The Open University

OPEN
DISCUSSION PAPERS IN
ECONOMICS

The Evolution of the UK software market: scale of demand and the role of competencies

Suma Athreye

September 2000

NUMBER 31

***Copies may be obtained from**:*
Economics Department
Faculty of Social Sciences
The Open University
Walton Hall Milton Keynes MK7 6AA
Telephone: 01908 654437
Email: Socsci-economics-support-list@open.ac.uk
Fax: 01908 654488

This series is registered under
ISSN 1753-2590 (Print)
ISSN 1753-2604 (Online)

Economics Research at The Open University

Throughout the 1990s, The Open University has been developing its research capacity in economics. Economists at the OU comprise a lively and expanding group with a wide set of interests ranging from development policy to decision theory, from Marxist theories of profit to libertarian foundations of environmental policy and from econometric analysis of large data sets through institutional economics to the use of case-studies in policy formation. Nearly a 1000 students from around the world register each year to study economics courses and their needs, together with the multi-disciplinary nature of social science at the university, shape out research. Through a variety of personal and group research projects, our work makes a strong contribution to areas like business, public policy and even philosophy where sharply focused analysis can inform decision-making as well as contribute to scientific progress.

In 1999, approximately £250,000 million worth of externally funded grants (3 from the ESRC) were held by discipline members, some of whom also act as consultants to national and international bodies. Approximately half a dozen students are currently reading for doctorates with members of the discipline and we are always interested in proposals from colleagues or potential students who would like to do research with us.

Some of the journals in which discipline members have published include: *Annals of Operations Research, Economic Journal, Economica, Economics and Philosophy, Feminist Economics, Feminist Review, International Journal of the Economics of Business, International Journal of Industrial Organisation, Journal of Economic Issues, Journal of Economic Psychology, Journal of the History of Ideas, Journal of Social Policy, Local Government Studies, The Locke Newsletter, Open Learning, Oxford Economic Papers, Public Policy and Administration, Radical Statistics, Revue d' Économie Politique, Risk Decision and Policy, Structural Change and Economic Dynamics, Technovation* and *Theory and Decision.*

The papers contain results of economic research which are the sole responsibility of the authors. Opinions expressed in these papers are hence those of the authors and do not necessarily reflect views of the University.

The evolution of the UK software market:

scale of demand and the role of competencies

Suma S Athreye

The Economics Discipline
The Faculty of Social Sciences
The Open University
Walton Hall
MK7 6AA
Email: Suma Athreye@umist.ac.uk

Abstract

This chapter studies the evolution of the computer software and services market in the UK. We show that independent vendors of software gradually replaced in-house development of software in the UK in a process of gradual vertical disintegration. We trace the demand and supply side influences on the development of the market. We argue that the heterogeneity of demand for software has meant that niche markets based on externalisation are more important than arms-length markets in the process of vertical disintegration.

This in turn has contributed to the creation of specialised niche market skills over general skills such as in R&D, general management and marketing amongst firms, since niche markets do not develop the skills required for large scale marketing. This lack of generalised skills is also the main barrier to the entry of firms in the rapid growth ' product' segments of the market. Thus, we argue that the nature of demand influenced the development of the UK software market and the firm skills and competencies not developed in the process prevent a shift to a different, more radical, trajectory of growth of the UK software sector.

The evolution of the UK software market: scale of demand and the role of competencies

This chapter studies the evolution of the software industry in the UK. Previous work on the evolution of the software industry in the UK by Grindley (1996) emphasised the constraints imposed on the newly emerging software sector due to the steady erosion of a domestic hardware capability. While hardware manufacturers were an important source of demand and often supplied the entrepreneurship required for software firms in the early stages, we show that independent vendors of software gradually dominated the supply of output in this sector. They also replaced in-house development of software in a process of vertical disintegration.

The global emergence of the software market took two forms: outsourcing by large firms to independent software consultancies and the emergence of a package software sector comprising genuinely independent producers of ' commodity' software. In the UK, the demand side of the newly emerging software market was always scale constrained, though less so than for other European countries whose markets for software were linguistically fragmented. This slow growth of software demand delayed a full fledged arms length market in package software market from emerging in the UK despite a considerable strengths in the nations science-base in computing and related sciences.

When a market started to emerge for traded software in the 1980s, niche market strategies, driven by heterogeneous demand had an important impact on both the evolution of firm competencies and on the nature of competition and competitive advantages in the UK software sector. While outsourcing of software has been an important stimulus to the emergence and growth of the UK software industry, this trajectory of growth has had its limits. Firms are constrained by the growth of demand and by the lack of marketing skills that might re-invent market boundaries so necessary for the development of software products. The absence of a large commodity software market has also prevented a more radical impact of the software market upon industrial growth in the economy.

Thus, in this chapter, we describe the evolution of an industry driven by the need for outsourcing and limited by the competencies developed by outsourcing. The UK software sector is not alone in this trend –indeed the situation is far worse for the European software sector. The remainder of the paper is organised in the following way: Section 1 distinguishes between the development of arms-length markets and outsourced markets in the process of vertical disintegration and emphasises the role of demand factors in this process. Section 2 reviews the role of demand factors and the changing need for software in the growth of the global software industry. Section 3 reviews the role of a narrow demand base in the emergence of a market for traded software in the UK. Section 4 examines the supply side of the software market and details the nature of firms that are entrants to the industry in the UK. Section 5 examines the impact of these demand and supply side factors on the nature of competition, competitive advantages and barriers to growth for firms in the UK software sector. Section 6 concludes.

1 Vertical disintegration and the growth of the software market

1.1 Vertical disintegration and the emergence of intermediate markets

Adam Smith linked the growth of inter-firm division of labour and the emergence of specialised industries to the growth of final good demands in the Wealth of Nations. The idea of inter-firm division of labour received less attention from the economists of the nineteenth century than the notion of intra-firm division of labour. In 1928, Allyn Young drew attention to the important notion of inter-firm division of labour and the consequent 'production round-aboutness' in the economy. To him this was an important source of increasing returns in the economy. Among later economists Stigler (1951) developed the importance of division of labour for the vertical disintegration of production and Rosenberg (1963) drew attention to the emergence of intermediate technology markets due to the growth of demands and to the economies of specialisation that an economy as a whole derived due to the existence of specialised technology sectors.

Rosenberg's work on the machine tool industry also drew attention to another important phenomenon that he associated with the rise of specialised technology sectors. This was the phenomenon of 'technological convergence' whereby several industrial sectors began to share a common set of techniques. Thus, he pointed out that industries as diverse as bicycles and sewing machines and firearms shared the same mechanical principles and in fact the manufacturers of sewing machine made the first bicycles. The cross-sectoral demand made possible by technological convergence created a large enough scale of demand for the specialised machine tools sector to emerge. Firms no longer needed to manufacture their own machines but could buy them from the independent firms in the machine tool sector. In turn, the capital goods sector that emerged, was a technology market capable of serving diverse upstream sectors, which benefited from the efficiency improvements in design and innovations simply by virtue of production round-aboutness.

The emergence of the software industry has many characteristics reminiscent of the growth of the capital goods sector. Firstly, the growth of the package 'product' software industry has been fuelled by the widespread computerisation of administrative and production activity. Thus, it is an intermediate demand based on the growth of computerisation in the economy. Secondly, the market for package software is often across sectors of use. Lastly, the package (or commodity) software industry today serves many upstream sectors and embedded and new software is rated as an important source of innovation in several services sectors.

1.2 Arms-length markets and outsourced markets

Vertically disintegrated intermediate markets could emerge as arms-length markets or as outsourced markets. Which of the two sorts of market dominates depends upon the extent to which the final demands increase. Where the growth of final demands has been relatively rapid and the scale of the market is large, arms length intermediate markets will characterise the organisation of production. Where the growth of final demands has been relatively constrained, intermediate markets develop due to outsourcing.

An arms-length specialised market that emerges due to a process of vertical disintegration is not a frequently observed economic process. This is because such specialised intermediate

markets can only emerge when both the separability of a production process into smaller elementary components is possible (Scazzieri 1993) and the volume of demand becomes large enough to justify the specialised investment (Stigler 1951). The conjunction of the two factors happens uncommonly. Thus, specialisation due to vertical disintegration tends to be uneven both across industrial sectors and regions.

A more frequent occurrence is the development of intermediate markets due to outsourcing of parts of production by large firms, which can happen with moderate growth of exchange markets for final goods. Also known as externalisation, outsourcing is the contracting out of services previously performed within a large integrated firm to smaller firms that may be independent entities. Outsourcing allows the large firm to cut down on overheads and to overcome supervision costs that may arise due to the managerial complexity created by having to handle many different stages of production at large volumes of production.

Supplier firms in a situation of outsourcing behave very similarly to intermediate firms in the case of vertically disintegrated specialised markets. Nevertheless the two situations are different. The difference lies in the fact that in vertically disintegrated markets are arms-length markets. The producers of intermediate goods in such markets are reasonably independent entities and not tied to the firms to whom they sell their output. They are independent with regard to their decisions about how to expand their growth and less constrained about the technological and production decisions they might have to take to achieve their growth. In contrast, outsourcing is often characterised by the dominance of a few large buying firms and the decisions of the several ancillary firms supplying almost exclusively to these firms are often constrained by the objectives of their large buyers. As a consequence outsourcing is also very often accompanied by the dominance of relational contracting between the large firms and their suppliers.

1.3 The 'product' and ' service' segments of the software market

In the software industry the distinction between 'professional services' (including customised software) and the 'software packages and products' segments of the market has always been recognised by industry analysts. The professional services component of the software demand is similar to outsourcing while the software packages and products segment of the market resembles an arms length market. The larger part of the aggregate revenues from software in every country comes from professional services. Nevertheless the size of the package segment is indicative of the extent to which arms length markets have developed in software. The package software market is also the more rapid growth segment of the market. As Malerba and Torrisi (1996) show Europe lags behind America in the relative size of this sector. The UK has a smaller package software market when compared to the US, but is ahead of other countries of Europe.[1]

Hoch *et al* (1999) also observe that the product and services segments of the market operate to a very different competitive logic. Product provision in software is akin to the commodification of software, and requires investment in anticipation of demand. Software product providers however, have mostly fixed costs. The only variable cost that they incur

[1] Grindley (1996) , Table 8-1 shows that in 1994 Package software (including applications solutions and applications tools) accounted for 37% of all software revenues in the UK, compared to 32% for all of Europe.

is the cost of additional units, which for software is the cost of reproduction. When there is the large dominance of fixed costs standard economies of scale accrue to the producer. Total profits increase as market share grows.

Service providers in software, in contrast, have very few fixed costs. Typically their costs are incurred as they produce and often with the client incurring these costs. Most of their costs are the costs of labour and they maximise their profits by utilising their labour resources fully. Their objective is to develop their human resources and to exploit their value as fully as possible. Achieving large scales of output is not necessarily a goal.

In microeconomics terminology, the balance of fixed and variable costs changes is different if a firm is a product provider or a service provider. This affects both the way in which firms think and compete and also has consequences for the market structure that emerges. In the remainder of this chapter we will emphasise the first rather than the second.

2 Demand factors and the changing need for software in the global economy

Computer software is the stored, machine-readable code that instructs a microchip to carry out specific tasks. Over thirty years of its evolution the software market has encompassed this basic functionality, across a differentiated range of uses. Based upon the function of the software and what sort of tasks it instructs the microchip to carry out, there are three broad categories of software: operating systems, tools and applications. Conceiving the software sector in this way in terms of the need for code defines the importance of particular computer science skills that are required to write those kinds of software.

A second classification is in terms of how software and its associated services are provided by producers. Thus there are 'product providers' or 'customised software/service providers'. Each of these two kinds of producers may provide operating systems, tools or applications. Such a classification is useful because it emphasises the associated differences in the nature of markets and competition between the two segments (Mowery 1996, Hoch *et al* 1999).

Hoch, *et al* (1999) argues that the software business unfolded in five stages. The first stage (1949–59) comprised the development of professional service firms in the US, who developed tailor-made solutions for several big software projects underwritten by the US government and later by large corporations. The SAGE and the SABRE systems were both products developed in this period. Nevertheless in the 1960s the demand for software came from a few large firms and the conventional wisdom was that software couldn't, by itself, make money.

1959–69 saw the emergence of the first two software product companies. Mark IV written by Informatics was one of the most successful software products. The other software product came about due to a failed contract. ADR produced the product. Autoflow for another firm (RCA) who decided they didn't want it after all. ADR reacted by trying to recover its costs by selling the same product to other buyer. Eventually they rewrote the product slightly for IBM 1401 and later for IBM/ 360 series.

The decade of the 70s started with the unbundling decision of IBM. The immediate consequence was that a number of software product companies emerged, providing database applications across a range of business operations, for finance and insurance companies. These companies also called independent enterprise solution providers included firms like SAP, BAAN and Oracle – all established during this period.

The decade of the 1980s saw the rapid spread of the personal computer and the associated need for a different kind of software – mass packaged software that could be installed on small systems. The software market splintered into more areas of application. Even before the 80s there were two competing platforms for operating systems on personal computers, viz. the DOS system and the Mackintosh. In the 80s, Windows emerged as the standard operating system. Applications software for the personal computer were written based on the operating system it was to run upon, and this grew as a distinct area of software.

The spread of the PC created the possibility of replacing mainframe systems with networked PCs. This created a new kind of software market where PCs on different operating systems and on the same operating systems could 'talk' to each other. The Internet is an extension of this same basic idea. The possibility of writing software that enables different microchips communicate to each other also opens up whole new areas of application – in telecommunications, in media and in 'intelligent' consumer durables. These are also the important growth areas for the future of the software industry.

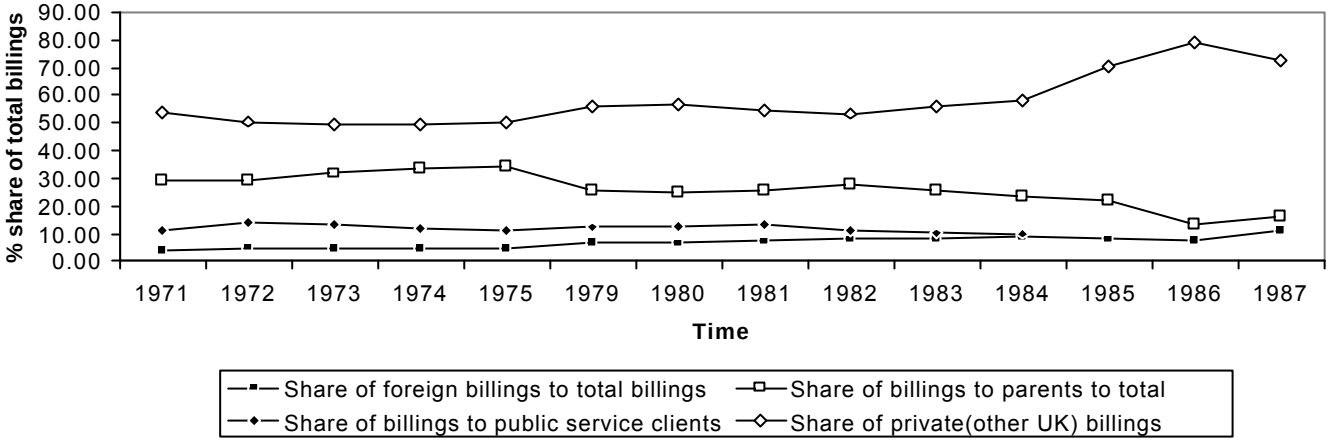
3 Demand for software in the UK economy

Demand for software was slow to develop in the UK despite the fact that the two universities of Cambridge and Manchester were involved in the first attempt to build a modern computer in the University of Pennsylvania and Prof. Maurice Wilkes at Cambridge also envisaged several uses for the computer and foresaw that software would dominate the use of the computer. More than anything else this reveals that a capacity to develop computer science in Universities was necessary but not sufficient for the development of a software market.

The emergence of independent vendors and the growth of the software market in the UK really took place with the spread of microcomputers in the 1980s. Many companies were using software and computerised systems in administration, which were largely produced in-house or for embedding in electronic capital goods such as telecommunications and defence systems. Grindley (1996: 208) shows that in 1984 just about a quarter of all software production was traded software: the total 'market' for software was only $1.4 billion, though the UK produced software worth $5.9 billion.

Though the emergence of a software market was delayed in the UK, when compared to the US, when it emerged it mimicked the stages of evolution of the software industry described in Section 2. Figure 1 based on the SDQ Monitor for computer services shows the gradual process of vertical disintegration in the growth of the UK software sector. It charts the growth of billings of computer services (including software) between 1971–91. The share of billings from parents and associate firms declines overtime, while that of private vendors increased. The governments share of demand for services was never very high and that of foreign billings shows a marginal increase overtime.

Figure 1: Breakdown of billings to clients in the UK software sector (1974-1988)



In the US, the initial demand for software came from Government laboratories followed by hobbyists and large firms. In the UK there was a notable absence of any large-scale government demand and large firms were slow to adopt computerisation. It is very difficult to get a sense of what sectors of the UK economy drove the demand for software. Table 1 derived from data based upon the CBR survey indicates that they were manufacturing, finance and financial services, followed by trade and other service sectors.

Table 1 Sector-wise distribution of computer software and services sales

Sector	% of all firms reporting any sales to
Manufacturing	46.5
Financial and business services	44.2
Retail and wholesale trade	37.2
Other services	37.2
Health and Education	21.9
Central and Local Government	32.6
Personal consumers	4.7

The newly emerging computer software firms were dependent upon the spread of computerisation and the replacement demand for computers (across sectors of industry) to expand the demand side of the market. The big shift from mainframe to distributed computing brought this opportunity because the small and medium sized firms could also benefit from the benefits of computerisation. This expanded the overall market for software rapidly as is clear from Figure 1.

The slow spread of computerisation created, however, heterogeneity of hardware platforms to which software had to be written. Furthermore, industrial sectors were not identical in the sort of software that they needed for computerising their administrative tasks. Thus, payroll systems and inventory systems for different industrial sectors were quite different and UK

software producers (of operating systems, tools and applications) faced a fairly heterogeneous demand for software. This heterogeneity created a further segmentation of the newly emerging software market, especially in application areas. Consequently, the emerging software market developed mostly due to the externalisation of software production by large firms, rather than a radical redefinition of software market boundaries around the attributes of software as had happened in the US when the first product software packages had emerged.

Some support for this argument comes from the CBR survey of UK computer firms. The survey found very few software firms that did not earn revenue from services as well. 63% of the software and services firms interviewed in 1995–96 felt that they were doing work that clients once did themselves. Further as Table 2 shows that roughly 2 in 3 UK software firms sold half or more of all their output to private large firms.

Table 2 Importance of sales that went to large private sector firms

% of total sales	Number of firms	Percentage
Less than 10%	11	28
10–50 %	3	8
Over 50%	25	64
Missing	4	
	43	100

Though independent vendors of software gradually replaced in-house departments of large firms as suppliers of software, they did not manage to re-define parts of the software market in the way that the first producers of products had done in the U.S. Indeed in many of these areas, UK firms still face the stiffest competition from US firms as the next section will show. A consequence of this was that though a market for software supplied by independent vendors did emerge in the UK in the mid 80s it was a market that was still tied to a narrow base of demand that emanated from a few large firms, with a large service component attached to it. In what follows we will argue that this had important consequences for competition and competitive strategies.

4 Nature of firms and the supply side of the UK software market

As we have indicated the supply side of the UK software market showed the expected changes overtime. Initial entry into the newly emerging software market came from firms in adjacent sectors: hardware firms and education and training establishments. Grindley (1996) details the nature of firms that provided software in the period 1983–89, and this is reproduced in the second column of Table 3 below. The table shows that independent providers of software were becoming important in the professional services category, dominating hardware manufacturers. The faster growing software packages market, for which detailed figures are not reported here, was still dominated by hardware manufacturers.

More recent data drawn from the CBR computer survey for the period 1996–97, and reported in the forth column of Table 3 present a different picture. The randomly drawn

sample of the survey revealed that only 12% of software and services firms faced serious competitors who were hardware manufacturers. The serious competition for UK Software and Services firms in the mid 90s came more from independent software houses and system houses/integrators.

Table 3 Sectors of origin of the main competitors

Share of market by provider (%)	1989	Share of firms reporting one or more competitor, by type (%)	1995–96
Hardware	5	Hardware manufacturers	12
Independent software vendors	24	Independent software vendors	55
Subtotal of all professional services	29	Suppliers of EDP	24
Training companies	7	System houses/integrators	38
Facilities management companies	5		
Processing services	22		
Subtotal package software	38		
Total	100		

Note: Column 2 is from Grindley (1996): Table 8–2, page 207. Column 4 is derived from the CBR survey, which is described in Appendix 1.

The late start of the software market has meant that UK software producers always faced severe foreign competition. Over 40% of firms face no overseas competition, but for others the consequence of the late UK start in the software has also meant that the stiffest competition that they face is from US competitors. This is clear from Table 4 below.

Table 4 Nationality of the main overseas competitors

Number of serious competitors	US firms	European firms	Other firms
1–2	12	7	3
3–5	6	2	1
>5	1	-	1

5 Competition, competitive strategies and barriers to growth of firms in the UK software sector

Our discussion this far has showed that in the aggregate the UK software industry has been constrained by the lack of a large enough scale of homogenous demand for software products, and thus the share of professional services is greater part of software revenues. The professional services segment of the software market functions more like an outsourced market than an arms-length market. At the same time on the supply side the nature of entrants has changed with hardware manufacturers accounting for smaller and smaller

portion of the competition and giving way to independent vendors. In this section we explore how the aggregate changes on the demand side have influenced the nature of competition and of competitive advantages in the software market. We also explore also the barriers to growth reported by software firms and relate these to the nature of demand and competition facing firms in the UK software market.

Firms in the UK software market principally operate in small outsourced niche markets where they are insulated from competition and they can develop specialised products for a few large firms. The CBR computer survey gives many indications of this tendency and we have already reported on the tendency to outsourcing in Section 3. Table 5 reports the evidence on the nature of competition faced by firms. Less than a third of firms faced more than 5 competitors and most firms faced between 3 and 5 competitors. This is what we would expect in niche markets.

Table 5 Serious competitors faced by UK software and computer services firms

Number of serious competitors	Number of firms	Percentage of firms
0–2	10	23.8
3–5	20	47.6
>5	12	28.6

Firms were asked to score the most important factors that contributed to their competitive advantage on a scale of 1 (denoting not important) to 5 (denoting crucial to the firm). The frequency of the extreme scores of 4 and 5 is reported in Table 6 below. The factors that received the largest proportion of extreme scores across firms were the niche market skills of specialised expertise and the abilities to deal with particular clients effectively. Generalised skills like R&D expertise and marketing and sales expertise in contrast ranked very low. The importance of reputation effects in securing competitive advantages is also clearly indicated.

Table 6 Factors contributing to the competitive advantage of firms

Factors in competitive advantage	Extreme scores	
	N	%
Specialised expertise	41	95
Long term relations with clients	37	86
Responsiveness to client needs	36	84
Product quality or design	34	79
Established reputation	31	72
Technological leadership and innovation	24	56
Growth of market demand in the UK	22	51
R&D expertise	20	47
Marketing and sales expertise	16	37
Competitive prices	14	33
Diversification	12	28
Growth of market demand globally	11	26
Growth of market demand in Europe	10	23
Low production costs	10	23
All firms	43	

The relatively low importance of domestic and foreign demand growth in imparting any advantages to the firm is also significant and indicative of the demand constraints faced by UK firms in this sector. However, from Table 7 it is clear that demand is not the most important barrier to growth reported by UK software firms. The highest barriers reported by firms are those concerning the availability of finance and of marketing, management and technical skills.

Table 7 Barriers to the growth of UK software firms

Type of barrier to growth	Extreme scores	
	Frequency	% of firms
Availability of finance	21	49
Marketing and sales skills	19	44
Availability of highly qualified staff	15	35
Management skills	14	33
Cost of finance	13	30
Growth of demand in principal product markets	10	23
Increasing competition globally	9	21
Increasing competition locally/nationally	9	21
All firms	43	

Table 8 Entry barriers for different types of European software producers (average scores)

Firm type	Financial resources	Marketing and sales network	Knowledge of user's environment	Technological skills and capabilities	Image and reputation	Corporate culture
Software and services	2.83	3.25	3.64	3.20	3.68	2.69
System software and utilities	1.50	2.00	3.50	5.00	4.00	4.00
Packaged software	3.50	3.36	3.73	3.00	3.45	3.50
Services EDP, Consulting/ training)	2.23	3.36	3.73	3.14	4.36	2.50
Technical services (software development tools, expert systems)	3.50	3.25	3.25	3.00	2.25	1.00

Notes: Scores are from 1 'not relevant' to 5 'very relevant'.

Source: Malerba and Torrisi (1996), Table 7–9; page 178.

Both the availability of finance and marketing ability are crucial factors if a firm must successfully make the transition from being a service provider to being a product provider. In Section 1 we discussed the different nature of costs in the product and service segments of the software market. This different balance of fixed and variable costs is also accompanied by a different balance of skills and competence among firms in the two segments making the transition from one segment to another very difficult. Indeed there is not even one example of a firm that has made a successful transition from being a service firm to being a software product firm in the global economy.

In an earlier study of the West European software industry Malerba and Torrisi (1996) found that reputation and knowledge of user needs usually acquired through long term relationships with the customer were the important barriers to entry in the customised market. In contrast, the package software market demonstrated barriers to entry on account of marketing and distribution networks as well. The balance of skills needed and their variety is clearly evident in Table 8 below reproduced from Malerba and Torrisi (1996).

It is remarkable that the barriers to growth reported by UK firms are those that also constitute barriers to entry in the product segments of the software market. But perhaps this is not surprising. Niche markets along a narrow demand base could have predisposed firms to develop and acquire specialised client specific management skills over generic management skills of various types. Further growth of such firms however, requires value addition to the product or a broadening of the demand base. A useful analogy here is that of tailors and readymade garment manufacturers in the clothing industry. The history of

clothing tells us that the best tailors did not set up readymade garment shops. Yet many tailors went out of business because of the emergence of these shops. A similar story is likely to be true of the product and services segments of the software industry.

6 Conclusion

In this chapter we have studied the emergence of the UK Software and Computer Services sector using the available empirical evidence on the industry. Our analysis shows that independent software vendors came to replace in-house development of software as the market for software services grew. The growth of the traded software market was however slow to take off, despite a strong science base, and even as late as 1984, only 25 per cent of all software produced was traded. Entry into the newly emerging software sector took place by firms from many other sectors and in the 80s the existence of different platforms meant hardware producers were dominant software producers. This appeared less common in the 90s, where independent software houses became the important source of competition for other software firms.

Externalisation of their software demand by large firms remains the dominant process underlying the growth of this sector. For UK software firms this has meant a narrow base of demand and the pursuit of niche market strategies in segmented markets that are relatively insulated from competition. But such a strategy has its limits. Niche markets do not develop the skills required for larger scale product development and marketing. Breaking into the more lucrative and higher growth software product market is hampered by the lack of marketing and management skills and the availability of finance for investment.

We have suggested that there is a story of cumulative causation that explains the pattern of growth of the UK software market. The emergence of demand and the formation of markets in the UK software sector has pre-disposed firms to the acquisition of skills that are suitable for niche markets. Crossing over to a commodity or product market is made much harder, because this requires a more balanced distribution of technical, financial, management and marketing abilities. However, the failure of an arms-length 'product' market to form also reduces the scope for externalities of the sort that we described in Section 1. We conjecture that the way that software markets have formed in the UK probably make the impact of software on the economy less radical than it could have been.

References

Grindley, P. (1996) The future of the software industry in the United Kingdom: the limitations of independent production. *In Mowery, D.C (1996) (ed.)*: The international software industry: A comparative study of industry evolution and structure. *New York and Oxford: Oxford University Press.*

Hoch, D.J., Roeding, C.R., Purkert, G., and Lindner, S.K. (1999) Secrets of software success. *Boston: Harvard Business School Press.*

Malerba, F. and Torrisi, S. (1996) The dynamics of market structure and innovation in the Western European software industry. *In Mowery, D.C (1996) (ed.)*: The international software industry: A comparative study of industry evolution and structure. *New York and Oxford: Oxford University Press.*

Mowery, D.C (1996) (ed.) The international software industry: A comparative study of industry evolution and structure. *New York and Oxford: Oxford University Press.*

Rosenberg, N. (1963) Capital goods, technology and economic growth. *Reprinted in Rosenberg (ed.) (1976) Perspectives on technology. Cambridge: Cambridge University Press.*

Scazzieri, R. (1993) A Theory of Production. *Clarendon Press. Oxford.*

Stigler, G.J. (1951) The division of labour is limited by the extent of the market. *The Journal of Political Economy, 59(3): 185–193.*

Appendix 1: Note on the data sources

(i) Tables 1–7

The main source of data for Tables 1–7 is the CBR computer survey of 83 firms in the UK Computer sector (hardware and software/services), conducted by the author and directed by Dr. David Keeble, in 1995–96. In the averages reported here, we use data on the randomly selected software and computer services firms, which were 43 in number. Very few of these firms provided products only and about 1/3 of revenues for most firms came from the customisation services offered around the software products they provided, hence the term 'software and services' .

The survey of firms was conducted in two stages. The first stage was the sending out of a pre-interview questionnaire which asked the firms to report on factual details such as year of establishment, years of experience in the computer industry, sales, employment details, exports and R&D expenditures. In the second stage these questionnaires were followed up by detailed interviews with firms. The interview was based on a semi-structured questionnaire and addressed questions relating to innovation, competition and competitive strategies. The sampling frame used was a random sampling frame drawn from Dun and Bradstreet data on computer sector firms.

(ii) Figure 1 is based upon figures obtained from SDQ9 business monitor series for computer services; various volumes 1974–92.

Titles available in the series:

Number 1	Valuing the environmental impacts of open cast coalmining: the case of the Trent Valley in North Staffordshire *Andrew B Trigg and W Richard Dubourg, June 1993*
Number 2	Scarcity and stability in a very simple general equilibrium model *Vivienne Brown, February 1994*
Number 3	A conflict model, with rational expectations, of the disinflation of the early 1980s *Graham Dawson, February 1994*
Number 4	Foreign Investment, Globalisation and International Economic Governance *Grahame Thompson, May 1994*
Number 5	Testing the Small Country Hypothesis for Developing Countries *Jonathan Perraton, December 1994*
Number 6	The Discovery of 'Unpaid Work': the social consequences of the expansion of 'work' *Susan Himmelweit, June 1995*
Number 7	Exit, Voice and Values in Economic Institutions *Graham Dawson, June 1995*
Number 8	Residential Summer Schools Attendance and Students' Assessed Performances on Open University Foundation Courses *Alan Gillie and Alan Woodley, June 1995*
Number 9	Putting Words into People's Mouths? Economic Culture and its Implications for Local Government *Maureen Mackintosh, December 1995*
Number 10	What is a Fair Wage? A Critique of the Concept of the Value of Labour-Power *Susan Himmelweit, December 1995*
Number 11	The Origin of the Poverty Line *Alan Gillie, December 1995*
Number 12	The Determinants of Product and Process Innovations *Roberto Simonetti, Daniele Archibugi, Rinaldo Evangelista, February 1996*
Number 13	Technical Change and Firm Growth: 'Creative Destruction' in the Fortune List, 1963-1987 *Roberto Simonetti, February 1996*
Number 14	Utilities vs. Rights to Publicly Provided Goods: Arguments and Evidence from Health-Care Rationing *Paul Anand and Allan Wailoo, January 2000*
Number 15	Proceeding to the Paddling Pool: The Selection and Shaping of Call Centre Labour *George Callaghan and Paul Thompson, January 2000*
Number 16	Doing 'Qualitative Research' in Economics: Two Examples and Some Reflections *Elizabeth Hill and Gabrielle Meagher, November 1999*
Number 17	Veblen, Bourdieu and Conspicuous Consumption *Andrew B Trigg, January 2000*

Number 18	The Effect of Idiosyncratic Events on the Feedback between Firm Size and Innovation *Mariana Mazzucato, January 2000*
Number 19	Non-market relationships in health care *Maureen Mackintosh and Lucy Gilson, January 2000*
Number 20	Selling pollution and safeguarding lives: international justice, emissions trading and the Kyoto Protocol *Graham Dawson, October 2000*
Number 21	Entrepreneurship by Alliance *Judith Mehta and Barbara Krug, September 2000*
Number 22	A disorderly household - voicing the noise *Judith Mehta, October 2000*
Number 23	Sustainable redistribution with health care markets? Rethinking regulatory intervention in the Tanzanian context *Maureen Mackintosh and Paula Tibandebage, November 2000*
Number 24	Surplus Value and the Keynesian Multiplier *Andrew B Trigg, October 2000*
Number 25	Edwards Revised: Technical Control and Call Centres *George Callaghan and Paul Thompson, November 2000*
Number 26	Social Norms, Occupational Groups and Income Tax Evasion: A Survey In The UK Construction Industry *Maria Sigala, November 2000*
Number 27	Procedural Fairness in Economic and Social Choice: Evidence from a Survey of Voters *Paul Anand, December 2000*
Number 28	Alternative rationalities, or why do economists become parents? *Susan Himmelweit, December 2000*
Number 29	Agglomeration and Growth: A Study of the Cambridge Hi-Tech Cluster *Suma Athreye, December 2000*
Number 30	Sources of Increasing Returns and Regional Innovation in the UK *Suma Athreye and David Keeble, January 2001*