

8

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

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Introduction

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 arm’s-length market in package software from emerging in the UK despite considerable national strengths 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 both on the evolution of firm competences and on the nature of competition and competitive advantage 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 both 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 meant a less radical impact of the software industry upon industrial growth in the UK economy.

Thus, in this chapter, we describe the evolution of an industry driven by the need for outsourcing and limited by the competences 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 body of this chapter is organised in the following way: the next section describes the role of demand factors in the process of vertical disintegration and distinguishes between the product and service segments of the software market. Section three reviews the changing need for software in the growth of the global software industry. Section four highlights the role of a narrow demand base in the emergence of a market for traded software in the UK. The fifth section examines the supply side of the software market and details the nature of the firms that are entrants to the industry in the UK. Section six examines the impact of these demand- and supply-side factors on the nature of competition, competitive advantage and barriers to growth for firms in the UK software sector.

Vertical disintegration and the growth of the software market

Vertical disintegration and the emergence of intermediate markets

Adam Smith in *The Wealth of Nations* linked the growth of the inter-firm division of labour and the emergence of specialised industries to the growth in the demand for final goods. The idea of inter-firm division of labour had received less attention from the economists of the nineteenth century than did 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 the 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 in demand and to the economies of specialisation that an economy as a whole derives due to the existence of specialised technology sectors.

Rosenberg’s work on the machine tool industry 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 begin to share a set of common 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 machines made the first bicycles. The cross-sectoral demand made possible by technological convergence created a large enough scale of demand for the specialised machine tool 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 innovation 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 new software is rated an important source of innovation in several services sectors.

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 depends upon the outsourcing of IT needs by other firms, while the software packages and products segment of the market resembles an arm's-length market. The key difference between the two types of market revolves around the degree of client/customer concentration for a typical firm operating in these markets.

Service markets are generally outsourced markets with a large element of customisation, and they tend to have small numbers of buyers. The average value of transaction for each buyer, however, can be high, making the scale of demand viable for market-based production even though customer numbers are often small – ranging from five to eight customers a year. In contrast, firms create software product markets by anticipating and bundling the software needs of users, whether in the area of operating systems or software applications. There are large fixed costs in the development of products: R&D expenditures, testing of prototypes, and marketing expenditures. Products are successful when there are many users willing to buy them. This spreads the fixed costs over many units and brings down the value of each transaction. A large number of customers also implies the relative anonymity of any individual customer. Client concentration is low, and in that sense product markets are like arm's-length markets.

The larger part of the aggregate revenues from software in every country comes from the professional services segment. Nevertheless the size of the package segment is indicative of the extent to which arm's-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 USA, but is ahead of other countries of Europe.¹

Hoch *et al.* (1999) observe that the product and services segments of the market operate to very different competitive logics. 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 they incur 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 those 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 utilise the human capital created as fully as possible. Achieving large scales of output is not necessarily a goal.

In microeconomics' terminology, the balance of fixed and variable costs differs according to whether 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. Throughout the remainder of this chapter the emphasis will be on the first rather than the second.

A final difference between the service and product segments of software concerns the way that marketing is actually done in the two segments. Service software is customised and its selling is closely tied to how well the software producer understands the business domain of the firm that she is selling to. Close and repeated interaction with the user are useful in expanding the credibility of the service producer, and a successful project with one user will create a market by establishing a reputation for the service producer.

Product segments rely on different modes of marketing, depending on the nature of the product they are selling. Information about the uses of the product is created initially through advertising, usually in trade magazines.² Trial promotions of software products have usually taken place through retailers of hardware who distribute some software free with the computers sold by them. More specialised software (for example, computational programs, specialised database products) are usually advertised through the educational press in a manner similar to the promotion of textbooks. Similarly, the marketing of games borrows the instituted selling arrangements that are often used for the selling of films for the screen. Thus, depending upon the nature of the product, the method of actually marketing the product borrows from the institutions that exist to market other similar products.

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

Computer software is the machine-readable stored code that instructs a microchip to carry out specific tasks. Over the thirty years of its evolution the software market has encompassed this basic functionality, across a range of differentiated uses. Based on the function of the software and the sorts of tasks it instructs the microchip to carry out, there are three broad categories of software: operating systems, tools and applications. Conceiving of 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 the markets and the competition between the two segments (Mowery, 1996; Hoch *et al.*, 1999). It is therefore that distinction which is emphasised in this chapter.

Hoch *et al.* (1999) argue that the software business unfolded in five stages. The first stage (1949–59) comprised the development of professional service firms in the USA, which 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 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 could not, by itself, make money.

The decade 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) which decided that the product was not what it wanted after all. ADR tried to recover its costs by selling the same product to other buyers. Eventually ADR rewrote the product slightly for the IBM 1401 and later for the IBM 360 series.

The 1970s 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 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 areas of application. Prior to the 1980s there were two competing platforms for operating systems on personal computers, viz. the DOS system and the Mackintosh. In the 1980s, Windows emerged as the standard operating system. Applications software for the personal computer were written based on the operating system on which it was to run, and this grew as a distinct area of software.

The spread of the PC created the possibility of replacing mainframe systems with networked PCs. From this there emerged a new kind of software market where PCs, whether running different operating systems or the same operating system, could ‘talk’ to each other. The Internet is an extension of that basic idea. The possibility of writing software that enables different

microchips to communicate with 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.

Demand for software in the UK economy

Demand for software was slow to develop in the UK despite the involvement of the universities of Cambridge and Manchester in the first attempt to build a modern computer at the University of Pennsylvania, and despite the uses for the computer envisaged by Maurice Wilkes at Cambridge, who foresaw that software would dominate the use of the computer. More than anything else this reveals that a capacity to develop computer science in the universities was necessary to 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 only with the spread of microcomputers in the 1980s. Many companies were using in-house developed software and computerised systems in administration or for embedding in electronic capital goods such as telecommunications and defence systems. Such software was, however, produced internally for use within a large firm. Only a small proportion of software written by firms was ‘traded’ between firms. Thus, Grindley (1996, p. 208) shows that in 1984 only 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 as compared to the USA, when it did emerge it mimicked the stages of evolution of the software industry described earlier (pp. 147–9). Figure 8.1, based on the *SDQ9 Business Monitor* series for computer services, shows the gradual process of vertical disintegration in the growth of the UK software sector. It charts the growth of billings for computer services (including software) between 1971–87. The share of billings from parents and associate firms declined over time, while that of private vendors increased. The government’s demand for services was never very high and that of foreign billings shows a marginal increase overtime.

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 governmental demand, and large firms were slow to adopt computerisation. It is very difficult to get a sense of which sectors of the UK economy drove the demand for software. Table 8.1, derived from data based on the CBR survey (see Appendix), indicates that those sectors were manufacturing, finance and financial services, followed by trade and other service sectors.

Table 8.1 Sector-wise distribution of computer software and services sales

Sector	% of all firms reporting any sales to the sector
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 on 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 produced this opportunity: small and medium-sized firms also could benefit from computerisation. This expanded the overall market for software rapidly, as is clear from Figure 8.1.

The generally slow spread of computerisation took place alongside development of a heterogeneity of hardware platforms for which software had to be written. This, in turn, was because of a lack of standardisation among the operating systems both across companies and across different vintages of computers from the same manufacturer. Furthermore, industrial sectors differed in the kinds of software they needed for computerising their administrative tasks: for example, payroll systems and inventory systems differed

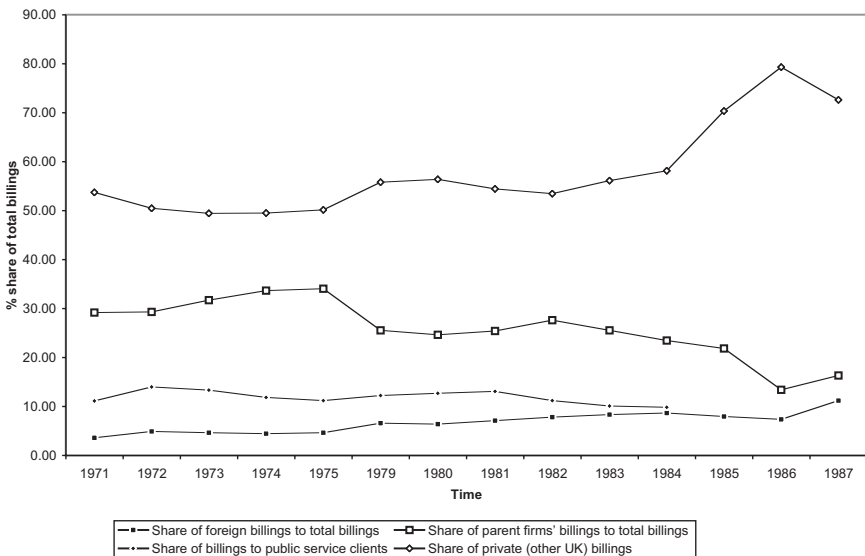


Figure 8.1 Breakdown of billings to clients in the UK software sector (1971–87)

across industrial sectors. All these factors meant that UK software producers (of operating systems, tools and applications) faced fairly heterogeneous demands 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 because of a radical redefinition of market boundaries around the attributes of software, as had happened in the USA when the first product software packages emerged.

Some support for these arguments 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 per cent of the software and services firms interviewed over 1995–96 felt that they were doing work which clients once did themselves. As table 8.2 shows that roughly two in three UK software firms sold half or more of their total output to large private firms.

Table 8.2 Rankings of sales (%) to large private sector firms

<i>% of total sales</i>	<i>Number of firms</i>	<i>% of all firms</i>
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, there were parts of the software market that they did not manage to redefine in the way that the first producers of products had done in the USA. This is in part because in many of these areas UK firms still face the stiffest competition from US firms. A consequence of this inability to redefine software market boundaries, however, was that though a market for software supplied by independent vendors did emerge in the UK in the mid-1980s 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 I argue that this had important consequences for competition and competitive strategies.

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

As I have indicated the supply side of the UK software market showed the expected changes overtime. Initial entry into the newly emerging software market was by 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 8.3. 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 no detailed figures are reported here, was still dominated by hardware manufacturers.

More recent data drawn from the CBR computer survey (see Appendix) for the period 1996–97, and reported in the fourth column of table 8.3 present a different picture. The randomly drawn sample of the survey revealed that only 2 per cent of software and services firms faced serious competitors who were hardware manufacturers. The serious competition for UK software and services firms in the mid-1990s came more from independent software houses and system houses/integrators.

Table 8.3 Sectors of origin of the main competitors

<i>Share of market by provider (%)</i>	<i>1989</i>	<i>Share of firms reporting one or more competitor, by type (%)</i>	<i>1995–96</i>
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		

Sources: Column 2 is from Grindley (1996): Table 8.2, p. 207; column 4 is derived from the CBR survey, which is described in the Appendix.

The late start of the software market has meant that UK software producers have always faced severe foreign competition. Over 40 per cent 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 they face is from US competitors. This is clear from table 8.4.

Table 8.4 Nationality of the main overseas competitors

<i>No. of serious competitors</i>	<i>US firms</i>	<i>European firms</i>	<i>Other firms</i>
1–2	12	7	3
3–5	6	2	1
Over 5	1	–	1

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

The discussion thus far has shown that, as a whole, the UK software industry has been constrained by an insufficiently large demand for homogenous software products, and thus professional services accounts for the greater part of software revenues. At the same time, on the supply side the nature of entrants has changed, with hardware manufacturers accounting for a diminishing portion of the competition and giving way to independent vendors. In this section I explore how the aggregate changes on the demand side have influenced the nature of competition and of competitive advantage in the software market. The barriers to growth reported by software firms are considered and are related to the nature of demand and competition facing firms in the UK software market.

Firms in the UK software market operate principally in small outsourced niche markets where they are insulated from competition and where they can develop specialised products for a few large firms. The CBR computer survey gives many indications of this tendency, as already reported. Table 8.5 reports the evidence on the nature of competition faced by firms. Less than a third of firms faced more than five competitors and most firms faced between three and five competitors. This is what one would expect in niche markets.

Table 8.5 Serious competitors faced by UK software and computer services firms

<i>No. of serious competitors</i>	<i>No. of firms</i>	<i>% of firms</i>
0–2	10	23.8
3–5	20	47.6
Over 5	12	28.6

Firms were asked to score the most important factors that contributed to their competitive advantage on a scale of 1 (not important) to 5 (crucial to the firm). The frequency of the extreme scores of 4 and 5 is reported in table 8.6 below. The factors that received the largest proportion of extreme scores across firms were niche market specialised expertise and an ability to deal effectively with particular clients. Generalised skills, like R&D expertise and marketing and sales expertise, in contrast ranked very low. The importance of established reputation to firms in securing competitive advantages is also clearly indicated.

The relatively low importance of domestic and foreign demand growth in imparting any advantages to the firm is also significant, and is indicative of the demand constraints faced by UK firms in this sector. However, from table 8.7 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 8.6 Factors contributing to the competitive advantage of firms

<i>Factors in competitive advantage</i>	<i>Extreme scores</i>	
	<i>N</i>	<i>%</i>
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
Total firms	43	

Table 8.7 Barriers to the growth of UK software firms

<i>Type of barrier</i>	<i>Extreme scores</i>	
	<i>Frequency</i>	<i>% of firms</i>
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
Total firms	43	

Both the availability of finance and marketing ability are crucial factors if a firm is to successfully make the transition from service provider to product provider. The different costs in the product and service segments of the software market were discussed earlier (pp. 145–7). This different balance of fixed and variable costs is 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 a single example of a firm that has successfully made the transition from service firm to 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 to the customised market. The package software market demonstrated barriers to entry on account of marketing and distribution networks as well. The balance of skills needed and their requisite variety is clearly evident in table 8.8.

Table 8.8 Entry barriers for different types of European software producer (average scores)

<i>Firm type</i>	<i>Financial resources</i>	<i>Marketing and sales network</i>	<i>Knowledge of user's environment</i>	<i>Technological skill and capabilities</i>	<i>Image and reputation</i>	<i>Corporate culture</i>
Software and services	2.83	3.25	3.64	3.20	3.86	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 tool expert systems)	3.50	3.25	3.25	3.00	2.25	1.00

Note: Scores from 1 ('not relevant') to 5 ('very relevant').

Source: Malerba and Torrissi (1996), table 7.9, p. 178.

It is remarkable that the barriers to growth reported by UK firms are those which 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 acquire specialised client-specific management skills over generic management skills of various types. The 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 those shops. A similar outcome is likely in the product and services segments of the software industry.

Conclusion

This chapter has examined the emergence of the UK software and computer services sector using the available empirical evidence on the industry. The 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 the total software produced was traded. Entry to the newly emerging software sector was effected by firms from many other sectors, and in the 1980s the existence of different platforms

meant that hardware producers were also the dominant software producers. This situation changed in the 1990s, when independent software houses became the primary 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.

I have suggested that a story of cumulative causation underlies the pattern of growth of the UK software market. The emergence of demand and the formation of markets in the UK software sector have predisposed firms to the acquisition of skills that are suitable for niche markets. Crossing over to a commodity or product market is difficult, because to do so requires a more balanced distribution of technical, financial, management and marketing abilities. However, the lack of an arm's-length 'product' market also reduces the scope for externalities of the sort described earlier (pp. 145–7). Thus, the way that software markets have formed in the UK has probably lessened the potential impact of software on the economy.

Notes

- 1 Grindley (1996), table 8.1, shows that in 1994 package software (including applications solutions and applications tools) accounted for 37 per cent of all software revenues in the UK, compared to 32 per cent for all of Europe.
- 2 In the UK these are magazines such as *PC World*.

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Appendix note on the data sources

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. The averages reported here are based on data on the randomly selected software and computer services firms, which were forty-three in number. Very few of those firms provided products only, and about one-third of revenues for most firms came from the customisation services offered around the software products they provided, hence the term 'software and services' For more details on the survey, see Athreye (2001, pp. 21–2).

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.

Figure 8.1 is based on figures obtained from *SDQ9 Business Monitor* series for computer services; various volumes, 1974–92.