0.003	0.004	0.004	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Constant	0.066*	0.042	0.201***	0.198***	0.128**	0.149	-0.141***	-0.202***
	(0.036)	(0.042)	(0.045)	(0.047)	(0.062)	(0.347)	(0.047)	(0.050)
Observations	1614	1614	1756	1756	1047	1047	2685	2685
Adj. R sqd.	0.16		0.03		0.15		0.35	
SEE	0.14		0.15		0.17		0.18	
Hansen J (p-value)		0.35		0.83		0.44		0.75
Breusch-Pagan (p-value)		0.00		0.00		0.00		0.00
C statistic (p-value)		0.17		0.72		0.91		0.00
Instruments		Rank order product strategy New prod-ucts		Rank order product strategy Capacity utilisation Use of IT		Single site establish-ment Use of IT		Rank order product strategy New prod-ucts
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, region and site function. See text of Section 4.1 for further details of variable definitions.

Table 16: Increases in mean skills index resulting from one standard deviation increase in log product strategy index, analysed by sector

	Mean log skills	Mean skills (a)	Preferred model	Coef-ficient on log product strategy (PS)	Mean log skills after one SD increase in log PS	Mean skills after one SD increase in log PS	% increase in mean skills
All establishments	0.354	1.42	OLS	0.052	0.376	1.46	2.2
Engineering	0.346	1.41	IV	0.092	0.382	1.47	3.6
Chemicals	0.311	1.37	IV	0.108	0.355	1.43	4.6
Construction	0.340	1.41	IV	0.035	0.355	1.43	1.5
Retail and wholesale	0.276	1.32	OLS	0.043	0.296	1.34	2.0
Hotels and restaurants	0.285	1.33	OLS	0.024	0.296	1.34	1.1
Transport and communications	0.279	1.32	OLS	0.038	0.296	1.35	1.7
Financial and business services	0.494	1.64	IV	0.125	0.539	1.72	4.6

(a) Skills index ranges from 1.00 (for establishments where no employees hold formal qualifications) to 2.26 (for establishments where all employees hold qualifications at NVQ Level 4 or above). Intermediate values on this index are 1.09 (NVQ1), 1.23 (NVQ2) and 1.46 (NVQ3).

5. Summary and assessment

It is now widely recognised that employer demand for skills in Britain is quite low by comparison with several other industrialised nations. One apparent explanation for this is that a large proportion of British enterprises have adopted relatively low value-added product (or service) strategies, with production concentrated towards the more standardised and less complicated end of the quality spectrum for which skill requirements are relatively low. In consequence, some commentators have argued that the British economy may be trapped in a 'low skills / low quality equilibrium', with low demand for skills contributing to weak incentives for skills acquisition which in turn reduce the availability of skilled workers for enterprises which might otherwise consider shifting towards more skill-intensive high-quality product strategies.

This assessment is of particular concern for sectors where British-based producers face growing pressure to upgrade their product strategies due to competition from relatively low-cost foreign producers of low value-added products. If correct, it also bodes badly for the UK government's long-term objective of raising the rate of UK productivity growth over the economic cycle.

However, to date much of the evidence on these issues has been based on international comparisons (typically involving case studies) and there has been little attempt to investigate the extent and nature of *differences* between British-based companies in the links between product strategies, skill levels and indicators of economic performance.

This paper has drawn on the 2001 Employers Skills Survey in order to develop a new measure of product strategy which captures the choices made by establishments in relation to market niche, complexity of product specification, innovation leadership and the extent of their dependence on low prices for competitive success. This enables us to submit two of the central hypotheses arising from the product strategies and skills literature to detailed empirical scrutiny at sector and establishment level:

H1: All else being equal, high (low) levels of workforce skills are positively associated with high (low) value added product strategies

H2: All else being equal, high (low) value added product strategies are positively associated with a high (low) degree of exposure to foreign competition

Both hypotheses are strongly supported by multivariate analysis at establishment level which controls for employee size-group, sector, regional location, site function, recent sales growth and a number of other factors that influence skill requirements. Firstly, workforce skills are found to be significantly positively related to the measure of product strategy. Secondly, high-specification, high-skill product strategies are strongly associated with a focus on national and international product markets rather than on less competitive local and regional markets.

The results also shed light on the question of sustainability of different kinds of product strategy since high-end (low-end) product strategies are not only positively and significantly associated with recent growth (decline) in sales but also with a relatively high (low) level of capacity utilisation. One inference is that a significant proportion of British firms pursuing low value added product strategies could enhance their competitiveness by moving to higher specification, more skill-intensive products and services.

At the same time estimates of the impact of changes in product strategy on skill requirements suggest that, when enterprises do seek to upgrade their product strategies, the process may have a polarising impact on demand for skills. In sectors characterised by relatively high proportions of firms deploying high value added skill-intensive product strategies, further efforts to move up-market in response to competitive pressures are associated with disproportionately large increases in employers' demand for skills. Conversely, in sectors where low-end product strategies currently predominate, the impact on demand for skills of firms upgrading their product strategies appears to be relatively modest.

To some extent this polarisation already shows up in measures of the dispersion of product strategies within industries, with the lowest dispersion occurring in relatively high-skilled sectors such as computer services and health services and in relatively low-skilled sectors such as hotels and bars. But in several other sectors the analysis reveals a striking amount of within-industry variation in the degree of specialisation in 'high', 'medium' and 'low end' activities along the product quality spectrum, with associated variation in skill requirements. Examples of sectors with a particularly wide range of enterprise product strategies include postal and telecommunications services, printing and publishing and specialised retailing.

Taken together, these findings have a number of implications for:

(1) the conceptual framework underlying present debates on the relationship between product strategies and employers' demand for skills
(2) the development of policy with the aim of encouraging more enterprises to move to skill-intensive product strategies
(3) future research in the area of product strategies and skills

Concepts

The high correlation between the measures of product strategy and skills at sector and establishment levels confirms the existence of some form of correspondence between product strategy choices and skill requirements. However, the sheer diversity of such correspondences between and within industries shows that there is no question of an entire national economy (or even regional economy) being locked into any single kind of 'equilibrium'.

The existence of such diversity suggests that it is more useful to think in terms of enterprise product strategies occupying distinct positions on a spectrum of possible product strategy choices. In this context the essential point of difference between, say, Britain and Germany is better described in terms of Britain having a larger proportion of enterprises concentrated towards the low end of the product strategy/skills spectrum than is found in Germany, not in terms of the two economies tending towards different equilibria. The essential insight still remains that, within any national economy, the distribution of product strategy choices by enterprises is likely (via associated demands for skills) to have substantial effects on the incentives for skills acquisition within that country.

The neoclassical concept of an economic equilibrium usually refers to the outcome that might be expected when economic actors (eg, enterprises) complete a process of optimising behavior (eg, profit-maximising behaviour in the case of enterprises). As such, we do not necessarily expect to observe equilibria at any given point in time and, furthermore, the concept has long been criticised as static and ahistorical in nature (Kaldor, 1972, 1975). In this context the observable process of enterprises making changes to their product strategies and skill mixes over time is better captured, as Wilson and Hogarth (2003) suggest, in terms of product strategy/skill trajectories rather than equilibria. Indeed, discussion of enterprises' efforts to upgrade product strategies would do well to make use of concepts such as

path-dependence which are emphasised in the evolutionary economics literature. [14] This approach would do justice to the empirical reality of enterprises searching for profitable product strategies and progressively learning over time what complementary investments (eg, in skills formation) are needed to make a success of particular strategies.

Policy implications

As shown in the recent Skills Strategy White Paper published by the DfES, DTI and other government departments, UK policy-makers now clearly recognise that demand for skills in the UK economy is relatively low by international standards (DfES/DTI/HMT/DWP, 2003). Accordingly, it is now an important aim of government policy to encourage more companies to move into higher value-added skill-intensive product or service areas in order to help raise average labour productivity in the UK economy.

The results presented in this paper suggest that a sizeable proportion of UK-based enterprises may be resistant to such encouragement. In many sectors low-value added, low skilled product strategies are firmly entrenched, in part because so many enterprises serve local and regional product markets where competitive pressures are much weaker than in national or international markets. If low-end product strategies are profitable for various enterprises, and look set to remain so for the foreseeable future, the enterprises concerned will have little reason to change course.

At the same time the new analyses presented here show that, after controlling for a wide range of potential influences on performance at establishment level, low-specification product strategies are associated with relatively weak growth in sales in the 12 months preceding the ESS and with relatively low levels of capacity utilisation. This suggests that, for another large proportion of UK-based enterprises, their present product strategies may not be sustainable into the medium term.

Taken together these findings suggest that government policies designed to encourage more skill-intensive product strategies should be closely targetted rather than broad-brush in nature. Specifically, it might be most productive for skills and business support policies to focus primarily on:

[14] In essence, path dependence refers to the fact that present-day options confronting economic actors such as enterprises are partially shaped by past choices made by those enterprises and by spillover effects from the past actions of other economic actors. For a detailed assessment of this concept, see Liebowitz and Margolis (1995).

- Companies which are seeking to move upmarket but are constrained in various ways from doing so (eg, due to skill shortages or limited access to financial capital)
- Companies that need to move up-market (because there is no future in their current product strategies) but are too immersed in day-to-day problems to think about strategic changes in direction

Research agenda

Policy development in this area needs to be closely supported by new empirical research designed to learn more about the characteristics of different product strategy/skills spectra in the UK economy and to gather hard evidence on the sustainability of different types of product strategy. In addition, more evidence is needed on the possible product strategy/skills trajectories along which UK-based companies might move in response to competitive pressures, and the extent and nature of any constraints which they encounter in doing so.

At the same time there is a need for new and better theory to be developed, in particular, in order to provide a better framework for empirical research into enterprise decision-making on product strategies and skill formation. New work in this area could usefully be based in evolutionary theories of economic growth in which – in contrast to neoclassical theories -- enterprises are seen as profit seeking (rather than profit maximising) and operating in conditions of unquantifiable uncertainty rather than quantifiable risk. In addition, the existing industrial economics and management literatures on enterprise product strategies need to be mined for useful contributions to rigorous thinking on enterprise strategy formation and implementation.

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APPENDIX A: Tables 10-15 (full versions)

Table A10: Variable definitions and descriptive statistics (all private sector establishments with five or more employees)

A: Product strategy and skills indices (a), analysed by sector

Sector	Variable	Obs	Mean	Std. Dev.
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Whole economy:	Log product strategy	16760	4.021	0.425
	Log skills	15548	0.354	0.204
Engineering:	Log product strategy	1587	4.072	0.388
	Log skills	1445	0.346	0.175
Chemicals:	Log product strategy	443	4.053	0.412
	Log skills	395	0.311	0.155
Construction:	Log product strategy	1629	3.909	0.425
	Log skills	1444	0.340	0.179
Retail/wholesale:	Log product strategy	2019	3.954	0.456
	Log skills	1846	0.276	0.159
Hotels, restaurants and bars	Log product strategy	2103	3.928	0.456
	Log skills	1930	0.285	0.158
Transport and communications	Log product strategy	1304	3.961	0.449
	Log skills	1186	0.279	0.181
Financial and business services	Log product strategy	3271	4.127	0.363
	Log skills	3152	0.494	0.229

(b) See Section 3.2 of main text for definitions of product strategy and skill indices

B: Other variables (whole economy)

Variable name	Definition	Obs	Mean	Std. Dev.
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Single	=1 if establishment is a single-site enterprise	17982	0.451	0.498
Foreign-owned	=1 if wholly or partly foreign-owned	17982	0.133	0.340
Export share	Exports as percent of sales (Banded on1-6 scale: 1=zero; 6=50% or more)	16377	1.560	1.300
Low volumes	=1 if provide one-off or very low volume products	17074	0.068	0.252
Capacity utilisation	Ordered 1-4 variable where 1= operating considerably below full capacity and 4= operating at overload	17671	2.581	0.663
Use of Information Technology	Ordered 0-5 variable where 0= no use of IT and 5= using 'state of the art' IT	17597	3.104	1.360
New products	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to development of new products or services	17529	0.974	1.404
New work practices	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to introduction of new work practices	17529	1.433	1.542

New technologies	Ordered 0-4 variable based on number of occupations affected by changing skill needs due to introduction of new technologies	17529	1.610	1.554
Geographical market focus dummies (Reference category = local market focus):				
Local market focus	=1 if market for establishment's main product or service is primarily local	17949	0.337	0.473
Regional market focus	=1 if market for establishment's main product or service is primarily regional	17949	0.204	0.403
National market focus	=1 if market for establishment's main product or service is primarily within the UK	17949	0.322	0.467
European market focus	=1 if market for establishment's main product or service is primarily within the European Union	17949	0.040	0.195
World market focus	=1 if market for establishment's main product or service is primarily outside Europe	17949	0.098	0.297
Site function dummies (Reference category = office sites):				
Office site	Office, administrative services, finance or accounts	17969	0.294	0.456
Production site	Factory, production or construction	17969	0.227	0.419
Distribution site	Warehouse or distribution depot	17969	0.069	0.253
Research, development, design	Research, development, design	17969	0.021	0.144
Catering, entertainment or leisure	Catering, entertainment or leisure	17969	0.144	0.351
Shop, showroom, sales	Shop, showroom or other customer- or client-facing sales activities	17969	0.128	0.334
Education or healthcare site	Education, training or health care	17969	0.069	0.253
Other activities on site	Other site functions not classified above	17969	0.048	0.215
Sales change dummies (Reference category = no change in sales):				
No change in sales	=1 if sales stayed the same in previous 12 months	17982	0.238	0.426
Rapid growth in sales	=1 if sales grew a great deal in previous 12 months	17982	0.161	0.368
Some growth in sales	=1 if sales grew a little in previous 12 months	17982	0.375	0.484
Some decline in sales	=1 if sales declined a little in previous 12 months	17982	0.097	0.296
Sharp decline in sales	=1 if sales declined a great deal in previous 12 months	17982	0.027	0.161
Change in sales_nk	=1 if change in sales in previous 12 months not known	17982	0.092	0.289
Employee size group dummies (Reference category = 5-9 employee size group):				
Emp5_9	5-9 employee size group	17982	0.169	0.374
Emp10_24	10-24	17982	0.226	0.418
Emp25_49	25-49	17982	0.261	0.439
Emp50_99	50-99	17982	0.140	0.347
Emp100_199	100-199	17982	0.105	0.307
Emp200_499	200-499	17982	0.076	0.264
Emp500_999	500-999	17982	0.018	0.131

Emp1000plus	1000+	17982	0.006	0.078
Regional dummies (Reference category = East Midlands):				
East Midlands		17982	0.096	0.294
London		17982	0.152	0.359
Eastern		17982	0.115	0.319
North East		17982	0.067	0.250
North West		17982	0.115	0.319
South East		17982	0.142	0.349
South West		17982	0.104	0.306
West Midlands		17982	0.109	0.311
Yorks and Humberside		17982	0.100	0.300
Sector dummies (Reference category = Other services):				
Food and drink manufacturing	Food, drink and tobacco	17652	0.020	0.140
Printing, publishing	Printing, publishing, recorded media	17652	0.026	0.158
Chemicals	Chemicals, rubber and plastics	17652	0.027	0.161
Metal products	Fabricated metal products	17652	0.034	0.182
Electrical / electronic engineering	Electrical, electronic and instrument engineering	17652	0.020	0.140
Mechanical engineering	Mechanical engineering, vehicles and other engineering	17652	0.041	0.198
Other manufacturing	Other manufacturing industries	17652	0.043	0.202
Building complete constructions, civil engineering	Building of complete constructions; civil engineering	17652	0.052	0.223
Building installation and completion	Building installation, building completion and other construction activities	17652	0.045	0.208
Sales of motor vehicles	Sales of motor vehicles, parts, fuel	17652	0.020	0.139
Wholesaling	Wholesaling	17652	0.038	0.190
Retailing – specialised	Retailing - specialised stores	17652	0.049	0.217
Other retailing	Retailing - non-specialised stores; other retail and repair	17652	0.035	0.184
Hotels	Hotels, motels and other accommodation	17652	0.033	0.180
Restaurants	Restaurants, canteens, catering	17652	0.051	0.220
Bars	Bars	17652	0.040	0.196
Transport services	Transport services	17652	0.039	0.194
Post and telecoms services	Postal and telecommunications services	17652	0.015	0.122
Auxiliary transport services	Auxiliary transport activities, travel agents	17652	0.025	0.156
Financial services	Financial services, including insurance	17652	0.035	0.183
Computer services	Computer services	17652	0.023	0.150
Legal, accounting and related services	Legal, accounting, auditing, business and management consultancy, etc.	17652	0.041	0.197
Architectural, engineering and related technical services	Architectural and engineering activities and related technical consultancy; technical testing, analysis	17652	0.027	0.162
Other business	Other business services	17652	0.075	0.264

services				
Health	Human health activities	17652	0.022	0.148
Social work	Social work	17652	0.041	0.198
Sporting activities	Sporting activities, arenas, stadia	17652	0.017	0.130
Other services		17652	0.065	0.246

Table A11: Estimated determinants of establishment product strategies, All Sectors - All Establishments and All Sectors - Exporters Only, OLS regressions (Dependent variable = log product strategy index)

	(1)	(2)	(3)
	All sectors	**All sectors**	**All sectors - exporters only**
Regional market focus	0.038***		
	(0.010)		
National market focus	0.087***		
	(0.010)		
European market focus	0.128***		
	(0.017)		
World market focus	0.185***		
	(0.013)		
Export share		0.029***	0.024***
		(0.003)	(0.004)
Single	-0.042***	-0.037***	0.007
	(0.008)	(0.008)	(0.015)
Foreign-owned	0.040***	0.038***	0.022
	(0.010)	(0.011)	(0.017)
Low volumes	-0.017	-0.012	0.096***
	(0.015)	(0.016)	(0.023)
Rapid growth in sales	0.082***	0.090***	0.072***
	(0.010)	(0.011)	(0.018)
Some growth in sales	0.037***	0.040***	0.037**
	(0.008)	(0.009)	(0.017)
Some decline in sales	-0.057***	-0.051***	-0.035
	(0.014)	(0.014)	(0.024)
Sharp decline in sales	-0.076***	-0.078***	-0.027
	(0.024)	(0.025)	(0.031)
Change in sales_nk	0.049***	0.055***	0.028
	(0.013)	(0.015)	(0.038)
Capacity utilisation	0.031***	0.030***	0.033***
	(0.005)	(0.005)	(0.009)
Use of Information Technology	0.020***	0.021***	0.019***
	(0.003)	(0.003)	(0.005)
New products	0.006*	0.006**	0.008*
	(0.003)	(0.003)	(0.005)
New work practices	0.000	0.001	0.006
	(0.003)	(0.003)	(0.005)
New technologies	0.000	-0.000	-0.002
	(0.003)	(0.003)	(0.005)
Production site	-0.029**	-0.031**	-0.047**
	(0.012)	(0.012)	(0.018)
Distribution site	-0.033**	-0.031*	-0.028
	(0.016)	(0.017)	(0.029)
Research, development, design	0.065***	0.073***	0.032
	(0.018)	(0.019)	(0.024)
Catering, entertainment or leisure	-0.051***	-0.063***	0.018
	(0.019)	(0.021)	(0.056)
Shop, showroom, sales	-0.000	-0.019	-0.045
	(0.014)	(0.015)	(0.034)
Education or healthcare site	0.052***	0.043**	-0.025
	(0.019)	(0.021)	(0.057)
Other activities on site	-0.025	-0.026	-0.043
	(0.017)	(0.018)	(0.032)
Emp10_24	0.044***	0.044***	0.018
	(0.012)	(0.012)	(0.029)
Emp25_49	0.065***	0.074***	0.040

	(0.011)	(0.012)	(0.027)
Emp50_99	0.062***	0.073***	0.036
	(0.013)	(0.013)	(0.028)
Emp100_199	0.094***	0.104***	0.075**
	(0.014)	(0.015)	(0.029)
Emp200_499	0.136***	0.150***	0.114***
	(0.015)	(0.016)	(0.031)
Emp500_999	0.149***	0.164***	0.116***
	(0.021)	(0.024)	(0.037)
Emp1000plus	0.148***	0.155***	0.192***
	(0.037)	(0.044)	(0.050)
London	0.024*	0.036**	0.020
	(0.013)	(0.014)	(0.026)
Eastern	0.024*	0.031**	0.022
	(0.014)	(0.014)	(0.026)
North East	0.001	0.000	0.045
	(0.017)	(0.018)	(0.034)
North West	-0.003	0.005	0.025
	(0.014)	(0.015)	(0.029)
South East	0.029**	0.034**	0.068***
	(0.013)	(0.014)	(0.025)
South West	0.015	0.018	0.003
	(0.014)	(0.015)	(0.028)
West Midlands	-0.027*	-0.019	-0.025
	(0.015)	(0.016)	(0.028)
Yorks and Humberside	0.003	0.008	-0.023
	(0.015)	(0.015)	(0.029)
Food and drink manufacturing	-0.125***	-0.102***	-0.141**
	(0.031)	(0.034)	(0.060)
Printing, publishing	-0.074***	-0.060**	-0.083
	(0.027)	(0.029)	(0.055)
Chemicals	-0.069**	-0.058**	-0.095*
	(0.027)	(0.030)	(0.054)
Metal products	-0.082***	-0.060**	-0.097*
	(0.026)	(0.028)	(0.055)
Electrical / electronic engineering	0.023	0.036	-0.012
	(0.025)	(0.027)	(0.052)
Mechanical engineering	-0.024	-0.002	-0.044
	(0.024)	(0.026)	(0.052)
Other manufacturing	-0.073***	-0.044*	-0.037
	(0.025)	(0.026)	(0.052)
Building complete constructions, civil engineering	-0.129***	-0.121***	-0.025
	(0.023)	(0.024)	(0.060)
Building installation and completion	-0.114***	-0.097***	-0.034
	(0.024)	(0.025)	(0.066)
Sales of motor vehicles	-0.031	-0.021	-0.044
	(0.029)	(0.030)	(0.078)
Wholesaling	-0.149***	-0.128***	-0.191***
	(0.026)	(0.027)	(0.058)
Retailing – specialised	-0.109***	-0.101***	-0.092
	(0.024)	(0.025)	(0.071)
Other retailing	-0.145***	-0.152***	-0.068
	(0.027)	(0.028)	(0.070)
Hotels	-0.201***	-0.138***	-0.243***
	(0.029)	(0.030)	(0.088)
Restaurants	-0.008	-0.006	-0.015
	(0.025)	(0.027)	(0.103)
Bars	-0.094***	-0.097***	-0.411***
	(0.028)	(0.029)	(0.126)

Transport services	-0.172***	-0.153***	-0.182***
	(0.027)	(0.029)	(0.066)
Post and telecoms services	-0.044	-0.032	-0.035
	(0.029)	(0.032)	(0.060)
Auxiliary transport services	-0.062**	-0.042	-0.078
	(0.025)	(0.027)	(0.058)
Financial services	-0.031	0.002	-0.077
	(0.023)	(0.025)	(0.069)
Computer services	0.093***	0.131***	0.082
	(0.022)	(0.024)	(0.052)
Legal, accounting and related services	0.072***	0.094***	0.085
	(0.021)	(0.023)	(0.054)
Architectural, engineering and related technical services	0.053**	0.079***	0.022
	(0.022)	(0.024)	(0.052)
Other business services	-0.057***	-0.036	-0.008
	(0.021)	(0.022)	(0.054)
Health	0.117***	0.113***	0.005
	(0.026)	(0.028)	(0.064)
Social work	0.107***	0.102***	0.195***
	(0.026)	(0.028)	(0.068)
Sporting activities	-0.033	-0.026	-0.162*
	(0.029)	(0.031)	(0.094)
Other private services	0.078***	0.086***	0.052
	(0.029)	(0.032)	(0.085)
Constant	3.804***	3.779***	3.841***
	(0.027)	(0.029)	(0.067)
Observations	15062	13914	3199
Adj. R sqd.	0.12	0.11	0.11
SEE	0.40	0.40	0.35
No. of observations	15062	13914	3199
Robust standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Table A12: Estimated determinants of establishment skill levels – All Sectors (All Establishments) and All Sectors (Exporters Only), OLS and IV regressions (Dependent variable = log skills index)

	(1)	(2)	(3)	(4)	(5)	(6)
	All sectors – OLS	**All sectors - IV**	**All sectors – OLS**	**All sectors, - IV**	**All sectors, exporters only - OLS**	**All sectors, exporters only - IV**
Log product strategy index	0.052***	0.119*	0.055***	0.151**	0.072***	0.224*
	(0.004)	(0.069)	(0.004)	(0.074)	(0.009)	(0.133)
Regional market focus	0.019***	0.016***				
	(0.004)	(0.005)				
National market focus	0.036***	0.031***				
	(0.004)	(0.007)				
European market focus	0.063***	0.054***				
	(0.008)	(0.012)				
World market focus	0.098***	0.085***				
	(0.007)	(0.014)				
Export share			0.012***	0.009***	0.010***	0.006*
			(0.001)	(0.003)	(0.002)	(0.004)
Single	-0.009***	-0.006	-0.006*	-0.002	0.013*	0.014*
	(0.003)	(0.005)	(0.004)	(0.005)	(0.007)	(0.008)
Foreign-owned	0.020***	0.018***	0.023***	0.020***	0.030***	0.027***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.009)	(0.009)
Low volumes	0.011*	0.013*	0.013**	0.015**	0.023**	0.009
	(0.006)	(0.007)	(0.006)	(0.007)	(0.011)	(0.017)
Rapid growth in sales	0.025***	0.019**	0.029***	0.019**	0.024**	0.012
	(0.005)	(0.008)	(0.005)	(0.009)	(0.010)	(0.015)
Some growth in sales	0.018***	0.015***	0.019***	0.015***	0.017**	0.010
	(0.004)	(0.005)	(0.004)	(0.005)	(0.008)	(0.011)
Some decline in sales	0.002	0.006	0.005	0.010	0.005	0.010
	(0.005)	(0.007)	(0.005)	(0.007)	(0.010)	(0.012)
Sharp decline in sales	-0.001	0.005	-0.004	0.004	0.002	0.008
	(0.009)	(0.011)	(0.009)	(0.012)	(0.016)	(0.018)
Change in sales_nk	0.028***	0.025***	0.037***	0.032***	0.046**	0.037
	(0.007)	(0.008)	(0.008)	(0.009)	(0.021)	(0.024)
Capacity utilisation	0.002		0.003		0.005	
	(0.002)		(0.002)		(0.004)	
Use of Information Technology	0.003***	0.002	0.003***	0.001	0.006**	0.002
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
New products	0.000		0.001		0.001	
	(0.001)		(0.001)		(0.003)	
New work practices	0.003***	0.003***	0.004***	0.004***	0.003	0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
New technologies	0.000	0.000	-0.000	-0.000	-0.001	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Production site	-0.057***	-0.055***	-0.057***	-0.053***	-0.085***	-0.076***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.010)	(0.013)
Distribution site	-0.090***	-0.088***	-0.091***	-0.087***	-0.101***	-0.098***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.013)	(0.014)
Research, development, design	0.075***	0.071***	0.076***	0.069***	0.051***	0.045**
	(0.012)	(0.012)	(0.012)	(0.013)	(0.018)	(0.018)
Catering, entertainment or leisure	-0.050***	-0.046***	-0.058***	-0.053***	-0.036	-0.037
	(0.008)	(0.009)	(0.009)	(0.010)	(0.039)	(0.040)
Shop, showroom, sales	-0.058***	-0.058***	-0.065***	-0.063***	-0.074***	-0.069***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.018)	(0.019)
Education or	0.034***	0.030**	0.026**	0.021*	0.060	0.063

healthcare site						
	(0.012)	(0.012)	(0.012)	(0.013)	(0.043)	(0.043)
Other activities on site	-0.015*	-0.014	-0.017*	-0.015	-0.052**	-0.043*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.021)	(0.023)
Emp10_24	-0.009*	-0.012**	-0.007	-0.010*	-0.018	-0.020
	(0.005)	(0.006)	(0.005)	(0.006)	(0.015)	(0.015)
Emp25_49	-0.008	-0.012*	-0.003	-0.010	-0.010	-0.015
	(0.005)	(0.006)	(0.005)	(0.007)	(0.014)	(0.015)
Emp50_99	-0.010	-0.013*	-0.003	-0.010	-0.018	-0.023
	(0.006)	(0.007)	(0.006)	(0.008)	(0.015)	(0.016)
Emp100_199	-0.000	-0.006	0.006	-0.003	0.002	-0.007
	(0.006)	(0.009)	(0.006)	(0.010)	(0.015)	(0.018)
Emp200_499	-0.007	-0.016	0.005	-0.009	-0.005	-0.023
	(0.007)	(0.011)	(0.007)	(0.013)	(0.016)	(0.023)
Emp500_999	0.010	0.001	0.016	0.003	0.014	-0.001
	(0.011)	(0.015)	(0.012)	(0.016)	(0.021)	(0.026)
Emp1000plus	0.032*	0.022	0.054**	0.040	0.063**	0.036
	(0.019)	(0.022)	(0.022)	(0.025)	(0.029)	(0.038)
London	0.057***	0.055***	0.060***	0.057***	0.079***	0.077***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.014)	(0.015)
Eastern	-0.003	-0.005	-0.003	-0.006	0.015	0.010
	(0.006)	(0.007)	(0.006)	(0.007)	(0.015)	(0.016)
North East	0.010	0.010	0.010	0.010	0.025	0.017
	(0.007)	(0.007)	(0.007)	(0.008)	(0.016)	(0.019)
North West	0.012*	0.012*	0.014**	0.014**	0.015	0.012
	(0.006)	(0.006)	(0.006)	(0.007)	(0.014)	(0.015)
South East	0.023***	0.021***	0.024***	0.020***	0.035***	0.024
	(0.006)	(0.007)	(0.006)	(0.007)	(0.013)	(0.017)
South West	0.012*	0.011	0.011*	0.009	0.030**	0.028*
	(0.006)	(0.007)	(0.007)	(0.007)	(0.014)	(0.015)
West Midlands	0.011*	0.013**	0.014**	0.016**	0.009	0.014
	(0.006)	(0.007)	(0.006)	(0.007)	(0.013)	(0.014)
Yorks and Humberside	0.002	0.002	0.004	0.004	0.028**	0.031**
	(0.006)	(0.007)	(0.007)	(0.007)	(0.014)	(0.015)
Food and drink manufacturing	-0.091***	-0.084***	-0.083***	-0.075***	-0.168***	-0.148***
	(0.013)	(0.015)	(0.013)	(0.015)	(0.036)	(0.039)
Printing, publishing	0.008	0.014	0.013	0.020	-0.080**	-0.065*
	(0.013)	(0.015)	(0.014)	(0.015)	(0.037)	(0.038)
Chemicals	-0.058***	-0.052***	-0.050***	-0.043***	-0.135***	-0.117***
	(0.012)	(0.014)	(0.013)	(0.014)	(0.034)	(0.037)
Metal products	-0.042***	-0.035**	-0.031**	-0.024*	-0.129***	-0.112***
	(0.012)	(0.014)	(0.012)	(0.014)	(0.035)	(0.037)
Electrical / electronic engineering	0.004	0.002	0.016	0.012	-0.076**	-0.074**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.035)	(0.034)
Mechanical engineering	-0.024**	-0.022*	-0.016	-0.016	-0.110***	-0.102***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.035)	(0.034)
Other manufacturing	-0.090***	-0.083***	-0.078***	-0.072***	-0.176***	-0.167***
	(0.011)	(0.013)	(0.012)	(0.013)	(0.034)	(0.034)
Building complete constructions, civil engineering	-0.000	0.010	0.002	0.016	-0.078*	-0.071*
	(0.011)	(0.015)	(0.012)	(0.016)	(0.044)	(0.043)
Building installation and completion	-0.028**	-0.019	-0.022*	-0.011	-0.135***	-0.133***
	(0.011)	(0.014)	(0.011)	(0.014)	(0.038)	(0.037)
Sales of motor vehicles	-0.014	-0.010	-0.013	-0.010	-0.055	-0.054
	(0.012)	(0.013)	(0.012)	(0.013)	(0.045)	(0.045)
Wholesaling	-0.045***	-0.034**	-0.035***	-0.021	-0.125***	-0.093**
	(0.011)	(0.016)	(0.012)	(0.016)	(0.035)	(0.044)
Retailing – specialised	-0.054***	-0.046***	-0.055***	-0.043***	-0.119***	-0.099**
	(0.009)	(0.013)	(0.010)	(0.013)	(0.039)	(0.043)

Other retailing	-0.091***	-0.080***	-0.095***	-0.079***	-0.145***	-0.130***
	(0.010)	(0.015)	(0.010)	(0.016)	(0.039)	(0.040)
Hotels	-0.065***	-0.049**	-0.034***	-0.017	-0.170***	-0.132**
	(0.011)	(0.020)	(0.011)	(0.018)	(0.047)	(0.059)
Restaurants	-0.045***	-0.043***	-0.044***	-0.041***	-0.278***	-0.275***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.064)	(0.065)
Bars	-0.021**	-0.014	-0.021*	-0.010	-0.218***	-0.154**
	(0.011)	(0.013)	(0.011)	(0.014)	(0.044)	(0.072)
Transport services	-0.093***	-0.081***	-0.086***	-0.071***	-0.175***	-0.143***
	(0.011)	(0.017)	(0.012)	(0.017)	(0.037)	(0.046)
Post and telecoms services	-0.067***	-0.063***	-0.064***	-0.059***	-0.195***	-0.187***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.039)	(0.038)
Auxiliary transport services	-0.042***	-0.037***	-0.032**	-0.027**	-0.154***	-0.142***
	(0.013)	(0.014)	(0.013)	(0.014)	(0.038)	(0.038)
Financial services	0.025**	0.028**	0.037***	0.038***	-0.033	-0.020
	(0.012)	(0.012)	(0.013)	(0.013)	(0.042)	(0.042)
Computer services	0.170***	0.165***	0.187***	0.176***	0.076**	0.066*
	(0.014)	(0.015)	(0.015)	(0.017)	(0.036)	(0.036)
Legal, accounting and related services	0.186***	0.182***	0.194***	0.186***	0.074**	0.065*
	(0.011)	(0.012)	(0.012)	(0.013)	(0.036)	(0.035)
Architectural, engineering and related technical services	0.176***	0.173***	0.184***	0.177***	0.067*	0.066*
	(0.013)	(0.013)	(0.014)	(0.015)	(0.036)	(0.034)
Other business services	-0.010	-0.005	0.001	0.005	-0.063*	-0.059*
	(0.010)	(0.011)	(0.011)	(0.011)	(0.037)	(0.035)
Health	0.032**	0.025	0.027*	0.017	-0.181*	-0.179*
	(0.015)	(0.017)	(0.016)	(0.018)	(0.104)	(0.108)
Social work	-0.048***	-0.055***	-0.049***	-0.058***	0.069	0.040
	(0.014)	(0.016)	(0.015)	(0.016)	(0.089)	(0.092)
Sporting activities	-0.030**	-0.027*	-0.024*	-0.021	-0.244***	-0.222**
	(0.014)	(0.014)	(0.014)	(0.015)	(0.082)	(0.090)
Other private services	0.118***	0.113***	0.131***	0.123***	0.058	0.057
	(0.017)	(0.018)	(0.019)	(0.019)	(0.048)	(0.051)
Constant	0.115***	-0.144	0.093***	-0.270	0.121**	-0.468
	(0.019)	(0.268)	(0.019)	(0.289)	(0.053)	(0.523)
Observations	13284	13284	12314	12314	2820	2820
Adj. R sqd.	0.31		0.30		0.38	
SEE	0.17		0.17		0.16	
Hansen J test of overidentifying restrictions		0.01		0.01		0.03
P value		0.94		0.91		0.87
Breusch-Pagan test of heteroscedasticity		2340.79				
P value		0.00		0.00		0.00
C statistic (test of endogeneity of log product strategy)		0.99		1.74		1.47
P value		0.32		0.19		0.23
Instruments		New products Capacity utilisation		New products Capacity utilisation		New products Capacity utilisation
IV first stage equation:						
Adj. R sqd.		0.12		0.11		0.11
Partial R sqd of excluded instruments		0.003		0.003		0.005
F test of excluded		19.85***		17.07***		6.66***

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

Table A13: Estimated determinants of establishment product strategies - Engineering, Chemicals, Construction, Retail and wholesale, Hotels, restaurants and bars, Transport and communications, Financial and business services - OLS regressions (Dependent variable = log product strategy index)

	Engineer-ing	Chemicals	Construct-ion	Retail and wholesale	Hotels, restaurants and bars	Transport and commun-ications	Financial and business services
Regional market focus	0.022	0.116	-0.001	0.068**	0.061**	0.093**	0.057***
	(0.054)	(0.143)	(0.029)	(0.029)	(0.027)	(0.040)	(0.021)
National market focus	0.098**	0.108	0.104***	0.085***	0.025	0.116***	0.097***
	(0.045)	(0.135)	(0.032)	(0.032)	(0.032)	(0.034)	(0.020)
European market focus	0.131***	0.173	0.269***	0.082	-0.045	0.107*	0.133***
	(0.050)	(0.141)	(0.077)	(0.071)	(0.081)	(0.055)	(0.034)
World market focus	0.203***	0.267**	0.329***	0.181***	0.014	0.179***	0.184***
	(0.046)	(0.133)	(0.060)	(0.042)	(0.054)	(0.040)	(0.024)
Single	0.026	0.040	-0.056**	-0.037	-0.037	-0.096***	-0.051***
	(0.025)	(0.049)	(0.027)	(0.029)	(0.026)	(0.028)	(0.015)
Foreign-owned	0.067**	0.025	0.043	0.039	0.042	0.066**	0.031*
	(0.027)	(0.050)	(0.059)	(0.031)	(0.027)	(0.031)	(0.017)
Low volumes	0.097***	0.042	-0.066	0.002	-0.173**	-0.155*	-0.019
	(0.028)	(0.102)	(0.046)	(0.066)	(0.071)	(0.084)	(0.026)
Rapid growth in sales	0.121***	0.094	0.042	0.046	0.070**	0.117***	0.101***
	(0.029)	(0.071)	(0.035)	(0.034)	(0.032)	(0.039)	(0.019)
Some growth in sales	0.034	0.023	0.002	0.058**	0.016	0.068**	0.043**
	(0.025)	(0.054)	(0.027)	(0.029)	(0.026)	(0.032)	(0.018)
Some decline in sales	-0.035	-0.046	-0.035	-0.071	-0.069*	0.004	-0.060
	(0.033)	(0.062)	(0.053)	(0.044)	(0.039)	(0.050)	(0.040)
Sharp decline in sales	-0.051	-0.048	-0.046	-0.158	-0.208**	0.118	0.005
	(0.047)	(0.095)	(0.063)	(0.111)	(0.086)	(0.088)	(0.052)
Change in sales_nk	0.043	0.021	0.177***	0.064	0.020	0.075*	0.039
	(0.050)	(0.083)	(0.055)	(0.045)	(0.038)	(0.044)	(0.025)
Capacity utilisation	0.057***	0.062**	0.011	0.011	0.049***	0.006	0.021**
	(0.014)	(0.028)	(0.017)	(0.018)	(0.016)	(0.021)	(0.009)
Use of Information Technology	0.012	0.024	0.025***	0.020**	0.017**	0.022**	0.024***
	(0.008)	(0.016)	(0.009)	(0.008)	(0.007)	(0.010)	(0.005)
New products	-0.010	0.008	-0.005	0.018**	0.008	0.002	0.013**
	(0.008)	(0.016)	(0.010)	(0.009)	(0.010)	(0.012)	(0.006)
New work practices	0.011	-0.007	0.019**	0.000	-0.005	-0.011	-0.009*
	(0.008)	(0.015)	(0.009)	(0.009)	(0.011)	(0.011)	(0.005)
New technologies	0.006	0.009	-0.020**	-0.012	0.003	-0.001	0.003
	(0.007)	(0.017)	(0.010)	(0.008)	(0.010)	(0.011)	(0.005)
Production site	-0.039	-0.036	0.048*	-0.013		-0.106	-0.116***
	(0.030)	(0.054)	(0.025)	(0.053)		(0.085)	(0.030)
Distribution site	0.024	0.065	0.064	-0.013		-0.081***	-0.082*

	(0.075)	(0.100)	(0.051)	(0.037)		(0.028)	(0.043)
Research, development, design	0.012	0.104	0.188**				0.030
	(0.055)	(0.138)	(0.075)				(0.021)
Catering, entertainment or leisure					0.034	0.030	
					(0.047)	(0.082)	
Shop, showroom, sales	0.052		0.147**	-0.032	0.061	-0.031	-0.022
	(0.059)		(0.069)	(0.035)	(0.061)	(0.050)	(0.026)
Other activities on site	-0.046	0.128	0.060	-0.065	0.012	0.016	-0.055**
	(0.061)	(0.096)	(0.049)	(0.057)	(0.079)	(0.041)	(0.027)
Emp10_24	0.025	0.082	0.049	0.013	0.133***	0.081**	-0.003
	(0.046)	(0.115)	(0.032)	(0.040)	(0.037)	(0.041)	(0.021)
Emp25_49	0.086**	0.074	0.036	0.044	0.206***	0.111***	0.013
	(0.043)	(0.106)	(0.035)	(0.038)	(0.036)	(0.042)	(0.020)
Emp50_99	0.066	0.164	0.054	-0.021	0.210***	0.111***	0.009
	(0.047)	(0.106)	(0.044)	(0.044)	(0.042)	(0.042)	(0.025)
Emp100_199	0.098**	0.189*	0.058	0.145***	0.350***	0.157***	0.041*
	(0.045)	(0.112)	(0.053)	(0.041)	(0.050)	(0.053)	(0.024)
Emp200_499	0.164***	0.234**	0.099	0.186***	0.414***	0.208***	0.032
	(0.047)	(0.114)	(0.064)	(0.042)	(0.064)	(0.050)	(0.027)
Emp500_999	0.152***	0.350***	0.230*	0.226***	0.488***	0.014	0.005
	(0.058)	(0.124)	(0.121)	(0.051)	(0.084)	(0.121)	(0.042)
Emp1000plus	0.249***	0.148	0.237***	0.107	0.528**	-0.029	0.081
	(0.061)	(0.166)	(0.074)	(0.163)	(0.225)	(0.098)	(0.055)
London	0.026	0.038	0.040	0.053	0.039	0.176***	-0.011
	(0.048)	(0.103)	(0.042)	(0.041)	(0.040)	(0.048)	(0.028)
Eastern	-0.014	0.043	0.041	0.076*	0.038	0.107**	0.027
	(0.040)	(0.085)	(0.045)	(0.043)	(0.041)	(0.052)	(0.029)
North East	0.007	0.066	0.009	-0.039	-0.038	0.092	0.004
	(0.053)	(0.098)	(0.049)	(0.062)	(0.056)	(0.063)	(0.034)
North West	-0.048	0.138*	0.003	-0.035	-0.002	0.113**	-0.005
	(0.045)	(0.080)	(0.050)	(0.046)	(0.044)	(0.057)	(0.032)
South East	0.032	0.078	-0.001	0.077*	0.017	0.132**	0.027
	(0.038)	(0.080)	(0.046)	(0.042)	(0.044)	(0.054)	(0.028)
South West	-0.000	-0.126	0.027	0.022	0.030	0.118**	0.003
	(0.043)	(0.115)	(0.046)	(0.046)	(0.044)	(0.056)	(0.029)
West Midlands	-0.058	0.089	0.041	-0.061	-0.029	0.064	-0.001
	(0.040)	(0.083)	(0.050)	(0.051)	(0.046)	(0.060)	(0.031)
Yorks and Humberside	-0.054	0.021	0.069	-0.036	-0.028	0.112**	0.015
	(0.043)	(0.082)	(0.046)	(0.048)	(0.046)	(0.052)	(0.031)
Electrical / electronic engineering	0.108***						
	(0.026)						
Mechanical engineering	0.058**						
	(0.024)						
Building installation and completion			0.011				
			(0.022)				
Retailing – specialised				0.057*			
				(0.033)			
Other retailing				-0.004			

				(0.038)			
Hotels					-0.110***		
					(0.035)		
Restaurants					0.060**		
					(0.025)		
Transport services						-0.092***	
						(0.029)	
Post and telecoms services						0.021	
						(0.032)	
Financial services							0.019
							(0.020)
Computer services							0.153***
							(0.019)
Legal, accounting and related services							0.124***
							(0.018)
Architectural, engineering and related technical services							0.118***
							(0.019)
Constant	3.621***	3.468***	3.719***	3.714***	3.532***	3.672***	3.814***
	(0.086)	(0.213)	(0.073)	(0.083)	(0.081)	(0.089)	(0.047)
Observations	1462	413	1491	1837	1964	1208	2960
Adj. R sqd.	0.14	0.08	0.05	0.06	0.10	0.12	0.13
SEE	0.36	0.39	0.42	0.44	0.44	0.42	0.34
Robust standard errors in parentheses							
* significant at 10%; ** significant at 5%; *** significant at 1%							

Table A14: Estimated determinants of establishment skill levels – Engineering, Chemicals, Construction - OLS and IV regressions (Dependent variable = log skills index)

	(1)	(2)	(3)	(4)	(5)	(6)
	Engineering - OLS	**Engineering - IV**	**Chemicals - OLS**	**Chemicals - IV**	**Construction - OLS**	**Construct-ion - IV**
Log product strategy index	0.071***	0.092***	0.071***	0.108***	0.015	0.035***
	(0.015)	(0.014)	(0.021)	(0.021)	(0.012)	(0.013)
Regional market focus	-0.005	-0.006	-0.047	-0.054	0.013	0.013
	(0.021)	(0.021)	(0.039)	(0.036)	(0.011)	(0.011)
National market focus	-0.022	-0.024	0.019	0.014	0.022	0.019
	(0.016)	(0.016)	(0.033)	(0.031)	(0.014)	(0.014)
European market focus	-0.005	-0.007	0.029	0.017	0.047	0.042
	(0.020)	(0.020)	(0.037)	(0.035)	(0.045)	(0.045)
World market focus	0.030*	0.026	0.072**	0.060*	0.087*	0.077
	(0.018)	(0.018)	(0.036)	(0.034)	(0.051)	(0.051)
Single	0.000	-0.000	0.005	0.004	-0.070***	-0.069***
	(0.012)	(0.012)	(0.017)	(0.017)	(0.013)	(0.013)
Foreign-owned	0.033**	0.031**	0.068***	0.068***	0.014	0.012
	(0.013)	(0.013)	(0.023)	(0.022)	(0.035)	(0.034)
Low volumes	0.018	0.016	-0.011	-0.009	0.017	0.020
	(0.013)	(0.013)	(0.023)	(0.023)	(0.017)	(0.016)
Rapid growth in sales	0.010	0.007	0.014	0.008	0.060***	0.057***
	(0.016)	(0.015)	(0.028)	(0.027)	(0.015)	(0.015)
Some growth in sales	0.001	0.001	-0.026	-0.024	0.046***	0.045***
	(0.012)	(0.011)	(0.021)	(0.021)	(0.012)	(0.012)
Some decline in sales	-0.005	-0.005	-0.036	-0.034	0.016	0.016
	(0.014)	(0.014)	(0.024)	(0.022)	(0.017)	(0.016)
Sharp decline in sales	-0.034*	-0.033*	-0.004	-0.000	0.017	0.017
	(0.018)	(0.017)	(0.032)	(0.030)	(0.039)	(0.039)
Change in sales_nk	-0.003	-0.004	-0.059*	-0.064**	0.063	0.061
	(0.023)	(0.023)	(0.035)	(0.032)	(0.041)	(0.040)
Capacity utilisation	0.002		-0.002		-0.002	-0.003
	(0.007)		(0.012)		(0.008)	(0.007)
Use of Information Technology	0.007*	0.007*	-0.003	-0.004	-0.001	
	(0.004)	(0.004)	(0.007)	(0.007)	(0.004)	
New products	0.004	0.004	-0.001	-0.001	-0.006	-0.003
	(0.003)	(0.003)	(0.006)	(0.006)	(0.005)	(0.004)
New work practices	-0.004	-0.004	-0.004	-0.004	0.007	
	(0.003)	(0.003)	(0.007)	(0.006)	(0.004)	
New technologies	0.003	0.002	0.001	0.001	0.004	0.006*
	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
Production site	-0.045***	-0.044***	-0.064**	-0.064***	-0.003	-0.004
	(0.016)	(0.016)	(0.026)	(0.024)	(0.011)	(0.011)
Distribution site	-0.063**	-0.064**	-0.010	-0.015	-0.027	-0.030
	(0.030)	(0.030)	(0.047)	(0.044)	(0.024)	(0.023)
Research, development, design	0.111***	0.110***	-0.009	-0.006	0.087**	0.081**
	(0.033)	(0.032)	(0.039)	(0.037)	(0.041)	(0.041)
Shop, showroom, sales	-0.024	-0.025		-0.170***	-0.023	-0.026
	(0.044)	(0.043)		(0.065)	(0.031)	(0.031)
Other activities on site	0.006	0.007	-0.016	0.013	0.063**	0.061**
	(0.034)	(0.033)	(0.045)	(0.041)	(0.026)	(0.025)
Emp10_24	-0.003	-0.003	0.043	0.045	0.007	0.007
	(0.019)	(0.019)	(0.036)	(0.033)	(0.013)	(0.013)
Emp25_49	-0.007	-0.009	0.060*	0.061*	0.020	0.020
	(0.018)	(0.018)	(0.034)	(0.031)	(0.015)	(0.015)
Emp50_99	-0.008	-0.008	0.052	0.051	0.018	0.016
	(0.021)	(0.021)	(0.035)	(0.031)	(0.020)	(0.020)
Emp100_199	0.009	0.007	0.055	0.054	0.007	0.006
	(0.021)	(0.021)	(0.036)	(0.033)	(0.026)	(0.026)

Emp200_499	-0.026	-0.029	0.046	0.042	-0.007	-0.006
	(0.022)	(0.022)	(0.040)	(0.036)	(0.031)	(0.030)
Emp500_999	-0.009	-0.012	0.110*	0.098*		
	(0.029)	(0.029)	(0.062)	(0.058)		
Emp1000plus	0.070*	0.065*	0.159***	0.159***		
	(0.038)	(0.038)	(0.060)	(0.056)		
Emp500plus					0.023	0.020
					(0.049)	(0.049)
London	0.021	0.021	0.062*	0.059*	0.030	0.029
	(0.023)	(0.023)	(0.034)	(0.033)	(0.019)	(0.019)
Eastern	0.010	0.010	-0.014	-0.016	-0.002	-0.003
	(0.019)	(0.018)	(0.034)	(0.032)	(0.022)	(0.022)
North East	0.004	0.004	-0.028	-0.033	-0.022	-0.024
	(0.024)	(0.023)	(0.035)	(0.032)	(0.021)	(0.021)
North West	0.019	0.020	0.033	0.024	0.028	0.028
	(0.020)	(0.019)	(0.030)	(0.028)	(0.021)	(0.021)
South East	0.040**	0.040**	-0.011	-0.018	0.022	0.022
	(0.018)	(0.018)	(0.029)	(0.027)	(0.020)	(0.020)
South West	0.013	0.013	-0.002	0.005	-0.018	-0.020
	(0.019)	(0.019)	(0.031)	(0.030)	(0.021)	(0.020)
West Midlands	0.003	0.004	-0.023	-0.028	0.015	0.014
	(0.017)	(0.017)	(0.029)	(0.027)	(0.021)	(0.021)
Yorks and Humberside	0.009	0.010	0.013	0.009	-0.008	-0.011
	(0.019)	(0.018)	(0.031)	(0.029)	(0.021)	(0.021)
Electrical / electronic engineering	0.053***	0.050***				
	(0.013)	(0.013)				
Mechanical engineering	0.024**	0.022**				
	(0.011)	(0.011)				
Building installation and completion					-0.015	-0.016
					(0.010)	(0.010)
Constant	0.022	-0.049	0.010	-0.128	0.271***	0.196***
	(0.067)	(0.063)	(0.096)	(0.094)	(0.055)	(0.057)
Observations	1287	1287	350	350	1275	1275
Adj. R sqd.	0.15		0.19		0.08	
SEE	0.16		0.14		0.17	
Hansen J test of overidentifying restrictions		0.02		0.11		2.51
P value		0.89		0.75		0.28
Breusch-Pagan test of heteroscedasticity		327.65		74.79		286.67
P value		0.00		0.00		0.00
C statistic (test of endogeneity of log product strategy)		7.30		11.33		8.32
P value		0.01		0.00		0.00
Instruments		Rank order product strategy Capacity utilisation		Rank order product strategy Capacity utilisation		Rank order product strategy Use of Information Technology New work practices
IV first stage equation:						
Adj. R sqd.		0.86		0.79		0.77
Partial R sqd of excluded instruments		0.84		0.77		0.76
F test of excluded instruments		3215.13***		514.99***		1328.38***
Robust standard errors in parentheses						
* significant at 10%; ** significant at 5%; *** significant at 1%						

Table A15: Estimated determinants of establishment skill levels – Retail and wholesale, Hotels, restaurants and bars, Transport and communications, Financial and business services - OLS and IV regressions (Dependent variable = log skills index)

	(1) Retail and whole-sale - OLS	(2) Retail and whole-sale - IV	(3) Hotels, restaur-ants and bars - OLS	(4) Hotels, restaur-ants and bars - IV	(5) Trans-port and commun -ications - OLS	(6) Transport and commun-ications - IV	(7) Financial and business services - OLS	(8) Financial and business services - IV
Log product strategy index	0.043***	0.049***	0.024***	0.022**	0.038***	0.030	0.109***	0.125***
	(0.007)	(0.010)	(0.009)	(0.010)	(0.013)	(0.093)	(0.011)	(0.012)
Regional market focus	0.035***	0.034***	0.012	0.012	0.025*	0.025	0.007	0.006
	(0.010)	(0.010)	(0.010)	(0.010)	(0.015)	(0.017)	(0.011)	(0.011)
National market focus	0.070***	0.070***	-0.012	-0.012	0.045***	0.046***	0.029***	0.028***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.013)	(0.016)	(0.010)	(0.010)
European market focus	0.122***	0.121***	0.028	0.028	0.098***	0.099***	0.051***	0.049**
	(0.031)	(0.030)	(0.036)	(0.036)	(0.025)	(0.026)	(0.019)	(0.019)
World market focus	0.130***	0.128***	0.023	0.022	0.114***	0.114***	0.086***	0.083***
	(0.021)	(0.021)	(0.019)	(0.019)	(0.022)	(0.027)	(0.015)	(0.015)
Single	-0.000	-0.000	0.006	0.007	-0.004		-0.017**	-0.016**
	(0.011)	(0.011)	(0.009)	(0.009)	(0.012)		(0.008)	(0.008)
Foreign-owned	0.026**	0.026**	0.025**	0.025**	-0.007	-0.005	0.018	0.017
	(0.011)	(0.011)	(0.011)	(0.011)	(0.016)	(0.017)	(0.011)	(0.011)
Low volumes	0.003	0.002	-0.018	-0.018	0.033	0.032	0.013	0.014
	(0.020)	(0.020)	(0.023)	(0.022)	(0.032)	(0.037)	(0.012)	(0.012)
Rapid growth in sales	0.027**	0.027**	0.005	0.005	0.014	0.016	0.028**	0.026**
	(0.011)	(0.011)	(0.012)	(0.012)	(0.016)	(0.021)	(0.011)	(0.011)
Some growth in sales	0.020**	0.020**	0.001	0.001	0.003	0.004	0.025***	0.024**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.013)	(0.014)	(0.010)	(0.010)
Some decline in sales	0.019	0.020	-0.006	-0.006	-0.006	-0.006	0.002	0.003
	(0.012)	(0.012)	(0.013)	(0.013)	(0.019)	(0.019)	(0.018)	(0.018)
Sharp decline in sales	0.023	0.025	-0.032	-0.031	0.055*	0.056	-0.034	-0.034
	(0.032)	(0.032)	(0.028)	(0.028)	(0.032)	(0.035)	(0.026)	(0.026)
Change in sales_nk	0.025	0.024	0.037**	0.037**	0.043	0.044	0.029*	0.028*
	(0.017)	(0.017)	(0.017)	(0.017)	(0.027)	(0.029)	(0.015)	(0.015)
Capacity utilisation	0.002	0.002	-0.003		0.009	0.009	0.009*	0.009
	(0.006)	(0.006)	(0.006)		(0.008)	(0.008)	(0.006)	(0.005)
Use of Information Technology	0.004	0.004	-0.001		-0.003		0.004	0.003
	(0.003)	(0.003)	(0.003)		(0.004)		(0.003)	(0.003)
New products	-0.003		-0.001	-0.001	0.005	0.005	-0.001	
	(0.003)		(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	
New work practices	0.001	-0.000	0.005	0.005	-0.003	-0.003	0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
New technologies	0.005	0.004	-0.003	-0.003	0.004	0.004	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)

Production site	-0.021	-0.021			0.040	0.039	-0.125***	-0.123***
	(0.022)	(0.022)			(0.036)	(0.037)	(0.014)	(0.014)
Distribution site	-0.073***	-0.073***			-0.062***	-0.062***	-0.167***	-0.165***
	(0.014)	(0.014)			(0.011)	(0.013)	(0.017)	(0.017)
Research, development, design							0.053***	0.052***
							(0.014)	(0.014)
Catering, entertainment or leisure			-0.019	-0.019	0.050	0.050		
			(0.025)	(0.024)	(0.040)	(0.040)		
Shop, showroom, sales	-0.051***	-0.051***	-0.052*	-0.052*	0.016	0.017	-0.063***	-0.062***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.022)	(0.021)	(0.016)	(0.016)
Other activities on site	0.028	0.028	-0.027	-0.027	0.045*	0.045**	-0.033**	-0.032**
	(0.024)	(0.024)	(0.035)	(0.034)	(0.023)	(0.023)	(0.015)	(0.015)
Emp10_24	-0.015	-0.015	0.008	0.008	-0.046***	-0.045***	-0.014	-0.014
	(0.013)	(0.013)	(0.013)	(0.013)	(0.016)	(0.016)	(0.012)	(0.012)
Emp25_49	-0.009	-0.009	0.009	0.009	-0.034**	-0.033*	-0.012	-0.012
	(0.013)	(0.013)	(0.014)	(0.014)	(0.017)	(0.018)	(0.012)	(0.012)
Emp50_99	-0.028*	-0.027*	0.012	0.012	-0.027	-0.025	-0.011	-0.011
	(0.015)	(0.015)	(0.016)	(0.016)	(0.019)	(0.020)	(0.014)	(0.014)
Emp100_199	-0.024*	-0.026*	0.022	0.022	-0.022	-0.019	-0.016	-0.017
	(0.014)	(0.014)	(0.020)	(0.020)	(0.020)	(0.025)	(0.015)	(0.014)
Emp200_499	-0.021	-0.022*	0.043	0.042	0.022	0.025	-0.007	-0.007
	(0.013)	(0.013)	(0.034)	(0.034)	(0.031)	(0.034)	(0.016)	(0.016)
Emp500_999	0.029	0.028	0.036	0.037	-0.055	-0.054	0.003	0.003
	(0.028)	(0.028)	(0.064)	(0.063)	(0.053)	(0.051)	(0.026)	(0.025)
Emp1000plus	-0.077	-0.078	-0.077***	-0.077***	0.012	0.012	0.011	0.009
	(0.049)	(0.049)	(0.019)	(0.019)	(0.046)	(0.045)	(0.045)	(0.044)
London	0.039**	0.038**	0.054***	0.054***	0.025	0.026	0.111***	0.111***
	(0.016)	(0.015)	(0.016)	(0.016)	(0.021)	(0.025)	(0.017)	(0.017)
Eastern	0.008	0.007	-0.005	-0.005	-0.012	-0.011	0.013	0.013
	(0.016)	(0.016)	(0.015)	(0.015)	(0.023)	(0.024)	(0.017)	(0.017)
North East	0.010	0.010	0.019	0.019	-0.024	-0.024	0.055***	0.055***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.025)	(0.025)	(0.019)	(0.019)
North West	0.018	0.018	-0.017	-0.018	-0.016	-0.016	0.042**	0.042**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.023)	(0.024)	(0.018)	(0.018)
South East	0.022	0.021	0.041***	0.041***	0.017	0.017	0.033*	0.032*
	(0.015)	(0.015)	(0.016)	(0.015)	(0.022)	(0.023)	(0.017)	(0.017)
South West	-0.008	-0.008	0.005	0.005	0.011	0.013	0.032*	0.032*
	(0.015)	(0.015)	(0.016)	(0.016)	(0.025)	(0.028)	(0.018)	(0.018)
West Midlands	-0.008	-0.008	0.027*	0.027*	-0.003	-0.003	0.046***	0.047***
	(0.015)	(0.015)	(0.016)	(0.016)	(0.022)	(0.022)	(0.017)	(0.017)
Yorks and Humberside	0.002	0.002	0.000	-0.000	-0.015	-0.015	0.020	0.019
	(0.016)	(0.016)	(0.017)	(0.017)	(0.022)	(0.024)	(0.019)	(0.019)
Retailing – specialised	0.013	0.013						
	(0.012)	(0.012)						
Other retailing	-0.012	-0.012						
	(0.013)	(0.013)						
Hotels			-0.011	-0.011				
			(0.013)	(0.013)				
Restaurants			-0.018*	-0.018*				
			(0.009)	(0.009)				
Transport					-0.047***	-0.048***		

services								
					(0.013)	(0.017)		
Post and telecoms services					-0.015	-0.014		
					(0.017)	(0.016)		
Financial services							0.011	0.011
							(0.011)	(0.011)
Computer services							0.167***	0.164***
							(0.014)	(0.013)
Legal, accounting and related services							0.175***	0.173***
							(0.011)	(0.011)
Architectural, engineering and related technical services							0.182***	0.180***
							(0.012)	(0.012)
Constant	0.066*	0.042	0.201***	0.198***	0.128**	0.149	-0.141***	-0.202***
	(0.036)	(0.042)	(0.045)	(0.047)	(0.062)	(0.347)	(0.047)	(0.050)
Observations	1614	1614	1756	1756	1047	1047	2685	2685
Adj. R sqd.	0.16		0.03		0.15		0.35	
SEE	0.14		0.15		0.17		0.18	
Hansen J test of overidentifying restrictions		0.87		0.37		0.59		0.11
P value		0.35		0.83		0.44		0.75
Breusch-Pagan test of heterosced-asticity		883.14		845.34		449.45		114.60
P value		0.00		0.00		0.00		0.00
C statistic (test of endogeneity of log product strategy)		2.46		0.13		0.01		12.85
P value		0.17		0.72		0.91		0.00
Instruments		Rank order product strategy New prod-ucts		Rank order product strategy Capacity utilisation Use of IT		Single site establish-ment Use of IT		Rank order product strategy New prod-ucts
IV first stage equation:								
Adj. R sqd.		0.76		0.75		0.11		0.86
Partial R sqd of excluded instruments		0.75		0.73		0.02		0.84
F test of excluded instruments		2327.84***		1556.33***		8.55***		6954.69***
Robust standard errors in parentheses								
* significant at 10%; ** significant at 5%; *** significant at 1%								